EVALUATION OF THE
NORTH PLATTE RIVER MANAGEMENT MODEL

Volume 1 of 2

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and

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Introduction

Development and Use of the North Platte River Management Model (NPRMM)

The original version of the NPRMM was developed at the University of Wyoming Water Resources Research Institute (WRRI) by Dr. Tsong C. Wei at the request of and with financial support by the U.S. Bureau of Reclamation (USBR). The model was used to simulate North Platte River operations to the Wyoming-Nebraska State Line under various options and especially the evaluation of the impacts of enlarging Seminoe Reservoir. The impacts were evaluated and assessed by comparing with present conditions. Tests performed included maintaining minimum pool in different reservoirs, providing minimum flow in selected stream reaches, limiting flood discharge at system outlets to protect downstream areas, and combinations of these operations with other features. Based on the simulation results, changes in present operation methods and future development were suggested, and it was concluded that an enlargement of Seminoe Reservoir could not be justified. Test results as well as supplementary information were presented in "North Platte River Operational Options Study with or without an Enlarged Seminoe Reservoir Using a Simulation Model," by Tsong Chang Wei, June 1977.

In response to requests from various sources during 1980, a re-evaluation of the model was initiated, again with financial support from USBR. The work was performed by Mr. Michael Akerbergs, who was also associated with WRRI and resulted in modifications to the model and input data (Akerbergs, 1981). Resulting reports were "Final Report North Platte River Management Model Revision" and "User's Manual - North Platte River Management Model" both written by Akerbergs in March 1981.

These reports are located at the University of Wyoming Water Research Center (WWRC) library.

Work performed by Akerbergs included:

1. Transfer of the model from the Xerox Sigma-7 computer to a CDC Cyber 730/760 system.

2. Review of the entire set of historical flow input data.

3. Data update through water year 1980.

4. Revision of the Inland Lakes accrual and delivery.

5. Revision of water usage and accounting below Whalen Dam.

6. Revision of the Glendo Unit deliveries.

7. Revision of the priority order for irrigation season natural flow distribution was changed to:

    a. Five Ditch irrigation demand.

    b. North Platte Project direct flow senior to the storage rights (up to statutory limit).

    c. Pathfinder ownership.

    d. Guernsey ownership.

    e. Kendrick Project (Seminoe ownership - Alcova ownership - Kendrick direct flow).

    f. Glendo Unit ownership.

    g. River water, also referred to as excess-to-ownership water. This is the amount of water in the river in excess of any other demands.

8. System evaporation was increased by 22 percent. Guernsey evaporation was taken into account.

9. Grayrocks Reservoir depletions of the Laramie River were included.

10. Restriction of 4,000 cfs (when possible) was placed on the flow at the state line.

11. Alcova and Glendo Reservoir capacities were changed due to resurveys.

The Akerbergs revised model was used by Banner Associates, Inc. for Panhandle Eastern Pipe Line Company of Houston, Texas during 1981. Their usage of the model was to determine how much water was available for diversion from the North Platte River between Alcova and Glendo Reservoirs.

Purpose of the Current Study

In 1983, R.W. Beck and Associates performed a Level II Reconnaissance Study of Deer Creek for potential development. As a part of the study, the USBR was requested to use the NPRMM to determine the effect of the depletions by a Deer Creek Reservoir on the North Platte River. The problem was approached by adjusting the Alcova-Glendo Reservoir reach gain by the amount of the depletion by Deer Creek Reservoir as determined by Beck. The model entered an infinite loop, and no results from the model were obtained. Akerbergs, in his studies of the model, also ran into this type of problem when untested parts of the model were entered.

Due to the problems encountered with the NPRMM, the Wyoming Water Development Commission (WWDC) requested the aid of the WWRC to again re-evaluate the model. The re-evaluation was to determine if the NPRMM was in sufficient working order to use for the Level III studies of Deer Creek and the Little Snake River Management Project. WWRC contracted the model evaluation to Western Water Consultants, Inc (WWC). The original scope of work included:

1. Familiarization with the model, its assumptions, calculations, and operational requirements.
2. Development of short and understandable documentation of the legal and functional assumptions made in the model.

3. Development of an operational debugged version of the model.

4. Meet with representatives of the WWDC, State Engineer's Office, and Attorney General's Office for purposes of discussing the results of tasks 1 - 3 and developing potential revisions to the model.

5. Development of three additional versions of the model. These versions will be established at the above references meeting. It is likely that these versions will address operation of Glendo Reservoir power pool, the Inland Lakes diversions, and a model update.

During the course of meetings among WWDC, the State Engineer's Office, Board of Control, WWRC, and WWC personnel, it was decided that the model update would be performed under this contract and revisions to the model for evaluation of Deer Creek and Little Snake Diversion water would be performed under the Level III Deer Creek and Little Snake Rive Management Project through WWDC contracts.

Model Documentation

In the course of familiarization with the model, it became evident that many of the model operations were not sufficiently documented in previous write-ups by Wei and Akerbergs. This section will address those model operations not sufficiently documented.

Running the Model

The WWDC has recommended that the NPRMM be run on the University of Wyoming Cyber for the Deer Creek and Little Snake River Management Projects. The reason behind this recommendation is that 1) the current model is operational on the Cyber 730/760 system at the University of Wyoming, 2) that revisions made under this contract were made on the

Cyber, and 3) WWRC is starting a library of models used on WWDC projects that will be operational on the Cyber and it would be more convenient to have the model available through this source.

For these reasons, it was felt a detailed description of running the model on the Cyber was warranted. Underlined portions of the description represent what the Cyber provides as prompts.

To run the North Platte Model:

/ Get,DNPDT3=NPOPDAT (or other modified data file)

/ Get,NPOP (Main program)

/ Rewind,*

/ FTN,I=NPOP,GO,L=Ø,ROUND=/

[Program is now running, be patient, it will take a while]

Output is NPOT
To send output to the University of Wyoming line printer at the Ivinson Center.

/ COPYSBF,NPOT,OUT

/ Route,OUT,DC=LP,FC=XX

FC=XX is needed, as the output file is about 14,000 lines. This tells the U.W. printer to print out the file when demand is low. Pick up printout at the computer center. It is recommended print-outs be sent to the U.W. line printer, as the maximum line speed over the phone lines is 1200 BAUD.

Running the supplementary programs is documented on page 63 of the NPRMM User's Manual (Akerbergs, 1981). Operation of these supplementary programs is basically the same as above, with one exception. When running the program use:

/ FTN,I=[Program Name],GO,L=Ø

The supplementary programs that provide the greatest amount of usable information are NPDIFSO and NPCOMSO.

The Program NPDIFSO compares two different runs generated by the main program (NPOP). Difference tables are printed out by NPDIFSO. Note that the two runs to be compared must have the same period of record.

The program NPCOMSO prints out component tables from the output generated by the main program (NPOP). The component tables are simply summary tables of various components of the main program output such as end-of-month contents, evaporation, and ownerships.

Irrigation Project Demands

A) Kendrick Project: The original NPRMM used a constant annual demand and monthly distribution as follows:

Kendrick Project Demand (values in AF):

May	June	July	Aug.	Sept.	Total
7,000	17,000	20,000	17,000	9,000	70,000

Based on historical USGS records (1956 - 1980), the Kendrick Project diverted the following quantities of water through the Casper Canal:

Kendrick Project Diversions (Values in AF):

	May	June	July	Aug.	Sept.	Total
Max. Monthly	12,420	20,720	21,900	20,270	8.860	84,170
Avg.	5,254	14,572	17,611	15,744	6,389	59,570
Min. Monthly	0	6,222	8,760	7,904	4,190	27,076

Based upon these results, the value of 70,000 AF used in the model could not be supported. Carlton Hunter of the Wyoming Board of Control stated as a general rule of thumb the Kendrick Project demands an annual amount of 60,000 AF. This amount is close to the average demand as tabulated above. For this reason, the Kendrick Project demand was changed to an average annual demand of 60,000 AF. A description of the changes are presented in the model revisions section of this report.

An attempt was made to correlate the measured Kendrick Project diversions with water availability in an effort to devise a logical means to vary the Kendrick Project demands within the model. The correlations attempted included:

1. System inflow
2. Seminoe inflow
3. Pathfinder inflow

No good correlation was found. This type of approach was probably previously done with the same outcome. Thus it was concluded that a constant average demand would best represent current conditions in the model.

B) North Platte Project: The model determines the North Platte Project demands in the following manner:

May	$IRD = 223.4 - 0.216Q$	$20 \le IRD \le 75$
June	$IRD = 214.3 - 0.143Q$	$50 \le IRD \le 170$
July*	$IRD = 327.0 - 0.434Q$	$230 \le IRD \le 285$
August	$IRD = 301.8 - 0.251Q$	$260 \le IRD \le 290$
September	$IRD = 213.5 - 0.644Q$	$140 \le IRD \le 170$

where IRD = monthly irrigation demand
Q = system inflow for current month

*Note: Published model documentation shows July irrigation demand = 327.0 - 0.343Q, an apparent transposition of numbers, because the model actually uses the coefficient of 0.434. This value (0.434) was left in the model.

The North Platte Project demand was evaluated by averaging the measured Fort Laramie Canal and Interstate Canal diversions and the maximum Five Ditch demand as set forth in the North Platte Decree:

North Platte Project Average Delivery (1960 - 1974)
(Values in AF)

	May	June	July	Aug.	Sept.	Total
Fort Laramie Canal	27,337	37,014	84,378	90,209	56,019	294,957
Interstate Canal	63,062	40,048	114,060	116,818	82,607	416,595
Subtotal	90,399	77,062	198,438	207,027	138,626	711,552
Five Ditch Max. Legal Demand	25,900	38,900	77,800	64,800	51,900	259,300
TOTAL	116,299	115,962	276,238	271,827	190,526	970,852
Maximum Model Demands	75,000	170,000	285,000	290,000	170,000	990,000

While there were variations from the May and June measured diversions, the model demands were close for the other months and annually. Therefore, it was decided that the North Platte Project demands would not be revised at this time. This decision was made during a June 5, 1984, meeting of State agency people, WWRC, and WWC.

C) Glendo Unit Project: As the Glendo Unit Project demands will be revised in future studies (Level III Deer Creek study), the Glendo Unit Project was not studied in detail under this contract.

North Platte Decree

The model conforms to the North Platte Decree with the exception of how it handles river carriage losses. The North Platte Decree specifies river carriage losses for sections of the river between:

Alcova and Glendo Reservoir

Guernsey Reservoir and Whalen Dam

Whalen Dam and the State Line

Owed to the River Water

It was determined that the model approximated the proper method for handling "owed to river" water. However, this terminology is antiquated, with correct current terminology being "excess-to-ownership." This change in terminology has no effect on the operation of the model.

Excess-to-ownership is defined as follows: After natural flow has been distributed to ownership and irrigation demands, the remaining natural flow is identified as "excess-to-ownership," or simply surplus river water.

Model Evaporation

The system evaporation estimates from the Wei model were analyzed by Akerbergs in 1980 and it was found that the system evaporation was being underestimated by an average of about 22 percent. Rather than re-compute evaporation for each reservoir, the system evaporation was increased by 22 percent over that used in the model developed by Wei (1977).

Figure 1 compares model and "actual" evaporation curves for Pathfinder Reservoir for the month of July. The "actual" curve was determined by multiplying reservoir area as read from the area-capacity curves published by the USBR times the monthly average Pathfinder Dam pan evaporation for the period 1949 - 1980. A 0.7 pan coefficient was

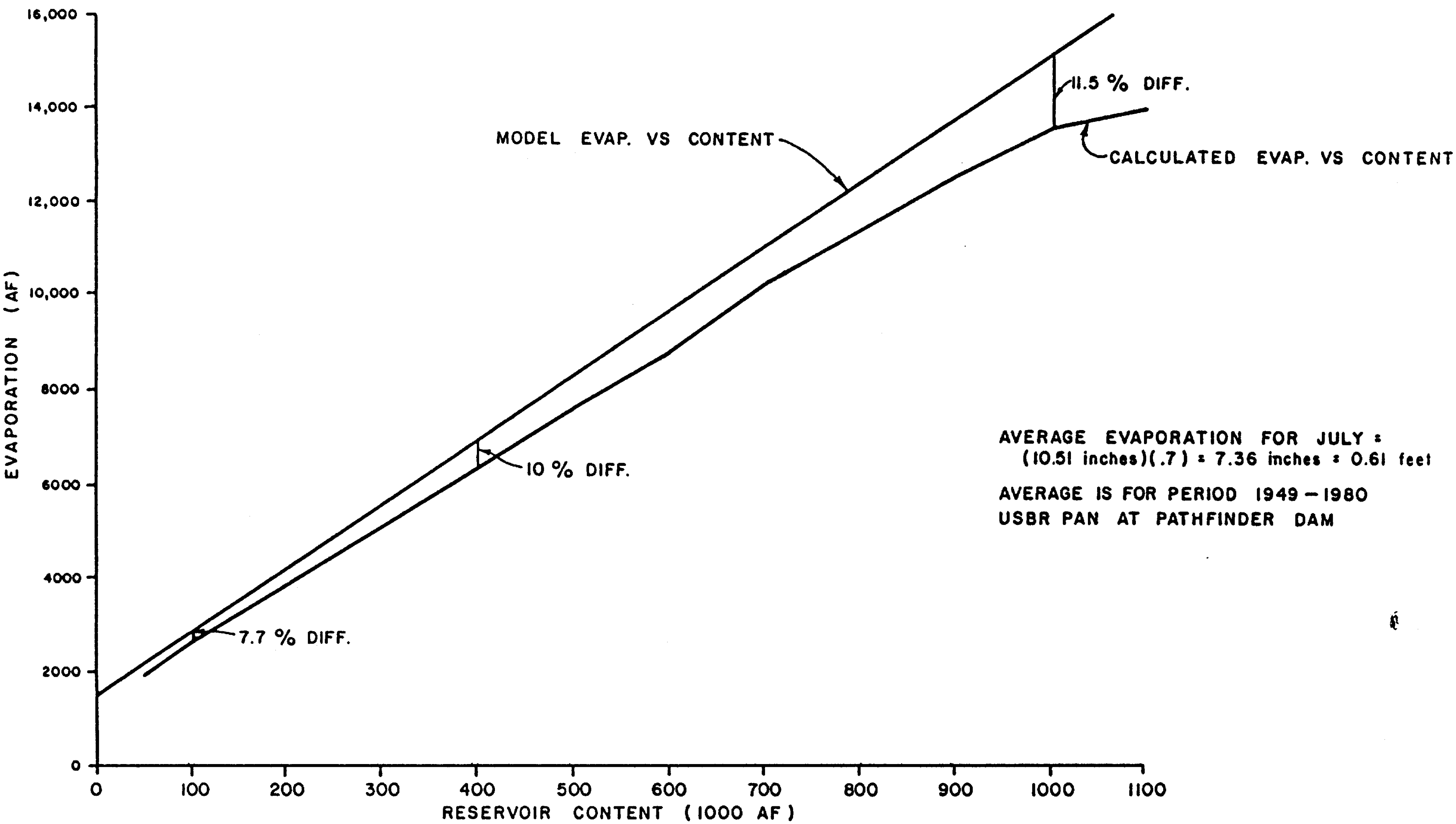


FIGURE 1 : EVAPORATION VS AVERAGE RESERVOIR CONTENT FOR PATHFINDER RESERVOIR (July)

applied to the Pathfinder Dam pan evaporation rate as set forth by the North Platte Decree. The model evaporation curve is that line after the 22 percent increase. The curve shows evaporation is overestimated by the model for this particular month. Figure 2 compares model and "actual" evaporation for Seminoe Reservoir for the month of August. The figure shows "actual" evaporation computed using both Pathfinder and Seminoe Dam pan evaporation data. This was done because the USBR currently uses the Seminoe Dam evaporation pan data in the operational accounting, while the North Platte River Decree specifies that the Pathfinder Dam pan data should be used for Seminoe Reservoir evaporation.

The USBR currently uses four evaporation pans: Seminoe, Pathfinder, Glendo, and Whalen. The pans are used as follows:

1. Seminoe evaporation pan - Seminoe and Kortes reservoirs
2. Pathfinder evaporation pan - Alcova and Pathfinder reservoirs
3. Glendo evaporation pan - Glendo Reservoir
4. Whalen evaporation pan - Guernsey Reservoir

Revisions were made to the model to more accurately reflect evaporation. The details of the revision are presented in the model revisions section of this report.

Model Operation of System below Guernsey Dam

The Akerbergs model assigns 49,000 AF/year for the Wyoming Private canals below Guernsey Dam. This quantity represents the average historical demand. The model assumes that natural flow supplies the entire demand, and the full amount is obtained every year. From

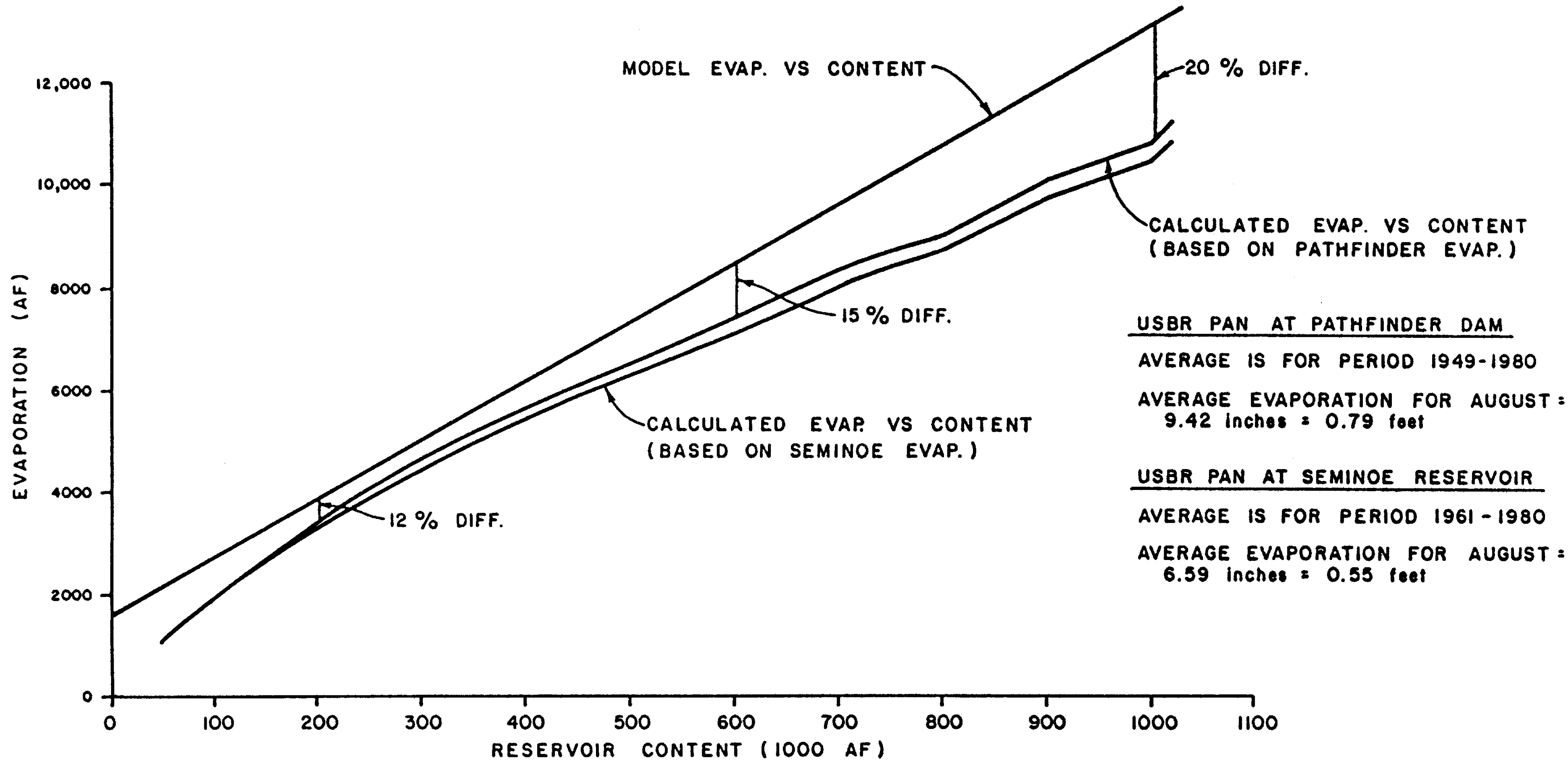


FIGURE 2 : EVAPORATION VS AVERAGE RESERVOIR CONTENT FOR SEMINOE RESERVOIR (August)

experience, in a typical year, the Wyoming Private canals will be using about half natural flow and half storage water.

It was decided that a revision of the model operation of the North Platte River below Guernsey Dam would be included as a part of the Little Snake River Water Management Project. Thus, no further work was accomplished on this matter under this contract.

Comparison of 1984 North Platte River Operating Agreement and the NPRMM

The 1984 Operating Agreement and the manner in which the NPRMM operated the river were compared. Little difference was noted between the two with the following exception. The 1984 Operating Agreement states that "in the event that 'Excess to Ownership' storage accrues less than 16,000 AF in any year, the first 12,000 AF shall be used as operation or regulation water for the Guernsey to Tri-State section. The remaining "Excess to Ownership" water as apportioned to each state shall by mutual agreement be released from storage; by agreement be credited to refill storage ownership accounts; or may be carried over in an amount not to exceed 12,000 AF for use the following year as operational or regulation water."

The NPRMM does not include this accounting. However, this portion of the Operating Agreement was introduced in 1984 and is still being discussed by Wyoming and Nebraska. Due to possible future revisions of this portion of the 1984 Operating Agreement and its lack of use in previous years, it was decided not to include this accounting in the NPRMM. Once a final decision is made concerning this item, a revision to the NPRMM may be warranted. More detailed discussion of the comparison can be found in Appendix A1.

Comparison of Actual Versus Calculated End-of-Month Reservoir Contents

A graph was prepared that compared actual and calculated end-of-month contents for Seminoe, Pathfinder, Alcova, Glendo, and Guernsey reservoirs for the period 1960 - 1979. The results were very good. Generally, any large discrepancy between the two could be attributed to some type of management decision (such as lowering of reservoir content for outlet works repair) rather than some type of model problem. The graphs of actual and calculated end-of-month contents are presented in Appendix A2.

Additional Documentation

Many details of the NPRMM were studied and discussed under this contract. The items discussed and a description of their functions can be found in Appendix A1, A2, and A3.

Supplementary Studies

1. The data base was modified to reflect depletions to the North Platte River between Alcova and Glendo Reservoirs due to a proposed Deer Creek Reservoir for the period 1936 - 1938. The model was then run, and output was obtained. This procedure was performed because the USBR had problems with this procedure during their work on the Level II Deer Creek study. Results are available in Appendix A3.
2. Thirty-thousand acre-feet was introduced into the North Platte River system annually (10,000 acre-feet in each of July, August, and September) above Seminoe Reservoir as though the water were being imported from the Little Snake River Basin. The results of

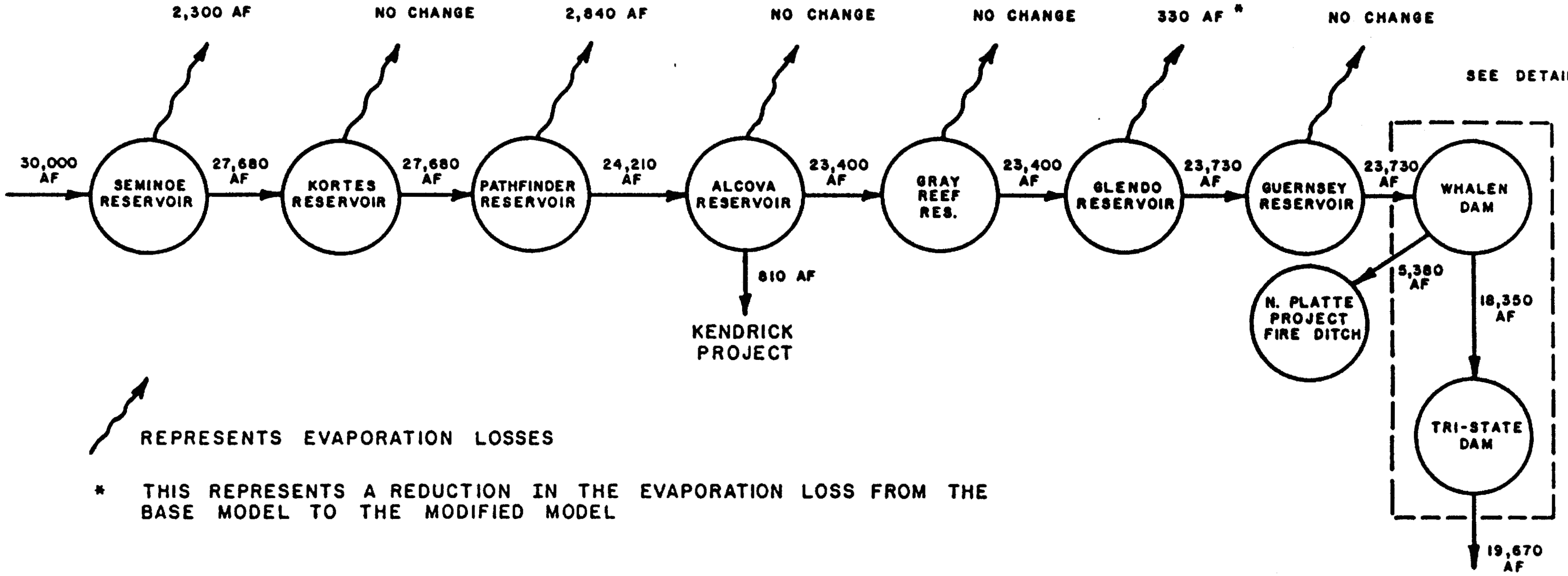
the run show that the Kendrick Project, North Platte Project, and the State of Nebraska would be the beneficiaries of the import when using the current NPRMM. It was agreed that a new subroutine will be required to address the usage and ownership of the water imported from the Little Snake River Basin. Figure 3 represents the change in the output from the Akerbergs, 1981 model (base run) and the output modified to account for the imported water.

Subroutine Functions

Flowcharts for each subroutine (other than input and output routines) are presented in Appendix B. It is recommended that these detailed flowcharts be used in conjunction with the general flowcharts presented in the NPRMM User's Manual (Akerbergs, 1981). The general flowcharts show the sequence of operations used in the NPRMM. The detailed flowcharts can then be studied to understand their operation. Most of the variables used within the NPRMM are defined within the description of the model input presented in the NPRMM User's Manual (Akerbergs, 1981).

History of NPRMM Following Original Model Completion

The NPRMM has received considerable attention since its completion by Tsong Wei in 1977. Many meetings have been held concerning the NPRMM operations and have included representatives from the State Engineer's Office, Wyoming Attorney General's Office, Wyoming Board of Control, Wyoming Water Development Commission, University of Wyoming Water Resources Research Institute (now the Wyoming Water Research Center),

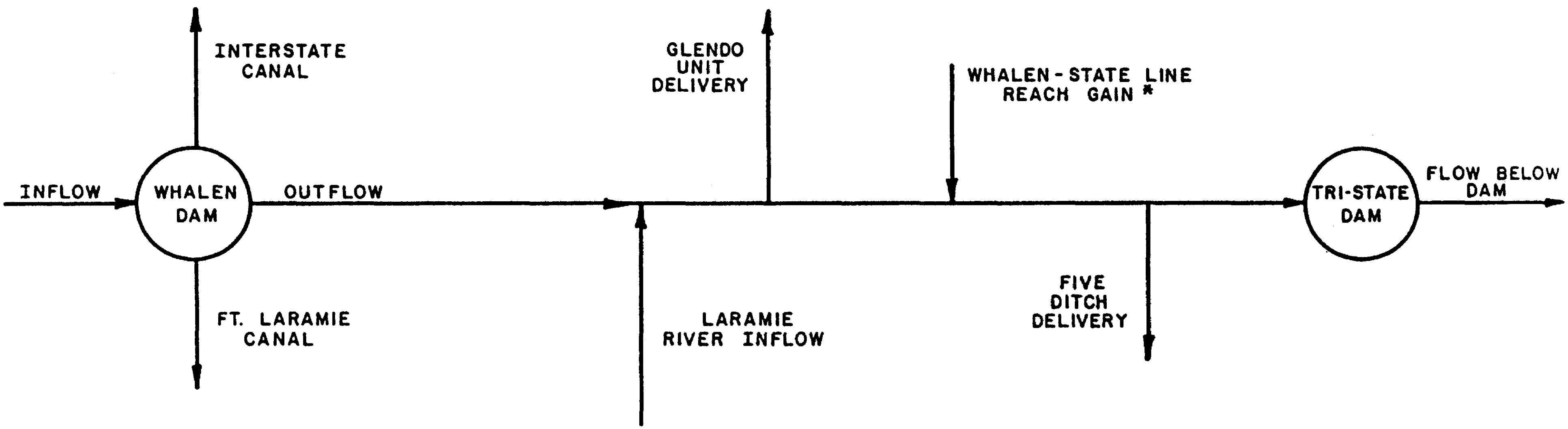


REPRESENTS EVAPORATION LOSSES

* THIS REPRESENTS A REDUCTION IN THE EVAPORATION LOSS FROM THE BASE MODEL TO THE MODIFIED MODEL

NOTE: THE NATURAL FLOW IN THE GUERNSEY DAM TO TRI-STATE DAM SECTION BETWEEN AND INCLUDING MAY 1 AND SEPTEMBER 30 OF EACH YEAR IS APPORTIONED 25 PERCENT TO WYOMING AND 75 PERCENT TO NEBRASKA

FIGURE 3 : 30,000 AF INFLOW TO SEMINOE RESERVOIR ANNUALLY. NUMBERS SHOWN ARE FOR 1928 - 1980. VALUES REPRESENT CHANGES FROM THE BASE RUN



* WHALEN - STATE LINE REACH GAIN = (TRI - STATE CANAL + RAMSHORN CANAL + FRENCH CANAL + GERING CANAL + FLOW PAST TRI - STATE) - NORTH PLATTE RIVER BELOW WHALEN

FIGURE 3 (Continued)

USBR, Panhandle Eastern Pipe Line Company, Banner and Associates, and Western Water Consultants, Inc. A search was made for documentation of these meetings and subsequent decisions concerning the model. It was felt that these records should be compiled and published in one document. These records are presented in Appendix A4.

Model Revisions

As a result of the studies undertaken by WWC for the Wyoming Water Research Center and presented to the WWDC and State Engineer's Office, the following revisions were requested to be made to the model:

1. Annual demand for the Kendrick Project was reduced from 70,000 acre-feet to the average annual historical diversion of 60,000 acre-feet.

2. The evaporation curves presently used in the model were replaced by algorithms representative of evaporation at the four evaporation pans operated by the USBR.

3. Carriage losses, as specified in the North Platte River Decree for each reach of the river should be incorporated within the model in addition to the present gains-losses routine.

4. Glendo Reservoir storage accounting need not be changed at this time. However, better documentation should be provided for how the model accomplishes the accounting and model changes necessary to accommodate Glendo ownership.

5. The data base was extended to include the years through 1983.

Descriptions of each of the revisions made to the model are presented below.

1. Kendrick Project Demands: The annual diversions to the Kendrick Project for the period 1956-1980 were 59,570 AF. This value was rounded to 60,000 AF for inclusion in the model.

Values in Acre-Feet

	May	June	July	Aug.	Sept.	Total
Avg. Kendrick Project Diversion(1956-1980)	5,254	14,572	17,611	15,744	6,389	59,570
Model Avg. Kendrick Project Demand	5,280	14,700	17,760	15,840	6,420	60,000

2. System Evaporation: The four USBR evaporation pans used for day to day operation of the system include Seminoe Dam, Pathfinder Dam, Glendo Dam, and Whalen Dam. Published records are available from the National Weather Service for the Pathfinder and Whalen Dam evaporation pans. The USBR collects data from the Seminoe and Glendo evaporation pans, but these data are not published.

In 1977, Larry Lewis prepared a study on evaporation in the State of Wyoming (1978). As part of his work, he obtained from the USBR files in Mills, Wyoming, the evaporation data for the Seminoe and Glendo pans. His compiled data were for the period 1960-1977. The data for Seminoe Dam are presented in Table 1 and for Glendo Dam in Table 2. Average evaporation for the period was used in the model.

As part of Lewis' study, an annual evaporation distribution was developed based on data collected at the Pathfinder Dam evaporation station. The distribution is presented in Table 3. This distribution was used in developing the monthly evaporation curves for the model.

Area-capacity curves published by the USBR were used to develop curves of average end-of-month reservoir content versus evaporation. A straight line was fitted to the data of the monthly average end-of-month reservoir content versus evaporation using

Table 1. Seminoe Dam Gross Pan Evaporation (in inches).

Year	May	June	July	August	September
1961	--	10.9	11.3	9.8	4.7
1962	6.8	8.1	10.5	11.4	7.1
1963	8.6	10.1	11.4	8.1	7.5
1964	7.9	7.0	11.4	9.5	7.9
1965	6.7	8.0	9.9	9.4	5.0
1966	8.6	7.9	10.9	9.5	6.3
1967	5.6	6.3	9.8	9.5	6.0
1968	5.7	9.4	10.5	7.8	6.8
1969	8.0	7.4	11.7	10.1	7.1
1970	6.4	8.6	10.1	9.1	5.5
1971	5.6	9.1	10.0	9.3	6.1
1972	6.3	8.5	10.0	8.7	7.5
1973	6.7	9.7	9.3	9.2	4.7
1974	8.3	9.3	9.4	9.2	5.9
1975	4.9	8.2	10.8	10.2	7.1
1976	6.2	9.1	11.2	9.3	6.2
1977	7.2	11.5	11.8	8.7	8.1

Table 2. Glendo Dam Gross Pan Evaporation (in inches).

Year	May	June	July	August	September
1960	8.1	10.1	12.1	12.0	7.2
1961	8.0	9.6	11.2	11.1	6.4
1962	9.4	7.2	10.1	11.3	7.7
1963	8.6	10.3	12.6	10.4	8.5
1964	9.0	8.5	14.1	11.8	9.6
1965	8.2	8.5	10.1	9.9	5.7
1966	10.3	10.4	13.7	10.9	7.5
1967	6.0	6.5	9.4	10.8	7.5
1968	7.4	9.7	11.2	10.2	7.2
1969	8.9	8.0	12.0	12.9	10.1
1970	7.7	9.5	11.5	10.4	7.3
1971	6.9	9.2	11.3	10.6	6.9
1972	7.6	8.9	10.3	9.9	7.9
1973	8.4	10.7	11.4	10.7	5.9
1974	8.5	10.8	13.0	10.5	7.0
1975	7.3	9.3	12.7	12.0	8.7
1976	6.9	9.8	12.3	11.1	7.0
1977	8.4	11.4	11.5	9.6	9.3

Table 3. Distribution of Annual Evaporation Based on Pathfinder Dam Pan Evaporation Data (Lewis, 1978).

Month	Percent of Annual
January	2.7
February	2.5
March	3.9
April	8.0
May	11.5
June	13.1
July	17.1
August	15.6
September	11.5
October	7.6
November	3.9
December	2.6
	100.0

linear regression techniques. The coefficients as put into the data file for the model for the straight line approximations are presented in Table 4. Both Alcova and Kortes reservoirs had a pre-determined end-of-month content for each month so average evaporation based on the end-of-month content is inserted into the model rather than as an equation.

The revised straight line approximation is accurate except at very low reservoir contents, as shown on plots in Appendix C.

3. River Carriage Losses: The river carriage losses as set forth in the North Platte Decree are based on Pathfinder Dam evaporation and are quantified as follows:

	Daily Loss...Cubic Feet per Second				
	May	June	July	Aug.	Sept.
Alcova to Glendo Res.	43	61	70	61	45
Guernsey Res. to Whalen	4	5	6	5	4
Whalen to State Line	16	22	25	22	16

The monthly river carriage losses are:

	Monthly Loss...Acre-Feet				
	May	June	July	Aug.	Sept.
Alcova to Glendo Res.	2640	3623	4297	374	2673
Guernsey Res. to Whalen	246	297	368	307	238
Whalen to State Line	980	1307	1535	1350	950

The river carriage loss is charged against water released from storage only. For example, assuming that a release of 30,000 acre-feet from Pathfinder Reservoir is made to supply water to the July irrigation demand of the North Platte Project. There is 100,000 acre-feet of water in the river below Alcova Reservoir. Of this 100,000 acre-feet, 70,000

Table 4. Coefficients for Straight Line Approximation of Average End-of-Month Content Versus Evaporation.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Guernsey Reservoir	C_1	.2	.2	.3	.7	.9	1.1	1.3	1.2	.8	.5	.3	.2
	C_2	51.9	42.0	75.8	170.0	237.0	284.0	330.0	293.0	202.0	137.0	75.8	50.0
Glendo Reservoir	C_1	2.1	1.9	3.0	6.2	9.1	10.5	13.1	12.2	8.6	5.9	3.0	2.0
	C_2	22.0	20.0	31.9	65.6	95.7	111.0	138.0	129.0	90.2	62.3	31.9	21.3
Pathfinder Reservoir	C_1	2.3	2.1	3.3	6.8	9.4	11.6	14.6	13.2	9.9	7.3	3.3	2.2
	C_2	21.4	18.6	29.0	59.5	80.7	99.8	122.4	113.6	84.8	62.5	28.9	19.3
Seminoe Reservoir	C_1	1.8	1.6	2.5	5.2	7.3	9.3	11.3	9.9	6.8	4.9	2.5	1.7
	C_2	17.8	16.4	25.7	52.7	74.1	95.0	115.0	101.0	69.6	50.1	25.7	17.1

$y = C_2 x + C_1$

Note: Values presented above are C_1 x 10. and C_2 x 10,000 acre-feet is natural flow and 30,000 acre-feet is storage water released from Pathfinder Reservoir. The percentage of water below Alcova Reservoir that originated from storage is 30% (30,000/100,000 x 100). The carriage loss assigned to the reach Alcova to Glendo Reservoir would then be (4,297 AF)(0.30) = 1,289 AF.

It is noted that in actual river operations, the carriage loss is calculated daily. Since this is a monthly model, the river carriage loss represents an average monthly value.

4. Glendo Unit Operation

The calculation of the annual delivery of Glendo Unit water can be found in Subroutine GLUIRD1 and the monthly distribution is presented in Subroutine GLUDIST.

These subroutines should be modified when the desired operation of the Glendo Unit is decided upon. Two options discussed in meetings conducted under this contract are: 1) maximum utilization of the 40,000 AF pool assuming the Corn Creek Project and Central Nebraska Project come on line, or 2) Central Nebraska demands Nebraska's full share and Wyoming's portion is utilized as it has been in the past. Option (1) will require the determination of a distribution (May - September) for the utilization of the 40,000 acre-foot pool, while option (2) will require the necessary distributions and a scheme to account for carryover storage.

The NPRMM User's Manual states the current Glendo Unit accounting is based on historical records. Insufficient records were available at this time to verify the results. The yearly irrigation demand uses the following equations:

GLAUVX = XMULT * (10**(-2.39308*ALOGIO (SYIN) + 18.334))/1000

where: GLAUVX = Glendo Unit Annual Irrigation Demand
XMULT = multiplier to change the maximum annual demand

SYIN = system inflow calculated as follows:

where: SEIN = Seminoe Inflow
CPGN = Kortes - Pathfinder Reach Gain
AGGN = Alcova - Guernsey Reach Gain
AGDV = Additional diversion between Alcova and Glendo Reservoirs, (currently zero)

The equation for annual Glendo Unit demand is based on a maximum of 20,000 acre-feet and a minimum of 4,000 acre-feet. The maximum demand is varied by the use of XMULT. The value of XMULT is not a factor but rather the actual demand in thousands of acre-feet.

The Glendo Unit demand is distributed as follows:

	Month				
	May	June	July	Aug.	Sept.
Percent of Annual Demand	10	15	25	25	25

4. Data Base: All recorded data through water year 1983 were inserted into the data file. The reach gains in streamflow for each reach were obtained from the USBR Annual Operating Reports. The remaining data were obtained from the Annual Hydrographers Reports

prepared for the Wyoming State Engineer's Office. The information obtained from both of these reports included:

a. North Platte River below Whalen Diversion Dam

b. Laramie River inflows

c. Tri-State Canal Diversions

d. Ramshorn Canal Diversions

e. French Canal Diversions

f. Mitchell-Gering Canal Diversions

g. Flow past Tri-State Dam

h. Inflows from:

   i. Rawhide Creek

   ii. Cherry Creek Drain

   iii. Katzer Drain

   iv. Spring Creek

   v. Sand Point

   vi. Sand Draw

   vii. Arnold Drain

   viii. North Platte Ditch waste

There is an input which reflects depletions in the Laramie River due to Grayrocks Reservoir. Depletions were set to zero for the years 1981, 1982, and 1983 as the gage flow at the mouth of the Laramie River already reflects these depletions. The model is operational for the extended data base.

References

Akerbergs, Michael, 1981. Final Report - North Platte River Management Model Revision. Water Resources Research Institute. University of Wyoming, Laramie.

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APPENDIX A

HISTORY OF THE NORTH PLATTE RIVER MANAGEMENT MODEL FOLLOWING ORIGINAL MODEL COMPLETION

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Water Development Commission

BARRETT BUILDING TELEPHONE: 307-777-7626 CHEYENNE, WYOMING 82002

Michael K. Purcell
Administrator

June 6, 1984

Dr. Victor Hasfurther
Department of Civil Engineering
University of Wyoming
PO Box 3295
Laramie, Wyoming 82071

Dear Vic:

This letter is to provide a follow-up to our North Platte model meeting of June 5th, 1984. Summarized below are those tasks that were determined to be the next phase of work on the model. These specific tasks are:

1. Examine river operations for those years in which major discrepancies occur between the predicted (model) and actual reservoir storage values. Determine whether these discrepancies are the result of inaccuracies in the model or unique operations of the river for the given year.

2. Determine the derivation of the evaporation curves for the North Platte Reservoirs and verify their validity.

3. Revise the "owed-to-river" terminology to "excess-to-ownership" and correct the model documentation to be compatible with river operation.

4. Modify the model to account for Nebraska and Wyoming ownerships in Glendo Reservoir.

5. Examine current operations and understanding of river carriage losses and make necessary model modifications to incorporate this understanding.

6. Review model operation and changes required in the model to more accurately represent current operations of the system below Guernsey Dam.

7. Evaluate the new (interim) operating plan for the North Platte and compare this plan to the one utilized by the model.

We will be discussing these tasks at a meeting on June 28th, 1984 at 1:00 p.m. in the State Engineer's conference room. We hope to have the revised model documentation available for our consultant negotiations the first week of July and to have the model fully operational by July 15th, 1984.

If you have any questions, please contact me. Thank you for your assistance.

Sincerely,

Michael K. Purcell
Administrator

MKP:CG/rlb

cc: George Christopulos, State Engineer
Bob Brocksen, UW Water Research Center

6/28/84

North Platte River Management Model Studies

1. Examine river operations for those years in which major discrepancies occur between the predicted (model) and actual reservoir storage values. Determine whether these discrepancies are the result of inaccuracies in the model or unique operations of the river for the given year.

The evaluation was done by examining the Annual Operating Reports published by the USBR. Results of the investigation are presented on the graphical actual vs. calculated reservoir end-of-month contents.

In addition it was found that the end-of-month contents of Seminoe and Alcova Reservoirs was affected by the Kendrick Project demands. The model uses a constant demand as follows:

(Values in AF)

	May	June	July	Aug	Sept
Kendrick Project Demand:	7,000	17,000	20,000	17,000	9,000

Based on historical records (1956-1980 of diversions to the Casper Canal the following Kendrick Project demands were found:

Kendrick Project Demand:

Max.	12,420	20,720	21,900	20,270	8,860
Avg.	5,254	14,572	17,611	15,744	6,389
Min.	0	6,222	8,760	7,904	4,190

Comparing the range of actual Kendrick Project demands and the model demands shows that most of the time the model demand are greater than the historical demands. This corresponds to a greater draw on Seminoe and Alcova Reservoirs.

An attempt was made to correlate the Kendrick Project demands to various other flows in order to vary the Kendrick Project demands within the model. The correlations included:

1. System Inflow
2. Seminoe Inflow
3. Pathfinder Inflow
4. Mitchell Ditch
5. Lucerne Ditch
6. Wright and Murphy Ditch
7. Torrington Ditch
8. Gratton Ditch

No good correlation was found. This type of approach was probably previously done and with the same outcome resulting in a constant demand being input to the model.

2. Evaporation: The current model uses a straight line equation which is defined by average content of the reservoir vs. evaporation. The evaporation estimates were analyzed by Mike Akerbergs in 1980 and it was found that the system evaporation was being underestimated by about 22 percent on the average. Rather than refine the evaporation curves to more accurately represent the system evaporation a factor of 22 percent was applied in the model. Attached is a figure which compares model and actual evaporation for Pathfinder Reservoir for the month of July. The actual curve was determined from the area-capacity curves published by the USBR and average Pathfinder Dam pan evaporation for the period 1949-1980. A 0.7 pan coefficient was applied to the Pathfinder Dam evaporation as set forth by the North Platte Decree. The curve shows evaporation is overestimated by the model for this particular month. Also attached is a figure which compares model and actual evaporation for Seminoe Reservoir for the month of August. The figure shows actual evaporation using both Pathfinder and Seminoe Dam pan evaporation data. It was not evident which pan evaporation data was used in the model for Seminoe Reservoir.

Proposed Solution: Using the published area-capacity curves from the USBR for Seminoe, Kortes, Pathfinder, Alcova, Grey Reef, Glendo, and Guernsey Reservoirs develop new evaporation versus average content curves. Dependent on the June 29, 1984 meeting with the State Engineer the following pan evaporation data should be used:

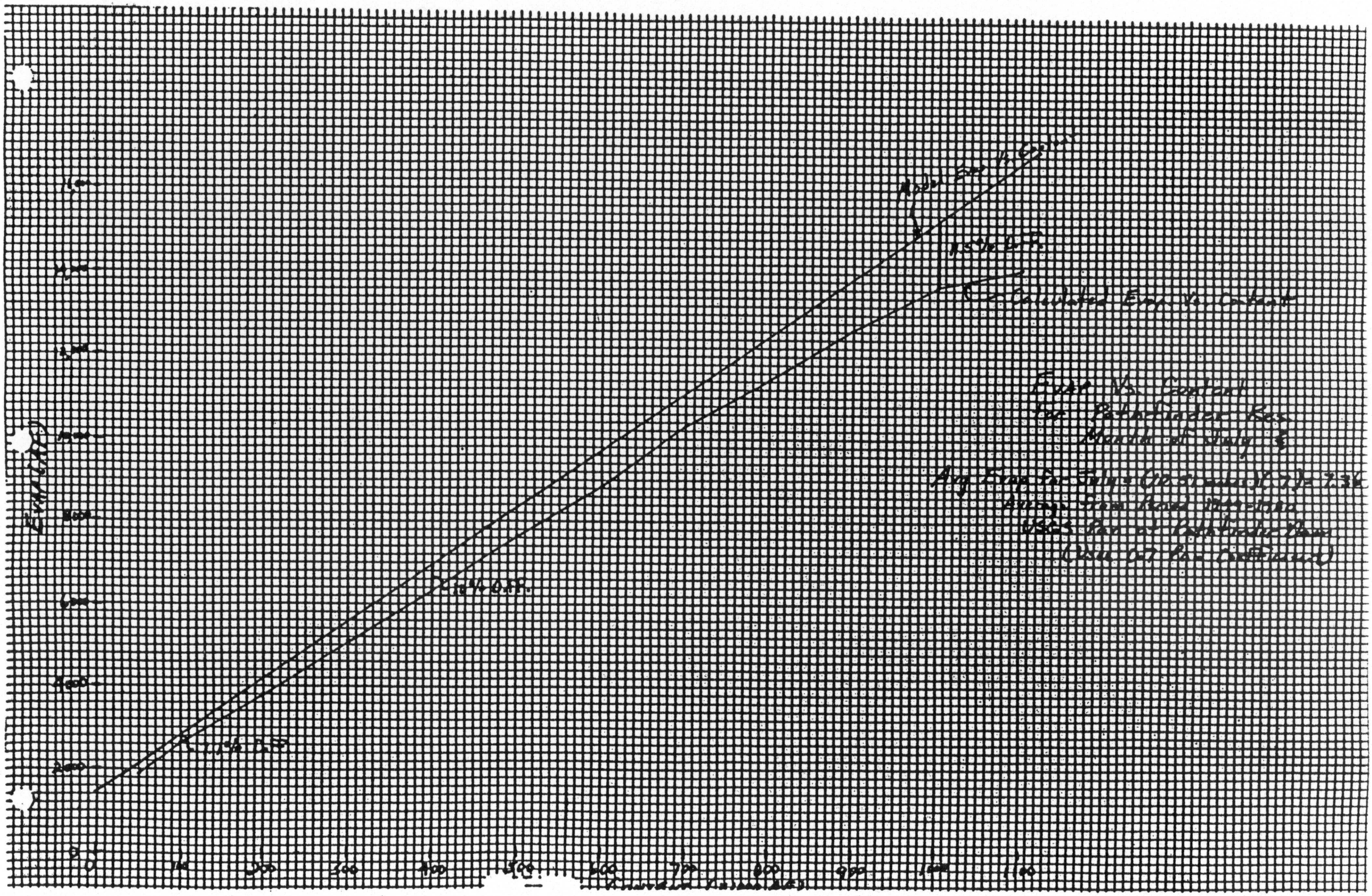
A. As set forth in the North Platte Decree Pathfinder Dam evaporation data should be used for Seminoe, Kortes, Pathfinder, Alcova and Grey Reef Reservoirs. Whalen Dam evaporation data should be used for Glendo and Guernsey Reservoirs.

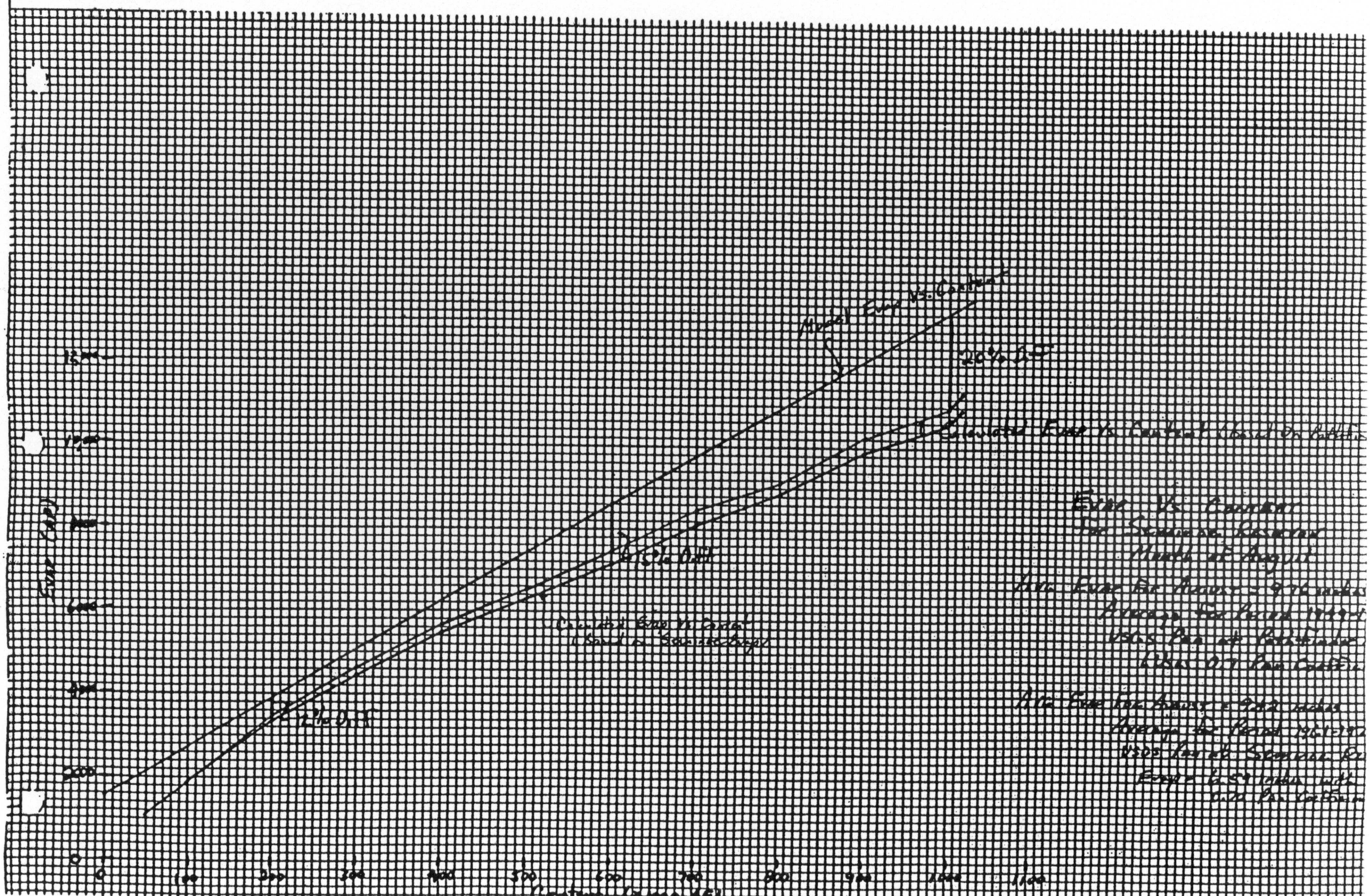
B. In actual practice the USBR uses Seminoe Dam evaporation data for Seminoe and Kortes Reservoirs; Pathfinder Dam evaporation data for Pathfinder, Alcova, and Grey Reef Reservoirs; Glendo Dam evaporation data for Glendo Reservoir; and Whalen Dam evaporation data for Guernsey Reservoir.

The curves input into the model could be modified in one of the following ways:

1. Redefine the equation of the line to more accurately estimate reservoir evaporation.

2. A straight line may not be the best estimate of reservoir evaporation as the evaporation versus average content plot is curvilinear. It may be more accurate to replace the straight line equation with a curvilinear equation.
3. Note: Alcova and Guernsey Reservoirs are "fixed reservoirs" meaning that the water content of the reservoirs are set for each month of the year. For this reason the evaporation is input as a constant for each month of the year rather than an equation as for the other reservoirs. If the operation of these reservoirs is changed in any manner the evaporation must also be revised.


Calculated Evap. Vs. Content
Evap. Vs. Content
for Pathfinder Res.
Month of July
0
100
200
300
400
500
600
700
800
900
1000
1100



Model Evap vs. Content
20% Diff
15% Diff
12% Diff
0
100
200
300
400
500
600
700
800
900
1000
1100

3. Revise the "owed-to-river" terminology to "excess-to-ownership" and correct the model documentation to be compatible with river operation.

Documentation:

9. After the natural flow has been appropriated to ownership and irrigation demands, the remaining natural flow is identified as "excess-to-ownership", or simply surplus river water. River water accrued during October-February is stored in reservoirs and released in March. In other months, the river water is released immediately unless flood-control operation is requested. No evaporation losses are charged to the river water in storage.

15d. If natural flow remains in the system after Glendo Unit ownership and Guernsey evaporation have been satisfied, this flow is identified as "excess-to-ownership" and handled as described in (9).

How the "excess-to-ownership" is calculated will be more thoroughly documented in the final report.

4. Modification of the 40,000 AF pool in Glendo Reservoir:

The North Platte River Decree states the pool can store up to 40,000 AF/year with a maximum accrual of 100,000 AF. The current model uses water from this pool based upon historical records. Unfortunately, the historical records do not reflect demands for the entire 40,000 AF pool. At one time the demand from Glendo Reservoir approached 20,000 AF. The model, in an attempt to simulate the demand on the 40,000 AF pool, simply multiplied the historical records by two. This is not a fair representation of the utilization of the 40,000 AF available.

Once the Corn Creek Project and Central Nebraska Project come on line the entire 40,000 AF will be committed. The worst case scenario would be that the available water (up to 40,000 AF) would be called for each year. This would prevent any carryover storage.

Proposed Solution: Revise the equations in the model so that the available water (up to 40,000 AF) is utilized each year. This is the worst case scenario that could be imposed upon the system. The monthly distribution of the water will need to be determined. Possible sources of the distribution include:

a. Historical records of other diversion near the Wyoming - Nebraska line.

b. Estimates that may have been developed by the Corn Creek Project and/or the Corn Creek Project.

An optional revision of the model would be to differentiate the distribution of water to Wyoming and Nebraska. This revision could provide valuable information concerning these projects.

5. River Carriage Losses:

The model in its current form does not include the river carriage losses as specified in the North Platte Decree. These carriage losses are based on Pathfinder Dam evaporation and are quantified as follows:

River Section	Daily Loss ... Second Feet				
	May	June	July	Aug	Sept
Alcova to Glendo Res.	43	61	70	61	45
Guernsey Res. to Whalen	4	5	6	5	4
Whalen to State Line	16	22	25	22	16

As this is a monthly model the river carriage losses will be input into the model as follows:

River Section	Monthly Loss ... Acre-Feet				
	May	June	July	Aug	Sept
Alcova to Glendo Res.	2640	3623	4297	3744	2673
Guernsey Res. to Whalen	246	297	368	307	238
Whalen to State Line	980	1307	1535	1350	950

The river carriage loss is charged against water released from storage only. It is important this be incorporated into the model as it is a legal requirement and will affect the storage in the system.

Proposed Solution: In the output from the main operational model the following should be added:

A. Storage water passing below this point must be charged a carriage loss. Consequently the release from reservoir storage where the water originates must be increased by a similar amount. The carriage loss charged would be the Alcova - Glendo amount set forth by the North Platte Decree.

B. Storage water released below this point must be charged a carriage loss as dictated in the North Platte Decree for the Guernsey - Whalen River Section. The release from the reservoir from where the water originated must be increased accordingly.

C. Same as above only the carriage loss assigned would be the Whalen - State Line river section.

The carriage loss should be applied as follows:

Assume a release from Pathfinder Reservoir is made to supply water to the North Platte Project. It is found that 100,000 acre-feet of water is released below Alcova Reservoir for the month of July. Of this 100,000 acre-feet, 70,000 acre-feet is natural flow and 30,000 acre-feet is released storage water from Pathfinder Reservoir. The percentage of water below Alcova Reservoir that originated from storage is 30% (30,000/100,000 x 100). The carriage loss assigned to this reach would then be (4,297 AF)(.30) = 1,289 AF.

It would also be helpful to add several rows to the output which summarizes the carriage losses in each section. It is urged that this incorporation be directed by personnel of the Wyoming State Engineer's Office, particularly Mr. Earl Michael, Gary Mehling, and Carlton Hunter.

It is anticipated that this task will be the most time consuming of the tasks listed in the model revision.

6. Revise the model operation to more accurately represent current operations of the system below Guernsey Dam:

The current model presents the Wyoming Private canals as receiving 49,000 AF/year which represents an average historical demand. The model assumes that natural flow supplies the entire demand and the full amount is obtained every year. In actuality the Wyoming Private canals in a typical year will be using about half natural flow and half storage water. The records will need to be researched and the operation of the private canals incorporated into the model. (Currently the model only recognizes the existence of the Wyoming Private canals but they have no effect on the operation of the model.)

The operation of the North Platte River between Whalen Dam and the State Line is very complicated. The revisions of this part of the model should be closely coordinated with the Wyoming State Engineer's Office, particularly Mr. Michael, Gary Mehling, and Carlton Hunter.

7. Summary of Comparison of 1984 North Platte River Operating Agreement and the North Platte River Management Model (NPRMM)

1984 Operating Agreement:

A.2. Any Pathfinder ownership in Guernsey Reservoir on September 30 will remain Pathfinder ownership after October 1. This water will not transfer to Guernsey ownership, but will remain in Pathfinder ownership and may be transferred upstream as Guernsey ownership or the Inland Lakes accrue water.

The NPRMM does not account for water in this manner. Once Guernsey ownership is depleted, Pathfinder ownership from Pathfinder and Glendo Reservoirs is used.

1984 Operating Agreement:

B.3. The amount of water transferred from this account to the Inland Lakes shall not exceed 46,000 AF annually less evaporation losses, measured into the Interstate Canal if other water is being released and at Guernsey of only the Inland Lakes water is being released.

The NPRMM states how much water (46,000 AF maximum) is transferred to the Inland Lakes but not the point where the measurement is taken.

1984 Operating Agreement:

E. Glendo Reservoir Capacity = 183,238 AF

The NPRMM uses a capacity of 789,400 AF

E.5. The Glendo ownership will be accounted for on both a state and an individual contractor basis. Such accounting will include accruals, releases, evaporation, exchanges, and carry-over storage. Such amounts will be allocated by account in proportion to each entity's contracted amount of the Glendo water supply. Neither state will be allowed to accrue, in any one year, more than its proportionate share of the ownership (15,000 AF to Wyoming and 25,00 AF to Nebraska), nor will the irrigation pool including carryover storage accrue beyond 37,500 AF for Wyoming or 62,000 AF for Nebraska.

The NPRMM does not include this type of accounting.

1984 Operating Agreement:

F.2. In the event that "Excess to Ownership" storage accrues less than 16,000 AF in any year, the first 12,000 AF shall be used as operation or regulation water for the Guernsey to Tri-State section. the remaining "Excess to Ownership" water as apportioned to each state shall be mutual agreement be released from storage; by agreement may be credited to refill storage ownership accounts; or may be carried over in an amount not to exceed 12,000 AF for use the following year as operational or regulation water.

The NPRMM does not include this accounting.

Comparison of 1984 North Platte River Operating Agreement and the North Platte River Management Model (NPRMM)

1984 Operating Agreement:

A. Pathfinder - 1,015,888 AF (current capacity) Priority Date - 12/06/04

1. All River gains upstream of Pathfinder Reservoir for the October 1 through April 30 period are to accrue to this ownership unto filled. Gains May 1 through September 30 in excess of natural flow demands may accrue to Pathfinder ownership until filled.

2. Any Pathfinder ownership in Guernsey Reservoir on September 30 will remain Pathfinder ownership after October 1. This water will not transfer to Guernsey ownership, but will remain in Pathfinder ownership and may be transferred upstream as Guernsey ownership or the Inland Lake accrue water.

3. The Pathfinder evaporation charge is computed as though all Pathfinder ownership is in Pathfinder Reservoir, except for that portion which may be in Guernsey Reservoir which shall be computed at the same rate as that of Guernsey Reservoir.

NPRMM:

A. Pathfinder maximum capacity - 1,015,888 AF

1. Upstream inflow is accrued first to Pathfinder ownership up to the capacity of the Reservoir during the period October 1 through April 30. Natural flow is distributed to each demand in the following priority during the period May 1 through September 30:

   a. Five Ditch irrigation demand

   b. North Platte irrigation demand

   c. Pathfinder Ownership

   d. Guernsey Ownership

   (The model agrees with the 1984 Operating Plan)

2. The model does not transfer Pathfinder Ownership to Guernsey Reservoir. Once Guernsey Ownership is depleted, Pathfinder Ownership in Pathfinder Reservoir is used.

3. <u>North Platte Project Evaporation</u>: Ownership in storage less Guernsey Reservoir storage is assumed to reside in Pathfinder Reservoir in order to compute evaporation curve; then Guernsey Reservoir evaporation is added to obtain the North Platte Project evaporation (no difference in evaporation accounting from the 1984 Operating Agreement and the NPRMM).

1984 Operating Agreement:

B. Inland Lakes - 46,000 (Lakes Alice and Minatare)

1. During the months of October, November, and April, gains downstream from Alcova Reservoir will accrue to the Inland Lakes, up to a total of 46,00 AF, and at a rate not to exceed 910 cubic feet per second. these gains may be stored in Guernsey and Glendo Reservoirs and transferred to the Inland Lakes when Pathfinder Irrigation district resumes spring operations. The transfer is to be completed no later than May 15.

2. Evaporation will be charged to this ownership for water stored in upstream reservoirs at the rate determined for the reservoir where stored.

3. The amount of water transferred from this account to the Inland Lakes shall not exceed 46,000 AF annually less evaporation losses, measured into the Interstate Canal if other water is being released and at Guernsey if only the Inland Lakes water is being released.

NPRMM:

1. Inland Lakes can accrue water downstream of Alcova Reservoir in October, November, and April up to a total of 46,000 AF. The model stores the Inland Lakes water in Guernsey Reservoir until it is transferred to Lakes Minatare and Alice. This transfer takes place in March (up to 30,000 AF) with the balance in April.

   (The model handles the operation of the Inland Lakes fairly well relative to the 1984 Operating agreement. The 910 cfs maximum diversion rate loses most of its significance with a monthly model)

2. Evaporation is charged to the Inland Lakes at the Guernsey Reservoir rate.

3. The model states how much water is transferred to the Inland Lakes but not the point where the measurement is taken.

1984 Operating Agreement:

C. Guernsey - 45, 612 AF (current capacity) Priority Date - 04/20/23

1. River gains upstream of Guernsey Reservoir for the October 1 through April 30 period and not credited to the Inland Lakes will accrue to this ownership until filled. Gains May 1 through September 30 in excess of natural flow demands may accrue to Guernsey ownership until filled.

2. The Guernsey evaporation charge is computed as though all Guernsey ownership is in Guernsey Reservoir.

3. All releases made to fulfill contractual obligations to Federal contractors by the Bureau of Reclamation at its Torrington office will be coordinated with the Hydrographer-Commissioner of District 14. Guernsey Reservoir releases after April 30 are to be natural flow class upon the river following coordination among Wyoming, Nebraska, and Bureau of Reclamation personnel.

4. When Guernsey Reservoir releases exceed the natural flow of the river at this point, then the difference is a release of storage water.

NPRMM:

1. The model handles the operation of Guernsey Reservoir in the same manner. In addition, after the Inland Lakes water has been transferred to Lakes Alice and Minatare, the vacancy can be filled by Guernsey ownership.

2. Guernsey evaporation charge is computed as though all Guernsey ownership is in Guernsey Reservoir.

3. Not applicable to the model.

4. Model handles this point in the same manner.

1984 Operating Agreement:

D. Kendrick - 1,201,574 AF (current capacity; Seminoe - 1,017,279 AF, Alcova - 184,295 AF) Priority Dates (Seminoe - 12/01/31, Alcova - 04/25/36)

1. All gains upstream of Seminoe Reservoir for the October 1 through April 30 period after Pathfinder and Guernsey ownerships have filled are to accrue to Kendrick (Seminoe) ownership for the October 1 through April 30 period after Pathfinder and Guernsey ownerships have filled are to accrue to Kendrick (Alcova) ownership until filled. Gains May 1 through September 30 in excess of natural flow demands may accrue to the Kendrick ownership until filled.

2. The evaporation chargeable to Kendrick ownership shall be the actual Seminoe and Alcova Reservoir evaporation yesterday, plus the evaporation for Kendrick ownership stored in any other reservoir but assumed to be in Seminoe Reservoir, minus any loss charged to storage held under contract for other entities by the Bureau of Reclamation in Seminoe Reservoir.

NPRMM:

Seminoe Capacity = 1,017,280 AF
Alcova Capacity - 184,300 AF

1. The model priority is as follows:

   a. Five Ditch irrigation demand

   b. North Platte irrigation demand

   c. Pathfinder ownership

   d. Guernsey ownership

   e Seminoe and Alcova ownerships

This agrees with No. 1 above.

2. The water stored in Seminoe Reservoir is charged at Seminoe evaporation rates. The water stored in Alcova Reservoir is charged at Alcova evaporation rates.

1984 Operating Agreement:

E. Glendo - 183,238 AF (current capacity) Priority Date - 08/30/51
   1. This ownership consists of a power head pool of 63,148 AF (elevation 4,570), an irrigation ownership pool not to exceed 100,000 AF, and an estimated evaporation pool of 20,090 AF.

   2. All gains upstream of Glendo Reservoir for the period October 1 through April 30 after the Pathfinder, Guernsey, and Kendrick ownerships and the Inland Lakes Account have filled are to accrue to the Glendo ownership until filled. At any time that the Guernsey ownership has filled and the Pathfinder or Kendrick ownerships have not filled, all gains between Alcova and Glendo will accrue to Glendo ownership. Gains May 1 through September 30 in excess of natural flow demands may accrue to this ownership until filled.

   3. When the power head pool of 63,148 AF (elevation 4,570) is filled, no further accounting need be made for this pool. this minimum power head pool can be filled but once from the river, all Glendo ownership evaporation will be charged

against the irrigation pool unless storage for evaporation has been underestimated and evaporation encroaches upon the power head pool. In this case, refilling of the power head pool will be allowed as an exception.

4. Glendo ownership can accrue annually in the irrigation pool up to 40,000 AF plus estimated evaporation, provided this total irrigation ownership including carry-over does not exceed 100,000 AF plus estimated evaporation. Any difference between actual evaporation charged to the Glendo ownership and that estimated previously will be accounted for by adjustment of the next year's allowable storage for evaporation.

5. The Glendo ownership will be accounted for on both a state and individual contractor basis. Such accounting will include accruals, releases, evaporation, exchanges, and carry-over storage. Such amounts will be allocated by account in proportion to each entity's contracted amount of the Glendo water supply. Neither state will be allowed to accrue, in any one year, more than its proportionate share of the ownership (15,000 AF to Wyoming and 25,000 AF to Nebraska), nor will the irrigation pool including carry-over storage accrue beyond 37,500 for Wyoming or 62,500 AF for Nebraska.

6. The evaporation chargeable to the Glendo ownership is the total actual evaporation minus that chargeable to other ownerships and minus any loss charged to storage held under contract for other entities by the Bureau of Reclamation in Glendo Reservoir.

7. Gains Alcova to Glendo for the October 1 through April 30 period are to be computed as Glendo Reservoir inflow minus 98% of the Grey Reef outflow two days earlier.

NPRMM:

Glendo Capacity = 789,400 AF (Note difference)

1. Power head pool = 63,150 AF
   Carryover not to exceed 100,000 AF
   Evaporation pool = 20, 090 AF

2. Priority in model is as follows:

   a. Five Ditch demand

   b. North Platte irrigation demand

   c. Pathfinder ownership

   d. Guernsey ownership

   e Seminoe and Alcova ownerships

f. Kendrick irrigation demand

g. Glendo Unit ownership

(Matches No. 2 above)

3. The Glendo minimum pool is 60,000 AF

4. Same as operating plan

5. Not included in model

6. Same as operating plan

7. River carriage losses are being checked at this time.

1984 Operating Agreement:

F. Excess to ownership storage

1. River gains upstream of Guernsey Reservoir for the May 1 through September 30 period in excess of natural flow demands not applied to storage ownership accounts will accrue to "Excess to Ownership."

2. In the event that "Excess to Ownership" storage accrues less than 16,000 AF in any year, the first 12,000 AF shall be used as operational or regulation water for the Guernsey to Tri-State section. The remaining "Excess to Ownership" will be credited to Wyoming and shall be released for use in that state; or by agreement may be credited to refill storage ownership accounts. If the "Excess to Ownership" storage accrues in excess of 16,000 AF in any year, the account is to be divided between Nebraska (75%) and Wyoming (25%). For Nebraska's share, 12,000 AF will be reserved for use as operational or regulation water for the Guernsey to Tri-State dam section. The remaining "Excess to Ownership" water as apportioned to each state shall by mutual agreement be released from storage; by agreement may be credited to refill storage ownership accounts, or may be carried over in an amount not to exceed 12,000 AF for use the following year as operational or regulation water.

3. The "Excess to Ownership Account" will accrue in such a manner so as not to interfere with authorized project purposes or would endanger the safety of a structure.

NPRMM:

1. Same as in model, only "Excess to Ownership is termed "Owed to River."

2. Not included in the model.

3. The "Excess to Ownership Account" does not interfere with project purposes. The account is constrained by the capacities of the reservoirs and, thus, does not endanger the safety of a structure.

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Water Development Commission

BARRETT BUILDING TELEPHONE: 307-777-7626 CHEYENNE, WYOMING 82002

Michael K. Purcell
Administrator

June 29, 1984

Dr. Victor Hasfurther, Associate Director
Wyoming Water Research Center
P.O. Box 3067
Laramie, Wyoming 82071

Dear Vic:

This letter is to follow-up our meeting of June 28th and to answer some of the questions which you have raised. Based upon your presentation, it was decided that the following changes should be made to the NPRMM.

1. Annual demand for the Kendrick Project should be reduced from the present 70,000 acre-feet to the average annual historical diversion of 60,000 acre-feet.

2. The evaporation curves presently used in the model should be replaced by algorithms representative of evaporation at the four BUREC evaporation pans.

3. Carriage losses, as given for each North Platte reach within the Decree, should be incorporated within the model in lieu of the present gains-losses routine.

4. Incorporate an ownership routine into the model such that Pathfinder ownership in Guernsey Reservoir can be accounted for, as per item A.2 in your handout.

5. Glendo Reservoir storage accounting should not be changed at this time (as per item E.5 of your handout) but the present method of the model's handling this situation and model changes necessary to accomodate Glendo ownership should be documented.

As per our discussions, I am more interested in having the above tasks completed first before you begin work on the revised model documentation. I feel that the information you have provided at our several meetings is adequate documentation for now. Therefore, I would like you to expend your efforts at this time in completing the above tasks by July 15th, and then begin on documentation to be provided in draft form by August 1st. As I stated in our phone conversation, I will request funds be made available after June 18th to continue this work through the completion of documentation.

I would like to commend you and Greg on the excellent job you have been doing on this study and am looking forward to your continuing involvement. If you have any questions or problems, please contact me.

Sincerely,

Michael K. Purcell
Administrator

CG/MKP/sj

cc: Bob Brocksen, UW Water Research Center
George Christopulos, State Engineers Office

Rm 1662

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Water Development Commission

BARRETT BUILDING TELEPHONE: 307-777-7626 CHEYENNE, WYOMING 82002

Michael K. Purcell
Administrator

July 9, 1984

Dr. Victor Hasfurther, Associate Director
Wyoming Water Research Center
PO Box 3067
Laramie, Wyoming 82071

Dear Vic:

This is to request your help in two additional tasks in making the North Platte River Management Model usable by the WWDC in its studies. These are:

1. Extend the data base to include the years through 1983.

2. Hold a presentation describing the recent changes made in the model.

This should be held after all changes are made but prior to the documentation phase, so that consultants needing use of the model will be aware of the recent changes.

If the addition of these two tasks causes a financial problem for the project, please let me know.

Sincerely,

Mike

Michael K. Purcell
Administrator

MKP:CG/rlb

North Platte River Management Model

Revisions

1. Requested Revision:

Annual demand for the Kendrick Project should be reduced from the present 70,000 acre-feet to the average annual historical diversion of 60,000 acre-feet.

Result:

The input data file was modified to reduce the Kendrick Project demand from 70,000 acre-feet annually to 60,000 acre-feet annually. The 60,000 acre-foot value is based upon average Kendrick Project demands as reflected in records maintained for the Casper Canal. No problems were encountered in this modification. The Kendrick Project demands were changed in Card 117-118 (DKRD) to the following:

Kendrick Project Demand

May	June	July	August	September	Total
5.28	14.7	17.76	15.84	6.42	60.00

2. Requested Revision:

The evaporation curves presently used in the model should be replaced by algorithms representative of evaporation at the four BUREC evaporation pans.

Result:

The coefficients for the straight line estimation of evaporation were changed as they are included as input data and did not require any model changes. The result was that the model entered an infinite loop and failed to produce any output. Two minor modifications to the model were made to allow execution. While the modifications to the model were minor they were of major importance to the execution of the program and took time to isolate. The modified straight line estimation method of evaporation was used in the model. It was found the revised straight line approximation was accurate except at very low reservoir contents.

Another problem encountered was the evaporation data for Seminoe and Glendo are recorded by the BUREC but do not provide a published record. Time was spent locating the necessary data. The BUREC in Denver has no record and the personnel in the Casper office said to come to Casper and dig through their files. The evaporation data for the two pans, through 1977, were finally located in an unpublished Master's thesis by Larry Lewis.

3. Requested Revision:

Carriage losses, as given for each North Platte reach within the Decree, should be incorporated within the model in lieu of the present gains-losses routine.

Result:

The requested revision should be reworded to "should be incorporated within the model in addition to the present gains-losses routine." Gains-losses are input data to the model while carriage losses are applied only to the calculated release of water from storage.

We have not been able to complete the incorporation of the carriage losses into the model. The work will be continued for use in the Little Snake River Project.

While carriage losses are an important part of the model, their impact on the quantitative evaluation of water supply by using the model should not be significant. The magnitude of the carriage loss in the Alcova-Glendo reach is comparable to Alcova Reservoir evaporation.

4. Requested Revision:

Incorporate an ownership routine into the model such that Pathfinder ownership in Guernsey Reservoir can be accounted for, as per item A.2 in the 6/28/84 handout.

Result:

Item A.2 states: "Any Pathfinder ownership in Guernsey Reservoir on September 30 will remain Pathfinder ownership after October 1. This water will not transfer to Guernsey ownership, but will remain in Pathfinder ownership and may be transferred upstream as Guernsey ownership or the Inland Lakes accrue water".

As the Ownership Accounting portions of the model were studied, it became apparent that the model does not transfer ownership of water. In any month the amount of water in ownership equals the amount of water in storage. The model does not quantify how much ownership occurs in which reservoirs. It was felt after studying the algorithms that the current model addresses item A.2

and that identifying ownerships in reservoirs would require a major model revision which could not be completed by August 1, 1984. This revision would require close coordination with the Board of Control to accurately assign ownerships to reservoirs.

5. Required Documentation:

Glendo Reservoir storage accounting should not be changed at this time (as per item E.5 of handout) but the present method of the model's handling this situation and model changes necessary to accommodate Glendo ownership should be documented.

Response:

The NPRMM User's Manual states the current Glendo Unit accounting is based on historical records. Insufficient records were available at this time to verify the results. The yearly irrigation demand uses the following equations:

GLAUVX = XMULT * (10**(-2.39308* ALOGIO (SYIN) + 18.334))/1000

where: GLAUVX = Glendo Unit Annual Irrigation Demand
XMULT = multiplier to change the maximum annual demand

SYIN = system inflow calculated as follows:

SYIN = (SEIN + CPGN + AGGN + GGGN + AGDV)*1000

where: SEIN = Seminoe Inflow
CPGN = Kortes - Pathfinder Reach Gain
AGGN = Alcova - Glendo Reach Gain
GGGN = Glendo - Guernsey Reach Gain
AGDV = Additional diversion between Alcova and Glendo Reservoirs, (currently zero)

SEIN, CPGN, AGGN, GGGN and AGDV are included as input data to the model and will not require modification.

The equation for annual Glendo Unit demand is based on a maximum of 20,000 acre-feet and a minimum of 4,000 acre-feet. The maximum demand is varied by the use of XMULT. The value of XMULT is not a factor but rather the actual demand in thousands of acre-feet.

The Glendo Unit demand is distributed as follows:

	Month				
	May	June	July	Aug	Sept
Percent of Annual Demand	10	15	25	25	25

The calculation of the annual delivery can be found in Subroutine GLUIRD1 and the distribution can be found in Subroutine GLUDIST.

These subroutines should be modified when the desired operation of the Glendo Unit is decided upon. Two options previously discussed are; (1) maximum utilization of the 40,000 AF pool assuming the Corn Creek Project and Central Nebraska Project come on line, and (2) Central Nebraska demands Nebraska's full share and Wyoming's portion is utilized as it has been in the past.

(1) Will require the determination of a distribution (May-Sept) for the utilization of the 40,000 acre-foot pool.

(2) Will require the necessary distributions and a scheme to account for carryover storage.

6. <u>Requested Revisions</u>:

Extend the data base to include the years through 1983.

<u>Result</u>:

The model data base was updated through 1983 by reviewing the 1981 and 1982 Annual Hydrographers Reports. Data for 1983 were obtained from Gary Mehling and John Shields. The model is now operational for the extended data base.

THE STATE OF WYOMING

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Water Development Commission

BARRETT BUILDING TELEPHONE: 307-777-7626 CHEYENNE, WYOMING 82002

Michael K. Purcell
Administrator

March 26, 1984

Dr. Robert Brocksen, Director
Wyoming Water Research Center
University of Wyoming
Box 3067
Laramie, Wyoming 82071

Dear Bob:

This letter is to follow-up our phone conversation and formally request the aide of the Water Center in the use of the North Platte River Management Model. We would like to have the model operational to perform various studies for the Deer Creek and Little Snake River Water Management projects. I believe that the model's output will also be useful to the State Engineer, who will be able to use the output in assessing our projects' water rights, and to the Attorney General, who would be able to utilize the model in potential discussions with Nebraska and the Bureau of Reclamation.

The North Platte River Management Model (NPRMM) was developed for the U.S. Bureau of Reclamation by Tsong C. Wei at the University of Wyoming Water Resources Research Institute (now the Wyoming Water Research Center) in 1977. Substantial modifications were made to the NPRMM by Michael Akerbergs in 1981. Because it has been several years since its use at the University, and because the Bureau of Reclamation discovered new "bugs" in the model during its attempt to use it in the Deer Creek study, it is expected that some time and effort will be involved in familiarization and debugging the model.

The following is a list of tasks which are necessary to insure the model can assist us in evaluating the North Platte River system and impacts on the system from our proposed projects:

1. Familiarization with the model, its assumptions, calculations, and operational requirements.

2. Development of short and understandable documentation of the legal and functional assumptions made in the model.

3. Development of an operational debugged version of the model.

4. Meet with representatives of the WWDC, State Engineer's Office and Attorney General's Office for purposes of discussing the results of tasks 1-3 and developing potential revisions to the model.

5. Development of three additional versions of the model. These versions will be established at the above referenced meeting. It is likely that these versions will address operation of Glendo Reservoir power pool, the Inland Lakes diversions, and a model update.

We would appreciate completion of the above referenced work by July 15, 1984, so that we may proceed with our studies on schedule. If you have any questions or comments, please feel free to contact me. Thank you for your assistance.

Sincerely,

Mike

Michael K. Purcell
Administrator

MKP/CG/vsb
cc: George Christopulos
Larry Wolfe

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Water Development Commission

BARRETT BUILDING TELEPHONE: 307-777-7626 CHEYENNE, WYOMING 82002

Michael K. Purcell
Administrator

May 15, 1984

Dr. Victor Hasfurther
Department of Civil Engineering
University of Wyoming
PO Box 3295
Laramie, Wyoming 82071

Dear Vic:

This letter is to provide a follow-up summarization of our North Platte Model meetings of May 14th, 1984. It is our understanding that at the present time, the following have been accomplished:

1. The model is running, has been debugged, and could be operated by others.

2. The Alcova - Glendo reach gains have been modified for 1936 - 1938 for depletions resulting from a Deer Creek Reservoir.

3. The model has been checked and appears to comply with th Decree.

Tasks which you will be performing and which we plan to discuss at our upcoming June meeting are:

1. The comparison of actual reservoir storage values versus model calculated values for the period 1960 - 1980.

2. A detailed check of model subroutines to establish how they are performing river operations.

3. Summarize and document the above with particular emphasis on how the model handles:

   a. Glendo Reservoir,
   b. The Inland Lakes, X
   c. The Supreme Court Decree,
   d. Owed to the River Water.

4. Develop the data base modifications necessary to run the model with the following conditions:

   a. Thirty-thousand acre-feet introduced into the system annually (10,000 acre-feet in each of July, August, and September) from the Little Snake River basin.

   b. Full use of the 40,000 acre-foot Glendo water right by the Corn Creek Project and Central Nebraska Project.

If you have questions concerning this information, please contact me. Thank you for your assistance.

Sincerely,

Michael K. Purcell
Administrator

MKP:CG/rlb

cc: George Christopulos, State Engineer
    Bob Brocksen, University of Wyoming

THE STATE OF WYOMING

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BARRETT BUILDING TELEPHONE: 307-777-7626 CHEYENNE, WYOMING 82002

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May 15, 1984

Mr. Gary Mehling, Hydrographer - Commissioner
511 W. 27th
Torrington, Wyoming 82240

Dear Mr. Mehling:

We will be holding a meeting in the State Engineer's conference room at 10:00 a.m. on Tuesday, June 5, 1984 to discuss the use of the North Platte River Management Model, particularly for the WWDC Deer Creek and Little Snake projects. The Water Center at the University is currently reestablishing the model on the University computer and is preparing documentation of its modeling procedures.

At the June 5th meeting we will discuss the following topics:

1. Details of how the Model operates. In particular, the following topics:

    a. Glendo Reservoir,
    b. The Inland Lakes,
    c. Owed to the River Water.

2. The effects of fully operational Corn Creek and Central Nebraska projects upon Glendo Reservoir and water availability.

3. Reservoir operations with the introduction of 30,000 acre-feet annually into the North Platte River from the Little Snake River.

4. The potential for modifying the model to account North Platte water on a daily basis.

We are seeking your advice and input at this meeting and hope that the outcome is to have the model operate as realistically as possible. If you have any questions regarding the topics to be discussed at this meeting, please feel free to contact me. Your assistance in this matter is appreciated.

Sincerely,

Michael K. Purcell
Administrator

MKP:CG/rlb

cc: Bob Brocksen, University of Wyoming
Victor Hasfurther, University of Wyoming

North Platte River Management Model

6/5/84

Summary of Studies:

1. Comparison of actual reservoir storage values versus model calculated values for the period 1960-1980.

   The comparison was made for the period 1960-1979. Results show good correlation between the actual vs. modelled EOM contents.

2. Detailed check of model subroutines to establish how they are performing river operations.

   There are approximately 70 subroutines in the main model. The detailed check of model subroutines is ongoing. A description of what each subroutine does is included as Table 1.

3. Summarize and document the above with particular emphasis on how the model handles:

   a. Glendo Reservoir: The model closely addresses the operation of Glendo Reservoir as can be seen in the EOM comparisons. The delivery of water from Glendo Reservoir needs work as discussed later. An available input to the model is the minimum pool of Glendo Reservoir. This option has not been run as yet.

   b. Inlands Lakes: Inland Lakes can accrue natural flow below Alcova in October, November and April up to 46,000 acre-feet. This is transferred to Lakes Alice and Minitare in March up to 30,000 acre-feet and the balance in April. If Inland Lakes water in storage is less than 30,000 acre-feet in March, April accrual may be transferred in advance by borrowing water from Guernsey ownership and returning it in April.

      The downstream inflow is distributed to Inland Lakes water and Guernsey ownership as defined above. This is assumed to be stored in Guernsey Reservoir and cannot exceed the reservoir capacity. After the Inland Lakes water has been transferred to Lakes Alice and Minitare, the vacancy created can be filled by Guernsey ownership. However, if part of Guernsey ownership is transferred to Inland Lakes in April the vacancy cannot be filled since cumulative ownership is restricted by the reservoir capacity. A summary of the operation of the Inland Lakes for the period 1928-1981 is provided as Table 2.

   c. The Supreme Court Decree: Areas of concern relating to the Decree include:

      (i) Does Colorado currently export 60,000 AF of North Platte River water in a ten-year period? Is Colorado utilizing water for 145,000 acres and 17,000 AF of storage?

(ii) Is Wyoming utilizing water for the full 168,000 acres allowed by the decree? A 1969 inventory showed 156,620 acres being irrigated, a deficit of 11,380 acres. Using one cfs/70 acres for the 11,380 acres an additional 69,000 AF of water could be diverted for irrigation, neglecting return flows.

(iii) The reservoir evaporation losses for Seminor, Pathfinder, and Alcova Reservoirs are to be determined daily based upon evaporation data from Pathfinder Reservoir as stated by the North Platte River decree.

The model uses evaporation curves for each reservoir. No documentation has been found to detail how these curves were developed, how they are used, or if they related to the Pathfinder Reservoir evaporation data.

(iv) River Carriage Losses: The North Platte Decree quantifies the river carriage losses for sections of the river including:

Alcova to Wendover
Guernsey Reservoir to Whalen
Whalen to State Line

The model uses historic data in which the river carriage losses are implied. The model does not specifically apply the river carriage losses quantified in the Decree.

d. Owed to the River Water: After the natural flow has been appropriated to ownership and irrigation demands, the remaining natural flow is identified as that owed to the river, or simply river water. River water accrued during October - February is stored in reservoirs and released in March. In other months, the river water is released immediately unless flood control operation is requested. No evaporation losses are charges to the river water in storage. The owed to river accounting is done for two reaches; above Alcova Reservoir and above Guernsey Reservoir. Summaries of the owed to river accounting is provided in Table 3.

4. Develop the data base modifications necessary to run the model with the following conditions:

a. Thirty-thousand acre-feet introduced into the system annually (10,000 acre-feet in each of July, August, and September) from the Little Snake River basin.

The data base was developed and the model was run. The results show that the Kendrick Project, North Platte Project, and the State of Nebraska are the beneficiaries of the project. A new subroutine will be required to address the usage and ownership of the imported water. Refer to Figure 1.

b. Full use of the 40,000 acre-foot Glendo water right by the Corn Creek Project and Central Nebraska Project.

An option in the input data of the model is the full use of the 40,000 acre-foot Glendo pool. The model delivers this water to the Glendo Unit Project below Whalen Dam. Currently it is not possible to be able to distinguish individual uses of the water (Corn Creek, Central Nebraska). The model does not currently distinguish between the 25,000 AF to Nebraska and 15,000 AF to Wyoming. Refer to Figure 2.

5. Miscellaneous:

(A) A spot check of the North Platte Project demands were made. A comparison of the calculated vs. model demands follows:

Values in Acre-feet

	May	June	July	Aug	Sept	Total
Calculated	116,299	115,962	276,238	271,827	190,526	970,852
Model	75,000	170,000	285,000	290,000	170,000	990,000

The calculated numbers include USGS records of the Fort Laramie and Interstate Canals for the period 1960-1974. The model values represent maximum demands and are input data to the model. Records were not available for the Five Ditch demand so the model demands were used:

Values in Acre-Feet

	May	June	July	Aug	Sept	Total
Five Ditch Demand	25,900	38,900	77,800	64,800	51,900	259,300

The calculated values do not include Warren Act Contractors and Northport District deliveries.

Conclusion: Demands should be verified.

B. A search was made of Water Research Center files (formerly WRRI), no files or documentation were found.

C. No documentation was found to verify such items as:

(i) North Platte Project demands

(ii) Five Ditch demand percentage of North Platte Project

(iii) Kendrick Project Demands

(iv) Reservoir evaporation

North Platte River Management Model

Subroutines - Alphabetical Order

Subroutines - Alphabetical Order

Functions

North Platte River Management Model

Subroutines

Sysbal - Water Balance of the System

Downwc - Controls the computation of water component for the downstream reservoir (Alcova, Glendo, and Guernsey)

Downpw - Adjustment of Water Use and Computation of Power Generation for the downstream reservoirs (include Alcova, Gray Reef, Glendo and Guernsey) Set North Platte Proj. Ownership in Guernsey.

Updnpr - Adjust and compute water use and power generation for the upstream reservoirs (include Seminoe, Kortes, and Pathfinder), recalculate downstream reservoir when Pathfinder operation required to change downstream flow and finally check the storage ownership and total delivery of irrigation projects.

UPWPAJ -

ONWCAT - Computes primary ownership when actual system flow is given and will be activated with IAC=1

RVWTAJ - Adjustment of River Gain and Release
IC = ϕ No adjustment made
IC = 1 Adjusted

PNIROL - Irrigation delivery to North Platte Project is determined as follows. The demand on the North Platte Project in each month is given as input. However from May to September are adjusted according to the water available with maximum amount of delivery during that period cannot exceed the demand.

ALIROL - Alcova irrigation delivery to Kendrick Project Irrigation is performed May to Sept. according to the amount of water available with maximum given as input ALICO

ADDINF - Increase the outflow of upstream reservoir to maintain storage of computing reservoir at a desired level.
Return 1 To further upstream reservoir
Return 2 To The Computing Reservoir for reducing Flow

REDINF - Reduce the outflow of upstream reservoir to maintain the storage of computing reservoir at a desired level.

AJBYPS - Ensures Water Goes through turbine up to capacity before bypass.

AUGMNT - Increase the Amount of Ex in turbine (TR) and Bypass (RL)

REDUCE - Reduces amount of EX from Bypass (RL) and turbine release (TR).

ITERAT - Iteration counter and path control

GUOWNR - From the water gain below Alcova determine ownership of Inland Lakes and Guernsey, Water accrued to Glendo Unit and Credited as owed to river.

GUGLTR - From the downstream water demand determine inflow to and outflow from Guernsey, River water release and outflow from Glendo By Assuming all water goes through turbine with exception of seepage

TABLE 1

ALTEST - Compute daily release from Alcova to fill up Glendo at the end of May.

FLOOD - Controls flood passing through the state line and diversion from Whalen Dam. Glendo Unit and North Platte irrigation water are diverted at the Whalen Dam. When the flood water (RVRL) exceeded the normal flood discharge (STNMFL) Flood pool at the Glendo will be activated. Then the flood pool reach critical level, expressed as percentage of effective pool, the maximum flood discharge (STMXFL) will be used for control at the State Line.

ALPWAJ - Computes Alcova Inflow and Storage, adjusts Fremont Canyon and Alcova turbine release according to reservoir storage in Alcova and Pathfinder, calculate power generated in Alcova.

ALPWCM - Compute Alcova power generation and assign excess water to spill

GRDREG - Regulate downstream flow at Gray Reef to keep minimum discharge

GLPWAJ - Computation of inflow, storage, water use and power generation and adjustment of Alcova and Fremont Canyon turbine release according to the storage in Glendo and Alcova

ICC Controls computation procedures

ICC=0 Preliminary estimation of downstream demand and FCTR

ICC=1 Adjustment of downstream flow requested from project ownership accounting.

ICC=2 Adjustment of downstream flow requested from Pathfinder.

GUPWAJ - Computation of inflow, storage, water use and power generation in Guernsey and adjustment of Glendo turbine release

COMPAJ - Assign release water to proper component

PLTADD - New power plant added below Glendo and Guernsey dam assumed when bypass and spill water are used for the new plant. Max. hydraulic capacity of the plant is minimum flow of Glendo or Guernsey whichever is available. The new power generated and water goes through turbine are added to the original term GLPG and GLTR for Glendo and GUPG and GUTR for Guernsey respectively without listed as separate terms. Bypass and spill are reduced accordingly the amount taken away to the new plant. The present plant characteristics of Glendo and Guernsey was used for new plant.

SETROJ - Primary estimation of turbine release for Seminoe in Oct. to Jan. according to Seminoe Storage and Pathfinder storage at the end of Jan.

SETRFM - Primary estimation of turbine release for Seminoe in Feb and Mar. According to estimated available water to be released in TTH According to estimated available water to be released in this period.

SETRAS - Primary estimation of turbine release for Seminoe in Apr. to Sept. according to estimated available water to be released in this period.

SKTRAJ - Seminoe and Kortes combine operation for a given period. First compute and adjust water use and power generation in a period for Seminoe. Then assume the turbine release from Kortes is equal to that of Seminoe to compute and adjust water use and power generation in Kortes. If the Kortes turbine release value changed, reset Seminoe turbine release and repeat the computation.

CTPWAJ - Kortes power and water components computation At the beginning Seminoe turbine release is set as that of Kortes. Later it is checked with Kortes plant capacity and the excess water is set as spill

PTWPAJ - Compute and adjust water use and power generation in Pathfinder, the adjust the turbine release of Seminoe, Fremont Canyon, and Alcova according to storage in Pathfinder and Seminoe.

PTMFCK - ?

PTPGAD - New Power Plant added below Pathfinder dam, assumed all bypass and spill water delivered to the plant. No plant max. hydraulic capacity imposed. Fremont Canyon power characteristics used.

PROJAJ - Calculation of Irrigation projects owned storage and total delivery to the project from reservoirs. The check the projects storage and adjust water use in reservoirs.

PNPROJ - North Platte Project ownership and Kendrick project ownership gain calculation.

DKPROJ - Kendrick project ownership calculation

GUPROJ - Glendo unit project ownership accounting

PRMXAJ - Project ownership exceeded the maximum allowed. Set the ownership at maximum and release excess water as river water.

PRMNAJ - Adjustment of irrigation delivery when the project ownership lower than minimum allowed

EVADJS - Check projects evaporation against system evaporation, the evaporation is redistributed in proportion of average ownership of each project. When EOM ownership is zero, evaporation should equal to the ownership of beginning of the month.

EVSTCK - Check ownership for evaporation distribution

SEQNCE - Sequence operation of entire basin

ADJPC2 - This program considers several months of period as a whole and adjust the water use whenever spill and shortage occur IF first adjust within each month then balance the entire period

ADJPC1 - This program checks generated power with plant capacity and computes the EOM storage. IF spill or shortage occur water use component are adjusted within the month to eliminate or minimize them.

DISTBT - In a given period, some of the months have spill that storage exceeded the maximum capacity of reservoir or shortage that storage lower than minimum allowed.
This program selects a water use component and increases or decreases the water use but not exceed the requred limits to reduce or eliminate the spill or shorage in the period.
(storage or shortage?)

CKPWCP - Check the generated power with plant capability and adjust for the power generate water.

ENDSTO - Compute the EOM reservoir storage taking into account of those components expressed as the Function of average storage. Right now, only the evaporation loss is involved.
Note - Before call this sub program, ST2 must be estimated.

AJOVER - Reservoir storage became greater than maximum allowable capacity. This program selects one water use and increases the water use as high as permitted to abolish the spill.
EOM storage set to the maximum reservoir capacity.

AJUNDR - Reservoir storage become lower than minimum allowable capacity. This program selects one water use and reduces the water use as low as permitted to maintain reservoir storage at lowest point EOM storage actual amount.

FUNCTION TABLE - linear interpolation of a table with data in ascending order. If the value located outside the range, boundary value is assumed.

Function IV - Provide the region where a given value V belong in the given criteria C1 (Lower Limit) and C2 (upper limit)

IV=1 -- Below Lower Limit
IV=2 -- Between the limits
IV=3 -- Above upper limit

FUNCTION SUM - Sum up a given array X(K) from K=I to K=N

FUNCTION ROUND - Round off the value X at nth decimal place

FUNCTION SEHT - ICASE Controls the Seminoe Dam Height
=Ø Present height 1017.28
=1 Enlargement height 1406.78
=2 Enlargement height when flow greater than mean * CRIT

FDIRDL - Irrigation delivery to the five ditches with highest priority. P is percentage of North Platte demand assigned to Five Ditch.

SEMFAS - Seminoe outflow less than minimum required. Adjust previous months to eliminate the shortage.

PTENDY - Pathfinder end of year storage should be kept at 50,000 Ac-Ft. When Seminoe and Pathfinder combined storage is less than 400,000 Ac-Ft by adjusting the last three month outflow from Seminoe

GLENDY - Glendo End of year storage should be adjusted to a required level.

OUTPT2 - Horizontal form result output (Type 2 output)

RDATA - Read or set zero the array of input data X(K) from K=L to K=M. According to IO = 1 or Φ. K1 the number of data on a data card, K2 the width of data and K3 the fractional digits of data. The programx, returns to location assigned at *.

REDPAT - Standard pattern to read data
J1, J2, and J6 are no. of components
J3, J4, and J5 are no. of data

SUBRED - Sub-pattern of subprogram REDPAT
NO - no. of data
NC - no. of components
NL - Location of ID Column
K1 - Beginning location of data
K2 - Max. no. of data in a card
K3 - Width of data
K4 - Fractional digits of data
X - input data

RESERV - Standard form of Type I output

PROJMS - This is ownership redistribution described in original completion report (pre-1980/1981 revision version)
Ownership redistribution for May through September priority followed the order of
1. Five Ditch
2. Pathfinder ownership in storage
3. Guernsey ownership in storage
4. Kendrick ownership in storage
5. Glendo unit ownership in storage
6. North Platte direct flow right
7. Kendrick direct flow right
8. Glendo Unit direct flow right
9. River Water
10. Deer Creek
Evaporation Inland Lakes assumed as been computed

STOACC - ownership gain for storage up to STMX

DIRCTF - Glendo Unit Irrigation delivery. Based on historic delivery with adjustment to increase to maximum possible use (40,000 Ac-Ft). IF IGLU OPT = ∅ use present (1980) 20,000 max. possible use variables computed .. GLUI, GLUS

GLUDIST - ?

PROJMS1 - Ownership redistribution for May-Sept. (1980/1981 Revision) Contains some redundant code due to attempted separation of Kendrick project into Seminoe, Alcova and direct flow and subsequent recombination into one priority. Same comment applies to some code in subroutine OUTPT2

Priority followed the order of

1 Five Ditches
2. North Platte Direct Flow up to statutory limit
3. Pathfinder ownership in storage
4. Kendrick project (Seminoe, Alcova, direct flow)
5. Glendo Unit ownership in storage.
6. River Water

Evaporation assumed as computed except for Guernsey for which evaporation is recomputed.

VG.	342.23	408.20	440.59	440.16	507.14	534.73	572.98	706.30	861.91	916.30	729.09	472.19	367.73

TEST 1000 - 1980 REVISION - BASE RUN WITH MOST RECENT OWNERSHIP ACCOUNTING PAGE 7

WATER IN 1,000 ACRE FEET * * * * * * * * * * ENERGY IN MILLION KWH

IRRIGATION DELIVERY -- INLAND LAKES OWNERSHIP (6)

EAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT	TOTAL
928	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1929	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1930	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
931	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
932	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
933	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
934	0.00	0.00	0.00	0.00	0.00	25.12	20.88	0.00	0.00	0.00	0.00	0.00	46.00
1935	0.00	0.00	0.00	0.00	0.00	13.49	4.37	0.00	0.00	0.00	0.00	0.00	17.86
936	0.00	0.00	0.00	0.00	0.00	22.75	.00	0.00	0.00	0.00	0.00	0.00	22.75
937	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
938	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
939	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1940	0.00	0.00	0.00	0.00	0.00	29.96	5.38	0.00	0.00	0.00	0.00	0.00	35.34
941	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
942	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
943	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
944	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1945	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1946	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
947	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
948	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
949	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1950	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1951	0.00	0.00	0.00	0.00	0.00	30.00	5.24	0.00	0.00	0.00	0.00	0.00	35.24
1952	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1953	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1954	0.00	0.00	0.00	0.00	0.00	25.18	18.88	0.00	0.00	0.00	0.00	0.00	44.06
1955	0.00	0.00	0.00	0.00	0.00	23.86	22.14	0.00	0.00	0.00	0.00	0.00	46.00
1956	0.00	0.00	0.00	0.00	0.00	30.00	.15	0.00	0.00	0.00	0.00	0.00	30.15
1957	0.00	0.00	0.00	0.00	0.00	30.00	6.14	0.00	0.00	0.00	0.00	0.00	36.14
1958	0.00	0.00	0.00	0.00	0.00	18.75	7.50	0.00	0.00	0.00	0.00	0.00	26.25
1959	0.00	0.00	0.00	0.00	0.00	30.00	8.55	0.00	0.00	0.00	0.00	0.00	38.55
1960	0.00	0.00	0.00	0.00	0.00	29.81	6.54	0.00	0.00	0.00	0.00	0.00	36.35
1961	0.00	0.00	0.00	0.00	0.00	28.98	3.19	0.00	0.00	0.00	0.00	0.00	32.17
1962	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
963	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1964	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1965	0.00	0.00	0.00	0.00	0.00	30.00	8.58	0.00	0.00	0.00	0.00	0.00	38.58
1966	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1967	0.00	0.00	0.00	0.00	0.00	30.00	5.58	0.00	0.00	0.00	0.00	0.00	35.58
1968	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1969	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1970	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1971	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1972	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1973	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1974	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1975	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1976	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1977	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1978	0.00	0.00	0.00	0.00	0.00	30.00	13.27	0.00	0.00	0.00	0.00	0.00	43.27
1979	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
1980	0.00	0.00	0.00	0.00	0.00	30.00	16.00	0.00	0.00	0.00	0.00	0.00	46.00
OTAL	0.00	0.00	0.00	0.00	0.00	1537.90	728.39	0.00	0.00	0.00	0.00	0.00	2266.29

TOTAL 0.00 [illegible]

AVG.	0.00	0.00	0.00	0.00	0.00	29.02	13.74	0.00	0.00	0.00	0.00	0.00	42.76

WATER IN 1,000 ACRE FEET . . . . ENERGY IN MILLION KWH

EVAPORATION LOSS -- INLAND LAKES OWNERSHIP (7)

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT	TOTAL
1928	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1929	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1930	.09	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.14
1931	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1932	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1933	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1934	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1935	.09	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.13
1936	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1937	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1938	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1939	0.00	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.04
1940	.09	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.14
1941	.09	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.13
1942	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1943	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1944	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1945	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1946	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1947	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1948	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1949	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1950	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1951	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1952	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1953	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1954	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1955	.09	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.14
1956	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1957	.09	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.14
1958	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1959	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1960	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1961	.09	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.13
1962	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1963	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1964	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1965	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1966	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1967	.09	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.14
1968	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1969	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1970	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1971	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1972	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1973	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.15
1974	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	.15
1975	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	.15
1976	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	.15
1977	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	.15
1978	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	.15
1979	.10	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	.15
1980	.09	.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]
TOTALS	5.11	2.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	[illegible]	[illegible]

WATER IN 1,000 ACRE FEET * * * * * * * * * * ENERGY IN MILLION KWH

OWNERSHIP GAIN -- INLAND LAKES OWNERSHIP (8)

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT	TOTAL
1928	33.50	10.88	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	46.15
1929	24.10	20.28	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	46.15
1930	8.39	18.09	0.00	0.00	0.00	0.00	19.66	0.00	0.00	0.00	0.00	0.00	46.14
1931	37.50	6.88	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	46.15
1932	13.61	15.49	0.00	0.00	0.00	0.00	17.05	0.00	0.00	0.00	0.00	0.00	46.15
1933	24.01	14.49	0.00	0.00	0.00	0.00	7.65	0.00	0.00	0.00	0.00	0.00	46.15
1934	21.30	18.71	0.00	0.00	0.00	0.00	6.14	0.00	0.00	0.00	0.00	0.00	46.15
1935	5.19	5.00	0.00	0.00	0.00	0.00	7.80	0.00	0.00	0.00	0.00	0.00	17.99
1936	11.79	9.60	0.00	0.00	0.00	0.00	1.51	0.00	0.00	0.00	0.00	0.00	22.90
1937	13.90	11.31	0.00	0.00	0.00	0.00	20.94	0.00	0.00	0.00	0.00	0.00	46.15
1938	22.30	12.20	0.00	0.00	0.00	0.00	11.65	0.00	0.00	0.00	0.00	0.00	46.15
1939	0.00	13.60	0.00	0.00	0.00	0.00	32.44	0.00	0.00	0.00	0.00	0.00	46.04
1940	10.39	9.09	0.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00	0.00	0.00	35.48
1941	8.70	5.20	0.00	0.00	0.00	0.00	32.23	0.00	0.00	0.00	0.00	0.00	46.13
1942	22.90	15.20	0.00	0.00	0.00	0.00	8.05	0.00	0.00	0.00	0.00	0.00	46.15
1943	22.10	16.20	0.00	0.00	0.00	0.00	7.85	0.00	0.00	0.00	0.00	0.00	46.15
1944	17.70	11.20	0.00	0.00	0.00	0.00	17.25	0.00	0.00	0.00	0.00	0.00	46.15
1945	17.10	11.29	0.00	0.00	0.00	0.00	17.76	0.00	0.00	0.00	0.00	0.00	46.15
1946	22.10	15.20	0.00	0.00	0.00	0.00	8.85	0.00	0.00	0.00	0.00	0.00	46.15
1947	21.30	17.00	0.00	0.00	0.00	0.00	7.85	0.00	0.00	0.00	0.00	0.00	46.15
1948	19.10	14.60	0.00	0.00	0.00	0.00	12.45	0.00	0.00	0.00	0.00	0.00	46.15
1949	16.79	10.89	0.00	0.00	0.00	0.00	18.47	0.00	0.00	0.00	0.00	0.00	46.15
1950	22.90	13.29	0.00	0.00	0.00	0.00	9.96	0.00	0.00	0.00	0.00	0.00	46.15
1951	19.70	12.60	0.00	0.00	0.00	0.00	3.09	0.00	0.00	0.00	0.00	0.00	35.39
1952	20.99	14.89	0.00	0.00	0.00	0.00	10.27	0.00	0.00	0.00	0.00	0.00	46.15
1953	36.61	7.77	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	46.15
1954	13.41	10.00	0.00	0.00	0.00	0.00	20.80	0.00	0.00	0.00	0.00	0.00	44.21
1955	11.19	7.89	0.00	0.00	0.00	0.00	27.06	0.00	0.00	0.00	0.00	0.00	46.14
1956	11.90	8.40	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	30.30
1957	9.50	8.29	0.00	0.00	0.00	0.00	16.49	0.00	0.00	0.00	0.00	0.00	36.28
1958	15.90	10.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.40
1959	20.80	5.30	0.00	0.00	0.00	0.00	12.60	0.00	0.00	0.00	0.00	0.00	38.70
1960	12.90	7.60	0.00	0.00	0.00	0.00	16.00	0.00	0.00	0.00	0.00	0.00	36.50
1961	7.90	7.10	0.00	0.00	0.00	0.00	17.30	0.00	0.00	0.00	0.00	0.00	32.30
1962	13.00	14.30	0.00	0.00	0.00	0.00	18.85	0.00	0.00	0.00	0.00	0.00	46.15
1963	26.50	13.70	0.00	0.00	0.00	0.00	5.95	0.00	0.00	0.00	0.00	0.00	46.15
1964	13.26	10.22	0.00	0.00	0.00	0.00	22.67	0.00	0.00	0.00	0.00	0.00	46.15
1965	13.83	9.95	0.00	0.00	0.00	0.00	14.95	0.00	0.00	0.00	0.00	0.00	38.73
1966	19.17	14.95	0.00	0.00	0.00	0.00	12.03	0.00	0.00	0.00	0.00	0.00	46.15
1967	8.31	8.72	0.00	0.00	0.00	0.00	16.69	0.00	0.00	0.00	0.00	0.00	35.72
1968	12.62	13.57	0.00	0.00	0.00	0.00	19.96	0.00	0.00	0.00	0.00	0.00	46.15
1969	17.72	14.04	0.00	0.00	0.00	0.00	14.39	0.00	0.00	0.00	0.00	0.00	46.15
1970	19.72	17.47	0.00	0.00	0.00	0.00	8.96	0.00	0.00	0.00	0.00	0.00	46.15
1971	21.51	18.70	0.00	0.00	0.00	0.00	5.94	0.00	0.00	0.00	0.00	0.00	46.15
1972	25.02	19.36	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	46.15
1973	16.75	17.11	0.00	0.00	0.00	0.00	12.29	0.00	0.00	0.00	0.00	0.00	46.15
1974	33.29	11.09	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	0.00	46.15
1975	19.13	14.05	0.00	0.00	0.00	0.00	12.97	0.00	0.00	0.00	0.00	0.00	46.15
1976	23.02	9.37	0.00	0.00	0.00	0.00	13.76	0.00	0.00	0.00	0.00	0.00	46.15
1977	20.20	9.45	0.00	0.00	0.00	0.00	16.50	0.00	0.00	0.00	0.00	0.00	46.15
1978	14.06	10.79	0.00	0.00	0.00	0.00	18.57	0.00	0.00	0.00	0.00	0.00	43.42
1979	15.28	10.92	0.00	0.00	0.00	0.00	19.95	0.00	0.00	0.00	0.00	0.00	46.15
1980	10.37	12.67	0.00	0.00	0.00	0.00	23.10	0.00	0.00	0.00	0.00	0.00	46.14
TOTAL	941.05	646.45	0.00	0.00	0.00	0.00	686.51	0.00	0.00	0.00	0.00	0.00	2274.01
AVG.	17.76	12.20	0.00	0.00	0.00	0.00	12.95	0.00	0.00	0.00	0.00	0.00	42.91

AVG.	17.76	12.20	0.00	0.00	0.00	0.00	12.95	0.00	0.00	0.00	0.00	0.00	42.91

VALUES IN 1,000 ACRE FEET ENERGY IN MILLION KWH

END OF MONTH OWNERSHIP -- INLAND LAKES OWNERSHIP (9)

YEAR	INITIAL	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT
1928	0.00	33.40	44.23	44.23	44.23	44.23	14.23	0.00	0.00	0.00	0.00	0.00	0.00
1929	0.00	24.00	44.23	44.23	44.23	44.23	14.23	0.00	0.00	0.00	0.00	0.00	0.00
1930	0.00	8.30	26.34	26.34	26.34	26.34	-3.66	0.00	0.00	0.00	0.00	0.00	0.00
1931	0.00	37.40	44.23	44.23	44.23	44.23	14.23	0.00	0.00	0.00	0.00	0.00	0.00
1932	0.00	13.51	26.95	26.95	26.95	26.95	-1.05	0.00	0.00	0.00	0.00	0.00	0.00
1933	0.00	29.71	39.15	39.15	39.15	39.15	9.15	0.00	0.00	0.00	0.00	0.00	0.00
1934	0.00	21.20	39.66	39.66	39.66	39.66	14.74	0.00	0.00	0.00	0.00	0.00	0.00
1935	0.00	5.10	10.06	10.06	10.06	10.06	-3.43	0.00	0.00	0.00	0.00	0.00	0.00
1936	0.00	11.69	21.24	21.24	21.24	21.24	-1.51	0.00	0.00	0.00	0.00	0.00	0.00
1937	0.00	13.80	25.06	25.06	25.06	25.06	-4.94	0.00	0.00	0.00	0.00	0.00	0.00
1938	0.00	22.20	34.35	34.35	34.35	34.35	4.35	0.00	0.00	0.00	0.00	0.00	0.00
1939	0.00	0.00	13.56	13.56	13.56	13.56	-16.44	0.00	0.00	0.00	0.00	0.00	0.00
1940	0.00	10.30	19.34	19.34	19.34	19.34	-10.62	0.00	0.00	0.00	0.00	0.00	0.00
1941	0.00	8.61	13.77	13.77	13.77	13.77	-16.23	0.00	0.00	0.00	0.00	0.00	0.00
1942	0.00	22.80	37.95	37.95	37.95	37.95	7.95	0.00	0.00	0.00	0.00	0.00	0.00
1943	0.00	22.00	38.15	38.15	38.15	38.15	8.15	0.00	0.00	0.00	0.00	0.00	0.00
1944	0.00	17.60	28.75	28.75	28.75	28.75	-1.25	0.00	0.00	0.00	0.00	0.00	0.00
1945	0.00	17.00	28.24	28.24	28.24	28.24	-1.76	0.00	0.00	0.00	0.00	0.00	0.00
1946	0.00	22.00	37.15	37.15	37.15	37.15	7.15	0.00	0.00	0.00	0.00	0.00	0.00
1947	0.00	21.20	38.15	38.15	38.15	38.15	8.15	0.00	0.00	0.00	0.00	0.00	0.00
1948	0.00	19.00	33.55	33.55	33.55	33.55	3.55	0.00	0.00	0.00	0.00	0.00	0.00
1949	0.00	16.69	27.53	27.53	27.53	27.53	-2.47	0.00	0.00	0.00	0.00	0.00	0.00
1950	0.00	22.80	36.04	36.04	36.04	36.04	6.04	0.00	0.00	0.00	0.00	0.00	0.00
1951	0.00	19.60	32.15	32.15	32.15	32.15	2.15	0.00	0.00	0.00	0.00	0.00	0.00
1952	0.00	20.89	35.73	35.73	35.73	35.73	5.73	0.00	0.00	0.00	0.00	0.00	0.00
1953	0.00	36.51	44.23	44.23	44.23	44.23	14.23	0.00	0.00	0.00	0.00	0.00	0.00
1954	0.00	13.31	23.26	23.26	23.26	23.26	-1.92	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	11.10	18.94	18.94	18.94	18.94	-4.92	0.00	0.00	0.00	0.00	0.00	0.00
1956	0.00	11.80	20.15	20.15	20.15	20.15	-9.85	0.00	0.00	0.00	0.00	0.00	0.00
1957	0.00	9.41	17.65	17.65	17.65	17.65	-12.35	0.00	0.00	0.00	0.00	0.00	0.00
1958	0.00	15.80	26.25	26.25	26.25	26.25	7.50	0.00	0.00	0.00	0.00	0.00	0.00
1959	0.00	20.70	25.95	25.95	25.95	25.95	-4.05	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	12.80	20.35	20.35	20.35	20.35	-9.46	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	7.81	14.87	14.87	14.87	14.87	-14.11	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	12.90	27.15	27.15	27.15	27.15	-2.85	0.00	0.00	0.00	0.00	0.00	0.00
1963	0.00	26.40	40.05	40.05	40.05	40.05	10.05	0.00	0.00	0.00	0.00	0.00	0.00
1964	0.00	13.16	23.33	23.33	23.33	23.33	-6.67	0.00	0.00	0.00	0.00	0.00	0.00
1965	0.00	13.75	23.64	23.64	23.64	23.64	-6.36	0.00	0.00	0.00	0.00	0.00	0.00
1966	0.00	19.07	33.97	33.97	33.97	33.97	3.97	0.00	0.00	0.00	0.00	0.00	0.00
1967	0.00	8.22	16.89	16.89	16.89	16.89	-13.11	0.00	0.00	0.00	0.00	0.00	0.00
1968	0.00	12.52	26.64	26.04	26.04	26.04	-3.96	0.00	0.00	0.00	0.00	0.00	0.00
1969	0.00	17.62	31.61	31.61	31.61	31.61	1.61	0.00	0.00	0.00	0.00	0.00	0.00
1970	0.00	19.62	37.04	37.04	37.04	37.04	7.04	0.00	0.00	0.00	0.00	0.00	0.00
1971	0.00	21.41	40.06	40.06	40.06	40.06	10.06	0.00	0.00	0.00	0.00	0.00	0.00
1972	0.00	24.92	44.23	44.23	44.23	44.23	14.23	0.00	0.00	0.00	0.00	0.00	0.00
1973	0.00	16.65	33.71	33.71	33.71	33.71	3.71	0.00	0.00	0.00	0.00	0.00	0.00
1974	0.00	33.19	44.23	44.23	44.23	44.23	14.23	0.00	0.00	0.00	0.00	0.00	0.00
1975	0.00	19.03	33.03	33.03	33.03	33.03	3.03	0.00	0.00	0.00	0.00	0.00	0.00
1976	0.00	22.92	32.24	32.24	32.24	32.24	2.24	0.00	0.00	0.00	0.00	0.00	0.00
1977	0.00	20.10	29.50	29.50	29.50	29.50	-.50	0.00	0.00	0.00	0.00	0.00	0.00
1978	0.00	13.96	24.70	24.70	24.70	24.70	-5.30	0.00	0.00	0.00	0.00	0.00	0.00
1979	0.00	15.18	26.05	26.05	26.05	26.05	-3.95	0.00	0.00	0.00	0.00	0.00	0.00
1980	0.00	10.26	22.90	22.90	22.90	22.90	-7.10	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	935.94	1579.78	1579.78	1579.78	1579.78	41.88	0.00	0.00	0.00	0.00	0.00	0.00

GAIN TO RIVER -- SURPLUS RIVER WATER (18)

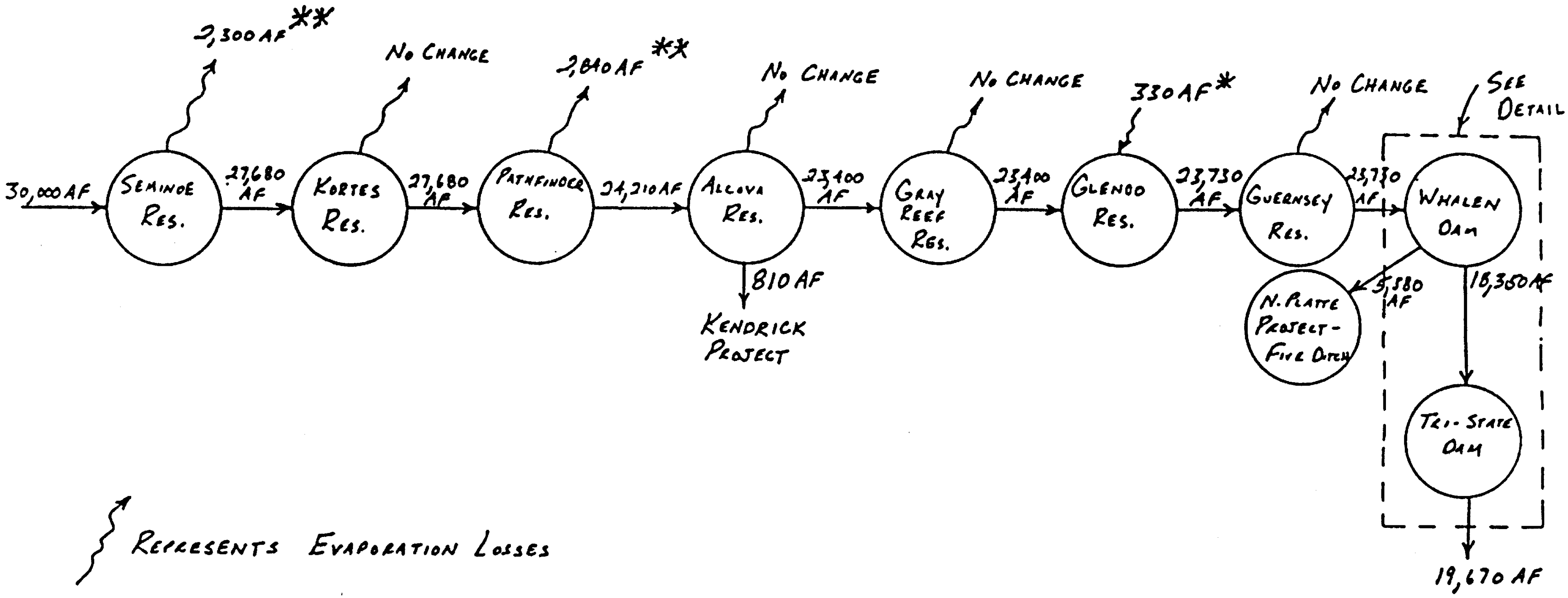
YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT	TOTAL
1928	0.00	0.00	.85	2.04	2.54	0.00	0.00	7.46	0.00	0.00	0.00	0.00	12.91
1929	0.00	0.00	2.26	3.65	9.45	15.05	56.60	294.11	545.48	0.00	0.00	0.00	925.94
1930	0.00	0.00	0.00	3.72	31.25	2.62	36.22	164.45	1.71	0.00	0.00	0.00	239.97
1931	0.00	0.00	6.12	14.77	17.34	0.00	9.36	0.00	0.00	0.00	0.00	0.00	47.61
1932	0.00	0.00	0.00	0.00	2.52	0.00	9.85	0.00	16.14	0.00	0.00	0.00	28.51
1933	0.00	0.00	0.00	1.65	6.35	0.00	21.07	137.06	118.54	0.00	0.00	0.00	284.67
1934	0.00	0.00	0.00	6.90	12.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.15
1935	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1936	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1937	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1938	0.00	0.00	0.00	1.75	1.79	0.00	4.42	0.00	0.00	0.00	0.00	0.00	7.96
1939	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1940	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1941	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1942	0.00	0.00	0.00	1.32	1.62	0.00	0.00	170.57	0.00	0.00	0.00	0.00	173.51
1943	0.00	0.00	0.00	2.22	2.28	0.00	24.31	0.00	0.00	0.00	0.00	0.00	28.81
1944	0.00	0.00	0.00	0.00	1.62	0.00	.23	50.40	0.00	0.00	0.00	0.00	52.25
1945	0.00	0.00	0.00	0.00	1.79	0.00	6.42	65.05	0.00	0.00	0.00	0.00	73.26
1946	0.00	0.00	0.00	10.78	12.34	0.00	3.89	0.00	0.00	0.00	0.00	0.00	27.01
1947	0.00	0.00	0.00	1.74	6.88	0.00	44.86	.33	0.00	0.00	0.00	0.00	53.81
1948	0.00	0.00	0.00	10.41	16.54	10.16	25.00	0.00	0.00	0.00	0.00	0.00	62.11
1949	0.00	0.00	0.00	0.00	.64	0.00	1.10	22.66	0.00	0.00	0.00	0.00	24.40
1950	0.00	0.00	0.00	1.48	8.92	0.00	0.00	0.00	34.57	0.00	0.00	0.00	44.97
1951	0.00	0.00	0.00	.14	4.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.42
1952	0.00	0.00	0.00	1.24	1.70	0.00	0.00	202.37	381.21	0.00	0.00	0.00	586.52
1953	0.00	0.00	1.68	11.69	9.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.82
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1956	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1957	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1958	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00	2.34	0.00	0.00	0.00	0.00	0.00	2.34
1963	0.00	0.00	0.00	0.00	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.85
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1965	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.48	8.84	0.00	0.00	0.00	44.32
1966	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.34
1967	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1968	0.00	0.00	0.00	0.00	2.35	0.00	0.00	50.48	0.00	0.00	0.00	0.00	52.83
1969	0.00	0.00	0.00	0.00	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.74
1970	0.00	0.00	0.00	2.19	1.15	0.00	0.00	141.71	115.51	0.00	0.00	0.00	260.56
1971	0.00	0.00	0.00	8.51	14.65	0.00	45.98	410.68	560.28	0.00	0.00	0.00	1040.10
1972	0.00	0.00	2.57	7.60	23.76	.99	35.56	64.86	191.16	0.00	0.00	0.00	326.50
1973	0.00	0.00	0.00	1.13	8.51	0.00	44.38	739.13	369.69	0.00	0.00	0.00	1162.84
1974	0.00	.18	13.55	14.78	17.34	0.00	170.88	433.46	291.01	0.00	0.00	0.00	941.26
1975	0.00	0.00	0.00	0.00	1.44	0.00	0.00	0.00	41.38	0.00	0.00	0.00	42.82
1976	0.00	0.00	0.00	0.00	13.53	0.00	10.67	81.74	89.82	0.00	0.00	0.00	195.76
1977	0.00	0.00	0.00	0.00	.40	0.00	27.01	0.00	0.00	0.00	0.00	0.00	27.41
1978	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.87	0.00	0.00	0.00	0.00	64.87
1979	0.00	0.00	0.00	0.00	2.84	0.00	3.74	0.00	0.00	0.00	0.00	0.00	6.58
1980	0.00	0.00	0.00	0.00	13.30	0.00	27.71	306.92	179.52	0.00	0.00	0.00	527.45
TOTAL	0.00	.18	26.97	109.09	255.75	26.82	611.62	3443.83	2944.66	0.00	0.00	0.00	7421.12
AVG	0.00	.00	.51	2.06	4.83	.54	11.54	64.98	55.56	0.00	0.00	0.00	140.02

WATER IN 1,000 ACRE FEET * * * * * * * * * * ENERGY IN MILLION KWH

RIVER WATER RELEASED -- SURPLUS RIVER WATER (19)

YEAR	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT	TOTAL
1928	0.00	0.00	0.00	0.00	0.00	5.43	0.00	7.48	0.00	0.00	0.00	0.00	12.91
1929	0.00	0.00	0.00	0.00	0.00	25.75	56.80	169.59	144.86	245.89	245.89	33.02	925.94
1930	0.00	0.00	0.00	0.00	0.00	37.59	36.22	153.94	12.22	0.00	0.00	0.00	239.97
1931	0.00	0.00	0.00	0.00	0.00	38.23	9.38	0.00	0.00	0.00	0.00	0.00	47.61
1932	0.00	0.00	0.00	0.00	0.00	2.52	9.65	0.00	16.00	.14	0.00	0.00	28.31
1933	0.00	0.00	0.00	0.00	0.00	7.90	21.07	137.06	118.64	0.00	0.00	0.00	284.67
1934	0.00	0.00	0.00	0.00	0.00	19.15	0.00	0.00	0.00	0.00	0.00	0.00	19.15
1935	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1936	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1937	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1938	0.00	0.00	0.00	0.00	0.00	3.54	4.42	0.00	0.00	0.00	0.00	0.00	7.96
1939	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1940	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1941	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1942	0.00	0.00	0.00	0.00	0.00	2.94	0.00	170.57	0.00	0.00	0.00	0.00	173.51
1943	0.00	0.00	0.00	0.00	0.00	4.50	24.31	0.00	0.00	0.00	0.00	0.00	28.81
1944	0.00	0.00	0.00	0.00	0.00	1.62	.23	50.40	0.00	0.00	0.00	0.00	52.25
1945	0.00	0.00	0.00	0.00	0.00	1.79	6.42	65.05	0.00	0.00	0.00	0.00	73.26
1946	0.00	0.00	0.00	0.00	0.00	23.12	3.89	0.00	0.00	0.00	0.00	0.00	27.01
1947	0.00	0.00	0.00	0.00	0.00	8.62	44.86	.33	0.00	0.00	0.00	0.00	53.81
1948	0.00	0.00	0.00	0.00	0.00	37.11	25.00	0.00	0.00	0.00	0.00	0.00	62.11
1949	0.00	0.00	0.00	0.00	0.00	.64	1.10	22.66	0.00	0.00	0.00	0.00	24.40
1950	0.00	0.00	0.00	0.00	0.00	10.40	0.00	0.00	34.57	0.00	0.00	0.00	44.97
1951	0.00	0.00	0.00	0.00	0.00	4.42	0.00	0.00	0.00	0.00	0.00	0.00	4.42
1952	0.00	0.00	0.00	0.00	0.00	2.94	0.00	202.37	233.62	147.59	0.00	0.00	586.52
1953	0.00	0.00	0.00	0.00	0.00	22.82	0.00	0.00	0.00	0.00	0.00	0.00	22.82
1954	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1955	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1956	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1957	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1958	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1959	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1961	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1962	0.00	0.00	0.00	0.00	0.00	0.00	2.34	0.00	0.00	0.00	0.00	0.00	2.34
1963	0.00	0.00	0.00	0.00	0.00	1.85	0.00	0.00	0.00	0.00	0.00	0.00	1.85
1964	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1965	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.46	8.86	0.00	0.00	0.00	44.32
1966	0.00	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	0.00	0.00	1.34
1967	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1968	0.00	0.00	0.00	0.00	0.00	2.35	0.00	50.48	0.00	0.00	0.00	0.00	52.83
1969	0.00	0.00	0.00	0.00	0.00	1.74	0.00	0.00	0.00	0.00	0.00	0.00	1.74
1970	0.00	0.00	0.00	0.00	0.00	3.34	0.00	141.71	115.51	0.00	0.00	0.00	260.56
1971	0.00	0.00	0.00	0.00	0.00	23.16	45.98	107.33	226.04	245.89	245.89	145.81	1040.10
1972	0.00	0.00	0.00	0.00	0.00	34.92	35.56	64.41	191.61	0.00	0.00	0.00	326.50
1973	0.00	0.00	0.00	0.00	0.00	9.64	44.36	138.23	346.04	245.85	245.89	134.77	1162.84
1974	0.00	0.00	0.00	0.00	0.00	45.85	170.88	245.89	237.96	240.62	0.00	0.00	941.20
1975	0.00	0.00	0.00	0.00	0.00	1.44	0.00	0.00	41.38	0.00	0.00	0.00	42.82
1976	0.00	0.00	0.00	0.00	0.00	13.53	10.87	81.19	90.17	0.00	0.00	0.00	195.76
1977	0.00	0.00	0.00	0.00	0.00	.40	27.01	0.00	0.00	0.00	0.00	0.00	27.41
1978	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.87	0.00	0.00	0.00	0.00	64.87
1979	0.00	0.00	0.00	0.00	0.00	2.84	3.74	0.00	0.00	0.00	0.00	0.00	6.58
1980	0.00	0.00	0.00	0.00	0.00	13.30	27.71	221.45	237.96	27.03	0.00	0.00	527.45
TOTAL	0.00	0.00	0.00	0.00	0.00	420.81	611.82	2126.91	2055.26	1153.05	737.67	313.60	7421.12
AVG.	0.00	0.00	0.00	0.00	0.00	7.94	11.54	40.17	36.76	21.76	13.92	5.92	140.02

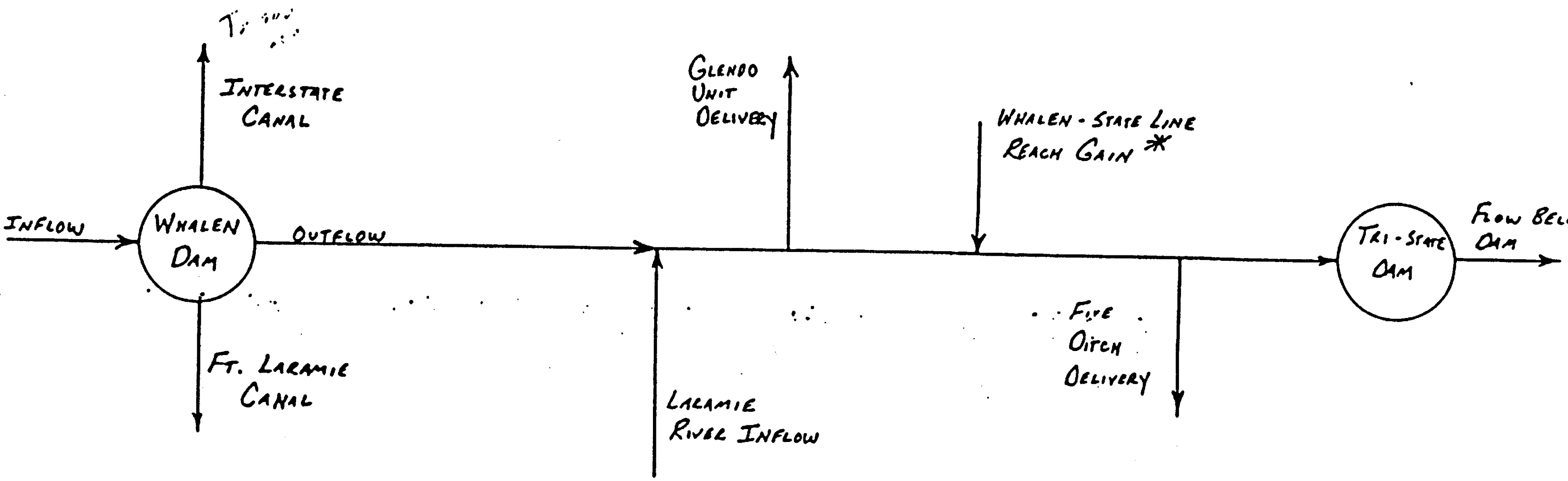
30,000 AF INFLOW TO SEMINOE RES. ANNUALLY. NUMBERS SHOWN ARE FOR 1928-1980.
VALUES REPRESENT CHANGES FROM THE BASE RUN.



* THIS REPRESENTS A REDUCTION IN THE EVAPORATION LOSS FROM THE BASE MODEL TO THE MODIFIED MODEL

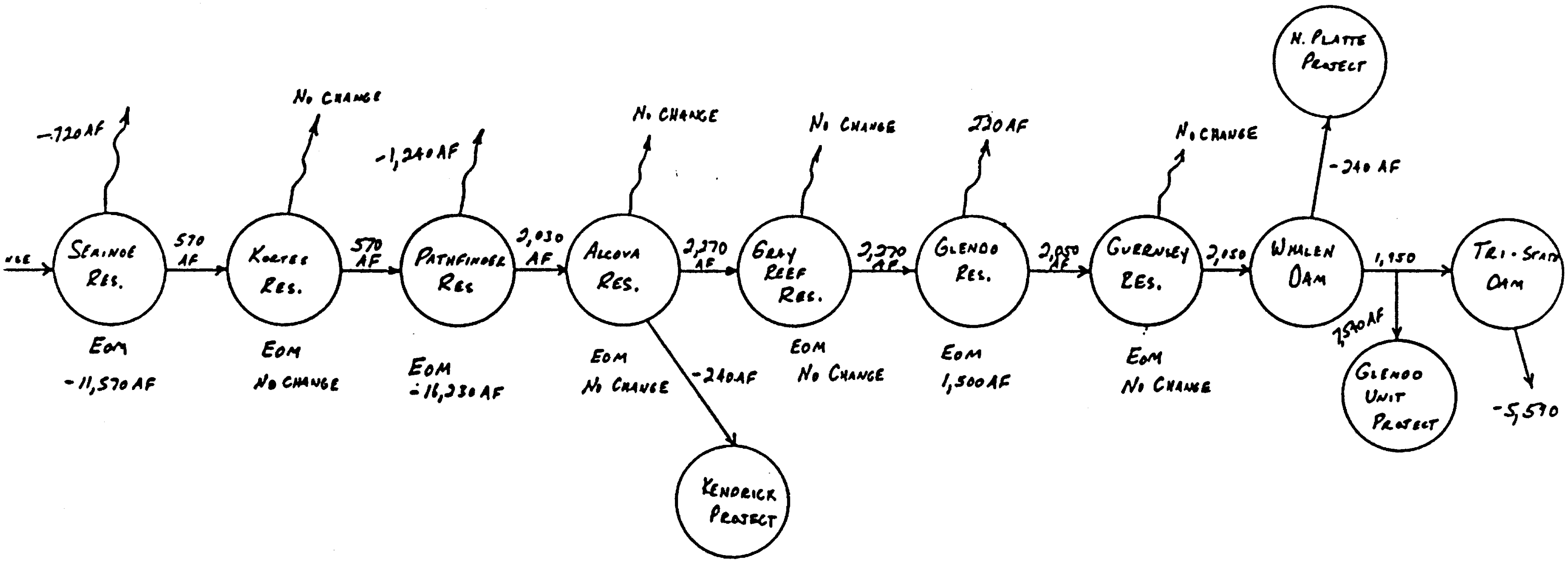
** NOTE INFLOW - LOSS DOES NOT QUITE EQUAL OUTFLOW. POSSIBLY MIGHT BE ATTRIBUTED TO ROUNDING ERRORS - MORE DEFINITE ANSWER IS CURRENTLY BEING RESEARCHED.

DETAIL SHEET



* WHALEN - STATE LINE REACH GAIN = (TRI-STATE CANAL + RAMSHORN CANAL + FRENCH CANAL + GERING CANAL + FLOW PAST TRI-STATE) - NORTH PLATTE RIVER BELOW WHALEN.

40,000 AF IN GLENDO RES. FULLY UTILIZED WHEN AVAILABLE. NUMBERS SHOWN ARE FOR 1928-1980.
VALUES REPRESENT CHANGES FROM THE BASE RUN.



REPORT ON THE NORTH PLATTE RIVER MANAGEMENT MODEL SIMULATION OF FISH AND WILDLIFE MINIMUM FLOW STUDY

I. Computer Runs and Criteria

The purpose of the simulation runs is to maintain a minimum streamflow at a selected reach of the system for the enhancement of fish and wildlife activities and to study its effects on specific aspects of present management of the system such as irrigation, power generation, reservoir operation, etc. The computer runs performed with the minimum stream flow assigned to various reaches are given below. All runs use streamflow data for water years 1928 to 1973, a total of 46 years.

Test 100, present condition run: All physical and regulatory criteria are the same as the present system. No minimum flow requirements are imposed on any reaches with the exception of the Miracle Mile (below Seminoe Reservoir) and the reach below Alcova Reservoir, which have been regulated to 500 cfs and 300 cfs minimum flow respectively under present operation criteria.

Test 111, 150 cfs minimum flow below Pathfinder with present Seminoe dam height: Water originally released through Fremont Canyon powerplant from Pathfinder reservoir is partially transferred and released from bypass devices to maintain the 150 cfs (9,000 acre-feet per month used in the model) minimum streamflow requirement for the reach just below Pathfinder.

Test 112, 200 cfs minimum flow below Pathfinder with present Seminoe dam height: Same as Test 111 with minimum streamflow increased to 200 cfs (12,000 acre-feet per month used in the model).

Test 113, 100 cfs minimum flow below Glendo and Guernsey with present Seminoe dam height: Maintain 100 cfs (6,000 acre-feet per month used in the model) minimum release of flow from Glendo Reservoir and the same amount of release from Guernsey Reservoir in addition to the normal delivery of irrigation water to provide the minimum flow for the reach below Whalen diversion dam.

Test 114, 150 cfs minimum flow below Glendo and Guernsey with present Seminoe dam height: Same as Test 113 with minimum streamflow for reaches below Glendo and Guernsey increased to 150 cfs (9,000 acre-feet per month used in the model).

Test 211, 150 cfs minimum flow below Pathfinder with Seminoe enlargement: Same as Test 111 with Seminoe maximum storage capacity enlarged to 1,406,777 acre-feet (el. 6,374 feet).

Test 212, 200 cfs minimum flow below Pathfinder with Seminoe enlargement: Same as Test 112 with Seminoe maximum storage capacity enlarged to 1,406,777 acre-feet (el. 6,374 feet).

Test 213, 100 cfs minimum flow below Glendo and Guernsey with Seminoe enlargement: Same as Test 113 with Seminoe maximum storage capacity enlarged to 1,406,777 acre-feet (el. 6,374 feet).

Test 214, 150 cfs minimum flow below Glendo and Guernsey with Seminoe enlargement: Same as Test 114 with Seminoe maximum storage capacity enlarged to 1,406,777 acre-feet (el. 6,374 feet).

In order for the model to accommodate the minimum flow requirement, the computer program has been modified and adjusted to suit such competing situations as the reservoirs' drawdown to minimum storage capacity coupled with downstream water demands such as irrigation delivery and minimum flow requirement attempts to withdraw water from the system. To overcome the reservoir storage shortage, the irrigation delivery is reduced to satisfy the other restraints. Since the change in the program is rather extensive, the base run—that is, the system operated under present operational and regulatory rules—was recalculated and compared with the original base run used for the minimum pool study. The two runs were found to differ slightly, as shown in the difference table Test run 100. Most of the discrepancies are within one percent of the original value, and the t-distribution is inside the critical region with 5% significance level; the differences are considered insignificant in general and the latest base run values are used for evaluation of minimum flow effects.

Two operational alternatives are possible to satisfy the Pathfinder minimum flow requirements. One is to reduce the water released from the Fremont Canyon powerplant to meet the minimum flow requirement without changing the total amount of water released from the reservoir, and the other is to release the minimum required flow directly from the reservoir in addition to the present release through Fremont Canyon powerplant. Present operation of the system determines the Pathfinder release according to the downstream water demands and adjusted to the physical restraints of the reservoir. If additional water were released from Pathfinder, it would not only waste the water but it would also be impossible to find enough space in the downstream reservoirs to store the water. Thus, the first alternative is selected for the operation.

Minimum flow requirement of Glendo and Guernsey is intended to maintain a minimum streamflow for reaches below Glendo. At present, both reservoirs are shut down during the winter months and both release river water and irrigation water in the summer. Since irrigation waters are diverted at Whalen dam to Interstate Canal and Laramie Canal, the river water release must be increased to meet the minimum requirement for the reach below Whalen. All waters are released through Glendo and Guernsey powerplants for power generation to compensate for possible power loss in the upstream powerplants.

II. Analysis of Test Results

Generally speaking, Pathfinder minimum flow requirement decreases power generation by 3 to 5% while Glendo minimum flow requirement reduces the irrigation revenue by 3 to 5% and power by 1 to 2% for the entire period. Seminoe enlargement does not improve and in practice slightly worsens the situation. Following are detailed analyses of the effects by items.

Effects on Power Generation

Pathfinder minimum flow requirements (Test 111, 112, 211, and 212), as expected, reduce the power generation of the system as shown in Table 1. The largest reduction occurs at the Fremont Canyon powerplant. It decreases about 11% for 150 cfs minimum flow and 15% for 200 cfs minimum flow at present conditions, and 12% and 16% respectively for the Seminoe enlargement. Power generation change in other plants is insignificant. Tables 2, 3, and 4 show the reasons for the effects. A large amount of water that originally goes into the Fremont Canyon powerplant (Table 2) is released through bypass devices (Table 3) to maintain the requested minimum at the streamflow just below Pathfinder reservoir. The average monthly storage head of

Pathfinder reservoir (Table 4) is also slightly lowered. As a result, power generation from the Fremont powerplant declines tremendously. The storage head and flow distribution in other reservoirs remain relatively unaffected, with little less effect on their power generation.

During the 46-year test period, the Pathfinder minimum flow constantly reduces the system annual power generation every year (Table 5). On the average, the 150 cfs minimum flow lost 24.32 million kWh and 200 cfs minimum flow lost 32.71 million kWh in the power revenue under present conditions and 26.74 million kWh and 35.03 million kWh respectively after Seminoe enlargement.

Glendo and Guernsey minimum flow (Test 113, 114, 213, and 214) also reduces the system power generation, but much less than that of the Pathfinder minimum flow case (Table 1). In general, the power generation decreases in Seminoe, Fremont Canyon, and Glendo powerplants and increases in Alcova and Guernsey powerplants. The minimum flow requirement requests extra water release from the system and consequently reduces all reservoir storages (Table 4) and the head for power generation. Under present conditions, turbine release of all powerplants increased except the Fremont Canyon. After Seminoe enlargement, only the downstream powerplants (Alcova, Glendo, and Guernsey) increase about the same amount of turbine release as under present conditions, while the upstream powerplants (Seminoe, Kortes, and Fremont Canyons) decrease the turbine release.

Effects on the annual power generation due to Glendo and Guernsey minimum flow are given in Table 5. The results are a mixture of increase and decrease throughout the 46-year period. No specific trend in the variations was found; they probably are due to the combined effect of water storage in each individual reservoir and downstream water demands.

Effects on Irrigation Delivery and Project Ownership

The Pathfinder minimum flow has insignificant effects on the irrigation delivery to the North Platte project, Kendrick project, and Glendo Unit project and their ownerships, as shown in Table 6 and Table 7. However, Glendo and Guernsey minimum flow decreases irrigation delivery as well as the water ownership. The North Platte project delivers 2% less water under 100 cfs minimum flow requirement and 3.5% less water for 150 cfs minimum flow. The Kendrick project reduces 10% and 13% respectively, while the Glendo Unit project drops 49% and 67% (Table 6). Seminoe enlargement does not affect the results at all. The average monthly ownership of North Platte, Kendrick, and Glendo Unit declines 5%, 8%, and 44% respectively for 100 cfs minimum flow case and 7%, 17%, and 55% for 150 cfs minimum flow case.

Table 8 shows the effects on system annual irrigation delivery during the 46-year test period. The annual irrigation demand of the system is 1,138,000 acre-feet. It is important to note that a great reduction in annual irrigation delivery occurs in dry years when irrigation is most needed for crops. The test results indicate that the Glendo Unit project is the most affected project. The detailed printout of the computer output reveals that the project cannot deliver any water in 24 years out of the 46, and in another 4 years delivers less than one-half of the irrigation demand.

Effects on Nonirrigation Water Release

The Pathfinder minimum flow has almost no effect on the nonirrigation water release--also known as river water or natural water.

The Glendo and Guernsey minimum flow increases the nonirrigation release about 44% and 70% for 100 cfs requirement and 150 cfs requirement respectively (Table 9). The Seminoe enlargement has about the same magnitude of increase in both cases. The annual run-down of the change in nonirrigation release is given in Table 10. The increased amount in most years supplements the actual river water release of Test 100 to satisfy its annual minimum requirement of 72,000 acre-feet and 108,000 acre-feet.

Effects on Reservoir Storage

Table 11, Table 12, and Table 13 show the effect of minimum flow requirements on the end-of-month storage of Seminoe, Pathfinder, and Glendo, respectively. For Seminoe reservoir, Pathfinder minimum flow increases the reservoir storage, while the Glendo and Guernsey minimum flow decreases the storage. With the Seminoe enlargement, the Pathfinder minimum flow further increases the reservoir storage and the Glendo and Guernsey minimum flow reduces the amount of the decrease. In Pathfinder reservoir, both minimum flow cases reduce the storage with the Glendo and Guernsey minimum flow requirement having more significant influences. The Seminoe enlargement further worsens the situation. In Glendo reservoir, the Pathfinder minimum flow has no effect on reservoir storage, while the Glendo and Guernsey minimum flow reduce the reservoir storage.

Table 1. Effects on Total Power Generation in the 46-Year Test Period for the System and Powerplants in Million kWh

Test Run Number	System Total	Seminoe Powerplant	Kortes Powerplant	Fremont Canyon Powerplant	Alcova Powerplant	Glendo Powerplant	Guernsey Powerplant
	Actual Generation						
100	34,495.62	6,205.32	7,051.59	10,493.92	5,725.19	3,807.59	1,211.94
	Difference of Test 100 and Test						
111	-1,118.61	17.65	-2.34	-1,138.36	1.05	3.26	0.11
112	-1,504.56	21.95	-2.93	-1,528.32	1.25	3.31	0.14
113	-308.77	-190.29	59.47	-313.89	86.02	-9.21	59.12
114	-533.80	-284.87	74.04	-542.95	143.44	-19.89	96.42
211	-1,229.90	77.14	-88.53	-1,229.55	5.08	5.12	0.88
212	-1,611.35	81.27	-85.15	-1,618.97	5.29	5.26	0.94
213	-450.30	-145.65	-46.34	-402.02	90.28	-6.61	60.07
214	-698.28	-257.54	-34.95	-631.81	147.22	-17.72	96.52

Table 2. Effects on Total Water Released through Turbine in the 46-Year Test Period at Each Powerplant in Thousand Acre-Feet

Test Run Number	Seminoe Powerplant	Kortes Powerplant	Fremont Canyon Powerplant	Alcova Powerplant	Glendo Powerplant	Guernsey Powerplant
			Actual Release			
100	41,328.70	40,997.46	41,704.12	40.563.79	41,734.29	17,686.67
			Difference of Test 100 and Test			
111	-11.39	-13.52	-4,396.83	6.54	4.59	1.58
112	-14.07	-16.94	-5,923.37	7.96	5.21	2.06
113	182.15	346.21	-405.64	554.42	919.00	1,322.12
114	267.61	435.92	-616.20	919.74	1,594.57	2,079.13
211	-366.62	-514.74	-4,201.66	34.03	28.18	12.77
212	-368.63	-494.98	-5,738.29	35.72	29.04	13.66
213	-221.79	-268.97	-190.20	583.67	947.60	1,335.11
214	-162.87	-197.81	-450.66	945.71	1,621.68	2,077.57

Table 3. Effects on Total Water Released through Bypass in the 46-Year Test Period from Each Reservoir in Thousand Acre-Feet

Test Run Number	Seminoe Reservoir	Kortes Reservoir	Pathfinder Reservoir	Alcova Reservoir	Glendo Reservoir	Guernsey Reservoir
			Actual Release			
100	271.51	591.70	3,049.84	841.25	8,023.27	33,780.48
			Difference of Test 100 and Test			
111	-1.76	0.36	4,404.52	1.44	3.41	6.42
112	-2.60	0.26	5,932.52	1.55	4.35	7.50
113	-52.52	-216.58	717.17	49.11	-193.08	-627.83
114	-74.86	-243.17	1,120.67	22.06	-555.70	-1,068.89
211	-271.51	-123.39	4,246.97	10.74	17.29	32.71
212	-271.51	-145.16	5,785.50	11.04	18.44	33.83
213	-271.14	223.96	533.14	51.28	-189.89	-609.02
214	-248.84	-213.90	983.91	18.90	-553.51	-1,041.04

Table 4. Effects on Average Monthly Reservoir Storage for the 46-Year Test Period in Thousand Acre-Feet

Test Run Number	Seminoe Reservoir	Pathfinder Reservoir	Glendo Reservoir	Guernsey Reservoir
	Actual Average Monthly Storage			
100	471.72	393.77	277.29	18.35
	Difference of Test 100 and Test			
111	6.68	-6.58	0.15	0.00
112	8.59	-8.34	0.15	0.00
113	-52.95	-57.14	-21.78	-0.26
114	-77.17	-99.65	-35.30	-0.23
211	58.34	-57.42	0.04	0.00
212	60.64	-59.46	0.06	0.00
213	-4.59	-104.27	-21.82	-0.26
214	-35.45	-13.74	-35.36	-0.23

Table 5. Effects on System Annual Power Generation during the 46-Year Test Period in Million kWh

Water Year	Actual Generation Test 100	Difference of Test 100 and Test 111	112	113	114	211	212	213	214
1928	870.27	-26.91	-35.88	21.50	38.55	-172.88	-181.39	-129.88	-113.68
1929	1,071.74	-19.16	-25.56	-14.48	-36.65	0.59	-5.88	10.46	-11.29
1930	795.06	-22.77	-31.99	.96	2.33	23.40	10.69	65.03	67.55
1931	727.51	-42.01	-56.27	26.41	35.61	65.50	55.18	113.10	118.22
1932	916.69	-10.75	-15.10	3.04	10.85	-145.73	-149.89	-128.80	-125.26
1933	869.24	-15.74	-22.12	-14.22	-32.01	-29.91	41.55	-10.81	-18.55
1934	670.80	-46.55	-62.56	18.24	27.83	90.20	80.07	123.27	119.95
1935	576.60	-20.63	-27.43	5.27	6.34	-19.20	-26.08	8.07	10.38
1936	745.45	-20.23	-27.21	34.87	32.55	-19.45	-26.50	35.80	33.58
1937	749.06	-26.15	-34.88	16.51	23.98	-26.26	-34.98	16.44	23.97
1938	751.03	-26.73	-35.69	-6.02	16.74	-49.67	-58.63	-6.58	16.73
1939	832.11	-24.82	-33.49	13.37	29.46	-26.97	-35.47	13.36	29.46
1940	615.60	-27.01	-35.64	-37.56	-79.16	-8.15	-16.63	-37.54	-79.16
1941	662.54	-21.33	-29.20	-9.91	-41.76	-21.51	-29.35	-9.89	-41.78
1942	696.66	-22.15	-30.09	-42.05	-39.16	-22.34	-30.26	-42.05	-39.19
1943	742.80	-20.73	-28.13	-24.45	-23.09	-20.98	-28.35	-24.44	-23.09
1944	661.06	-19.88	-27.67	2.06	-3.65	-20.01	-27.78	2.06	-3.66
1945	633.32	-24.33	-32.29	-20.90	-26.50	-24.53	-32.47	-20.90	-26.50
1946	667.67	-24.77	-32.97	11.47	15.24	-24.79	-32.99	11.47	15.24
1947	705.41	-25.91	-34.46	-7.44	6.88	-26.03	-34.57	-7.43	6.88
1948	743.98	-27.15	-36.15	-1.89	27.22	-27.28	-36.27	-1.89	27.22
1949	852.34	-27.42	-36.39	-50.87	-89.28	-117.68	-126.41	-79.85	-89.28
1950	826.38	-22.71	-33.27	4.63	-3.28	-9.29	-18.69	12.69	-3.28
1951	780.72	-35.01	-45.10	36.83	59.99	10.71	1.41	43.34	59.99
1952	942.62	-9.17	-11.59	-24.92	-49.99	-129.83	-135.12	-155.72	-143.45
1953	746.92	-36.69	-50.81	56.08	63.72	78.70	67.79	100.77	98.77
1954	579.58	-17.50	-23.36	-38.82	-67.88	-13.80	-21.61	9.16	-46.43
1955	514.27	-28.99	-38.65	-47.10	-90.04	-29.29	-38.91	-35.07	-82.82
1956	617.75	-25.97	-34.46	5.80	49.34	-25.81	-34.31	11.48	49.32
1957	740.78	-22.73	-30.88	-7.01	3.07	-34.10	-42.18	-6.90	2.81
1958	832.97	-23.51	-31.36	17.32	14.18	-23.46	-31.24	17.41	14.11
1959	785.43	-26.59	-35.46	39.98	3.63	-18.40	-27.22	40.08	3.32
1960	738.28	-22.95	-31.25	-96.66	-221.24	-23.04	-31.22	-96.47	-221.13
1961	703.54	-23.68	-31.65	-7.77	-14.48	-24.03	-32.09	-7.49	-14.50

Table 5 (continued)

Water Year	Actual Generation Test 100	Difference of Test 100 and Test							
		111	112	113	114	211	212	213	214
1962	765.01	-25.53	-34.00	20.24	35.98	-25.76	-34.28	20.43	35.98
1963	654.16	-22.42	-30.31	-131.34	-189.47	-22.38	-30.23	-131.40	-187.46
1964	607.89	-18.99	-26.05	-66.70	-34.92	-18.92	-25.89	-66.82	-34.95
1965	602.67	-21.20	-29.02	-26.79	-30.80	-21.01	-28.84	-26.51	-30.80
1966	681.85	-23.50	-31.31	30.14	56.51	-23.51	-31.14	30.08	56.51
1967	643.46	-24.69	-32.95	13.49	-16.56	-24.69	-32.96	13.70	-16.56
1968	635.02	-26.67	-35.57	26.05	66.98	-26.67	-35.57	25.95	66.98
1969	753.83	-26.18	-34.41	18.34	33.96	-26.29	-34.52	18.37	33.96
1970	861.38	-28.49	-38.09	-50.43	-110.15	-134.01	-143.40	-139.89	-156.69
1971	1,088.82	-19.25	-25.40	-9.64	-25.11	-40.19	-45.41	-71.56	-139.23
1972	770.03	-23.77	-33.10	5.10	17.19	38.61	24.60	92.42	102.45
1973	1,065.38	-19.26	-25.33	.49	11.21	-39.77	-40.74	-47.32	-42.93
Average	749.90	-24.32	-32.71	-6.71	-11.60	-26.74	-35.03	-9.79	-15.18

Table 6. Effects on Irrigation Delivery in the 46-Year Test Period in Thousand Acre-Feet

Test Run Number	System Total	North Platte Project	Kendrick Project	Glendo Unit Project
		Actual Delivery		
100	50,021.61	46,370.30	2,972.12	679.20
111	5.06	1.39	-0.30	3.96
112	5.44	1.40	-0.37	4.41
113	-1,556.14	-931.62	-292.00	-332.52
114	-2,479.75	-1,632.01	-393.21	-454.53
211	6.34	2.92	0.53	2.88
212	6.83	2.97	0.44	3.42
213	-1,552.49	-926.31	-292.01	-334.17
214	-2,478.09	-1,628.44	-393.56	-456.09

Table 7. Effects on Average Monthly Project Ownership in the 46-Year Test Period in Thousand Acre-Feet.

Test Run Number	North Platte Project	Kendrick Project	Glendo Unit Project
		Actual Average Ownership	
100	556.55	671.01	108.68
		Difference of Test 100 and Test	
111	-0.12	-0.33	0.70
112	-0.12	-0.34	0.85
113	-27.60	-56.82	-47.37
114	-41.23	-112.63	-58.16
211	0.16	0.01	0.78
212	0.16	-0.01	1.06
213	-27.12	-56.28	-47.19
214	-40.80	-112.51	-58.01

Table 8. Effects on System Annual Irrigation Delivery during the 46-Year Test Period in Thousand Acre-Feet

Water Year	Actual Delivery Test 100	Difference of Test 100 and Test 111	112	113	114	211	212	213	214
1928	1,138.00	.00	.00	-3.24	.00	.00	.00	-3.24	.00
1929	1,138.00	.00	.00	.00	.00	.00	.00	.00	.00
1930	1,138.00	.00	.00	.00	.00	.00	.00	.00	.00
1931	1,138.00	.00	.00	.00	.00	.00	.00	.00	.00
1932	1,138.00	.00	.00	.00	.00	.00	.00	.00	.00
1933	1,138.00	.00	.00	.00	.00	.00	.00	.00	.00
1934	951.01	.00	.00	-59.00	-101.51	.00	.00	-59.00	-101.51
1935	895.55	.00	.00	-48.49	-77.79	.00	.00	-48.49	-77.79
1936	1,138.00	.00	.00	-25.41	-66.67	.00	.00	-26.16	-68.23
1937	1,138.00	.00	.00	-18.00	-18.00	.00	.00	-18.00	-18.00
1938	1,138.00	.00	.00	-14.13	-18.00	.00	.00	-15.06	-18.00
1939	1,138.00	.00	.00	-18.00	-18.00	.00	.00	-18.00	-18.00
1940	895.30	.00	.00	-131.48	-208.71	1.58	1.62	-131.45	-208.71
1941	1,138.00	.00	.00	-57.03	-123.04	.00	.00	-57.02	-123.04
1942	1,138.00	.00	.00	-58.92	-59.40	.00	.00	-58.92	-59.45
1943	1,138.00	.00	.00	-56.17	-88.00	.00	.00	-56.15	-88.00
1944	1,069.71	2.88	2.88	-7.67	-50.45	3.09	3.09	-7.67	-50.46
1945	1,014.54	.00	.00	-1.97	-9.13	.00	.00	-1.97	-9.13
1946	1,138.00	.00	.00	-60.31	-88.00	.00	.00	-60.31	-88.00
1947	1,138.00	.00	.00	-7.00	-25.00	.00	.00	-7.00	-25.00
1948	1,138.00	.00	.00	.00	-18.00	.00	.00	.00	-18.00
1949	1,138.00	.00	.00	-12.00	-18.00	.00	.00	-12.00	-18.00
1950	1,138.00	.00	.00	-18.00	-18.00	.00	.00	-18.00	-18.00
1951	1,138.00	.00	.00	-18.00	-18.00	.00	.00	-18.00	-18.00
1952	1,138.00	.00	.00	-18.00	-18.00	.00	.00	-18.00	-18.00
1953	1,138.00	.00	.00	-18.00	-18.00	.00	.00	-18.00	-18.00
1954	670.40	.00	.00	-68.33	-130.97	.00	.00	-64.13	-127.26
1955	827.41	.00	.00	-127.53	-168.97	.00	.00	-126.61	-169.07
1956	966.25	.00	.00	-85.09	-120.78	.00	.00	-85.10	-120.76
1957	1,120.00	.00	.00	.00	.00	.00	.00	.00	.00
1958	1,120.00	.00	.00	.00	.00	.00	.00	.00	.00
1959	1,120.00	.00	.00	.00	-33.99	.00	.00	.00	-34.32
1960	1,066.61	.00	.00	-152.47	-323.28	-.02	-.02	-152.45	-323.26
1961	1,120.00	.78	1.11	-1.68	-40.58	.00	.00	-1.01	-40.61

Table 8 (continued)

Water Year	Actual Delivery Test 100	Difference of Test 100 and Test 111	112	113	114	211	212	213	214
1962	1,120.00	.00	.00	.00	.00	.00	.00	.00	.00
1963	1,001.37	-.05	-.04	-191.84	-305.01	-.05	-.04	-191.85	-304.98
1964	1,099.48	.00	.00	-104.59	-104.13	.00	.00	-105.11	-104.17
1965	1,075.97	-.30	-.35	-64.01	-65.64	.26	.18	-64.01	-65.64
1966	1,112.55	1.75	1.84	-62.55	-62.55	1.48	1.94	-62.55	-62.55
1967	1,050.00	.00	.00	.00	.00	.00	.00	.00	.00
1968	1,138.00	.00	.00	-20.02	-25.00	.00	.00	-20.02	-25.00
1969	1,138.00	.00	.00	-18.00	-18.00	.00	.00	-18.00	-18.00
1970	1,137.50	.00	.00	-9.21	-21.15	.00	.00	-9.21	-21.15
1971	1,138.00	.00	.00	.00	.00	.00	.00	.00	.00
1972	1,138.00	.00	.00	.00	.00	.00	.00	.00	.00
1973	1,138.00	.00	.00	.00	.00	.00	.00		
Average	1,087.43	.11	.12	-33.83	-53.91	.14	.15	-33.75	-53.87

Table 9. Effects on Total River Water (Nonirrigation) Release from the System during the 46-Year Test Period in Thousand Acre-Feet

Actual Release Test 100	Difference of Test 100 and Test 111	112	113	114
4,417.79	2.65	3.75	1,958.43	3,093.78

	Difference of Test 100 and Test 211	212	213	214
	39.68	41.10	1,986.57	3,121.06

Table 10. Effects on System Annual River Water (Nonirrigation) Release during the 46-Year Test Period in Thousand Acre-Feet

Water	Actual Release	Difference of Test 100 and Test							
Year	Test 100	111	112	113	114	211	212	213	214
1928	22.64	.00	.00	52.99	85.72	.00	.00	52.99	85.72
1929	694.03	.00	.00	-26.77	-51.73	8.47	8.47	-18.30	-43.43
1930	168.32	.26	.28	1.35	1.54	5.44	5.49	6.87	7.04
1931	25.80	1.25	-.03	51.06	83.59	.48	.93	51.06	83.59
1932	70.05	-.57	1.67	1.95	37.95	-3.75	-3.60	1.95	37.95
1933	263.56	.00	-.75	-40.49	-101.75	7.34	7.12	-37.86	-99.30
1934	3.87	.00	.00	68.13	104.13	.00	.00	68.13	104.13
1935	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1936	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1937	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1938	25.42	.00	.00	46.58	82.58	.00	.00	46.58	82.58
1939	2.53	.00	.00	69.47	105.47	.00	.00	69.47	105.47
1940	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1941	1.26	.00	.00	70.74	106.74	.00	.00	70.74	106.74
1942	172.32	.00	.00	25.32	37.34	.00	.00	25.32	37.34
1943	41.93	.00	.00	32.26	66.07	.00	.00	32.26	66.07
1944	40.42	1.44	1.44	31.58	67.58	1.41	1.41	31.58	67.58
1945	57.41	.00	.00	25.35	50.59	.00	.00	25.35	50.59
1946	3.92	.00	.00	68.08	104.08	.00	.00	68.08	104.08
1947	35.62	.00	.00	36.38	72.38	.00	.00	36.38	72.38
1948	30.73	.00	.00	41.27	77.27	.00	.00	41.27	77.27
1949	4.10	.00	.00	67.90	103.90	.00	.00	67.90	103.90
1950	3.43	.00	.00	68.57	104.57	.00	.00	68.57	104.57
1951	1.89	.00	.00	70.11	106.11	.00	.00	70.11	106.11
1952	139.70	-.35	.38	-67.70	-31.70	2.56	3.12	-67.70	-31.70
1953	5.07	.00	.00	68.33	102.93	3.64	3.53	68.33	102.93
1954	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1955	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1956	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1957	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1958	0.38	.00	.00	71.62	107.62	.00	.00	71.62	107.62
1959	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1960	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00

Table 10 (continued)

Water Year	Actual Release Test 100	Difference of Test 100 and Test 111	112	113	114	211	212	213	214
1961	32.84	.00	.00	39.16	75.16	.00	.00	39.16	75.16
1962	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1963	3.18	.00	.00	68.82	104.82	.00	.00	68.82	104.82
1964	19.11	.00	.00	52.89	88.89	.00	.00	52.89	88.89
1965	56.53	.00	.00	43.08	66.92	.00	.00	43.08	66.94
1966	1.35	.00	.00	70.65	106.65	.00	.00	70.65	106.65
1967	0.00	.00	.00	72.00	108.00	.00	.00	72.00	108.00
1968	52.95	.00	.00	25.46	55.05	.00	.00	25.46	55.05
1969	1.75	.00	.00	70.25	106.25	.00	.00	70.25	106.65
1970	189.69	.00	.00	19.33	28.36	.00	.00	19.33	28.36
1971	948.36	.56	.61	-132.28	-259.96	6.91	6.94	-126.68	-257.49
1972	243.09	.04	.07	-.06	-1.85	6.49	6.60	7.50	8.26
1973	1,054.55	.05	.08	3.05	4.49	.69	1.09	1.41	2.94
Average	96.04	.06	.08	42.57	67.26	.86	.89	43.19	67.85

Table 11. Effects of Minimum Flow Requirement on Seminoe Reservoir End-of-Month Storage in Thousand Acre-Feet

Month	Actual Storage Test 100	Difference of Test 100 and Test			
		111	112	113	114
Oct.	526.99	4.38	5.74	-65.19	-94.81
Nov.	469.30	5.18	6.80	-58.73	-84.85
Dec.	401.52	6.35	8.29	-52.09	-75.01
Jan.	326.03	7.80	10.11	-45.45	-63.66
Feb.	289.38	7.15	9.33	-42.12	-58.48
Mar.	288.67	6.73	8.78	-39.23	-54.71
Apr.	304.18	6.83	8.73	-44.47	-63.78
May	460.25	8.46	10.69	-50.17	-75.95
June	694.91	8.04	10.20	-48.37	-70.49
July	700.21	8.98	11.21	-54.68	-81.81
Aug.	638.09	7.59	9.37	-64.69	-98.47
Sept.	586.30	2.70	3.83	-70.28	-104.02

Month	Difference of Test 100 and Test			
	211	212	213	214
Oct.	69.91	71.73	-5.82	-44.76
Nov.	51.91	53.87	-14.61	-47.43
Dec.	34.91	37.06	-22.66	-49.65
Jan.	19.78	22.10	-29.31	-49.10
Feb.	27.27	29.53	-19.28	-38.41
Mar.	36.05	38.23	-8.86	-28.30
Apr.	43.57	46.15	-9.19	-32.99
May	54.95	57.88	-8.53	-39.53
June	77.55	80.24	14.26	-16.98
July	87.70	90.51	16.30	-20.22
Aug.	96.88	99.12	15.98	-28.75
Sept.	99.58	101.22	16.69	-29.22

Note: Values are monthly values averaged for the 46-year period.

Table 12. Effects of Minimum Flow Requirement on Pathfinder Reservoir End-of-Month Storage in Thousand Acre-Feet.

Month	Actual Storage Test 100	Difference of Test 100 and Test 111	112	113	114
Oct.	315.21	-4.11	-5.33	-50.95	-91.70
Nov.	348.16	-4.91	-6.38	-55.27	-98.41
Dec.	387.00	-6.07	-7.87	-59.79	-104.77
Jan.	431.94	-7.53	-9.69	-64.84	-112.25
Feb.	445.93	-6.86	-8.90	-67.36	-114.88
Mar.	451.39	-6.44	-8.34	-68.43	-115.46
Apr.	473.91	-6.54	-8.28	-60.98	-106.09
May	488.00	-8.40	-10.49	-53.43	-92.51
June	430.91	-8.25	-10.27	-52.49	-91.97
July	361.78	-9.38	-11.47	-51.59	-90.18
Aug.	306.65	-8.05	-9.69	-52.72	-91.73
Sept.	293.94	-2.43	-3.42	-47.88	-85.82

Month	Difference of Test 100 and Test 211	212	213	214
Oct.	-68.78	-70.34	-109.03	-141.00
Nov.	-50.73	-52.41	-98.07	-135.05
Dec.	-33.68	-35.58	-87.87	-129.33
Jan.	-18.54	-20.61	-79.64	-126.00
Feb.	-26.01	-28.02	-88.85	-134.12
Mar.	-34.76	-36.69	-97.43	-141.01
Apr.	-42.27	-44.60	-94.88	-136.02
May	-54.36	-57.04	-94.00	-128.36
June	-77.23	-79.68	-114.12	-144.91
July	-87.48	-90.05	-121.51	-151.12
Aug.	-96.69	-98.66	-132.24	-160.76
Sept.	-98.46	-99.85	-133.55	-159.84

Note: Values are monthly values averaged for the 46-year period.

Table 13. Effects of Minimum Flow Requirement on Glendo Reservoir End-of-Month Storage in Thousand Acre-Feet

Month	Actual Storage Test 100	Difference of Test 100 and Test 111	112	113	114
Oct.	126.50	.00	.00	-6.64	-10.35
Nov.	188.42	.00	.00	-14.11	-21.74
Dec.	248.41	.00	.00	-21.71	-33.62
Jan.	308.84	.00	.00	-28.82	-45.96
Feb.	365.95	.00	.00	-35.08	-56.88
Mar.	377.18	-.01	.00	-39.13	-63.67
Apr.	427.10	-.03	-.04	-37.97	-61.09
May	466.08	.11	.12	-39.19	-48.27
June	402.62	.40	.40	-25.85	-43.11
July	256.71	.61	.61	-18.18	-30.43
Aug.	99.58	.70	.70	-4.64	-8.50
Sept.	60.00	.00	.00	.00	.04

Month	Difference of Test 100 and Test 211	212	213	214
Oct	.00	.00	-6.64	-10.35
Nov.	.00	.00	-14.10	-21.75
Dec.	-.02	.00	-21.70	-33.63
Jan.	-.02	.00	-28.79	-45.97
Feb.	-.02	.00	-35.06	-56.90
Mar.	-.28	-.27	-39.10	-63.68
Apr.	-.28	-.27	-38.22	-61.10
May	-.17	-.16	-29.31	-48.44
June	.16	.17	-26.00	-43.35
July	.45	.47	-18.24	-30.61
Aug.	.71	.72	-4.63	-8.58
Sept.	.00	.00	.00	.04

Note: Values are monthly values averaged for the 46-year period.

FORMULA FOR COMPUTING THE NATURAL FLOW OF THE NORTH PLATTE RIVER

Representatives of the State of Nebraska, State of Wyoming and the Bureau of Reclamation met at Torrington, Wyoming on March 23, 1967, to discuss the method to be used in computing the Natural flow, Seminoe Reservoir to the North Platte River station, below the Tri-State Canal, located just East of Henry, Nebraska. At the March 23 meeting the following formula was adopted for the Irrigation season of May through September 1967.

INFLOW TO SEMINOE RESERVOIR

The Seminoe inflow will be the sum of the North Platte River above the Seminoe Reservoir and the sum of the Medicine Bow River above Seminoe Reservoir.

NATURAL FLOW ABOVE ALCOVA RESERVOIR

The natural flow above Alcova Reservoir will be the inflow to Seminoe plus the sum of the Sweetwater River entering Pathfinder Reservoir and to the total of these three streams will be added an accrual figure for that particular month, this total will be called the natural flow entering Alcova Reservoir and will be passed through these reservoirs without loss.

ACCRUAL SEMINOE RESERVOIR TO ALCOVA RESERVOIR

The accrual figures for 1967 were the same as those used in 1966. They are as follows:

May	June	July	August	September
90 s.f.	45 s.f.	40 s.f.	35 s.f.	35 s.f.

ALCOVA OUTFLOW OR GREY REEF RESERVOIR RELEASE

Water released at the Grey Reef Reservoir will be charged with the following losses set by the decree. The ammended loss figures Alcova to Glendo by months are shown below.

May	June	July	August	September
~~45~~ s.f. 43	61 s.f.	70 s.f.	61 s.f.	45 s.f.

GREY REEF RESERVOIR TO GLENDO RESERVOIR

There will be a two (2) day time lag in transporting water from Grey Reef Reservoir to Glendo Reservoir, water released at Grey Reef Reservoir will reach the Glendo Reservoir two (2) days after the release date.

GLENDO OUTFLOW

A one (1) day time lag will be used in transporting water through the Glendo Reservoir. Natural flow entering the Glendo Reservoir will be one (1) day later be called the Glendo Outflow and be passed through the Glendo Reservoir without loss.

GLENDO RESERVOIR THROUGH WHALEN DAM

Water released at the Glendo Reservoir plus twenty (20) feet of river accrual will be called the Guernsey inflow for that day. A one (1) day time lag will be used in bringing water from the Glendo Outflow through Whalen Dam which will include the two Government Canals just above Whalen Dam. This water will be passed through Whalen Dam without loss.

WHALEN DAM TO THE WYOMING-NEBRASKA STATE LINE OR TO THE TRI-STATE DAM

A one (1) day time lag is used in taking water from the River Station below Whalen Dam to the River Station below Tri-State Dam.

RIVER LOSSES

Carriage losses in the river section Guernsey Reservoir to the Wyoming-Nebraska State Line set by the Decree are as follows:

May	June	July	August	September	Daily Evaporation Losses shown by months.
20	27	31	27	20	

Losses are shown in second feet.

Computing the channel gain or loss, Whalen Dam to the Tri-State Canal, using run sheets.

(for period July 14, thru July 15, 1967)

The method to compute the gain or loss using the run sheets.
(example)

Total water at the Whalen Dam (T) July 14---------------------------------- 4533 sec. ft.
Minus evaporation loss for month of July, bottom of nat. flow run sheet--- 31 sec. ft.
Total water at Whalen Dam minus evaporation loss------------------------- 4502 sec. ft.

To the figure of 4502 sec. ft. for July 14, will be added the inflows in the reach Whalen Dam to the Wyo.-Nebr. State Line for July 15, 1967 (e) 340 sec. ft. this difference of one day is to make up the time lag that occurs Whalen Dam to the State Line.

Total water at Whalen Dam minus the evaporation loss---------------------- 4502 sec. ft.
To this total is added Whalen to State Line inflow (e)-------------------- 340 sec. ft.
Total water in reach Whalen Dam to the State Line for July 14, 15, ------- 4842 sec. ft.

Total diversions in the reach Guernsey Res. to river below Tri-State Dam for July 14, and July 15, 1967 as shown on run sheets (c)---------------------------------- 4643 sec. ft.
July 14, July 15, the total water in the reach Whalen Dam to the State Line is larger than the total diversions or (c)--- 4643 sec. ft.
Total water in the reach Whalen Dam to River below Tri-State Dam --------- 4842 sec. ft.
The loss in the reach Whalen to Below the Tri-State Dam is --- 4842 sec. ft.
Minus the total diversions or (c)----------------------------- 4643 sec. ft.
Loss in reach Whalen Dam to below Tri-State Dam--------------- 199 sec. ft.

The loss in the section is prorated percentage wise as shown (V) & (W) on the run sheets for July 14, 1967 and is 77% to natural flow or 199 X 77 = 153 sec. ft.
the storage water loss to be returned is ------ 199 X 23 = 46 sec. ft.

As only the portion of loss to storage water is to be returned or the 46 sec. ft. when the total diversions reach a larger figure or when (c) becomes larger than (T) plus (e) on the run sheets the gain is prorated the same as the loss using (V) & (W) percentage-wise and returned on the same basis, the storage portion of the gain is multiplied by (W) and subtracted from the amount of water charges out as loss to storage water in transit.

Loss = [illegible] diversions in Guernsey - Tri-State Dam

Water in transit from the Alcova Reservoir to the Wyoming-Nebraska State Line was charged with the following carriage losses, divided into the river sections as shown, and proportioned between natural flow and storage water on a prorate basis.

River Section	River area in acres	Daily losses in Second feet by months				
		May	June	July	August	September
Alcova Reservoir Glendo Reservoir	6,740 Acres	43	61	70	61	45
Glendo Reservoir to Wyoming.-Nebraska State Line	3,000 Acres	20	27	31	27	20

The above carriage losses were computed upon the basis of the area of the river water surface as determined by aerial survey made in 1939 and previous years and upon monthly evaporation at Pathfinder Reservoir for the period from 1921 to 1939 inclusive as provided by the decree of the United States Supreme Court in the North Platte River litigation.

The carriage loss from the Alcova Reservoir to the Wyoming-Nebraska State Line is the same as used in previous years and is based on the mean evaporation at the Pathfinder Reservoir. Loss figures by months are shown on the table below.

May	June	July	August	September
0.561	0.767	0.910	0.799	0.568

The coefficient of 0.71 is used to reduce pan records to open water surface records.

RESERVOIR EVAPORATION LOSSES

SEMINOE, PATHFINDER AND ALCOVA RESERVOIRS

Evaporation was computed daily, based on evaporation from weather bureau standard (4) foot in diameter class (A) pans located at Seminoe Reservoir and Pathfinder Reservoir. The daily evaporation was multiplied by the area of the water surface of the reservoirs in acres and by coefficient of 0.70 to reduce pan records to open water records.

GUERNSEY AND GLENDO RESERVOIRS

Computed same as above except pan evaporation at Whalen Dam is used for the Guernsey Reservoir. Pan evaporation at the Glendo Reservoir was started June 30, 1960.

North Platte Storage Ownership Accounting
(To be effective as of October 1, 1970)

1. General Criteria - October 1 through April 30.

(a) Total ownership equals total water in storage in Seminoe, Kortes, Alcova, Pathfinder, Gray Reef, Glendo, and Guernsey Reservoirs. This also applies May 1 through September 30.

(b) For simplicity, one day lag is considered in computing the evaporation chargeable to each ownership. In other words, today's total ownership evaporation charge is equal to yesterday's total annual evaporation. The evaporation chargeable to the Kendrick ownership is the actual Alcova evaporation yesterday plus the evaporation from the balance of Kendrick total ownership from yesterday assumed to all be in Seminoe Reservoir. The evaporation chargeable to Guernsey ownership is the larger of the actual evaporation or the evaporation computed from Guernsey ownership, including Lake Alice and Minatare water stored in channel reservoirs, all assumed to be in Guernsey, if Guernsey ownership is sufficient to pay this charge. The Pathfinder evaporation charge is computed as though all Pathfinder ownership, except that portion of Pathfinder ownership in Guernsey, is in Pathfinder Reservoir so long as there is any ownership in Guernsey priority. If there is no Guernsey ownership, then the Pathfinder evaporation charge will be the actual Guernsey evaporation plus the evaporation computed as though the balance of Pathfinder ownership was in Pathfinder Reservoir. This all on the assumption that physical water in Guernsey after Alice and Minatare plus Guernsey ownership is evacuated is Pathfinder storage water. Any Pathfinder water in Guernsey Reservoir as of September 30 of any year will remain in Pathfinder ownership as of October 1. The evaporation chargeable to the Glendo Unit is then the total actual evaporation minus that determined as chargeable to the other three ownerships.

(c) The river gains - Alcova to Glendo - are computed as the Glendo inflow, current day, minus 98 percent of the Alcova outflow two days earlier. The river gains - Glendo to Guernsey - are the Guernsey inflow minus the Glendo outflow with no time lag or losses considered.

(d) It is assumed that the river gains below Alcova during the months of October, November, and April will accrue to Lakes Alice and Minatare, up to a total of 46,000 acre-feet and at a rate not to exceed 910 second-feet. The October and November river gains which will accrue to Alice and Minatare can be stored in Guernsey Reservoir and transferred to their own reservoirs when the Interstate Canal is opened in March. However, if during the winter months, the Guernsey ownership plus Alice and Minatare water in Guernsey reaches 45,228 acre-feet, then the gains - Alcova to Glendo - are to be credited to the Glendo Unit until transfer of Alice and Minatare water is initiated. When this condition occurs, the river gains - Glendo to Guernsey - should first go to make up the Guernsey seepage and evaporation and the balance released to the river or credited as owed to the river. If the gains below Glendo are insufficient to make up the Guernsey evaporation and seepage, the difference is to be made up from gains below Alcova. When a negative gain occurs in Glendo to Guernsey section, then owed to the river will deplete by the negative gain. Owed to the river will take the loss as well as the gains in this section. The water which it is estimated Alice and Minatare are entitled to in April can be borrowed from Guernsey ownership and transferred during the March run prior to occurrence. After Alice and Minatare water is evacuated from Guernsey, Guernsey ownership can then accrue to 45,228 acre-feet. After Guernsey ownership accrues to 45,228 acre-feet, the gains - Alcova to Glendo - will accrue to the Glendo Unit, and the gains below Glendo minus the Guernsey evaporation and seepage are to be released to the river or credited as owed to the river.

There are two conditions under which the Guernsey ownership accrual to 45,228 acre-feet is restricted:

(1) When more than 46,000 acre-feet total is transferred to Alice and Minatare prior to May 1.

(2) When the transfer prior to May 1 exceeds the sum of the October, November, and April gains below Alcova limited to 910 second-feet.

(e) Transfer of Alice and Minatare water shall not be initiated prior to March 1.

(f) Accrual of water in Guernsey which is credited as owed to the river during the winter months is to be released at Guernsey prior to opening the Interstate Canal in March. This release is to be measured at Guernsey ard the release made at a rate suitable for power production.

(g) Accrual of water in Guernsey after the Interstate Canal is opened in March and which has been credited as owed to the river shall be released prior to the time when natural flow calls on the river are made. If release of this "owed to river" water is made while the Interstate Canal is opened, then the release is to be measured at Whalen.

(h) As of May 1, any accrual of water transferred to Alice and Minatare since the previous October 1 in excess of the smaller of 46,000 acre-feet or the sum of the October, November, and April gains below Alcova limited to 910 cfs will be considered water stored under the Guernsey priority, and thus limit the filling of Guernsey ownership.

2. <u>General Criteria - May 1 through September 30</u>.

(a) Guernsey releases after April 30 are assumed to be natural flow calls on the river unless this release exceeds the total natural flow of the river. If neither Guernsey nor Glendo ownerships are filled and the Guernsey release is smaller than the gains Alcova to Guernsey, then the difference between these gains and outflows first goes to make up Guernsey losses and the balance accrues to Guernsey ownership. If the Guernsey ownership is filled but Glendo has not filled, the Alcova-Guernsey gains first go to satisfy the Guernsey release and losses and the balance, limited to the Alcova-Glendo gains, accrues to Glendo ownership including an allowance for evaporation. If the Glendo-Guernsey gains are larger than the Guernsey releases and losses when the Guernsey ownership is full but Glendo is not, then the difference between these gains and releases including losses is owed to the river and are to be released as such. After both Guernsey and Glendo ownerships are full, including allowable storage in Glendo for evaporation, and the Guernsey releases and losses are less than the Alcova-Guernsey gains, then the difference between these gains and Guernsey outflow and losses is owed to the river and will be released in accordance with subparagraphs (f) and (g) of Article I of above.

(b) When the Guernsey outflow exceeds the total natural flow of the stream, then the difference is, of course, release of storage water. The North Platte Project is assumed to release water stored under the Guernsey priority before releasing that stored under the Pathfinder priority. Pathfinder ownership in Guernsey Reservoir on September 30 of any year will remain Pathfinder ownership on October 1 any year. This water will not transfer to Guernsey ownership but will remain in Pathfinder ownership and be transferred back up stream as Guernsey or Lakes Alice and Minatare accrue water. During this condition, the ownerships are to be computed as follows:

(1) Kendrick ownership equals yesterday's ownership minus Kendrick computed evaporation and minus Casper Canal deliveries.

(2) Glendo ownership equals yesterday's onwership minus computed ownership evaporation and minus the Glendo Unit deliveries.

(3) Pathfinder ownership is merely yesterday's ownership minus Pathfinder ownership evaporation so long as any ownership remains in the Guernsey priority.

(4) The Guernsey ownership is then the total of all water in storage minus (1), (2), and (3) above.

(5) After Guernsey ownership is reduced to zero, then Pathfinder ownership is all water in storage minus (1), and (2) above.

3. Glendo Unit Ownership.

Since the power head pool of 64,780 acre-feet is now filled, no further accounting need be made for this pool. This minimum power head pool can be filled but once from river water. All Glendo ownership evaporation will be charged against the irrigation pool unless storage for evaporation has been underestimated and evaporation encroaches on the power head pool. In this case refilling of the power head pool will be allowed as an exception to the above statement. Glendo ownership can accrue in the irrigation pool 40,000 acre-feet plus estimated evaporation in any water year provided this total irrigation ownership including carry-over storage does not exceed 100,000 acre-feet plus estimated evaporation. At the end of the irrigation season, any difference between the actual evaporation charged to the Glendo ownership and that estimated previously will be taken care of by adjustment of the next year's allowable storage for evaporation.

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FROM

BANNER ASSOCIATES, INC.
309 South 4th - P. O. Box 550
LARAMIE, WYOMING 82070

(307) 745-7366

Message Reply

RECEIVED
JUN 9 1980
STATE ENGINEER
Cheyenne, Wyo.

DATE: 6/4/80

FILE NO.

PRIORITY
- ☐ URGENT!
- ☐ SOON AS POSSIBLE
- ☐ NO REPLY NEEDED

ATTENTION:

TO: Geo. Christopulos

SUBJECT: Panhandle Eastern proposal to divert from N.P. River

MESSAGE

Enclosed is a copy of a letter I wrote to Paul Rechard several weeks ago about the North Platte River computer model and a list of problems I feel need to be addressed relative to that model. Paul is drafting a contract to do this, and if you have any additional problems that should be included or changes made please let either Paul or me know so we can get them included.

Best regards

SIGNED: Lloyd

DATE OF REPLY:

REPLY TO:

REPLY

SIGNED:

SENDER: MAIL RECIPIENT WHITE AND PINK SHEETS.

RECIPIENT: WRITE REPLY. RETURN WHITE TO SENDER. KEEP THIS PINK COPY.

BANNER ASSOCIATES, INC.
CONSULTING ENGINEERS & ARCHITECTS
Wyoming: Laramie, Cheyenne
South Dakota: Brookings, Rapid City
309 S. 4th Street, P.O. Box 550, Laramie, Wyoming 82070 Telephone 307/745-7366

RECEIVED
JUN 9 1980
STATE ENGINEER
Cheyenne, Wyo.

May 12, 1980

File
1687-1

Mr. Paul Rechard, Director
Water Resources Research Institute
Wyo Hall
University of Wyoming
Laramie, Wyoming 82071

Dear Paul:

I tried without success several times last week to contact you or Mike Ackerburg, and since I will be out of town most of this week, I decided to write you instead.

As you know, we have been talking about how much time and effort would be involved in trying to do some things with the North Platte River model by Dr. Wei. Our need for that information is becoming more imminent, and I would really like to get an idea of how long it would take and how much it would cost to do these things. I am enclosing a list of the problems I see with the model as it is, and unless there is some explanation that says the model is okay as is and my rationale is faulty, then I would want to correct the model.

I would appreciate your giving this some serious thought, and if the cost and time requirements are not too great, I believe we can come up with some funding for such a project. I'll try to contact you in a week or so, and we can discuss this in more detail.

Best personal regards,

Sincerely,

Floyd A. Bishop

FAB/ssb
Enclosure

North Platte River Operation Study With or Without Enl. Seminoe Res. Using a Simulation Model

By Tsong Chang Wei
June 1977

Problems

1. There are times when we are storing water in the upper reservoirs (Seminoe, Alcova and Pathfinder) and at the same time delivering storage water to North Platte Project lands. We should use the natural flow to fill the direct flow rights and store only what is left over. Does the model assume a direct flow demand greater than the direct flow rights at statutory rates — or what?

2. There are times when Kendrick Project is storing water and at the same time storage water is being delivered to North Platte Project lands (i.e. June 1945). This should not be.

3. The priority listing on page 32 of the report should be revised to reflect the priorities as they actually are. If this can be done without too much trouble, I think it will correct most of the problems with the model. It should be as follows:

(1) 5 Ditch Demand (okay).
(2) North Platte Project Irrigation Demand (12/06/04) (direct flow up to statutory limit) (check with George L. Christopulos to see if he agrees).
(3) Pathfinder Res. (12/06/04).
(4) Guernsey Res. (1923).
(5) Seminoe (including Alcova) Res. (1931 and 1936) (?) (check with George L. Christopulos)
(6) Kendrick Project Irrigation Demand (1934) (direct flow up to statutory limit).
(7) Glendo Res. (1951).
(8) River Water.

4. Why do we have a North Platte Project irrigation demand and delivery in March and April? It appears to be 30,000 acre-feet every March and up to 30,000 acre-feet in April.

5. In many years the Alcova to Guernsey gains exceed the total of water transferred to the Inland Lakes plus Guernsey Res. ownership gains, plus Glendo Res. ownership gains. Where this is true, the excess water must be going on over Tri State Dam and into Nebraska. Some of these differences are significant (i.e. 1937, where the difference was about 116,000 acre-feet). Still in 1937, the printout shows a shortage of water to fill Glendo demands of 34,000 acre-feet. There are many years when this situation occurs although the magnitude of the differences is usually less.

6. In 1967, the printout shows no irrigation delivery from Glendo Reservoir when there was water available in the reservoir. Why?

7. The latest run where Glendo demand was increased from 18,000 acre-feet per year to 40,000 acre-feet per year shows an increase in the "River Water" some months (i.e. April, 1938, May, 1928, May, 1929, etc.). It seems to me that the result of an increased Glendo demand should always be a decrease in the "River Water". Why is this not so?

8. The data should be expanded to include the years from 1974-79, if possible.

Floyd A. Bishop

Progress Report - Revision of N. Platte River Model

October 27, 1980

1. The entire set of historical flow input data (1928-1973) has been reviewed. This has led to considerable revision of the data. Revisions made fell in to 3 categories:

   A. Errors in the original data entry (for example: 28.0 entered as 280.0)

   B. Values that could not be matched with any available source of data. These types of discrepancies were found mainly in two areas: reach gains above Alcova and Whalen-state line reach gains. Inconsistencies were mainly found in the older (pre-1960) data. If the reach gains above Alcova were relatively close to the values shown in USBR records they were not changed. Whalen-state line reach gains are computed as N. Platte at state line minus N. Platte below Whalen (Laramie River inflow is entered separately). The values in the original input data deviate from USGS records up to around 1960. These values were changed accordingly. Not all of these changes, however, will have practical significance in the model operation since many of the changes were made in non-irrigation months when flow below Whalen simply passes below Tri-state into Nebraska.

   C. Some time in the early 1960's the Guernsey watershed runoff values published in the N. Platte Project Compiled Water Records were reviewed and revised by the USBR. The original input data for the model uses the pre-revision values (found in the 1960 edition of the N.P. Computed Water Records). These values were changed to the post-revision values (found in the 1967 edition of the N.P. Compiled Water Records). Changes were made to May-September values from 1930 to 1947 and 1953 to 1963. For years before Glendo Reservoir was constructed the Guernsey watershed runoff was distributed 85% Alcova to Glendo 15% Glendo to Guernsey. Total yearly runoff was not significantly affected in many years although individual monthly distributions did change. However, the differences for 1934-1936 were significant: 130,000, 30,000, and 48,000 ac-ft respectively.

2. The data set was updated to include the most recent data available: through Water Year 1980. The major sources for data were N. Platte Compiled Water Records and the daily computed storage and river record sheets in Mills, Wyo. USGS data was used for some values below Whalen.

3. In the original model the North Platte Project demand was set to a constant 30,000 ac-ft in March and between 20,000 and 30,000 ac-ft in April depending on system inflow (p. 57 in completion report). This demand represents, in the model, mainly water transferred to inland lakes during these months. However, the maximum release to inland lakes is 46,000 ac-ft per year limited by October, November and April reach gains below Alcova. The model was changed to reflect this 46,000 ac-ft maximum. In the printout constant 30,000 ac-ft and 16,000 ac-ft demands are shown as the N. Platte demand for March-April although the actual deliveries are determined by the October, November and April water gains below Alcova.

4. The original model runs show a considerable amount of flow passing Tri-state dam during all months. This should not be, especially for most late summer months. Flow below Tri-state dam should theoretically be zero excluding Warren act and Glendo Unit orders passing Tri-state dam. In the original model, demands below Guernsey are computed and this amount is released by Guernsey. Any reach gain below Guernsey therefore is forced to pass below Tri-state. In reality any gains below Whalen, while not available to Interstate and Fort Laramie canals, are available to the Five Ditches as part of their natural flow right. The model was changed so that the Five Ditch demand would come first from Whalen-state line reach and only the remainder from the system above Guernsey thereby reducing required releases from Guernsey and decreasing flow below Tri-state to zero whenever possible.

5. As mentioned above, in the original model, the Whalen-state line reach gain is not a part of any irrigation delivery. With the change described in (4) above the value of the gain becomes important. It was determined that Whalen-state line reach gain is not the desired figure. Mitchell-Gering canal (one of the Five Ditches) diverts upstream of the state line gage. Also, Tri-state canal includes water from drains. (This water, however, is return flow from Interstate Canal going mostly to Northport district and is therefore already accounted for in the water diverted at Whalen). It was felt that the correct figure was a Whalen-Tri-state gain (or more conceptually correct, a Whalen-Five Ditch gain). This figure replaces the Whalen-state line reach gain during irrigation months and is computed as Tri-state canal from river only plus Ramshorn, French, Mitchell, Gering canals plus flow past Tri-state (Total Nebraska Diversions) minus N. Platte below

Whalen. Required data are available only from 1937 on. A regression equation relating these flows with N. Platte at state line was developed for estimating 1928-1936 values. During non-irrigation months state line release is based on the original Whalen-state line reach gain. In the printout a line labeled "State line-Tri-state gain" shows the monthly difference between the original Whalen-state line reach gain and the Whalen-Tri-state reach gain as computed above.

6. In the revised model natural flow-storage water is segregated according to the method used on a daily basis in Torrington and Mills, Wyo. This type of segregation is relevant only in the Whalen-Tri-state reach. Initially, a simple natural flow-storage flow computation was included at each reservoir inflow and outflow point (except Gray Reef) and is shown in the lines "Natural Flow" and "Storage Flow" preceding total inflow and total outflow for each reservoir. It does not, however, take into account any carriage losses. This simple natural flow-storage flow segregation seems conceptually valid but with little practical significance although it seems to have been the basis for the water distribution above Whalen in the 1950's. The natural flow-storage segregation section in the printout is based on the method presently in use. There are, however, two differences: 1) in the model carriage losses are not included, 2) in reality, natural flow is computed at Alcova, Gray Reef outflow, Glendo inflow, plus 20 cfs gain Glendo to Guernsey. In the model, water might be stored in upstream reservoirs even though there are natural flow calls on it downstream. Therefore, total natural flow is based on system inflow (Seminoe inflow plus reach gains). "Below Whalen natural" is computed as deliveries at Whalen (Interstate and Laramie

Canals), plus Wyoming private canals, plus Glendo unit deliveries plus Five Ditch deliveries plus passing Tri-state minus Whalen storage. The natural flow, therefore, is computed exactly as it is done on the daily sheets. This natural flow is distributed 75% Nebraska - 25% Wyoming.

7. Two new lines were added to the "Whalen Dam" section of the printout:

   A. "Wyoming Private Canals" are part of the natural flow computations. Based on analysis of historical diversion records a constant 49,000 ac-ft is delivered to the eight or so private canals distributed May - September 6,860, 7,840, 13,230, 12,250 and 8,820 ac-ft. Diversion records shown that there is usually not much variance in the total yearly delivery. These canals have early priority dates and even in poor years will divert mostly natural flow. Therefore, these canals are not considered a discrete component in the model (like, for example, Kendrick project or N. Platte project); they always get their water and it is all natural flow.

   B. "Tri-state from drains" is also not involved in the model computations since it is return flow from water already accounted for in Whalen diversions. It is included in the printout because the value had already been computed earlier. A regression equation was developed for estimating 1928-1936 values.

8. A reappraisal of the equations used to compute the N. Platte Project and Five Ditch demands was done since these demands represent the bulk of deliveries within the system. Historical data were analyzed and compared with simulated demands. The model accurately simulates

Five Ditch demands: actual = 246,000 ac-ft, simulated = 243,000 ac-ft (1962-1976 mean). The mean N. Platte project deliveries (excluding Five Ditch, but including Warren act contractors) were 831,000 ac-ft, but simulated only 739,000 ac-ft. It appears that the original equations for N. Platte demand were based on historical deliveries to Interstate and Ft. Laramie canals. This does not include two components of the N. Platte Project: Northport district and Warren act contractors. Both divert about 36,000 ac-ft per year. The N. Platte project demand was therefore increased by 10% (5% each for Northport and Warren act) to bring the simulated demand more in line with actual deliveries.

9. The Glendo Unit deliveries were also reviewed. It is felt that the constant 6,000 ac-ft each in July, August and September are too low since the decree allows up to 40,000 ac-ft per year. 18,000 ac-ft may be reasonable for the amount of water presently contracted for (about half of the maximum 40,000 ac-ft) but the model should simulate maximum use conditions. These conditions may not be too far off since at this time applications have been submitted for most, if not all, of the remaining water. A variable Glendo demand curve based on historical deliveries and system inflow was developed. Since the equation represents only half of the potential demand the value was multiplied by two with a yearly maximum of 40,000 ac-ft and a minimum of 4,000 ac-ft (Glendo Unit contractors will most likely use at least 10% since they must pay for that amount whether they use it or not). Later the multiplication factor was increased to 3.0 with a minimum of 8,000 ac-ft.

10. The exact meaning of several lines in the "North Platte Project" section of the printout were changed. Several new ones have been added. In the original model "Irrigation demand" included Five Ditch demand. In the revised version they have been separated so that "Irrigation demand" is N. Platte project exclusive of Five Ditch demand. Since part of the Five Ditch demand is satisfied from flow below Whalen dam, a line "from system above Guernsey" has been added. The next line "Delivery from storage" is self explanatory. "Delivery from natural flow" includes all natural flow down to Tri-state dam. Inland lakes water is assumed to be storage water. The "Delivery from natural flow" is comprised of Five Ditches (up to 75% of natural flow below Whalen) with the remainder to North Platte project. The "Irrigation delivery" is not the total irrigation delivery but, rather, the delivery from the "system above Guernsey" and should equal the values in that line except when there is a shortage.

11. The priority order for natural flow distribution was changed from that appearing on p. 32 of the completion report. The revised order is:

    1. Five Ditch irrigation demand
    2. North Platte direct flow (up to statutory limit)
    3. Pathfinder ownership
    4. Guernsey ownership
    5. Seminoe ownership
    6. Kendrick direct flow (up to statutory limit)
    7. Alcova ownership
    8. Glendo unit ownership
    9. River water

Glendo unit direct flow was eliminated. The major change is the move of North Platte direct flow to directly behind Five Ditches. The direct flow right is now in its proper place thereby implicitly effecting a natural flow-storage flow segregation in the model. In reality Seminoe-Kendrick direct flow-Alcova are lumped together but are separated here according to their priority dates. Computer runs were made comparing ownership gains simulated with the original priority order; the revised order and actual data. Actual values for beginning of year storage and monthly releases from Guernsey were substituted in the data file. The revised priority order consistently resulted in simulated ownership gains much closer to the actual data than did the original priority order. During a number of years the original model showed an ownership gain sufficiently large to satisfy Glendo unit demand, yet deliveries made were far below the demand. This was traced to inconsistencies between the priority order and computation of water available to the Glendo unit made elsewhere in the program. The revised priority order corrected this problem. A minor change was made concerning the allocation of flow above Alcova. Normally Guernsey will fill from gains below Alcova so upstream gains would go first to Pathfinder and then to Kendrick project. Several test runs, however, showed that Guernsey did not fill from downstream gains. Therefore Guernsey was placed ahead of Kendrick for gains above Alcova.

12. During the course of work several "bugs" were discovered in the main program as well as in the five small utility programs used to convert the output to various printout formats. These "bugs" surfaced mainly as a result of input data changes which affected the flow paths

within the program. Though annoying and time consuming to trace and correct, the surfacing and elimination of "bugs" within any computer program of considerable size and complexity remains an almost constant inevitability.

13. A user guide for the model remains partially completed pending review and approval of proposed revisions.

THE UNIVERSITY OF WYOMING

WATER RESOURCES RESEARCH INSTITUTE

P. O. BOX 3067, UNIVERSITY STATION

LARAMIE, WYOMING 82071

PAUL RECHARD
DIRECTOR

TELEPHONE: 766-2143
AREA CODE: 307

October 31, 1980

Mr. George Christopulos
State Engineer's Office
2nd Floor, Barrett Building
Cheyenne, Wyoming 82002

Dear Mr. Christopulos:

WRRI is presently involved in a review of the North Platte River Management Model developed here several years ago (Final Completion Report, June, 1977, by Tsong Chang Wei). Several changes have been made to the model. These changes are based on a review of the original computer program, data from WPRS and the State Water Office and numerous consultations with personnel at Banner Associates, Board of Control in Torrington, and WPRS in Mills and Denver.

I would appreciate it if you would review the enclosed material and return any comments you may have on the work that has been done. The enclosed printout has been spot checked for errors. I would appreciate it if you would note any errors or inconsistencies found and include these along with any other comments.

Sincerely yours,

Michael Akerbergs
Scientist

Enclosure

/jaf

MEMORANDUM

TO: All Persons involved with WRRI's North Platte Planning Operations Study

FROM: John Buyok, Engineering Field Inspector

SUBJECT: Items discussed during meeting concerning North Platte Model held January 8, 1981 at W.R.R.I.

The following people attended the meeting:

W. G. McCracken - W.P.R.S.
Jack Marshall - W.P.R.S.
Gary Mehling - Wyoming Board of Control
Carlton Hunter - Wyoming Board of Control
John Buyok - Wyoming State Engineer's Office
Mike Akerbergs - W.R.R.I.

To start the meeting, new printouts containing the latest revisions of the program were passed out. One of the revisions was the addition of a line showing depletion of the Laramie River Inflow by Grayrocks Dam. Addition of the line caused Laramie River inflow to be negative at several times up until 1958. It was decided that diversions for the Lingle Power Plant were the cause of the negative numbers because they hadn't been accounted for in the program.

Carlton Hunter pointed out that many of the numbers used in the model came from W.P.R.S. annual operating plan rather than from the accounting sheets which list the actual flow figures. Mike Akerbergs agreed to double check the figures to make sure only actual figures were used.

Jack Marshall stated that the model was intended only as a planning study and a tool to discover relationships between various changes in the river. It was agreed to change the heading of the printout to Planning Operations Study to avoid confusion with the Annual Operating Plan. Actual starting storage values, inflow values, and demand values should be plugged into the program year by year if operation is to approach actual. Many of the storage and demand figures are estimated in the program in order to provide continuity through the computer run. Mike will run a wet, a dry, and an average year through with actual values in order to check the operations criteria.

A problem exists with the evaporation curves in the model. Evaporation is sometimes off by as much as 500%. Apparently the evaporation was used as an adjustment to make the other values balance out.

The Water Credited to River heading is to be changed to Surplus to Ownership. The section is then to be split between River Water in Storage and Water Gain above Alcova with a new heading, System Water Supply, placed between the portions. Whalen Storage is to be changed to Storage at Whalen in the Natural Flow - Storage Segregation section to avoid confusion with storage reservoirs. Total Water Uses under the reservoir headings should be eliminated because it is meaningless. Irrigation delivery and turbine release cannot be added because in most cases, turbine release is irrigation delivery.

An asterisk will be placed in front of those portions of the program that are for reference purposes only and have no effect on the rest of the program. Some of these that were mentioned were Tri-State From Drains and Depletion by Grayrocks.

The Glendo capacity used in the program is wrong because it does not take into account the flood pool. Water that is surplus to ownership is stored in the flood pool rather than being dumped down river all at once. The program should reflect this. Flow past Tri-State should be limited to a maximum of 10,000 cfs because of this storage. Maximum ownerships used in the program for Seminoe and Alcova are also incorrect because resurveys have been made and new capacities are available. Minimum ownerships are based upon several different criteria, some of which are arbitrary, as in the case of Guernsey.

Natural flow and storage flow segregation is meaningless during the non-irrigation months. It should be segregated only from May through September.

Conveyance losses are not calculated in the program. It was assumed that losses would show up in the gage flow. All diversions from the river which are not separately listed are included in the reach gain or loss and the user's guide should reflect this.

Natural flow should not be included in the ownership gain figures because it moves on down through the system. Only reservoir ownership gain should be counted. Reservoir ownership will probably be incorrect for a given year because of the problem with evaporation mentioned earlier and because the program is set up to calculate natural flow with reservoir storage used as a balance.

A problem may exist with the program because it is set up to use 40,000 AF every year from Glendo Reservoir. In some years Glendo may not gain 40,000 AF and the supply will be short. The program also does not take into account the fact that contracts have not yet been made for all of the 40,000 AF.

The 25% - 75% split of natural flow between Wyoming and Nebraska was discussed in depth. The present method of incorporating it into the program appears to be correct.

The changes suggested above will be made by Mike Akerbergs as soon as possible and copies of the revised run will be distributed. If necessary, another meeting will be held to straighten out any further problems.

JB/llw

Progress Report - Revision of North Platte River Model

January 27, 1981

This is the second progress report for this project. The first report was dated October 27, 1980. Many of the revisions discussed below were based on discussion at a meeting held at the Wyoming Water Resources Research Institute on January 8. Participants were W.G. McCracken - W.P.R.S., Jack Marshall - W.P.R.S., Gary Mehling - Wyoming Board of Control, Carlton Hunter - Wyoming Board of Control, John Buyok - Wyoming State Engineer's Office and Mike Akerbergs, W.R.R.I.

1) Guernsey evaporation is not charged against the ownership. The model has been changed so that any Guernsey evaporation is recovered from the river even if Guernsey is not in priority.

2) Banner Associates has recently completed an operations study for Grayrocks Dam on the Laramie River. A result of the study is an estimate of the depletion of Laramie River Flow due to the reservoir. This depletion can be either positive or negative. Monthly Laramie River depletion values were entered as data to the model. The option to use these data or run the model with no depletion is easily implemented. Effect of Grayrocks on Laramie River flow is listed in the line "Depletion by Grayrocks".

3) For the sake of clarity the terminology in the Whalen Dam, North Platte Project, Water Credited to River (changed to Surplus River Water), and Natural Flow-Storage Segregation sections of output was revised. Several footnotes were added at the bottom of page 4 of 4 in the printout to clarify some of the items.

4) Originally the Laramie River inflow data did not include water diverted to Lingle power plant. The result was negative inflows when Grayrocks depletion was implemented. The data for Laramie River inflow for 1928-1956 was changed to include this diverted flow. The Whalen-Tri-State reach gain had to be adjusted in an equal but opposite direction so that total gain remained the same.

5) An option was included to have the model compute Glendo Unit demands and deliveries based on either the present 20,000 ac-ft (approximate) per year or a maximum contract of 40,000 ac-ft.

6) A restriction of 4,000 cfs (if possible) was placed on the flow at state line. The previous runs of the model had no restrictions on flow at the state line with the result that water was never stored in the Glendo Flood pool. This is contrary to normal operating procedures. Restricting flows to 4000 cfs, if possible, forced the model to utilize the Glendo flood pool.

7) In the first progress report it was stated that the natural flow at Whalen was based on system inflow: if the water at Whalen equalled or exceeded system inflow natural flow at Whalen would equal system inflow. The model was changed so that maximum natural flow at Whalen is computed as system inflow minus any gains to ownership during that month.

8) October-April natural flow - storage flow at reservoir inflow and outflow points was deleted. Also, natural outflow and storage outflow at Guernsey were deleted since they would often conflict with natural flow-storage flow values at Whalen which are computed differently.

9) "Total water uses" was deleted from the printout. The terminology is incorrect and the line serves no purpose.

10) Earlier, Seminoe ownership-Kendrick direct flow-Alcova ownership were separated. It was decided to return to the original format where the three are combined as simply ownership gain. The separation appears to be artificial with no practical significance; furthermore, it has no effect on model oepration.

11) The line "ownership gain" in the North Platte Project section of the printout no longer includes direct flow.

12) Alcova reservoir capacity was changed to 184,300 ac-ft with April-August operating storage also set to 184,300 and maximum Kendrick accrual reduced accordingly, to 1,201,580 ac-ft. Glendo unit maximum ownership capacity was reduced to 183,240 ac-ft (100,000 ac-ft carry over storage, 63,150 ac-ft power head pool and 20,090 ac-ft evaporation allowance). These changes are based on recent resurveys.

13) A considerable amount of time was spent in eliminating "bugs" which surfaced when other changes forced the program to follow previously untested paths. The bugs manifested themselves as infinite loops within the program which prevented the program from running to completion. This debugging process is responsible for much of the computer time used and is a process that will certainly continue past the completion of this project for as long as the model is used in it's capacity as a versatile planning tool.

14) Several runs were made to compare simulated operation with actual operation. It was felt that this would provide an adequate test of the model's accuracy. Exact agreement between observed and actual values was not attained but due to the complexity of the system and the quantity of variables involved this would be an unreasonable and unattainable goal. A "reasonable" agreement indicates that the model criteria

simulate the way the system is actually operated and vice-versa.

Three runs were made:

1968-1980 - starting with actual (1968) storages and ownerships - average year

1973 - actual starting ownerships and storages - wet year

1974 - actual starting ownerships and storages - dry year

Comparison between simulated and measured values of selected components is presented tabularly and graphically in the following pages. Minor differences may be noted between certain values in the printout and the same values on the graphs: the graphs were drawn using runs before the changes in item 12 above had been implemented.

15) The user manual for the model is scheduled for completion within the next few weeks. It was originally thought that computer generated flow-charts produced at WAPRS in Denver could be incorporated as a useful part of the manual. However, preliminary results indicate that these flow charts are of limited utility and, therefore, will not be included.

Memorandum **Woodward-Clyde Consultants**

605760-2160
SF-30

To. John

From Charles Andrews

Office 3 Embarcadro
San Francisco, CA 94111
415-956-7070

Date February 4,1981

Subject

Enclosed in an agenda for the meeting to discuss the operations model of the North Platte River and the surface water supply system for the WyCoalGas Project on February 10,1981. The meeting will begin at 1:30 pm in the WRRI conference room in Wyo Hall on the University of Wyoming Campus (307-766-2143).

The purpose of the meeting is twofold:

1. to allow participants from the State Engineer's Office, Board of Control and WPRS to discuss changes made by Mike Ackerberg in operations model of North Platte River since meeting on January 8,1981.

2. to aid the BLM and Woodward Clyde, who are preparing the Environmental Impact Statement on the WyCoalGas Project, in assessing the adequacy of the North Platte and La Prele Creek operations models for determining the yield of the proposed WyCoalGas surface water supply systems and probable impacts on other users in the systems.

I think the meeting will be very productive, and I look forward to your participation. Please call if you have any questions.

Charles Andrews

Agenda for WyCoalGas Surface Water Meeting

February 10, 1981 1:30 at University of Wyoming

WRRI Conference Room

I.	Introduction and Purpose	Andrews
II.	WyCoalGas Surface Water Supply System	Coleman
III.	Operations Model of North Platte River	Ackerberg
	(a) background of model	
	(b) verification of model--changes made in model within past month	
	(c) applicability of model for analyzing water ~~under~~ yield	
	(d) availability of water for Panhandle	Ruff
IV.	Operations Model of LaPrele Creek	Ruff
V.	Impacts of Water Withdrawals	

Anticipated Participants

Lou Allen	State Engineers's Office
John Buyok	State Engineers's Office
Mike Coleman	Panhandle Eastern
Mike Brogan	BLM
Rob Currier	BLM
Mike Ackerberg	WRRI
Jim Ruff	WRRI
Sig Zvejnieks	Banner Ass
Floyd Bishop	Banner Ass
Charles Andrews	Woodward-Clyde
Gary Mehling	Board of Control
Carlton Hunter	Board of Control
Jack Marshall	Water & Power Resource Service

February 18, 1981

MEMO

FROM: Carlton Hunter

TO: Earl Michael, Superintendent, and John Buyok

SUBJECT: Meeting at WRRI, Feb. 10, 1981 concerning the review of Mike Ackerberg model of the North Platte River.

The following people were in attendance:

Coleman, Panhandle, Andrews, Woodward-Clyde, Brogan, BLM, Zvenjnieks, Banner, Ackerberg, WRRI, Hunter, Wyoming Board of Control.

We went over the new run on the model covering 1968 through 1980, Water Year. Actual figures were used beginning in 1968 and then carried through using segment accrual gains of each year.

Some of the figures used in model are Kendrick uses 70 KAF/yr, Glendo and North Platte Projects uses are from equation based on 15 year average with approximately 1,500 KAF demand each year for irrigation.

Under system summary gain to river (which is surplus river water below) is the number that Panhandle is looking at.

Mike said he would change gain to river to surplus river water as it was suggested earlier.

The following information was given by Panhandle concerning their priority of operation: 1. LaPrele Dam will yield them 4,100 AF/yr average; 2. North Platte River diversion; 3. Green Valley field (Barbers) and Morton's well.

The proposed delivery system would be from LaPrele Dam down LaPrele Creek to North Platte River, down North Platte River channel to point of diversion then to plant or the 26 KAF Reservoir for storage.

Morton Well Field to plant directly. Green Valley by pipeline to plant or reservoir.

The total system will have 6,000 AF/yr demand with an 8,000 AF/yr requirement.

This information about Panhandle operations was new to me, so I will pass it along. It probably already is known by you.

1984 Operating Agreement:

C. Guernsey - 45, 612 AF (current capacity) Priority Date - 04/20/23

1. River gains upstream of Guernsey Reservoir for the October 1 through April 30 period and not credited to the Inland Lakes will accrue to this ownership until filled. Gains May 1 through September 30 in excess of natural flow demands may accrue to Guernsey ownership until filled.

2. The Guernsey evaporation charge is computed as though all Guernsey ownership is in Guernsey Reservoir.

3. All releases made to fulfill contractual obligations to Federal contractors by the Bureau of Reclamation at its Torrington office will be coordinated with the Hydrographer-Commissioner of District 14. Guernsey Reservoir releases after April 30 are to be natural flow class upon the river following coordination among Wyoming, Nebraska, and Bureau of Reclamation personnel.

4. When Guernsey Reservoir releases exceed the natural flow of the river at this point, then the difference is a release of storage water.

NPRMM:

1. The model handles the operation of Guernsey Reservoir in the same manner. In addition, after the Inland Lakes water has been transferred to Lakes Alice and Minatare, the vacancy can be filled by Guernsey ownership.

2. Guernsey evaporation charge is computed as though all Guernsey ownership is in Guernsey Reservoir.

3. Not applicable to the model.

4. Model handles this point in the same manner.

1984 Operating Agreement:

D. Kendrick - 1,201,574 AF (current capacity; Seminoe - 1,017,279 AF, Alcova - 184,295 AF) Priority Dates (Seminoe - 12/01/31, Alcova - 04/25/36)

1. All gains upstream of Seminoe Reservoir for the October 1 through April 30 period after Pathfinder and Guernsey ownerships have filled are to accrue to Kendrick (Seminoe) ownership for the October 1 through April 30 period after Pathfinder and Guernsey ownerships have filled are to accrue to Kendrick (Alcova) ownership until filled. Gains May 1 through September 30 in excess of natural flow demands may accrue to the Kendrick ownership until filled.

RECEIVED FEB 21 1981 STATE ENGINEER Cheyenne, Wyo.

February 20, 1981

Memorandum

To: John Buyok and Division One Supt.
From: Carlton L. Hunter *CLH*
Subject: Review of WRRI North Platte River ~~Planning~~ Operations Study 1968-80

I have made a spot review of the WRRI North Platte River Operations Study and came up with the following comments.

I checked the beginning quantities in the program and all Reservoir storage and ownership quantities agreed with the exception of Pathfinder Reservoir being 283.18 KAF* and Pathfinder Ownership being 536.64 KAF when it should be 512.10 KAF. I didn't check all quantities in the program just the significant ones Reservoir storage, ownership quantities, evaporation and surplus water.

I tabulated the actual end of water year quantities in the Kendrick, Pathfinder and Glendo ownerships and compared them with what the computer generated. For the 13 years 1968-80 the overall percentage average was +10.4% or +86.6KAF when the three ownerships were considered, computer over actual.

A similair comparison was made using the three major reservoirs Seminoe, Pathfinder and Glendo, this being based on the actual physical storage. The overall average percentage was +12.8% or +93.3KAF computer over the actual quantity.

Another comparison was made of the Surplus water quantity in the computer run and it appears that the average of +74% or +165.7KAF above the actual average that I determined for the 1968-80 period.

The criteria for determining surplus actual quantity I used was that all water passing Guernsey Dam when all ownerships were full. In a couple years we dumped water early in the Water Year in anticipation of high flows. I counted this quantity as surplus water for that year if later on all ownerships filled. Water that went into Owed to the River storage account was accounted for as surplus as it accrued if ownerships were full and not accounted for when released.

A look was made concerning evaporation. The Water years 68,75 and 76 were used and the total evaporation for each reservoir was made and compared to the model quantity. Overall of the three years considered the computer was short about 22% or -35KAF. The years were 68 -29.6, 75 -15 and 76 -23 percent of actual. Another look could be made into other years if necessary.

It should be pointed out that the 13 years overall is above average for the runoff and there was surplus water available for seven of these years, one year 1973 had a surplus of over 1,300KAF which also was the highest runoff year since the early 20's. This needs to be considered when looking at the numbers generated by the model using this time frame.

Other areas that should be looked at later to polish the program are the Glendo reservoir physical carryover of 60KAF should be adjusted to the average of 88KAF.

No time was spent checking out other significant items and I looked specifically at things that I thought would effect the immediate concern being Panhandle looking for Surplus water in the North Platte River System for their coal plant near Douglas.

* when it should be 258.24 KAF

CALCULATION PROCEDURES

NOTES: ALL VALUES TO BE IN KAC-FT; IF ABSOLUTE VALVE <0.005, SET #0.00
ANY "Σ" REFERS TO VALVES IN PRESENT WATER YEAR ONLY

ABBREVIATIONS: Pr. = Previous Mo. = Month's Mos. = Months'
EOY = End-of-Year Max. = Maximum Min. = Minimum

(1) = 1.054 x Input (Gage 06-6490)
(2) = Input x (#Days in Month) ÷ 1,000
(4) = Input
(19) = Input
(20) = (19) - 6.00; Min. of 0.00; Max. of {0.399 x (# Days in Month)}
(28) = Input x (# Days in Month) ÷ 1,000
(2.1) Oct. - May
Pr. Year Total ((5) + (6)) x Monthly Factor
June - Sept.
Σ(Pr. Mos. ((5) + (6)) x Monthly Factor
(3) Lesser of: A) (2) - (2.1) ; Min. of Zero
B) (1) - (2.1) ; Min. of Zero
(5) Lesser of: A) (4) B) (1) - (3) C) 0.3246 x (# Days in Month)
(10) Lesser of: A) (19.54 - Pr. EOY (15)) - Σ(Pr. Mos. (10))
B) (1) - (3) - (5)
(10B) Oct. - Apr. Lesser of:
A) (10)
B) {2.50 - Σ(Pr. Mos. (10B)} + {(10) - (2.50 - Σ(Pr. Mos. (10B)))}x .25
MIN. OF ZERO MIN. OF ZERO MIN. OF ZERO
C) 5.00 -Σ(Pr. Mos. (10B))
May - Sept. Lesser of:
A) 0.25 x (10)
B) 5.00 -Σ(Pr. Mos. (10B))
(10A) = (10) - (10B)
(6) Lesser of: 1) Pr. Mo. (15A) + (10A) B) (4) - (5)
(7) = (4) - ((5) + (6))
(8) Base on Capacity of: {(Pr. Mo. (15))+(Pr. Mo. (15)+(10)-(6))}÷2}x(# Days in Month)÷1,000
(20A) Lesser of: A) (20) B) (28)-(0.90x(8)); Min. of 0.00
(20B) Lesser of: A) (20)-(20A)
B) (0.399 x # Days in Month) - (0.90 x (8)) - (20A)
C) 26.54- Pr. EOY (26B)-Σ(Pr. Mos. (20B))
D) 26.54 - {Pr. Mo. (26) + ((8)x0.90) - (28); Min of 0.00)} ; Min. of 0.00
(20C) = (20) -((20A) + (20B))
(20D) = (20A) + (20B)
(9) Oct. - Aug.
Check: is (20) > 0
<u>Yes</u> - Lesser of: A) {(28) - (0.90x(8))-(20A)}÷0.90; Min. of 0.00
B) Pr. Mo. (15B) + (10B) - (8) - 0.015
<u>No</u> - Lesser of: A) {(28) - (0.90 x (8))}÷0.90; Min of 0.00
Oct.-Apr.B) 2.00 - {Σ(Pr. Mos. (16)) + (8)}; Min. of 0.00
May- Aug.B) 4.50 - {Σ(Pr. Mos. (16)) + (8)}; Min. of 0.00
C) Pr. Mo. (15B) + (10B) - (8) - 0.015; Min. of 0.00
Sept. = Pr. Mo. (15B) + (10B) - (8) - 0.015; Min. of 0.00

(11) = (8) + (9) + (6)
(12) = (1) - ((3) + (5) + (10))
(13) Lesser of: A) Pr. Mo. (15) + (10) - (11)

B) (Evap. Rate) X (Surface Area @ Capacity of $\frac{\text{Pr. Mo. (15)} + (\text{Pr. Mo. (15)} + (10) - (11))}{2}$)

(13A) Check: is (Pr. Mo. (15) + (10) + (11)) >0.001

Yes: (13A) = (13) x $\frac{\text{Pr. Mo. (15A)} + (10A) - (6)}{\text{Pr. Mo. (15)} + (10) - (11)}$ No: (13A) = 0

(13B) = (13) - (13A)
(14) = (10) - (11) - (13)
(14B) = (10B) - ((8) + (9)) - (13B); Min of -(Pr. Mo. (15B))
(14A) = (14) - (14B)
NEW (6) = (10A) - (13A) - (14A)
(15) = Pr. Mo. (15) + (14); Min of 0.00
15B = Pr. Mo. (15B) + (14B)
(15A) = (15) - (15B)
(15C) Elevation (In Feet) at Storage Capacity of (15)
(15D) Surface Area (In Acres) at Storage Capacity of (15)
(15.1) Oct. - Apr. = (2.1) + (8) + (9) + (12) May - Sept. = .48 ((2.1) + (3)) + (8) + (9) + (12)
(16) = (8) + (9)
(17) = (16) x 0.10
(18) = (16) x 0.90
(18A) Lesser of: A) (18) B) (28)
(18B) = (18) - (18A)
(18C) = (Pr. Mo. (26) + (18B)) -26.54; Min. 0.00
(21A) = (18B) - (18C)
(21B) = (20B)
(21) = (21A) + (21B)
(22) Lesser of: A) (28) - (18A) - (20A)

B) Pr. Mo. (26) - 0.18; Min. of Zero

(22A) Lesser of: A) (22) B) Pr. Mo. (26A)
(22B) = (22) - (22A)
(23) Lesser of: A) (Pr. Mo. (26) + (21) - (22))

B) (Evap. Rate) x (Surface Area @ Capacity of $\frac{\text{Pr. Mo. (26)} + (\text{Pr. Mo. (26)} + (21) - (22))}{2}$)

(23A) Check: Is (Pr. Mo. (26) + (21) - (22)) >0.001

Yes: (23A) = (23) x $\frac{\text{Pr. Mo. (26A)} + (21A) - (22A)}{\text{Pr. Mo. (26)} + (21) - (22)}$ No: (23A) = 0

(23B) = (23) - (23A)
(25) = (21) - (22) - (23) - (24)
(25A) = (21A) - (22A) - (23A) - (24A)
(25B) = 21B - (22B) - (23B) - (24B)
(26) = Pr. Mo. (26) + (25); Min. of 0.00
(26A) = Pr. Mo. (26A) + (25A); Min of 0.00
(26B) = Pr. Mo. (26B) + (25B); Min of 0.00
(26C) Elevation (in feet) at Storage Capacity of (26)
(26D) Surface Area (Acres) at Storage Capacity of (26)
(27) Lesser of: A) ((28)-(20A)-(18A)-(22))

B) 4.00-Σ(Pr. Mos. (27))

(27A) Lesser of: A) (27)

B) 2.00-Σ(Pr. Mos. (27A))

(27B) = (27) - (27A)
(29) = (20A) + (18A) + (22) + (27)

(30) = (28) - (29)
(31) = (10A) - (6.0x (2.1)) + (5)
(32) = (10B) - (16) + ((18) - (18C)) + (20D)

P. O. Box 550 620 Plaza Court
LARAMIE, WYOMING 82070
(307) 745-7366

SHEET NO. ______ OF ______
CALCULATED BY SRZ DATE ______
CHECKED BY ______ DATE ______
SCALE ______

OPERATION STUDIES
DATA SHEET

(28) PANHANDLE EASTERN PLANT DEMAND

OCT. & SEPT.	13.65 AC-FT/DAY
NOV. – AUG.	17.06 AC-FT/DAY

(13) & (23) EVAPORATION RATES (GRAYROCKS OPERATION STUDIES)

OCT	0.17 FT/ACRE	APR	0.24 FT/ACRE
NOV	0.10	MAY	0.32
DEC	0.09	JUN	0.36
JAN	0.09	JUL	0.44
FEB	0.08	AUG	0.40
MAR	0.14	SEP	0.26

LAPRELE RESERVOIR (1969 BUREC.)

(2) SENIOR DOWNSTREAM RIGHTS
12.76 ACRES ⟹ 36.16 AC-FT/DAY

(11) ASSOCIATION DEMAND (11,454 TOTAL ACRES → 324.55 AC-FT/DAY DIRECT FLOW RT.)

MAY	JUNE	JULY	AUGUST	SEPT.	
2,829	5,549	9,793	8,814	7,182	AC-FT

(8) LAPRELE SEEPAGE (1980; TIPTON & KALMBACH, INC.)

CAPACITY (AC-FT)	SEEPAGE (AC-FT/DAY)
0	0
250	0
416	1.67
961	3.47
1,600	4.76
4,000	7.48
8,000	11.62
12,000	15.79
16,000	19.93
20,000	24.08

620 Plaza Court
LARAMIE, WYOMING 82070
(307) 745-7366

SHEET NO. ____ OF ____
CALCULATED BY SRZ DATE ____
CHECKED BY ____ DATE ____
SCALE ____

② SENIOR RIGHTS DEMAND
(1969 BUREC REPORT)

$1276 \text{ ACRES} \times \frac{1 \text{ CFS}}{70 \text{ ACRES}} \times \frac{1.98347 \text{ AC-FT/DAY}}{1 \text{ CFS}} = 36.16 \frac{\text{ACRE-FEET}}{\text{DAY}}$

MAY	JUNE	JULY	AUGUST	SEPTEMBER
1.121 KAC-FT	1.085	1.121	1.121	1.085

④ TOTAL ASSOCIATION DEMAND (INCLUDES CARRIER RIGHTS) 11,454 ACRES
(1969 BUREC REPORT - AVG. VALUES)

1,149.5 ACRES CARRIER RIGHTS
10,304.5 ACRES ASSOCIATION
} 5% OF DEMAND MET BY "INTERNAL" RETURN FLOWS

MAY	JUNE	JULY	AUGUST	SEPTEMBER
2.829 KAC-FT	5.549	9.793	8.814	7.182

BANNER ASSOCIATES, INC.
620 Plaza Court
LARAMIE, WYOMING 82070
(307) 745-7366

SHEET NO. ______ OF ______
CALCULATED BY SRZ DATE ______
CHECKED BY ______ DATE ______
SCALE ______

(2.1) LAPRELE CREEK RETURN FLOWS 8% OF IRRIGATION FLOWS
(1969 BUREC REPORT)

	LAPRELE CREEK × MONTHLY DISTRIBUTION	
OCT	(.08 X .08)	.0064
NOV	(.08 X .06)	.0048
DEC	(" X .05)	.0040
JAN	(" X .04)	.0032
FEB	(" X .04)	.0032
MAR	(" X .03)	.0024
APR	(" X .04)	.0032
MAY	(" X .07)	.0056

FOR JUN-SEP, IRR. PROJECTIONS FOR YEAR TOTAL BASED ON
(AVG. Σ IRR.) % of (AVG. YEAR TOTAL) ; (LP.002 2/23/81)

	MONTHLY DISTRIB. × LAPRELE CREEK × PROJECTION FACTOR	
JUNE	(.10 X .08 X 5.625)	.0450
JULY	(.16 X .08 X 2.016)	.0258
AUG	(.18 X .08 X 1.125)	.0162
SEP	(.15 X .08 X 1.008)	.0121

LAPRELE CREEK RETURN FLOWS
8% OF THE TOTAL RETURN FLOWS OF 48%
∴ TOTAL RETURN FLOWS = 6.0 X LAPRELE RETURNS

BANNER ASSOCIATES, INC.
620 Plaza Court
LARAMIE, WYOMING 82070
(307) 745-7366

SHEET NO. ____ OF ____
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LA PRELE RESERVOIR (1980 REPORT; TIPTON & KALMBACH, INC.)

ELEV.	AREA (ACRES)	CAPACITY	
5372	0	0	
5383	2.73	15	DEADPOOL
5400	11.98	140	
5410	17.82	289	
5420	42.18	589	
5430	71.62	1,158	
5440	126.98	2,151	
5450	209.02	3,831	
5460	285.98	6,306	
5470	383.82	9,655	
5480	483.38	13,991	
5490	626.82	19,542	

CONTOUR	AREA - ACRES	AVERAGE	VOLUME - AC FT IN INTERVAL	CUMULATIVE CAPACITY AC - FT
4860	0	0		0
		0.4	2	
4865	0.7			2
		2.4	12	
4870	4.0			14
		9.5	47	
4875	15.0			61
		23.3	116	
4880	31.5			177
		39.5	197	
4885	47.4			374
		56.4	282	
4890	65.4			656
		77.3	386	
4895	89.1			1042
		104.3	521	
4900	119.4			1563
		134.1	670	
4905	148.8			2233
		165.2	826	
4910	181.5			3059
		200.8	1004	
4915	220.0			4063
		240.9	1205	
4920	261.8			5268
		283.8	1419	
4925	315.8			6687
		337.6	1688	
4930	369.3			8375
		405.3	2027	
4935	441.3			10402
		475.6	2378	
4940	509.8			12780
		551.8	2759	
4945	593.7			15539
		639.2	3196	
4950	684.6			18735
		732.0	3660	
4955	779.3			22395
		801.5	1795	
4957.24	823.7			24190
		851.1	2349	
4960	878.4			26539

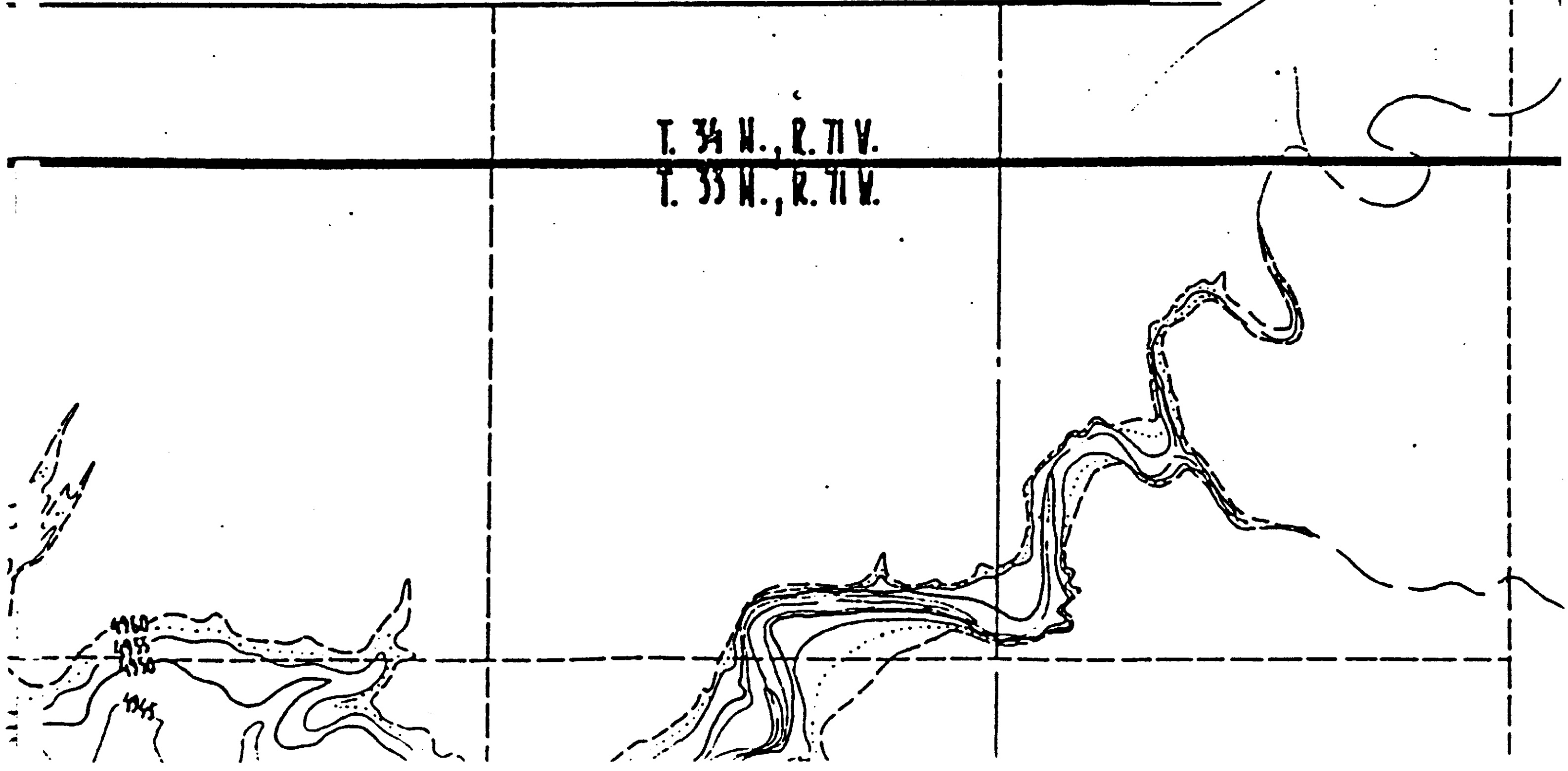
ASSUMED DEADPOOL

INDUSTRIAL
26,539.0 AC/FT

ORIGINAL
24,190 A

1ST ENLARGE
2,349 A

RESERVOIR CAPACITY TABLE



WYCOALGAS WATER SUPPLY OPERATION STUDY

1. Reservoir Inflow
Inflow to LaPrele Reservoir was based on USGS gage #06-6490 records. A multiplication factor of 1.054 was used to account for ungaged contributing drainage.[1]

2. Senior Rights Demand
Senior appropriators' rights along LaPrele Creek downstream of LaPrele Reservoir. The demand was based on 1 cfs per 70 acres during the irrigation season (May through September). 1276 acres = 36.16 $\frac{\text{Ac-Ft}}{\text{Day}}$.

2.1 Association Return Flows
Return flows to LaPrele Creek resulting from irrigation deliveries to LaPrele Association lands. The USBR report[1] on the LaPrele Unit showed return flow studies that indicate 8% of the annual diversions of the Association return to LaPrele Creek and are usable by senior downstream irrigators. The USBR studies also showed total return flows of 48% of annual diversions. For calculation purposes, October through May return flows were based on the previous water year's total diversions times a monthly distribution factor. June through September return flows were based on year-to-date total diversions times a monthly distribution factor (see Appendix A).

3. Senior Rights Bypass
This reflects water bypassed to meet senior downstream direct flow rights. The amount bypassed was the lesser of the reservoir inflow or the senior rights demand; this figure was then reduced by any return flows available for diversion.

4. Association Total Demand
The total demand was based on the optimum water necessary for irrigation requirements. Average monthly values were used based on the 1969 USBR report. The report calculated consumptive use requirements and then applied canal efficiencies of 65%, and farm efficiencies of 65%. The lands irrigated included the Association Lands (10,304.5 acres) as well as the carrier rights (1,149.5 acres) served by Association canals but not part of the Association. The total demand was then reduced by 5% for the demand being met by return flows within the unit itself (see Appendix A).[1]

5. Direct Flow Bypass
The Association Lands and the carrier rights have a direct flow rights amounting to 1 cfs per 70 acres, or a total of 324.55 $\frac{\text{Ac-Ft}}{\text{Day}}$. The amount bypassed was any remaining flows available after meeting senior rights, limited to the lesser of the total demand or the direct flow rights.

6. Storage Releases
LaPrele storage releases were from the Association's account to meet any irrigation demand not met by direct flow.

7. Deficit
Amount of Association's irrigation demand (including carrier rights) that could not be met by direct flow rights or storage releases.

8. Seepage

In accordance with the LaPrele agreement, reservoir seepage must be charged against WyCoalGas's storage account and delivered as part of WyCoalGas supply. The seepage was based on an initial estimate of the average monthly capacity of LaPrele Reservoir. A curve of seepage vs. capacity was used which was based on seepage information gathered since the LaPrele Dam rehabilitation (see Appendix A).

9. Storage Release

These were releases made from the WyCoalGas storage account above the seepage release. Storage releases were made to meet any WyCoalGas plant demands not met by seepage or by the WyCoalGas 1974 priority N. Platte right. If storage releases were required, the storage releases were increased to compensate for conveyance losses. In accordance with the LaPrele Agreement, total releases for the period of October-April cannot exceed 2,500 Ac-Ft. Due to this, total year-to-date releases plus the present month's storage release were not allowed to exceed 2,000 Ac-Ft to compensate for the uncontrolled seepage releases in future months that could cause the 2,500 Ac-Ft limit to be exceeded. Similarly, for the period of May through August, year-to-date releases were held to 4,500 Ac-Ft so as not to exceed the yearly 5,000 Ac-Ft limit. Any storage remaining in the WyCoalGas account in September was released in its entirety.

10. Add to Storage

The amount of water placed in storage was the inflow available after the direct flow rights were satisfied but restricted to the one-fill limitation. The storage was separated into two accounts: A) Association; B) WyCoalGas. During the nonirrigation season (Oct-April), all flows were placed in the WyCoalGas account up to 2,500 Ac-Ft. Above the amount, 25% of available flows up to a total maximum of 5,000 Ac-Ft in any year was placed in the WyCoalGas account. All remaining flows were placed in the Association account. Twenty-five percent of any available flows during the irrigation season were placed in the WyCoalGas account limited to the yearly total of 5,000 Ac-Ft with the remaining flows going to the Association account.

11. Total Storage Release

The total storage release includes storage releases for irrigation, storage releases for WyCoalGas, and seepage releases.

12. Spills

Spill will usually occur due to the one-fill limit being reached but can also occur due to the physical capacity of LaPrele Reservoir being exceeded.

13. Evaporation

The evaporation for the month was calculated by averaging the beginning and end-of-month storage in order to determine the average monthly storage. From this, the average surface area was determined and the appropriate evaporation rate applied to that surface area (refer to Appendix A). The losses were distributed between the accounts by a ratio of that account's storage to the total storage.

14. Change in Storage
The monthly storage change was calculated by subtracting storage releases and evaporation losses for each account from the amount added to storage for that account.

15. EOM Storage
The End-of-Month storage was the sum of the previous month's EOM storage plus the present month's change in storage. Each of the accounts was handled in a similar manner. The water surface elevation and the water surface area were based on the total LaPrele Reservoir EOM storage.

15.1 LaPrele Creek at Mouth
The projected flows of LaPrele Creek at its mouth reflect only the flows resulting from LaPrele Dam releases and irrigation return flows. The flows do not include any contributing drainage area below LaPrele Dam. During the nonirrigation season, this included total WyCoalGas releases, spills, and return flows to LaPrele Creek from the Association lands. During the irrigation season, it was assumed that all return flows to LaPrele Creek from the Association lands are utilized by senior downstream irrigators. Thus, the flows during the irrigation season consisted of total WyCoalGas releases, any spills, and return flows from the senior downstream irrigators (assumed to be 48%).

16. WyCoalGas LaPrele Supply
This is the total available to WyCoalGas from the LaPrele Reservoir below LaPrele Dam. This includes seepage plus storage releases from the WyCoalGas account.

17. Conveyance Loss
This is the conveyance loss between LaPrele Dam and WyCoalGas's point of diversion on the North Platte River, assumed to be 10% of the amount available below the LaPrele Dam.

18. Net LePrele Supply Available
The LePrele supply available at WyCoalGas's point of diversion on the North Platte River. This supply was handled either by A) Direct Diversion to Plant; B) Placement in storage in Panhandle Reservoir #1; or C) Bypass. The LePrele supply was first made available to meet the coal gasification plant demand with any excess going to storage. If the storage capacity of Panhandle Reservoir #1 had been reached, any excess was bypassed at the point of diversion.

19. O-T-R Water
The Owed-To-River water quantities were obtained from the "North Platte River Operational Study" performed by WRRI. These are the excess flows in the North Platte System above all ownership and irrigation requirements.

20. Water Available to Panhandle
WyCoalGas has a right to the North Platte O-T-R water of up to 201.2 cfs under a 1974 priority. To assure that no prior rights on the North Platte are harmed, it was assumed that no North Platte water was available to WyCoalGas unless the O-T-R water exceeded 6,000 Ac-Ft in any month. This supply was handled either by: A) Direct diversion to the plant; B) Placement in storage in Panhandle Reservoir #1; C) Bypass. The North Platte supply was first used to meet any plant demand not previously met with any excess going to storage. Water was bypassed if the one-fill limitation

20. Water Available to Panhandle Cont.
had been reached on the N. Platte supply in regard to Panhandle Reservoir #1, if the physical capacity of the Reservoir had been reached, or if limitations due to pipeline capacity existed. Column 20D tabulates the N. Platte supply utilized in any month.

21. Add to Storage
This consists of the total water added to storage in Panhandle Reservoir #1 from the LaPrele supply and the North Platte supply. Separate accounts of each supply source are maintained in the reservoir operations.

22. Storage Releases
Storage releases were made from Panhandle Reservoir #1 to meet any plant demands not previously satisfied by the direct LaPrele supply to the plant and/or the direct N. Platte supply to the plant. It was assumed that a dead pool of 177 Ac-Ft would exist. If storage releases were required, releases were first made from the LaPrele account with the remainder being made from the North Platte account.

23. Evaporation
The evaporation for the month was calculated by averaging the beginning and end-of-month storage in order to determine the average monthly storage. From this, the average surface area was determined and the appropriate evaporation rate applied to that surface area (see Appendix A). The losses were distributed between the accounts by a ratio of that account's storage to the total storage.

24. Change in Storage
The monthly storage change was calcuated by subtracting storage releases and evaporation losses for each account from the respective add to storage account.

25. EOM Storage
The end-of-month storage was the sum of the previous month's EOM storage plus the present month's change in storage. Each of the accounts was handled in a similar manner. The water surface elevation and the water surface area were based on the total Panhandle Reservoir #1 EOM storage.

26. Groundwater Supplied to Plant
The groundwater supply was assumed to be a backup supply only. Groundwater was supplied to the plant only when the plant demand could not be met by one or a combination of direct LaPrele supply, direct N. Platte supply, and/or storage releases from Panhandle Reservoir #1. The groundwater was supplied from the Green Valley Well Field and the Morton's Well Field with each well field limited to a maximum of 2,000 Ac-Ft in any year. It was also assumed that the full 2,000 Ac-Ft from the Green Valley Well Field would be used before the Morton's Well Field would be utilized.

27. Plant Demand
The coal gasification plant demand schedule was provided by WyCoalGas, Inc. (see Appendix A).

28. Total Plant Deliveries
The total plant deliveries consisted of the direct LaPrele supply, direct N. Platte supply, total Panhandle Reservoir #1 storage releases, and total groundwater supplied.

29. Plant Deficits
The plant deficit was the difference between the plant demand and the total plant deliveries.

30. LaPrele Association (Water Consumption)
This row represents the water used by the LaPrele Association in any month in comparison with flows that would have resulted had the LaPrele Unit not been there. This amounts to the water placed in the Association storage account plus the Association direct diversion less total return flows to the N. Platte System. Total return flows amount to 48% of total annual diversions of which 8% return to LaPrele Creek (refer to Row 2.1). Therefore, total return flows are six times row 2.1 for that month.

31. WyCoalGas (Water Consumption)
This row represents the total depletion by WyCoalGas on the North Platte System both from LaPrele Creek and directly from the N. Platte River. This amounts to the water placed in the WyCoalGas storage account in LaPrele less the total releases from the LaPrele WyCoalGas account plus the total water picked up at the WyCoalGas point of diversion on the N. Platte River.

[1] "Concluding Report on LaPrele Unit, Wyoming", 1969, USBR, Region 7.

CALCULATION PROCEDURES

NOTES: ALL VALUES TO BE IN KAC-FT; IF ABSOLUTE VALVE <0.005, SET #0.00
ANY "Σ" REFERS TO VALVES IN PRESENT WATER YEAR ONLY

ABBREVIATIONS: Pr. = Previous Mo. = Month's Mos. = Months'
EOY = End-of-Year Max. = Maximum Min. = Minimum

① = 1.054 x Input (Gage 06-6490)
② = Input x (#Days in Month) ÷ 1,000
④ = Input
⑲ = Input
⑳ = ⑲ - 6.00; Min. of 0.00; Max. of {0.399 x (# Days in Month)}
㉘ = Input x (# Days in Month) ÷ 1,000
②.1 Oct. - May
Pr. Year Total (⑤ + ⑥) x Monthly Factor
June - Sept.
Σ(Pr. Mos. (⑤ + ⑥) x Monthly Factor
③ Lesser of: A) ② - ②.1 ; Min. of Zero
B) ① - ②.1 ; Min. of Zero
⑤ Lesser of: A) ④ B) ① - ③ C) 0.3246 x (# Days in Month)
⑩ Lesser of: A) (19.54 - Pr. EOY ⑮) - Σ(Pr. Mos. ⑩)
B) ① - ③ - ⑤
⑩B Oct. - Apr. Lesser of:
A) ⑩
B) {2.50 - Σ(Pr. Mos. ⑩B)} [MIN. OF ZERO] + {⑩ - (2.50 - Σ(Pr. Mos. ⑩B)) [MIN. OF ZERO]} [MIN. OF ZERO] x .25
C) 5.00 -Σ(Pr. Mos. ⑩B)
May - Sept. Lesser of:
A) 0.25 x ⑩
B) 5.00 -Σ(Pr. Mos. ⑩B)
⑩A = ⑩ - ⑩B
⑥ Lesser of: 1) Pr. Mo. ⑮A + ⑩A B) ④ - ⑤
⑦ = ④ - (⑤ + ⑥)
⑧ Base on Capacity of: {(Pr. Mo. ⑮)+(Pr. Mo. ⑮+⑩-⑥)}÷2}x(# Days in Month)÷1,000
⑳A Lesser of: A) ⑳ B) ㉘-(0.90x⑧); Min. of 0.00
⑳B Lesser of: A) ⑳-⑳A
B) (0.399 x # Days in Month) - (0.90 x ⑧) - ⑳A
C) 26.54- Pr. EOY ㉖B-Σ(Pr. Mos. ⑳B)
D) 26.54 - {Pr. Mo. ㉖ + (⑧x0.90) - ㉘; Min of 0.00)} ; Min. of 0.00
⑳C = ⑳ -(⑳A + ⑳B)
⑳D = ⑳A + ⑳B
⑨ Oct. - Aug.
Check: is ⑳ > 0
<u>Yes</u> - Lesser of: A) {㉘ - (0.90x⑧)-⑳A}÷0.90; Min. of 0.00
B) Pr. Mo. ⑮B + ⑩B - ⑧ - 0.015
<u>No</u> - Lesser of: A) {㉘ - (0.90 x ⑧)}÷0.90; Min of 0.00
Oct.-Apr.B) 2.00 - {Σ(Pr. Mos. ⑥) + ⑧}; Min. of 0.00
May- Aug.B) 4.50 - {Σ(Pr. Mos. ⑥) + ⑧}; Min. of 0.00
C) Pr. Mo. ⑮B + ⑩B - ⑧ - 0.015; Min. of 0.00
Sept. = Pr. Mo. ⑮B + ⑩B - ⑧ - 0.015; Min. of 0.00

(11) = (8) + (9) + (6)
(12) = (1) - ((3) + (5) + (10))
(13) Lesser of: A) Pr. Mo. (15) + (10) - (11)

B) (Evap. Rate) X (Surface Area @ Capacity of $\frac{\text{Pr. Mo. (15)} + (\text{Pr. Mo. (15)} + (10) - (11))}{2}$)

(13A) Check: is (Pr. Mo. (15) + (10) + (11)) >0.001

Yes: (13A) = (13) x $\frac{\text{Pr. Mo. (15A)} + (10A) - (6)}{\text{Pr. Mo. (15)} + (10) - (11)}$ No: (13A) = 0

(13B) = (13) - (13A)
(14) = (10) - (11) - (13)
(14B) = (10B) - ((8) + (9)) - (13B); Min of -(Pr. Mo. (15B))
(14A) = (14) - (14B)
NEW (6) = (10A) - (13A) - (14A)
(15) = Pr. Mo. (15) + (14); Min of 0.00
15B = Pr. Mo. (15B) + (14B)
(15A) = (15) - (15B)
(15C) Elevation (In Feet) at Storage Capacity of (15)
(15D) Surface Area (In Acres) at Storage Capacity of (15)
(15.1) Oct. - Apr. = (2.1) + (8) + (9) + (12) May - Sept. = .48 ((2.1) + (3)) + (8) + (9) + (12)
(16) = (8) + (9)
(17) = (16) x 0.10
(18) = (16) x 0.90
(18A) Lesser of: A) (18) B) (28)
(18B) = (18) - (18A)
(18C) = (Pr. Mo. (26) + (18B)) -26.54; Min. 0.00
(21A) = (18B) - (18C)
(21B) = (20B)
(21) = (21A) + (21B)
(22) Lesser of: A) (28) - (18A) - (20A)
B) Pr. Mo. (26) - 0.18; Min. of Zero
(22A) Lesser of: A) (22) B) Pr. Mo. (26A)
(22B) = (22) - (22A)
(23) Lesser of: A) (Pr. Mo. (26) + (21) - (22))

B) (Evap. Rate) x (Surface Area @ Capacity of $\frac{\text{Pr. Mo. (26)} + (\text{Pr. Mo. (26)} + (21) - (22))}{2}$)

(23A) Check: Is (Pr. Mo. (26) + (21) - (22)) >0.001

Yes: (23A) = (23) x $\frac{\text{Pr. Mo. (26A)} + (21A) - (22A)}{\text{Pr. Mo. (26)} + (21) - (22)}$ No: (23A) = 0

(23B) = (23) - (23A)
(25) = (21) - (22) - (23) - (24)
(25A) = (21A) - (22A) - (23A) - (24A)
(25B) = 21B - (22B) - (23B) - (24B)
(26) = Pr. Mo. (26) + (25); Min. of 0.00
(26A) = Pr. Mo. (26A) + (25A); Min of 0.00
(26B) = Pr. Mo. (26B) + (25B); Min of 0.00
(26C) Elevation (in feet) at Storage Capacity of (26)
(26D) Surface Area (Acres) at Storage Capacity of (26)
(27) Lesser of: A) ((28)-(20A)-(18A)-(22))
B) 4.00-Σ(Pr. Mos. (27))
(27A) Lesser of: A) (27)
B) 2.00-Σ(Pr. Mos. (27A))
(27B) = (27) - (27A)
(29) = (20A) + (18A) + (22) + (27)

(30) = (28) - (29)
(31) = (10A) - (6.0x (2.1)) + (5)
(32) = (10B) - (16) + ((18) - (18C)) + (20D)

TER YEAR

PRELE RESERVOIR

1 RESERVOIR INFLOW
2 SENIOR RIGHTS DEMAND
2.1 ASSOC. RETURN FLOWS
3 SENIOR RIGHTS BYPASS

ASSOCIATION DEMAND (INCLUDING CARRIER RIGHTS)

4 TOTAL DEMAND
5 DIRECT FLOW BYPASS
6 STORAGE RELEASES
7 DEFICIT

WYCOALGAS SUPPLY

8 SEEPAGE (STORAGE ACCT.)
9 STORAGE RELEASE

RESERVOIR CONDITIONS

10 ADD TO STORAGE
A ASSOCIATION
B WYCOALGAS

11 TOTAL STORAGE RELEASE
12 SPILLS
13 EVAPORATION
A ASSOCIATION
B WYCOALGAS

14 CHANGE IN STORAGE
A ASSOCIATION
B WYCOALGAS

15 EOM STORAGE
A ASSOCIATION
B WYCOALGAS
C ELEVATION (FT)
D SURFACE AREA (ACRES)
15.1 LAPRELE CREEK AT MOUTH

NHANDLE RESERVOIR #1

APRELE SUPPLY

16 WYCOALGAS'S LAPRELE SUPPLY
17 CONVEYANCE LOSS
18 NET LAPRELE SUPPLY AVAILABLE
A DIRECT DIVERSION TO PLANT
B AVAILABLE FOR STORAGE
C BYPASS

E 1 STUDY LP. WATER YEAR

TER YEAR

1974 N. PLATTE RIVER SUPPLY
19 O-T-R WATER
20 WATER AVAILABLE TO PANHANDLE
A DIRECT DIVERSION TO PLANT
B TO RESERVOIR STORAGE
C BYPASS
D TOTAL WATER USED

'ESERVOIR CONDITIONS
21 ADD TO STORAGE
A LAPRELE
B N. PLATTE

22 STORAGE RELEASES
A LAPRELE
B N. PLATTE

23 EVAPORATION
A LAPRELE
B N. PLATTE

25 CHANGE IN STORAGE
A LAPRELE
B N. PLATTE

26 EOM STORAGE
A LAPRELE
B N. PLATTE
C ELEVATION (FT)
D SURFACE AREA (ACRES)

NDWATER SUPPLY
27 GROUNDWATER SUPPLIED TO PLANT
A GREEN VALLEY
B MORTON

AL GASIFICATION PLANT
28 PLANT DEMAND
29 TOTAL PLANT DELIVERIES
30 PLANT DEFICITS

L WATER CONSUMPTION IN SYSTEM
31 LAPRELE ASSOCIATION
32 WYCOALGAS

2 STUDY LP WATER YEAR

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LARAMIE, WYOMING 82070
(307) 745-7366

SHEET NO. ______ OF ______

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APPENDIX A

NEBS Inc., Groton, Mass. 01450

620 Plaza Court
LARAMIE, WYOMING 82070
(307) 745-7366

CALCULATED BY SRZ DATE
CHECKED BY DATE
SCALE

OPERATION STUDIES DATA

② SENIOR RIGHTS DEMAND
(1969 BUREC REPORT)

12.76 ACRES × 1 CFS / 70 ACRES × 1.98347 AC-FT/DAY / 1 CFS = 36.16 ACRE-FEET / DAY

MAY	JUNE	JULY	AUGUST	SEPTEMBER
1.121 KAC-FT	1.085	1.121	1.121	1.085

④ TOTAL ASSOCIATION DEMAND (INCLUDES CARRIER RIGHTS) 11,454 ACRES
(1969 BUREC REPORT – AVG. VALUES)

1,149.5 ACRES CARRIER RIGHTS
10,304.5 ACRES ASSOCIATION
} 5% OF DEMAND MET BY "INTERNAL" RETURN FLOWS

MAY	JUNE	JULY	AUGUST	SEPTEMBER
2.829 KAC-FT	5.549	9.793	8.814	7.182

⑧ LAPRELE SEEPAGE (1980; TIPTON & KALMBACH, INC.)
(LINEAR REGRESSION FROM COLLECTED DATA)

CAPACITY (AC-FT)	SEEPAGE (AC-FT/DAY)
0	0
250	0
416	1.67
961	3.47
1,600	4.76
4,000	7.48
8,000	11.62
12,000	15.79
16,000	19.93
20,000	24.08

620 Plaza Court
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(2.1) LAPRELE CREEK RETURN FLOWS 8% OF IRRIGATION FLOWS (1969 BUREC REPORT)

	LAPRELE CREEK × MONTHLY DISTRIBUTION	MONTHLY FACTOR
OCT	(.08 X .08)	.0064
NOV	(.08 X .06)	.0048
DEC	(" X .05)	.0040
JAN	(" X .04)	.0032
FEB	(" X .04)	.0032
MAR	(" X .03)	.0024
APR	(" X .04)	.0032
MAY	(" X .07)	.0056

FOR JUN-SEP, IRR. PROJECTIONS FOR YEAR TOTAL BASED ON (AVG. Σ IRR.) % of (AVG. YEAR TOTAL); (LP.002 2/23/81)

	MONTHLY DIST'N × LAPRELE CREEK × PROJECTION FACTOR	
JUNE	(.10 X .08 X 5.625)	.0450
JULY	(.16 X .08 X 2.016)	.0258
AUG	(.18 X .08 X 1.125)	.0162
SEP	(.15 X .08 X 1.008)	.0121

LAPRELE CREEK RETURN FLOWS
8% OF THE TOTAL RETURN FLOWS OF 48%
∴ TOTAL RETURN FLOWS = 6.0 X LAPRELE RETURNS

PRODUCT 204-1 NEBS Inc., Groton, Mass. 01450

P. O. Box 550 620 Plaza Court
LARAMIE, WYOMING 82070
(307) 745-7366

CALCULATED BY SRZ DATE
CHECKED BY DATE
SCALE

(13) & (23) EVAPORATION RATES

OCT	0.17 FT/ACRE	APR	0.24 FT/ACRE
NOV	0.10	MAY	0.32
DEC	0.09	JUN	0.36
JAN	0.09	JUL	0.44
FEB	0.08	AUG	0.40
MAR	0.14	SEP	0.26

(13) LAPRELE RESERVOIR (1980 REPORT; TIPTON & KALMBACH, INC.)

ELEV.	AREA (ACRES)	CAPACITY (AC-FT)	
5372	0	0	
5383	2.73	15	DEADPOOL
5400	11.98	140	
5410	17.82	289	
5420	42.18	589	
5430	71.62	1,158	
5440	126.98	2,151	
5450	209.02	3,831	
5460	285.98	6,306	
5470	383.82	9,655	
5480	483.38	13,991	
5490	626.82	19,542	

P. O. Box 550 620 Plaza Court
LARAMIE, WYOMING 82070
(307) 745-7366

SHEET NO. 1 OF 1
CALCULATED BY SRZ DATE
CHECKED BY DATE
SCALE

(26) PANHANDLE RESERVOIR #1

ELEV.	AREA (ACRES)	CAPACITY (AC-FT)	
4860	0	0	
4870	4.0	14	
4880	34.5	177	ASSUMED DEADPOOL
4890	65.4	656	
4900	119.4	1563	
4910	181.5	3059	
4920	261.8	5268	
4930	369.3	8,375	
4940	509.8	12,780	
4950	684.6	18,735	
4960	878.4	26,539	

(28) WY COAL GAS PLANT DEMAND

OCT. & SEPT.	13.65 AC-FT/DAY
NOV. – AUG.	17.06 AC-FT/DAY

ROUTING SLIP

Date: 2-27-81

	Initials	Action
Christopulos	GZC	
~~Schwieger~~		
~~Anderson~~		
~~Carr~~		
Buyok	JB	
~~Petty~~		
~~Stockdale~~		
Allen	LEA	
~~Balog~~		

Remarks: Tom & John - please discuss with GZC Tony

April 10,1981

Memorandum
To State Engineer And Division # 1 Supt.
From Carlton Hunter
Subject WyoCoalGas diversion possibilities

In my analysis I operated on the idea that they could not divert water until Guernsey and Alice & Minitare on channel ownerships were at 45228 AF. and Glendo ownership was filled to its maximum ownership storage capability.

When these conditions are met WyoCoalGas can divert water that is the Alcova Glendo segment of the North Platte River Natural Flow after an accumulated quantity of 6,000AF has been available to them. Based on the river miles, The WyoCoalGas Diversion point is located about 75% of the distance down the river from Alcova to Orin Jct, therefore they will only have available 75% of that segment gains.

The upper reservoirs may not be full, but will be filling and WyoCoalGas can be taking water. If the Alcova-Glendo segment is not producing enough water and the upper reservoirs are full they can take water.

WyoCoalGas diversion can continue until the time that a 6000 AF cushion remains of the divertable available water. I don't know how this will be defined.

Data was taken from the North Platte Storage Accounting Sheet and the Natural flow tabulation sheet after April 27.

1976	April 11 Glendo Ownership Full
	May 29 Pathfinder " "
	June 15 Kendrick " "
	June 29 Ownerships started charging storage
	April 17 thru June 28 72 days @400 AF/Day= 28,800 AF for WyoCoalGas
1977	April 28 Glendo Ownership full
	May 3 & 4 water available above 6000 AF cushion
1980	April 4 Glendo Ownership Full Guernsey Spilling 40AF/ day
	May 10 Pathfinder Ownership Full
	27 Evap and Storage refilled All Ownerships Full
	July 6 Ownerships started charging storage
	July 12 Owed to River Account depleted
	April 12 thru July 5 85 days @ 400 AF/day=34,000 AF for WyoCoalGas

RECEIVED
APR 13 1981
STATE ENGINEER
Cheyenne, Wyo.

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

State Engineer's Office

BARRETT BUILDING CHEYENNE, WYOMING 82002

May 15, 1981

Earl Michael
Supt. Division No. 1
511 West 27th Street
Torrington, WY 82240

Dear Earl:

Enclosed is a copy of the information I found in the Storage Ownership Accounting Sheets from 1964 to 1980 with regard to Panhandle Eastern's (Wy Coal Gas) proposed diversion from the North Platte. We have scheduled a meeting with Panhandle for 9:00 a.m. on Wednesday, May 20th to discuss their diversion. Could you look this over? I think it will answer some of the questions we've been asking.

Thanks

Sincerely,

John Buyok
Interstate Streams Engineer

JB/pw

CC: George C. Christopulos
State Engineer

Carlton Hunter
644 Pineview Place
Casper, WY 82601

Gary Mehling
511 West 27th
Torrington, WY 82240

ANALYSIS OF STORAGE OWNERSHIP AND ACCOUNTING (1964-1980)

Water Year 1964

None of the ownerships filled.
No OTR account.

Model shows no water diverted to Panhandle - low runoff year.

Water Year 1965

	May 1	154	passing Whalen		
	2	312	" "		
	3	360	" "		
	4	216	" "		
	5	564	" "		
	6	1256	" "		
	7	1304	" "		
	8	1304	" "		
	9	732	" "		
	10	604	" "		
	11	759	" "		
	12	1083	" "		
	13	1244	" "		
Guernsey filled	14	1028	" "		
	15	669	" "		
Glendo filled	16	11929	OTR gain	OTR from tribs between Alcova and Glendo (flood)	
	17	6996	OTR gain		
	18	6541	OTR gain		
	19	4257	OTR gain		
	20	1917	OTR gain		
	21	666	OTR gain	gain from Glendo to Guernsey	

June 9	102	OTR gain
10	2333	OTR gain
11	4399	OTR gain
12	3820	OTR gain
13	2595	OTR gain
14	3102	OTR gain
15	4908	OTR gain
16	3261	OTR gain
17	2019	OTR gain
18	2247	OTR gain

Total OTR gain - 61092 AF

Model shows 11,990 AF diverted to Panhanle in May.

Water was available for 16 days in May & June from tribs between Alcova and Glendo after Glendo ownership filled.

Maximum divertible by Panhandle 6138 AF

Water Year 1966

Jan. 4 - March 1 OTR gain 1375 AF

Glendo filled	March 2	623	OTR
	3	514	OTR
	5	308	OTR
	7	287	OTR
	8	835	OTR
	9	1612	OTR
	10	1619	OTR
	11	1810	OTR
	12	1509	OTR
	13	1022	OTR
	14	252	OTR
	15	868	OTR
	16	35	OTR
	17	114	OTR
	18	578	OTR

OTR transferred to Guernsey and Alice and Minatare to make up for gains lost when A & M water was in Guernsey ownership.

Water Year 1966 continued

March	19	570	OTR
	20	437	OTR
	21	262	OTR
	22	577	OTR
	23	83	OTR
	24	458	OTR
	26	931	OTR
	27	1077	OTR
	29	1284	OTR
	30	542	OTR
	31	661	OTR
April	1	824	OTR
	2	1317	OTR
	3	1682	OTR

Total OTR gain - 24066

OTR transferred to Guernsey and Alice and Minatare to make up for gains lost when A & M water was in Guernsey ownership.

Model shows no water diverted to Panhandle.

Below normal runoff year, no water available to Panhandle.

Water Year 1967

Feb. 15 to March 14 359 AF OTR gain
May 6 to May 17 6712 OTR gain
Glendo filled May 10
May 31 to June 29 56739 OTR gain

Model shows no water diverted to Panhandle. Probably because Reservoir was full from their model run.

OTR water from May 10 to May 17 available for diversion to Panhandle after Glendo filled gains from Alcova to Glendo.

OTR water from May 31 to June 29 transferred to Kendrick ownership on July 3.

Average runoff year.

Water Year 1968

Feb. 21 - March 23 10922 OTR gain
Glendo filled Feb. 28, 1968
April 4 - April 9 5142 OTR gain also releasing down river on these dates
Guernsey filled May 2, 1968
May 2 - May 8 6455 OTR gain
May 24 - June 12 26728 OTR gain also releasing down river on these dates

Model shows 11,890 AF diverted to Panhandle in May.

Water was available for 33 days after Glendo filled. Maximum divertible to Panhandle - 13,280 AF.

Above average runoff year.

Water Year 1969

Dec. 6, 1968 to March 23, 1969 26,848 AF OTR gain
Glendo filled Feb. 9, 1969
Guernsey never does fill.

Model shows no water diverted to Panhandle.

OTR water comes slowly and is all released down the river even though Guernsey never fills.

Panhandle could divert most of the 26,848 AF.

Above average carryover causes large OTR account even though it is a below normal runoff year.

Water Year 1970

Jan. 29 to April 8 10257 OTR gain transferred to Pathfinder
Glendo filled March 29
May 11 to May 25 41076 OTR gain transferred to Pathfinder
Guernsey filled April 28

Model shows 11,920 AF diverted in May and 4240 AF diverted in June to Panhandle.

Above average runoff year.

All OTR transferred to Pathfinder ownership in Glendo by agreement with Nebraska.

Water Year 1971

Jan. 29 to April 4 26,991 AF OTR gain
Glendo filled March 9
April 4 to May 6 gains from Alcova to Glendo
Passed at Tri-State (substantial 1000 to 5000 AF) above demand at Glendo and Guernsey
Guernsey filled April 29
Glendo refilled May 6
May 6 to May 12 70,574 AF OTR gain 4000 to 6500 AF passing Tri-State
Pathfinder filled May 12
May 13 to July 14 1000 to 9000 AF passing Tri-State
Kendrick filled June 2
All ownerships refilled June 17

Way above average runoff year.

Panhandle could divert approximately 67,600 AF

Model shows 3520 AF diverted to Panhandle in April.

Water Year 1972

Jan 25 to Feb. 13 1081 AF OTR gain
Glendo filled Feb. 22
Feb. 22 to April 4 97,926AF spilled in anticipation
Guernsey filled April 27
Pathfinder filled May 6

Water Year 1972 continued

Kendrick filled May 18
May 24 to July 9 — 500 to 2000 AF passing Tri-State
Glendo refilled June 4
Pathfinder and Kendrick evap. refilled June 5
Glendo evap. refilled June 6
Guernsey refilled June 7
June 7 to June 20 — 98,568 OTR gain

Model shows 3890 AF diverted in April and 70 AF diverted in May to Panhandle.

Panhandle could divert approximately 35,800 AF.

Above average runoff year with large carryover from 1971.

Water Year 1973

Jan. 24 to March 7	2270 AF	OTR gain
Glendo filled March 7		
March 7 to March 24	9582	OTR gain
March 21 to April 8	600 to 2000 AF spilled past Guernsey	
April 9 to April 28	47,676 AF spilled past Tri-State	
Guernsey filled May 1		
April 30 to June 27	4000 to 8000 spilled daily past Tri-State	
Pathfinder filled May 6		
Glendo refilled May 8		
May 8 to May 30	521,801 AF	OTR gain
Kendrick filled May 10		
All evap. refilled May 11		
June 28 to Sept. 30	500 to 4000 AF spilled past Tri-State	

Model shows 3720 AF diverted in April and 40 AF diverted in May to Panhandle.

Panhandle could divert approximately 71,630 AF.

Way above average runoff year, system wide spill.

Water Year 1974

Jan. 18 to Feb. 20	2663 AF	OTR gain
Feb. 26 to April 22	200,000 AF Pathfinder, 200,000 AF Kendrick spilled past Whalen	
Pathfinder filled March 15		
April 22 to May 14	53,316 AF	released from Glendo past Tri-State
Pathfinder refilled April 24		
Guernsey filled May 1		
Kendrick refilled May 14		
Glendo refilled June 2		
Pathfinder refilled June 4		
All ownerships refilled June 7		
June 7 to June 24	81,050	OTR gain
June 7 to July 5	500 to 2000 AF passing Tri-State	

Model shows 4110 AF in Dec., 470 AF in Jan., 400 AF in Feb., 250 AF in April, 70 AF in May, and 90 AF in June diverted to Panhandle.

Panhandle could divert approximately 47,080 AF.

Above average runoff year, early spill.

Water Year 1975

Feb. 25 to March 27	1101 AF	OTR gain
Glendo filled April 2		
April 2 to April 16	9430 AF	OTR gain
April 17 to April 26	500 to 2500 AF passing Whalen	
Pathfinder filled June 9		
Guernsey filled June 10		
Kendrick filled June 21		
June 21 to July 16	300 to 2000 AF passing Tri-State	
June 22 to June 29	23,796	OTR gain
Glendo refilled June 22		

Model shows 2880 AF diverted in June to Panhandle.

Panhandle could divert approximately 20,100 AF.

Above average runoff year.

Water Year 1976

Guernsey filled March 5		
March 6 to March 28	719 AF	OTR gain
April 6 to April 15	1889	OTR gain
Glendo filled April 11		
April 15 to May 3	300 to 700 AF passing Tri-State	
April 27 to April 30	2930	OTR gain
May 26 to May 28	1502	OTR gain

Model shows 2130 AF in Feb., 2770 AF in April, 220 AF in May, 170 AF in June, diverted to Panhandle.

Panhandle could divert approximately 4000 AF.

Average runoff year, large carry-over and high irrigation demands.

Water Year 1977

March 20 to April 1	431	OTR gain
April 8 to April 10	1694	OTR gain
April 14 to April 15	384	OTR gain
Glendo filled April 28		
April 28 to May 5	16,295	OTR gain
Gurensey filled May 3		
May 8 to May 11	300 to 800 AF passing Tri-State	

Model shows 3410 AF diverted to Panhandle in April.

Panhandle could divert 4400 AF.

Very low runoff year.

Water Year 1978

Feb. 10 to April 2	805	OTR gain
Guernsey filled May 14		
May 14 to May 23	45,062	OTR gain

Water Year 1978 continued
Glendo filled May 17

Model shows 3690 AF diverted to Panhandle in May.

Panhandle had water available for 10 days in May. Could have diverted 4024 AF.

Slightly above average runoff year.

Water Year 1979
Feb. 28 to April 1 847 OTR gain
April 10 to April 16 427 OTR gain
Pathfinder and Guernsey filled May 30

Model shows 4050 AF diverted to Panhandle in May.

No water was available.

Slightly above average runoff year.

Water Year 1980
Feb. 15 to April 6 4548 OTR gain
Glendo filled April 5
April 14 to May 1 4500 AF/day passing Tri-State
Guernsey filled May 1
May 1 to May 10 3000 AF/day passing Tri-State
Pathfinder filled May 10
May 10 to June 23 1000 to 2500 AF passing Tri-State
Glendo refilled June 9
June 9 to June 23 65,457 AF OTR gain

Model doesn't go to 1980.

Panhandle could divert for 72 days in April, May and June for a total of 28,973 AF.

Above average runoff year.

Panhandle Eastern (WyCoalGas) Meeting

9:00 a.m. 5-20-81 SEO Conference Room

Those in attendance were:

Earl Michael, Board of Control
Carlton Hunter, Board of Control
Gary Mehling, Board of Control
George L. Christopulos, SEO
Lou Allen, SEO
Dick Stockdale, SEO
John Buyok, SEO
Sig Zvejnieks, Banner
Don Vowell, Panhandle
Jack Palma, Panhandle

The meeting began with a discussion of the comparison of surplus flow numbers from the WRRI model to the actual amount of surplus flow taken from the North Platte Storage Ownership Accounting daily reports. The comparisons put together by John Buyok and Carlton Hunter differed because Hunter assumed that WyCoalGas would be able to divert whenever there was water in the OTR account and that they could divert as long as no storage water was being delivered to downstream users. Buyok only allowed diversions when the OTR account was gaining water or when water was being dumped past Tri-State Dam.

There was a question as to how WyCoalGas could be allowed to divert in the non-irrigation season as defined by the decree when late 1800's priority irrigation rights downstream could not divert. It was decided that the early priority rights would have to be allowed to divert if they wished. Another question was raised about the fact that the WRRI model and the comparison figures from the SOA reports take into account the whole river and not just the surplus water available at the WyCoalGas diversion. Sig Zvejnicks was asked to compile the stream records at the PP&L gaging station near Glenrock on the North Platte and compare them to Gray Reef outflow to try to determine the percentage of surplus water that is developed above the diversion point.

Another problem that was discussed is the fact that the years that SOA reports are available were, for the most part, above average runoff years and so would give an unrealistic picture of surplus water available from the North Platte. The cushion or contingency factor was also discussed. An adjustment is needed to take into account inflows and diversions between the plant and the state line to make the model come closer to the mark.

The possibility of objections from Nebraska was noted, especially in years when the lower system is spilling but the upper system is short of water. Stockdale brought up the preliminary results from the groundwater model which shows that pumping from the Madison wells may deplete surface water flow in the tributaries to the river, especially in Boxelder Creek. He asked if any other backup water has been obtained except for groundwater and Vowell said that the groundwater is the only backup.

Panhandle asked the SEO to begin looking at the LaPrele Creek supply and the groundwater supply. LaPrele information is to go to Lou Allen and Earl Michael for review and geohydrology information is to go to Dick Stockdale.

Earl Michael mentioned that he had heard that Panhandle and the LaPrele Irrigation District were having a disagreement as to how the direct flow rights below the reservoir are to be handled. The District favors bypassing the reservoir to fill direct flow rights with the same priority which would also bypass Panhandle's storage right.

JOHN BUYOK JB
Interstate Streams Engineer

, 1981

Memorandum
To: State Engineer and Division 1 Supt.
From: Carlton L. Hunter CLH
Subject: Number of days each year that surplus water was available in the Alcova-Glendo segment of the North Platte River.

This memo supersedes all previous memos on this subject, because of changing criteria.

Year	Days	
1960	0	Glendo not full
1961	0	"
1962	0	"
1963	0	"
1964	0	"
1965	32	Glendo full May 16, May 17 thru June 18, June 18 last day otr gain.
1966	61	Glendo full March 1, March 1 thru April 30, outside of irrig season.
1967	36	Glendo full May 11, otr gain May 11 thru May 17 & May 31 thru June 29.
1968	101	Glendo full Feb 28, dumping otr water till April 14, April 14 to April 30, Alice & Minitare taking gains, May 1 starting to store Otr, June 9 otr stopped gaining.
1969	142	Glendo Full Feb 9, Dumping water in March, April, May and June. June 30 started charging storage from Pathfinder.
1970	103	Glendo full March 28, May 25 all otr transfered to Pathfinder, Kendrick filling to July 9, the first day on storage.
1971	114	Glendo Full March 9, July 1 last otr gaining.
1972	118	Glendo Full Feb 22, June 20 last day otr gain.
1973	207	Glendo Full March 7, June 17 last day otr gaining, Sept 5 thru 30 Passing water at Tri State Dam. June 17 thru Sept 5 Guernsey outflow was 4to 5 thousand Acre Feet above normal.
1974	117	Feb 26 Storage being dumped early, June 2 Glendo full, June 4 Pathfinder full and June 6 Kendrick full. June23 day otr gaining.
1975	90	Glendo full April 2, June 30 last day otr gaining.
1976	10	Glendo full April 11, April 21 Passing Whalen stopped.
1977	6	Glendo Full April 28, May 4 last day Alcova-Guernsey gains met Guernsey outflow.
1978	6	Glendo Full May 17, May 23 last day otr gaining.
1979	0	
1980	78	Glendo Full April 4, June 20 last day otr gaining.

UNITED STATES
DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION
NORTH PLATTE RIVER PROJECTS OFFICE
CASPER, WYOMING

NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATIONS STUDIES

December, 1981

CONTENTS

The following material is a very brief summary of (1) Glendo Irrigation Unit and historical diversions of the present Glendo contractors and (2) Three computer generated operation studies pertaining to the Glendo Irrigation Unit.

The operation studies were made via the use of a computer modeling program (North Platte River Management Model) developed by the Wyoming Water Resources Research Institute. The program was developed as a "planning tool" and can be used to simulate the North Platte River operation under many options, and their impacts can be evaluated and assessed by comparing the results to a base run or base condition. This summary contains a synopsis of results for the Glendo Unit of the following three operation studies (simulations).

(1) Base Run - is a simulation of the present reservoir system and management decisions used in operation of the North Platte River system. The study period and hydrological data used are from 1941 to 1980. It is assumed that the present system and operations were "on-line" in 1941, the start of the study. The Glendo Irrigation Unit in this simulation would consist of various contracts totaling 20,000 acre-feet, with a minimum demand of 4,000 acre-feet in any one year. The demand pattern for this unit should closely correlate with the demand pattern of the present Glendo contractors.

(2) Increased Glendo Demand (40,000 acre-feet) - this study is intended to simulate the effects of contracting the full 40,000 acre-feet of irrigation water. It is assumed that the demand pattern would be similar to the existing Glendo contractors, i.e., the contracts would be made with small to medium sized irrigation districts. The maximum demand in any one year would be 40,000 acre-feet plus evaporation and the minimum demand would be 8,000 acre-feet plus evaporation.

(3) Base Run (With Increased Glendo Demand 40,000 acre-feet, with a Minimum Demand of 20,000 acre-feet) - is a simulation of the effects of contracting the full 40,000 acre-feet of irrigation water; however, a minimum demand of 20,000 acre-feet per year is placed on the unit. The maximum demand in any one year would be 40,000 acre-feet plus evaporation.

GLENDO PROJECT
SUMMARY - IRRIGATION UNIT
1952 STIPULATION AND WORKING AGREEMENT

POWER HEAD POOL	=	63,148 Ac-Ft
IRRIGATION POOL	=	100,000 Ac-Ft
EVAPORATION POOL	=	20,090 Ac-Ft
TOTAL		183,238 Ac-Ft

MAXIMUM IRRIGATION DELIVERY PER YEAR = 40,000 Ac-Ft

MAXIMUM ACCURAL PER YEAR = 40,000 Ac-Ft + Last year's evaporation

GLENDO PROJECT - IRRIGATION UNIT
CURRENT CONTRACTORS

Mitchell	12,000 Ac-Ft
Enterprise	3,000 Ac-Ft
Bridgeport	2,000 Ac-Ft
Sub-Total Nebraska (17,000/25,000 Ac-Ft = 68%)	17,000 Ac-Ft
Lucerne	2,500 Ac-Ft
Burbank	200 Ac-Ft
Wright & Murphy	200 Ac-Ft
New Grattan	500 Ac-Ft
Torrington	1,000 Ac-Ft
Sub-Total Wyoming (4,400/15,000 Ac-Ft = 29%)	4,400 Ac-Ft
TOTAL	21,400 Ac-Ft

PRESENT CONTRACTORS

HISTORICAL USE - 1961-1980

District	Irrigated Acres (1980)	Average Diversions (Ac-Ft) Storage	Average Diversions (Ac-Ft) Natural Flow	Storage % Average Diversion	Storage % - Average Diversion Dry Years (*)	Storage % - Average Diversion Dry Years (1977)
Mitchell	12,768	4,750	17,000	22%	52	69%
Enterprise	7,333	250	22,070	1%	1	0%
Bridgeport	8,103	1,430	28,270	5%		6%
Lucerne	3,351	570	14,210	4%	14	23%
Burbank	321	10	440	2%	9	23%
Wright & Murphy	149	130	250	33%	49	50%
New Grattan	1,142	80	4,290	2%	3	7%
Torrington	2,096	160	8,290	2%	4	5%

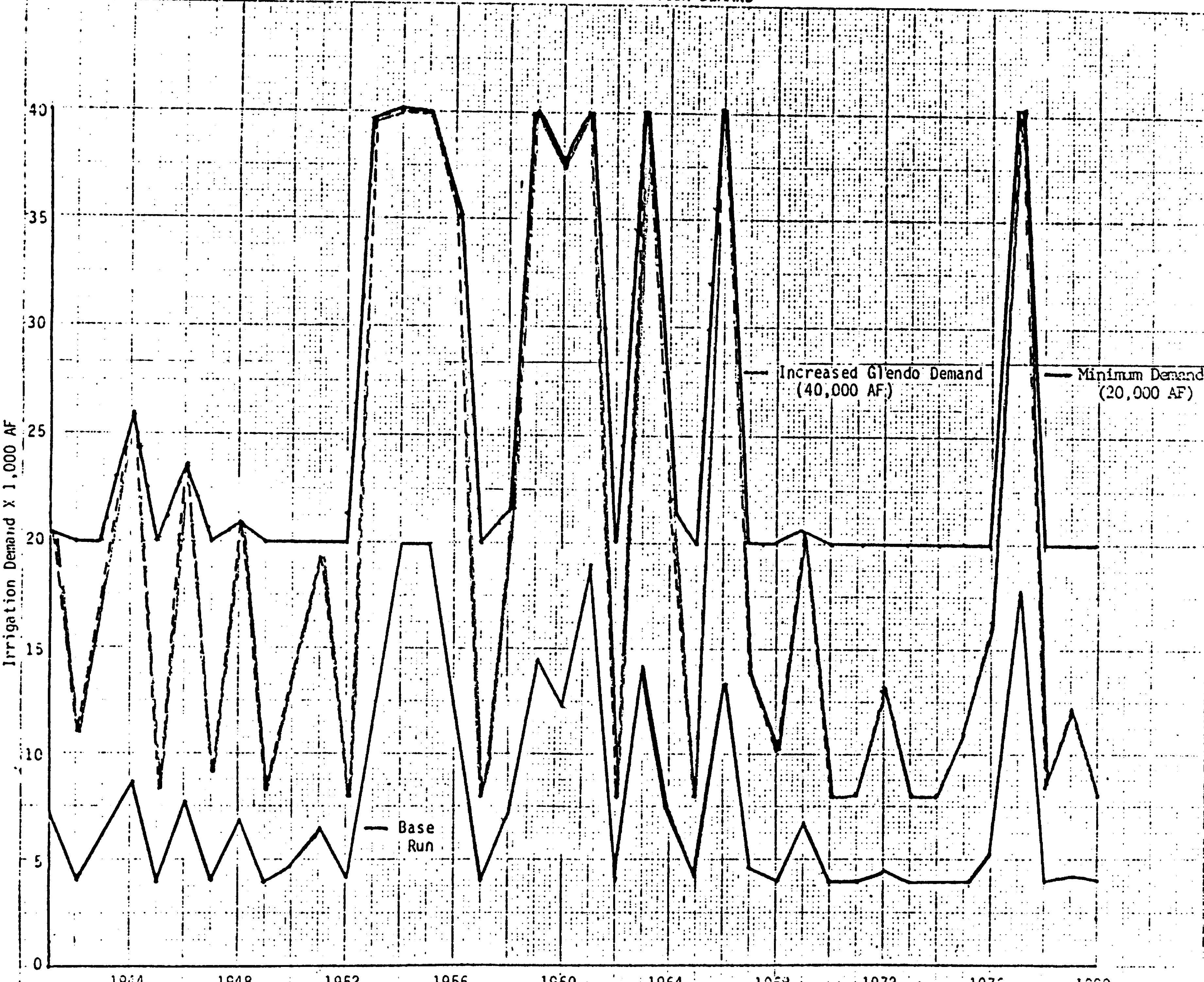
*Average - 1961, 1963, 1964, 1966

GLENDO PROJECT - IRRIGATION UNIT
NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATION STUDIES

IRRIGATION DEMAND (Water in 1,000 acre-feet)

Year	Base Run	Increased Glendo Demand (40,000 A.F.)	Base Run W/Increased Glendo 40,000 A.F. W/20,000 A.F. Min.
1941	7.15	21.44	21.44
1942	4.00	10.96	20.00
1943	6.04	18.12	20.00
1944	8.65	25.97	25.97
1945	4.00	8.32	20.00
1946	7.89	23.68	23.68
1947	4.00	9.08	20.00
1948	6.92	20.80	20.80
1949	4.00	8.24	20.00
1950	4.76	14.28	20.00
1951	6.48	19.44	20.00
1952	4.00	8.00	20.00
1953	13.23	39.68	39.68
1954	20.00	40.00	40.00
1955	20.00	40.00	40.00
1956	11.92	35.68	35.68
1957	4.00	8.00	20.00
1958	7.20	21.60	21.60
1959	14.40	40.00	40.00
1960	12.48	37.43	37.43
1961	19.16	40.00	40.00
1962	4.00	8.00	20.00
1963	14.32	40.00	40.00
1964	7.36	22.05	22.05
1965	4.00	8.00	20.00
1966	13.72	40.00	40.00
1967	4.60	13.80	20.00
1968	4.00	10.12	20.00
1969	6.88	20.60	20.60
1970	4.00	8.00	20.00
1971	4.00	8.00	20.00
1972	4.45	13.36	20.00
1973	4.00	8.00	20.00
1974	4.00	8.00	20.00
1975	4.00	11.00	20.00
1976	5.45	16.37	20.00
1977	17.80	40.00	40.00
1978	4.00	8.48	20.00
1979	4.08	12.25	20.00
1980	4.00	8.00	20.00
TOTAL	308.94	794.75	1,008.93
AVERAGE	7.72	19.87	25.22

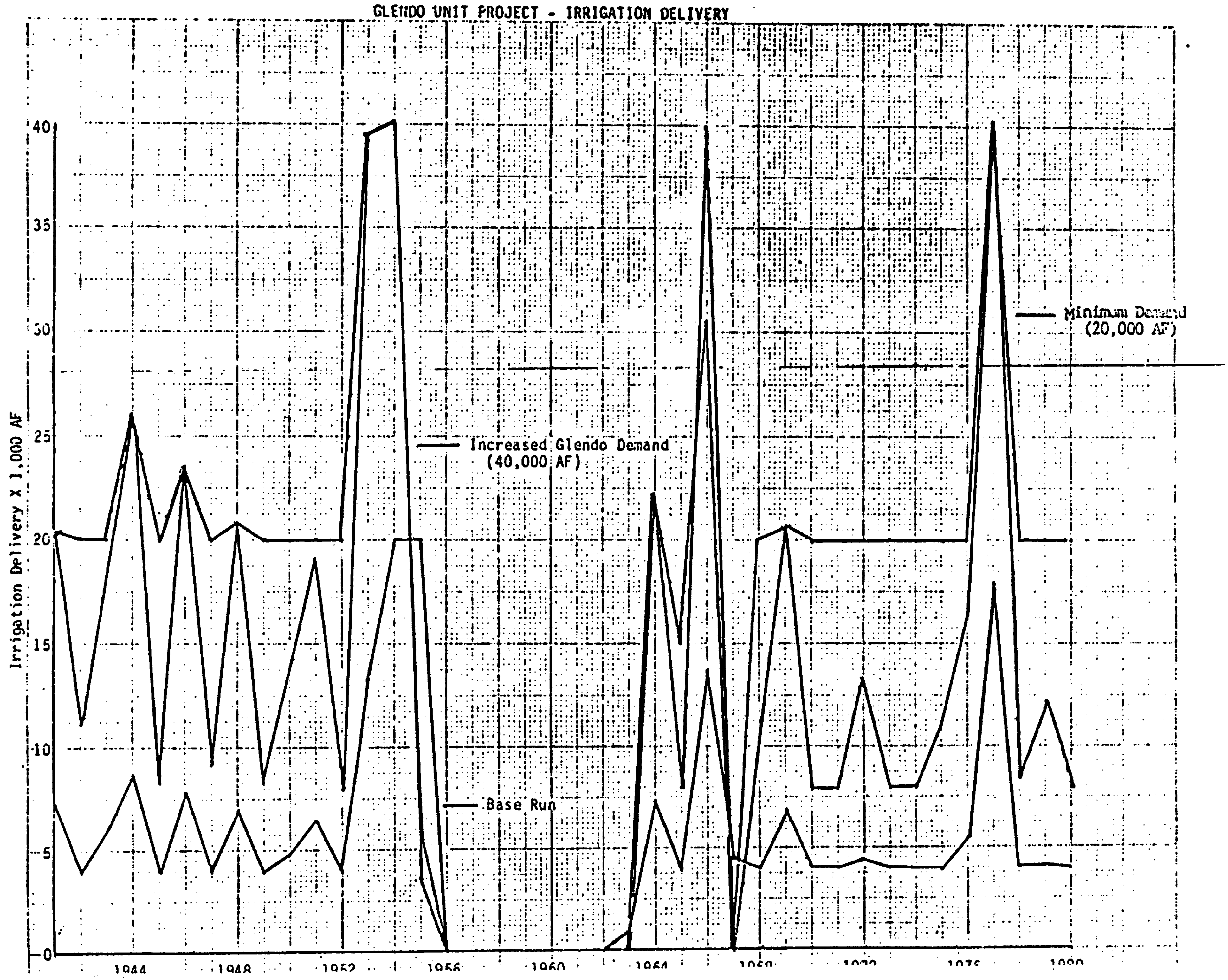
GLENDO UNIT PROJECT - IRRIGATION DEMAND



GLENDO PROJECT - IRRIGATION UNIT
NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATION STUDIES

IRRIGATION DELIVERIES (Water in 1,000 acre-feet)

Year	Base Run	Increased Glendo Demand (40,000 A.F.)	Base Run W/ Increased Glendo 40,000 A.F. W/20,000 A.F. Min.
1941	7.15	21.44	21.44
1942	4.00	10.96	20.00
1943	6.04	18.12	20.00
1944	8.65	25.97	25.97
1945	4.00	8.32	20.00
1946	7.89	23.68	23.68
1947	4.00	9.08	20.00
1948	6.92	20.80	20.80
1949	4.00	8.24	20.00
1950	4.76	14.28	20.00
1951	6.48	19.44	20.00
1952	4.00	8.00	20.00
1953	13.23	39.68	39.68
1954	20.00	40.00	40.00
1955	20.00	5.52	3.60
1956	0.00	0.00	0.00
1957	0.00	0.00	0.00
1958	0.00	0.00	0.00
1959	0.00	0.00	0.00
1960	0.00	0.00	0.00
1961	0.00	0.00	0.00
1962	0.00	0.00	0.00
1963	.96	0.00	0.00
1964	7.36	22.05	22.05
1965	4.00	8.00	20.00
1966	13.72	40.00	30.55
1967	4.60	0.00	0.00
1968	4.00	10.12	20.00
1969	6.88	20.60	20.60
1970	4.00	8.00	20.00
1971	4.00	8.00	20.00
1972	4.45	13.36	20.00
1973	4.00	8.00	20.00
1974	4.00	8.00	20.00
1975	4.00	11.00	20.00
1976	5.45	16.37	20.00
1977	17.80	40.00	40.00
1978	4.00	8.48	20.00
1979	4.08	12.25	20.00
1980	4.00	8.00	20.00
TOTAL	222.42	515.76	688.37
AVERAGE	5.56	12.89	17.21

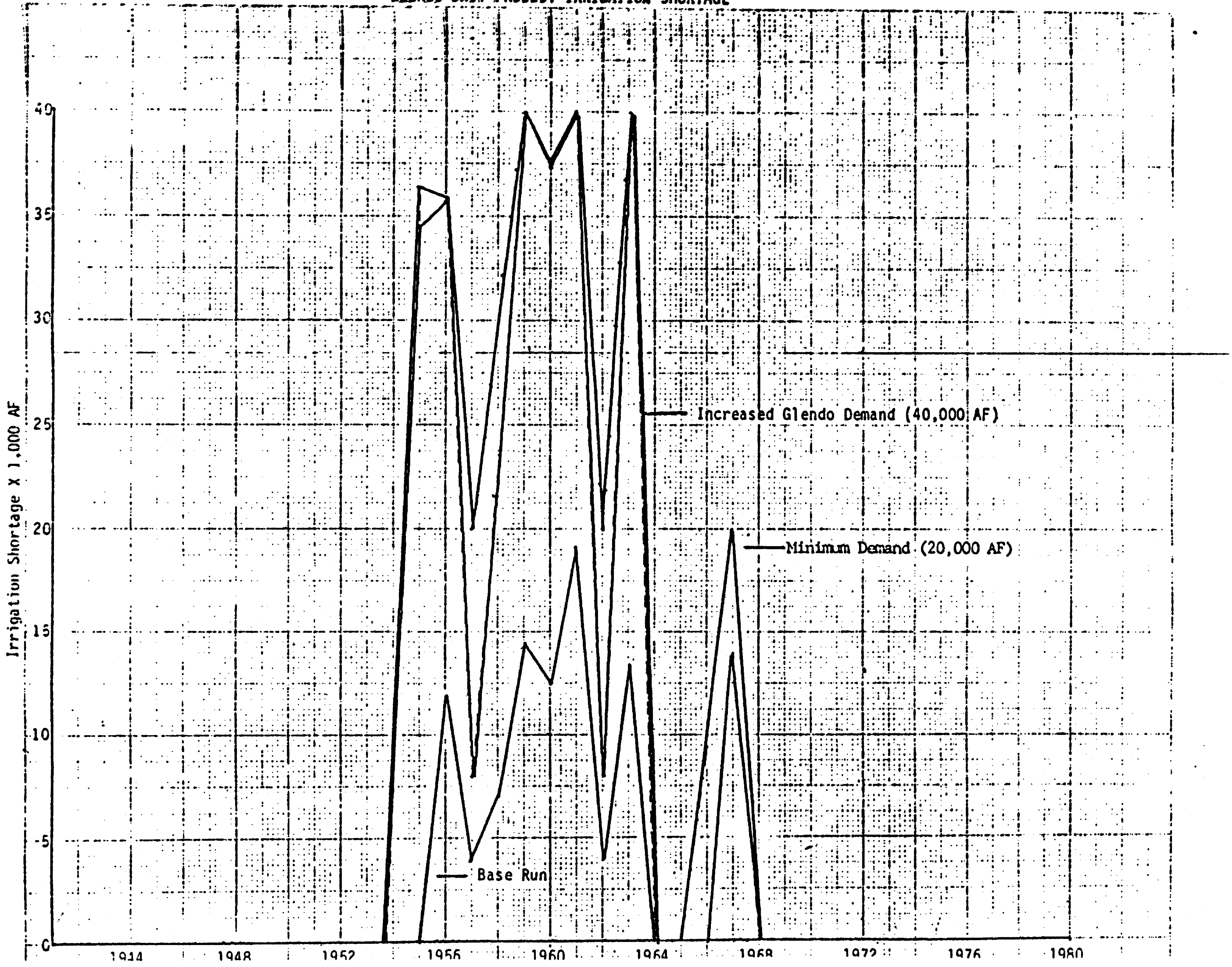

GLENDO UNIT PROJECT - IRRIGATION DELIVERY
Irrigation Delivery X 1,000 AF
0
5
10
15
20
25
30
35
40
1944
1948
1952
1956
1960
1964
Minimum Demand
(20,000 AF)
Increased Glendo Demand
(40,000 AF)
Base Run

GLENDO PROJECT - IRRIGATION UNIT
NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATION STUDIES

WATER SHORTAGE (Water in 1,000 acre-feet)

Year	Base Run	Increased Glendo Demand (40,000 A.F.)	Base Run W/Increased Glendo 40,000 A.F. W/20,000 A.F. Min.
1941	0.00	0.00	0.00
1942	0.00	0.00	0.00
1943	0.00	0.00	0.00
1944	0.00	0.00	0.00
1945	0.00	0.00	0.00
1946	0.00	0.00	0.00
1947	0.00	0.00	0.00
1948	0.00	0.00	0.00
1949	0.00	0.00	0.00
1950	0.00	0.00	0.00
1951	0.00	0.00	0.00
1952	0.00	0.00	0.00
1953	0.00	0.00	0.00
1954	0.00	0.00	0.00
1955	0.00	34.48	36.40
1956	11.92	35.68	35.68
1957	4.00	8.00	20.00
1958	7.20	21.60	21.60
1959	14.40	40.00	40.00
1960	12.48	37.43	37.43
1961	19.16	40.00	40.00
1962	4.00	8.00	20.00
1963	13.36	40.00	40.00
1964	0.00	0.00	0.00
1965	0.00	0.00	0.00
1966	0.00	0.00	9.45
1967	0.00	13.80	20.00
1968	0.00	0.00	0.00
1969	0.00	0.00	0.00
1970	0.00	0.00	0.00
1971	0.00	0.00	0.00
1972	0.00	0.00	0.00
1973	0.00	0.00	0.00
1974	0.00	0.00	0.00
1975	0.00	0.00	0.00
1976	0.00	0.00	0.00
1977	0.00	0.00	0.00
1978	0.00	0.00	0.00
1979	0.00	0.00	0.00
1980	0.00	0.00	0.00
TOTAL	86.52	278.99	320.56
AVERAGE	2.16	6.97	8.01

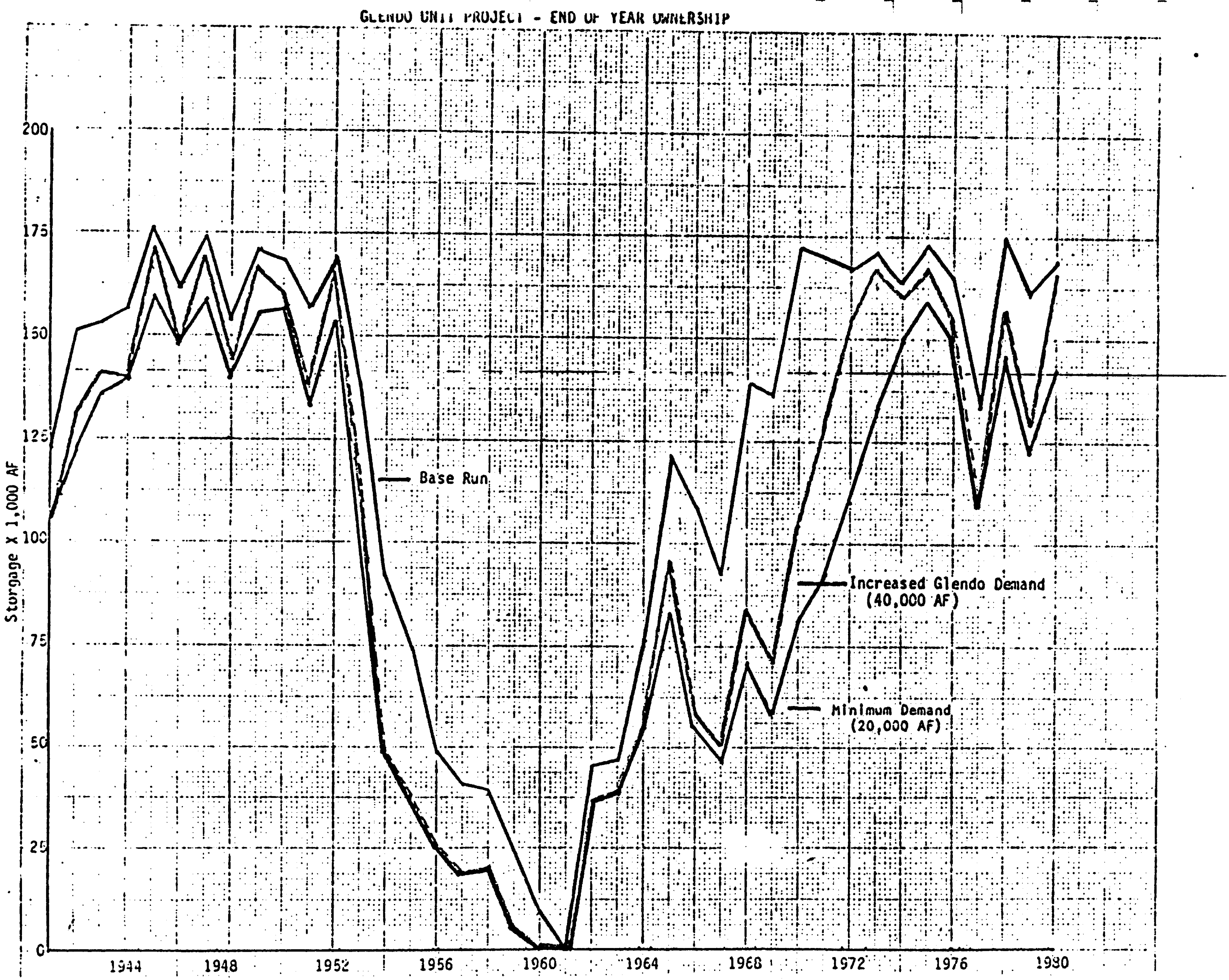
GLENDO UNIT PROJECT-IRRIGATION SHORTAGE



GLENDO PROJECT - IRRIGATION UNIT
NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATION STUDIES

END-OF-YEAR OWNERSHIP (Water in 1,000 acre-feet)

Year	Base Run	Increased Glendo Demand (40,000 A.F.)	Base Run W/Increased Glendo 40,000 A.F. W/20,000 A.F. Min.
1941	122.89	105.84	105.84
1942	151.19	130.52	121.68
1943	153.63	141.21	136.03
1944	156.59	139.68	139.75
1945	175.36	171.48	160.03
1946	161.40	148.46	148.45
1947	174.48	169.39	158.78
1948	154.06	144.37	141.03
1949	171.50	167.35	155.85
1950	169.00	160.57	157.01
1951	157.12	138.23	134.16
1952	169.73	165.50	153.55
1953	138.18	114.60	112.23
1954	91.25	49.83	47.90
1955	61.79	37.75	37.86
1956	48.56	25.84	25.92
1957	40.34	19.07	19.14
1958	39.43	19.96	20.03
1959	23.84	5.54	5.61
1960	9.48	0.00	0.00
1961	0.00	0.00	0.00
1962	45.60	36.70	36.70
1963	47.23	39.88	39.87
1964	76.61	55.81	55.80
1965	121.73	96.21	83.09
1966	109.42	58.66	55.07
1967	93.26	50.38	46.96
1968	138.86	84.01	71.02
1969	136.69	71.24	59.32
1970	172.51	104.86	81.17
1971	169.57	129.17	91.89
1972	167.16	153.64	110.16
1973	171.56	167.44	133.18
1974	164.04	160.09	149.77
1975	173.42	167.22	159.12
1976	165.39	154.62	151.11
1977	133.71	111.80	111.80
1978	175.07	157.49	146.16
1979	160.24	141.79	123.65
1980	169.56	165.46	142.88
TOTAL	4,961.95	4,161.66	3,829.57
AVERAGE	124.05	104.04	95.74



GLENDO UNIT PROJECT - END OF YEAR OWNERSHIP
Storgage X 1,000 AF
200
175
150
125
100
75
50
25
0
1944
1948
1952
1956
1960
1964
1968
1972
1976
1980
Base Run
Increased Glendo Demand (40,000 AF)
Minimum Demand (20,000 AF)

GLENDO PROJECT - IRRIGATION UNIT
NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATION STUDIES

Ownership Gain (Water in 1,000 acre-feet)

Year	Base Run	Increased Glendo Demand (40,000 A.F.)	Base Run W/Increased Glendo 40,000 A.F. W/20,000 A.F. Min.
1941	29.11	29.11	29.11
1942	51.17	53.93	53.93
1943	32.05	52.72	58.09
1944	38.57	50.57	55.57
1945	36.18	52.73	52.65
1946	7.38	11.76	23.21
1947	26.67	41.34	41.39
1948	8.76	13.85	24.46
1949	39.61	48.99	52.26
1950	24.82	29.90	40.14
1951	17.95	20.16	20.16
1952	36.98	55.59	59.57
1953	13.51	17.74	29.69
1954	6.93	6.93	6.93
1955	14.95	14.95	14.95
1956	.91	.91	.91
1957	.45	.45	.45
1958	8.11	8.11	8.11
1959	3.21	3.21	3.21
1960	0.00	0.00	0.00
1961	0.00	0.00	0.00
1962	49.48	40.00	40.00
1963	20.76	20.76	20.76
1964	54.30	54.30	54.30
1965	57.56	56.32	56.32
1966	12.85	12.85	12.85
1967	2.80	2.80	2.80
1968	54.36	51.08	50.91
1969	19.68	19.68	19.68
1970	54.97	51.85	50.78
1971	17.57	50.23	48.93
1972	23.04	57.92	58.21
1973	28.05	41.26	59.94
1974	17.34	21.40	55.05
1975	37.60	42.11	52.77
1976	17.55	23.67	31.68
1977	17.85	28.62	32.13
1978	63.79	71.44	71.44
1979	8.17	14.75	14.75
1980	31.98	50.25	57.26
TOTAL	989.02	1,224.24	1,365.35
AVERAGE	24.73	30.61	34.13

GLENDO PROJECT - IRRIGATION UNIT
NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATION STUDIES

EVAPORATION LOSS (Water in 1,000 acre-feet)

Year	Base Run	Increased Glendo Demand (40,000 A.F.)	Base Run W/Increased Glendo 40,000 A.F. W/20,000 A.F. Min.
1941	11.17	13.93	13.93
1942	18.87	18.29	18.09
1943	23.57	23.91	23.74
1944	26.96	26.13	25.88
1945	12.91	12.61	12.37
1946	13.95	11.10	11.11
1947	11.59	11.33	11.06
1948	22.26	18.07	21.41
1949	18.17	17.77	17.44
1950	22.56	22.40	18.98
1951	23.35	23.06	23.01
1952	20.37	20.32	20.18
1953	31.83	28.96	31.33
1954	33.86	31.70	31.26
1955	24.41	21.51	21.39
1956	14.14	12.82	12.85
1957	8.67	7.22	7.23
1958	9.02	7.22	7.22
1959	18.80	17.63	17.63
1960	14.36	5.54	5.61
1961	9.48	0.00	0.00
1962	3.88	3.30	3.30
1963	18.17	17.58	17.59
1964	17.56	16.32	16.32
1965	8.44	7.92	9.03
1966	11.44	10.40	10.32
1967	14.36	11.08	10.91
1968	4.76	7.33	6.85
1969	14.97	11.85	10.78
1970	15.15	10.23	8.93
1971	16.51	17.92	18.21
1972	21.00	20.09	19.94
1973	19.65	19.46	16.92
1974	20.86	20.75	18.46
1975	24.22	23.98	23.42
1976	20.13	19.90	19.69
1977	31.73	31.44	31.44
1978	18.43	17.27	17.08
1979	18.92	18.20	17.26
1980	18.66	18.58	18.03
TOTAL	709.14	655.12	646.20
AVERAGE	17.73	16.38	16.16

GLENDO PROJECT - IRRIGATION UNIT
NORTH PLATTE RIVER MANAGEMENT MODEL
OPERATION STUDIES

Surplus River Water (Released) Water in 1,000 Acre-Feet

Year	Base Run	Increased Glendo Demand (40,000 A.F.)	Base Run W/Increased Glendo 40,000 A.F. W/20,000 A.F. Min.
1941	0.00	0.00	0.00
1942	182.05	179.29	179.29
1943	49.58	28.91	23.54
1944	43.85	31.85	26.85
1945	67.04	50.49	50.57
1946	25.70	21.32	9.87
1947	54.19	41.52	41.47
1948	61.90	56.81	46.20
1949	25.37	15.99	12.72
1950	26.97	21.89	11.64
1951	4.06	1.85	1.85
1952	586.65	568.04	564.06
1953	22.83	18.60	6.65
1954	0.00	0.00	0.00
1955	0.00	0.00	0.00
1956	0.00	0.00	0.00
1957	0.00	0.00	0.00
1958	0.00	0.00	0.00
1959	0.00	0.00	0.00
1960	0.00	0.00	0.00
1961	0.00	0.00	0.00
1962	2.33	11.81	11.81
1963	1.85	1.85	1.85
1964	0.00	0.00	0.00
1965	44.34	45.58	45.58
1966	1.34	1.34	1.34
1967	0.00	0.00	0.00
1968	52.83	56.11	56.28
1969	1.74	1.74	1.74
1970	260.56	263.68	264.75
1971	1040.11	1012.66	1013.98
1972	326.50	291.62	291.33
1973	1162.84	1149.63	1130.95
1974	941.20	936.95	901.15
1975	42.82	38.31	29.70
1976	195.76	189.64	181.63
1977	27.41	16.64	13.13
1978	64.88	57.23	57.23
1979	6.58	0.00	0.00
1980	527.44	509.22	502.21
TOTAL	5,850.72	5,620.57	5,479.37
AVERAGE	146.27	140.51	136.98

AGREEMENT

THIS AGREEMENT, made and entered into this ____ day of ______________________, 1980, by and among Tri-State Generation and Transmission Association, Inc., on its own behalf and as agent for purposes of this Agreement for each of its present and future members (hereinafter referred to collectively as "Tri-State"); Basin Electric Power Cooperative, on its own behalf and as agent for purposes of this Agreement for each of its present and future members and their present and future members (hereinafter referred to collectively as "Basin"), and as project manager and agent for all participants and each of their present and future members in the Missouri Basin Power Project (hereinafter referred to collectively as "MBPP"); the National Wildlife Federation (hereinafter "NWF"); and The Central Nebraska Public Power and Irrigation District (hereinafter "Central"); Tri-State, Basin, MBPP, NWF and Central being hereinafter collectively referred to as "the parties."

WHEREAS, Central and Nebraska Public Power District ("NPPD") have filed a joint application with the Federal Energy Regulatory Commission ("FERC") for amendments of their respective licenses for FERC Project Nos. 1417 and 1835 ("FERC proceeding") to install a hydroelectric generating unit in Central's Kingsley Dam, with attendant modifications in Project Nos. 1417 and 1835, and tion in the FERC proceeding and have raised questions concerning the effect of the proposed modifications and the current operation of Project Nos. 1417 and 1835 on the area of the Platte River which the Department of the Interior Fish and Wildlife Service has stated is a critical habitat ("designated critical habitat") of the Whooping Crane (<u>Grus americana</u>), and on other endangered species, and have raised other issues, and

WHEREAS, under the terms of the modified decree of the United States Supreme Court in <u>Nebraska</u> v. <u>Wyoming</u>, 345 U.S. 981 (1953) ("Modified Decree"), and S.J. Res. No. 163, 68 Stat. 486 (1954) ("Joint Resolution"), water in the amount of twenty-five thousand (25,000) acre-feet annually has been allocated from Glendo Reservoir (now administered by the United States Department of the Interior Water and Power Resources Service ("WPRS")) for the irrigation of lands in the basin of the North Platte River in western Nebraska, and

WHEREAS, to date, water from the WPRS Glendo Reservoir (said water hereinafter referred to as "the Glendo water") in the amount of approximately eight thousand (8,000) acre-feet remains unallocated to a particular user for the irrigation of lands in the basin of the North Platte River in western Nebraska, and

WHEREAS, Central has applied to WPRS for a contract for delivery of the Glendo water to Central into the North Platte River below Glendo Dam for irrigation of lands in are bound by a December 4, 1978 Agreement of Settlement and Compromise ("Court Settlement"), approved by the United States District Court for the District of Nebraska and the United States Court of Appeals for the Eighth Circuit, which provides in Paragraph 5 that the MBPP is obligated, under certain circumstances, to deliver a certain quantity of water into the North Platte River, and which quantity of water may be obtained from sources in Wyoming and/or the North Platte basin in Nebraska, and the cost of so doing from sources of water other than Glendo water is expected to substantially exceed the cost of Glendo water, and

WHEREAS, the MBPP desires to effectuate an arrangement whereunder the Glendo water will serve to discharge *pro tanto* the obligation of MBPP referred to in the preceding recital and the parties desire to settle their differences in the FERC proceeding;

NOW THEREFORE, in consideration of the covenants and promises herein contained, the parties hereto agree as follows:

ARTICLE ONE: Central Covenants and Agreements

1.1 Central will diligently pursue its application with WPRS to obtain a contract for the Glendo water in the maximum amount available up to eight thousand (8,000) acre-feet, but the parties recognize that WPRS may not enter into such a contract. If Central obtains a contract with WPRS for the Glendo water to be delivered into the North Platte

River in accordance with applicable WPRS requirements in any irrigation season (as the term "irrigation season" is defined in Paragraph 7 of the Court Settlement), such Glendo water shall be applied to the irrigation of lands in the basin of the North Platte River in western Nebraska in accordance with the Modified Decree and Joint Resolution. Central may amend said application or substitute therefor an application for any other type of long term, renewable contract with WPRS that would accomplish delivery of the Glendo water into the North Platte River below Glendo Dam in which event, Central shall exercise the renewal and/or conversion rights provided for in such contract pursuant to the Act of July 2, 1956 (70 Stat. 483, 43 U.S.C. §485h). All references in this Agreement to Central's application shall mean such application as amended or such substitute application. All references in this Agreement to Central's contract with WPRS for the Glendo water shall mean said contract or such other type of contract that is entered into by Central with WPRS.

1.2 Central will continue the general mode of operations of its Project No. 1417.

1.3 Central will execute and file in the FERC proceeding the Offer of Settlement set forth as Exhibit A, which is attached hereto and hereby incorporated into this Agreement.

ARTICLE TWO: Tri-State Covenants and Agreements

2.1 Tri-State will support the application of Central to obtain the Glendo water.

2.2 Tri-State, concurrently with the execution of this Agreement, will execute and agree in the FERC proceeding to the Offer of Settlement, set forth as Exhibit A hereto, and to the Notice of Withdrawal of Intervention, set forth as Exhibit B-1 hereto and which is hereby incorporated into this Agreement.

2.3 Hereafter, Tri-State will not participate or attempt to intervene in the FERC proceeding.

2.4 Tri-State will not intervene or participate in any other proceeding or case at FERC or elsewhere involving what consists of Project Nos. 1417 and/or 1835.

2.5 Tri-State will deem the delivery of the Glendo water into the North Platte River to be "delivery" by the MBPP pursuant to Paragraphs 5, 6, and 7 of the Court Settlement, as provided in section 3.2 hereof, but irrespective of this section Tri-State shall continue to be bound by its other covenants and agreements under this Agreement.

2.6 Tri-State, concurrently with the execution of this Agreement, will cause a copy thereof to be sent to each of its present members.

ARTICLE THREE: MBPP and Basin Covenants and Agreements

3.1 MBPP and Basin will support the application of Central to obtain the Glendo water.

3.2 If Central obtains a contract for the Glendo water to be delivered into the North Platte River in accordance with applicable WPRS requirements, such Glendo water

MBPP to Central at least thirty (30) days before the time Central is obligated to make each such payment under said contract with WPRS, but MBPP shall not be obligated to make such payments to Central more frequently than each quarter of a calendar year.

3.5 If Central enters into a contract with WPRS for the Glendo water, in the event legislation is enacted that provides for termination of the acreage limitations under the Federal Reclamation laws upon payment in a lump sum of the balance of the repayment obligation thereunder, and Central wishes to avail itself of such termination, upon six (6) months written notice to MBPP, MBPP shall pay to Central an amount equal to the lump sum Central is obligated to pay at least thirty (30) days before the time Central is obligated to make such lump sum payment to WPRS. MBPP will also pay Central an amount equal to each amount Central is obligated to pay for operation, maintenance, renewal, and miscellaneous costs during the term of such contract and all renewals thereof.

3.6 In the event that Central obtains (whether pursuant to, as a result of, or irrespective of Central's contract with WPRS for the Glendo water) more than eight thousand (8,000) acre feet of water in a calendar year (hereinafter "extra water") from the Glendo Reservoir for delivery into the North Platte River below the Glendo Dam, MBPP will pay Central an amount equal to each amount Central is obligated to pay WPRS for said extra water, but not to exceed

In summary, the model is adequate if used for planning studies and as a tool to discover the relationships between changes in the regimen of the river. It was never intended to be accurate in terms of actual quantities of water in the North Platte River.

feet, and such payments shall be made by MBPP to Central at least thirty (30) days before the time Central is obligated to make each such payment. The provisions of the second sentence of section 1.1 and the provisions of section 3.2 shall apply equally to said extra water.

3.7 MBPP and Basin will not intervene or participate in the FERC proceeding or in any other proceeding or case at FERC or elsewhere involving what consists of Project Nos. 1417 and/or 1835.

3.8. Basin, concurrently with the execution of this Agreement, will cause a copy thereof to be sent to each of its present members and to each participant in MBPP and each participant's present members.

ARTICLE FOUR: NWF Covenants and Agreements

4.1 NWF will support the application of Central to obtain the Glendo water.

4.2 NWF will execute and agree in the FERC proceeding to the Offer of Settlement, set forth as Exhibit A hereto, and to the Notice of Withdrawal of Intervention, set forth as Exhibit B-2 hereto and which is hereby incorporated into this Agreement.

ARTICLE FIVE: General Covenants and Agreements

5.1 The parties hereto express their conclusion that this Agreement satisfies the requirements of the Federal Power Act, as amended to date, and the Endangered Species Act of 1973, as amended to date.

5.2 If WPRS does not enter into a contract with Central for Glendo water, the parties shall continue to be bound by their covenants and agreements under this Agreement, but no obligation to pay for the Glendo water shall arise.

5.3 In the event that FERC declines to accept the Offer of Settlement set out in Exhibit A, (1) Tri-State, Basin and MBPP, and those for whom they are acting as agent for purposes of this Agreement, and NWF waive all claims of privilege against the admissibility of this Agreement, and the Agreement entered into between Central, NPPD, and NWF on the 12th day of February 1980, as evidence or for other purposes in the FERC proceeding or in any other proceeding or case at FERC or elsewhere, and (2) the parties and those for whom they are acting as agents for purposes of this Agreement shall continue to be bound by their covenants and agreements under this Agreement.

5.4 Central and NWF agree that this Agreement shall not relieve any of them from their covenants and agreements under the agreement entered into by them on the 12th day of February 1980, except that the references therein to filing with FERC Exhibit A thereto shall be deemed to be satisfied by filing with FERC Exhibit A to this Agreement.

original of this Agreement, this Agreement shall be executed in six (6) counterparts. All such counterparts shall constitute an original and but one and the same instrument. No party shall be obligated for any purpose to account for more than one executed counterpart of this Agreement.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed by their duly authorized officers.

The Central Nebraska Public Power and Irrigation District

.... By: ....
Attest Date: ....

Tri-State Generation and Transmission Association, Inc. on its own behalf and as agent for each of its present and future members

.... By: ....
Attest Date: ....

Basin Electric Power Cooperative, on its own behalf, as agent for each of its present and future members and each of their present and future members, and as agent for all present and future participants and each of their present and future members in the Missouri Basin Power Project

.... By: ....
Attest Date: ....

National Wildlife Federation

.... By: ....
Attest Date: ....

Notes: Meeting to discuss North Platte Model, October 1, 1982, 10:00 a.m.

Attendance: Lou Allen, Gary Mehling, Carlton Hunter, John Buyok

We met on October 1, 1982 to discuss the North Platte Model developed by the Bureau of Reclamation and the Water Resources Research Institute. The most up-to-date copy of the model output that we have is the copy received September 16, 1982. from Jack Marshall of the Bureau office in Denver and dated June, 1981. This run uses a period of record of 1941-1980 and is titled "North Platte River Base Run with Most Recent Ownership Accounting." Hunter informed us that the Bureau is currently developing a new base run study with a 1962-1981 period of record. The more recent period of record will enable them to use more actual data on the river without having to adjust historical records to include reservoirs built after the data was collected. We will need to study this new base run to make sure that no major modifications which could possibly affect the results have been made by the Bureau.

One of the problems with the model in previous runs had been that projected numbers from the Annual Operating Plan had been used for input data instead of actual numbers from the North Platte accounting sheets. A brief review of the input data indicates that this problem has probably been corrected.

Evaporation from the Glendo Unit was another problem in the original runs because the model was set up to calculate evaporation from the various ownership accounts as the Bureau does it in actual practice; subtract this number from the total system evaporation losses, and consider the difference to be Glendo Unit evaporation loss. This method results in an inaccurate evaporation figure for the Glendo Unit, but the inaccuracy is generally very small in comparison to the yearly water supply.

There are many other inaccuracies in the model due to the difficulty of modeling actual operating conditions. For the most part, changes to improve the accuracy of the model would require a large amount of data and would result in very small percentage changes in the model output.

In summary, the model is adequate if used for planning studies and as a tool to discover the relationships between changes in the regimen of the river. It was never intended to be accurate in terms of actual quantities of water in the North Platte River.

United States Department of the Interior
BUREAU OF RECLAMATION
REGIONAL OFFICE, LOWER MISSOURI REGION
BUILDING 20, DENVER FEDERAL CENTER
P.O. BOX 25247
DENVER, COLORADO 80225

IN REPLY REFER TO: LM-730
511.

NOV 15 1983

Mr. Jon Wade
Geohydrologist, Wyoming Water
Development Commission
Barrett Building
Cheyenne, WY 82002

Dear Mr. Wade:

Enclosed is a copy of our analysis showing the effect of the proposed Deer Creek depletion to the North Platte River flows. The analysis was made using the North Platte River system ownership as reflected in our North Platte simulated model study No. 1141 depicting Gray Rocks (Laramie River depletion) operation on the system.

At this time, the North Platte simulation model will not produce any results with the diminished gains in the Alcova to Glendo reach of the river. Therefore, this analysis is based on the system ownership and river water ownership. Priority was given to the Deer Creek depletion. These results indicated the development of water on Deer Creek could have the following effect on the North Platte River operation:

1. Average reduction in ownership storage of 8,450 acre-feet per year.
2. There would be an average annual loss of 8,700 acre-feet of system ownership water.
3. The river water that is released past Whalen Diversion Dam would be reduced by an average of 13,340 acre-feet per year.
4. The total average annual effect on the North Platte River would be a reduction of 30,490 acre-feet.

Looking at this analysis, it appears that Glendo operation would be affected by an average reduction of 17,150 acre-feet of water per year. Three-fourths of the current Glendo irrigation water would be forfeited for the Deer Creek water development. The 13,340 acre-feet of river water would impact the distribution of the North Platte River waters that were allocated by the Supreme Court decree.

Line explanation is as follows:

1. System gain to ownership taken from simulation model study No. 1141

2. Deer Creek depletion computed from R. W. Beck and Associates data

3. The difference between lines 1. and 2. (1. - 2. = 3.)

4. System ownership water delivery from study No. 1141

5. Irrigation shortage = lines 3. -4. -6. + previous 7. for values less than 0

6. System ownership evaporation loss from study No. 1141

7. End-of-year storage ownership = previous lines 7. + 3. -4. -5. -6.

8. River water gain from study No. 1141

9. Use river water to make up depletions, then use ownership to make up depletions:

    9. = 2. when 8. > 2. and then 2. = 0
    When 8. < 2., 2 = absolute value of 8. -2. and 9. = 8.

10. The difference between lines 8. and 9. (8. - 9. = 10.)

11. Equals 2

12. Equals 9

The enclosed results can be used until they are superseded by a simulated model study.

If you have any questions or need further explanation, please call Jack Marshall of my staff, (303) 234-4418.

Sincerely yours,

William J. Steele

William J. Steele
Regional Planning Officer

Enclosures

Affect of Deer Creek Water Development Plan on the North Platte River

1000 A.F. Units

	Year						
	1941	1942	1943	1944	1945	1946	1947
System Ownership							
1. Gain (1141)	1122.78	1327.79	1162.06	993.40	1606.04	1050.86	1554.09
2. Deer Cr. Depletion	31.66	0	0	0	0	0	0
3. Net Gain	1091.12	1327.79	1162.06	993.40	1606.04	1050.86	1554.09
4. Water Delivery	1113.55	1017.12	1035.68	1014.40	967.23	1068.48	976.94
5. Shortage	0	0	0	0	0	0	0
6. Evap. Loss	68.22	85.27	90.73	86.89	92.36	113.11	112.56
7. Ownership 325.97	305.32	530.72	566.37	458.44	1004.89	874.16	1338.75
River Ownership							
8. Gain	0	152.28	42.58	42.66	62.62	25.83	54.42
9. Deer Cr. Depletion	0	21.92	18.67	25.34	23.27	22.45	24.24
10. Net Gain	0	130.36	23.91	17.32	39.35	3.38	30.18
11. System Loss	31.66	0	0	0	0	0	0
12. River Loss	0	21.92	18.67	25.34	23.27	22.45	24.24

BY [illegible] DATE 11-8-83
CHKD BY DATE
PROJECT North Platte River
FEATURE Proposed Deer Creek Development
DETAILS
SHEET 1 OF 6

Affect of Deer Creek Water Development Plan on the North Platte River

1000 A.F. Units

	Year						
	1948	1949	1950	1951	1952	1953	1954
System Ownership							
1. Gain (1141)	1074.86	1648.83	1319.56	1167.65	1154.36	845.00	533.20
2. Deer Cr. Depletion	0	0	11.45	16.00	0	0	15.88
3. Net Gain	1074.86	1648.83	1308.11	1151.65	1154.36	845.00	517.32
4. Water Delivery	1072.76	1012.78	1040.30	1061.54	1025.22	1113.14	758.54
5. Shortage	0	0	0	0	0	0	0
6. Evap. Loss	143.44	151.36	168.26	172.96	170.12	156.47	129.86
7. Ownership	1197.41	1682.10	1781.65	1698.80	1657.82	1233.21	862.13
1338.75							
River Ownership							
8. Gain	61.80	25.73	10.72	1.85	572.39	22.65	0
9. Deer Cr. Depletion	16.91	24.13	10.72	1.85	26.20	21.05	0
10. Net Gain	44.89	1.60	0	0	546.19	1.60	0
11. System Loss	0	0	11.45	16.00	0	0	15.88
12. River Loss	16.91	24.13	10.72	1.85	26.20	21.05	0

BY | CHKD BY | DATE | DATE | DETAILS | FEATURE | PROJECT

SHEET 2 OF 6

Affect of Deer Creek Water Development Plan on the North Platte River

1000 A.F. Units

	Year						
	1955	1956	1957	1958	1959	1960	1961
System Ownership							
1. Gain (1141)	711.46	906.99	1754.54	1119.20	837.40	889.20	743.20
2. Deer Cr. Depletion	19.00	3.33	23.39	25.76	11.70	17.17	7.02
3. Net Gain	692.46	903.66	1731.15	1093.44	825.70	872.03	736.18
4. Water Delivery	759.72	937.95	1033.87	1112.93	1138.43	992.52	788.77
5. Shortage	0	0	0	0	0	0	0
6. Evap. Loss	106.27	92.29	99.50	131.98	117.02	93.36	77.60
7. Ownership 862.13	688.60	562.02	1159.80	1008.33	578.53	364.68	234.49
River Ownership							
8. Gain	0	0	0	0	0	0	0
9. Deer Cr. Depletion	0	0	0	0	0	0	0
10. Net Gain	0	0	0	0	0	0	0
11. System Loss	19.00	3.33	23.39	25.76	11.70	17.17	7.02
12. River Loss	0	0	0	0	0	0	0

DETAILS | CHKD BY | BY | DATE | DATE | FEATURE | PROJECT

SHEET 3 OF 6

Affect of Deer Creek Water Development Plan on the North Platte River

1000 A.F. Units

	Year						
	1962	1963	1964	1965	1966	1967	1968
System Ownership							
1. Gain (1141)	1797.76	837.45	1109.54	1699.58	853.62	1350.22	1487.34
2. Deer Cr. Depletion	34.64	12.46	49.44	0	17.31	28.09	0
3. Net Gain	1763.12	824.99	1060.10	1699.58	836.31	1322.13	1487.34
4. Water Delivery	1098.56	1154.75	1164.20	996.39	1150.29	995.36	1061.30
5. Shortage	0	0	0	0	0	0	0
6. Evap. Loss	93.58	108.20	86.19	94.88	107.21	101.25	114.29
7. Ownership 234.49	805.47	367.51	177.22	785.53	364.34	589.86	901.21
River Ownership							
8. Gain	1.94	1.85	0	35.71	1.34	0	49.19
9. Deer Cr. Depletion	1.94	1.85	0	31.75	1.34	0	19.38
10. Net Gain	0	0	0	3.96	0	0	29.81
11. System Loss	34.64	12.46	49.44	0	17.31	28.09	0
12. River Loss	1.94	1.85	0	31.75	1.34	0	19.38

BY | DATE | CHKD BY | DATE | DETAILS | PROJECT | FEATURE

SHEET 4 OF 6

Affect of Deer Creek Water Development Plan on the North Platte River

1000 A.F. Units

	Year						
	1969	1970	1971	1972	1973	1974	1975
System Ownership							
1. Gain (1141)	1140.30	1781.81	1306.00	1050.40	1432.87	881.83	1423.89
2. Deer Cr. Depletion	16.94	0	0	0	0	0	0
3. Net Gain	1123.36	1781.81	1306.00	1050.40	1432.87	881.83	1423.89
4. Water Delivery	1141.73	983.04	911.76	1124.94	872.34	1050.86	1045.33
5. Shortage	0	0	0	0	0	0	0
6. Evap. Loss	130.50	146.41	175.57	176.02	172.03	180.37	179.96
7. Ownership	752.74 (901.61)	1405.10	1623.77	1373.21	1761.71	1412.31	1610.91
River Ownership							
8. Gain	1.74	264.69	1012.21	318.12	1160.74	934.31	59.22
9. Deer Cr. Depletion	1.74	25.74	22.40	21.75	24.96	19.42	23.90
10. Net Gain	0	238.95	989.81	296.37	1135.78	914.89	35.32
11. System Loss	16.94	0	0	0	0	0	0
12. River Loss	1.74	25.74	22.40	21.75	24.96	19.42	23.90

BY | CHKD BY | DATE | DATE | DETAILS | FEATURE | PROJECT

Affect of Deer Creek Water Development Plan on the North Platte River

1000 A.F. Units

	Year 1976	1977	1978	1979	1980	Total	AVE.
System Ownership							
1. Gain (1141)	1070.93	939.58	1608.26	1412.05	1172.61		
2. Deer Cr. Depletion	0	0	0	6.64	0		
3. Net Gain	[illegible]70.33	[illegible]38.58	1603.26	1405.41	1172.61		
4. Water Delivery	[illegible]	1135.58	1040.79	1063.54	1065.58		
5. Shortage	0	0	0	0	0		
6. Evap. Loss	175.36	157.88	143.39	166.46	170.69		
7. Ownership	1408.38	853.50	1277.58	1452.99	1389.33	338.02	8.45
1610.91							
River Ownership							
8. Gain	185.89	27.49	45.92	6.57	523.04		
9. Deer Cr. Depletion	22.08	19.52	23.60	6.57	28.75		
10. Net Gain	163.81	7.97	22.32	0	494.31		
11. System Loss	0	0	0	6.64	0	347.88	8.70
12. River Loss	22.08	19.52	23.60	6.57	28.75	533.44	13.34
						Total	30.49

DETAILS | CHKD BY | DATE | FEATURE | PROJECT | SHEET 6 OF 6

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

State Engineer's Office

BARRETT BUILDING CHEYENNE, WYOMING 82002

November 28, 1983

Jon Wade
Geohydrologist, Water Development Commission
Barrett Building
Cheyenne, Wyoming 82002

Dear Jon:

I have completed a brief review of the "Deer Creek Project Feasibility Report" prepared by R.W. Beck and Associates, dated October, 1983 and also the study prepared by the Bureau of Reclamation dated November 15, 1983, showing the effect of proposed Deer Creek depletions on North Platte River flows. The basic approach of the Feasibility Report appears to be acceptable to determine the firm yield of the proposed Deer Creek Reservoir assuming that the downstream requirements on the North Platte River will not have an effect on Deer Creek Reservoir storage. The Bureau of Reclamation study approach also appears to be acceptable to determine the effect of the Deer Creek Project on North Platte River flows using yearly flow averages. The problem is that neither study will provide an accurate estimate of the water legally available to the Deer Creek Reservoir. The two studies must be integrated to provide an accurate estimate of water supply.

The Bureau study should be refined to a daily basis rather than a yearly basis. Water will be physically available to be stored in the Deer Creek Reservoir in almost every year. However, the water stored in the reservoir will usually have to be released to meet prior downstream storage rights. Water will probably be available to Deer Creek Reservoir as firm storage only in two situations. The first is a system-wide spill. In this case, the Deer Creek Reservoir would probably be able to store and use any water that could be physically captured. The second situation would be the case where a relatively unusual set of circumstances result in a spill or storage beyond ownership entitlements in the lower North Platte River below Alcova Reservoir. The second situation usually only occurs over a period of a few days, however, and is not reflected in monthly or yearly flow averages. The amount of water available in the second case can only be determined using daily flow data.

The majority of water available to the Deer Creek Project over a span of years would probably occur as a result of the second situation. In most years, inflows in the lower North Platte system, combined with releases from the upper North Platte system above Alcova Reservoir for power generation, result in a short period of time when the reservoirs in the lower system are physically full even though their ownerships are not yet full. Some water is lost to the overall system through spills or storage as "owed to the river" water. A daily study of North Platte River operations should be combined with a Deer Creek Reservoir operations study to determine if this water, which would otherwise be lost to the system, could be captured in the Deer Creek Reservoir in order to determine if there is an adequate water supply for the Deer Creek Project.

In conclusion, the Bureau of Reclamation studies, whether done on a yearly basis or a monthly basis as is the case with their North Platte simulation model, will not be of much use in determining if there is a water supply available for the Deer Creek Project because most of the water supply will only be available on a daily basis. The Bureau also has an interest in showing that there is no water available for the Deer Creek Project. They manage the earlier priority downstream storage rights which may be impacted, if only in the sense that operations may have to be changed slightly, and they have also been receiving a partial water supply for some of their Nebraska projects which are in an ideal position to capture spills from the Wyoming North Platte system even though they are not allocated the water under the North Platte Supreme Court Decree. The R.W. Beck study is also not of much use in determining if there is a water supply available for the Deer Creek Project because it fails to take into account the downstream North Platte water rights.

If you have any questions, please let me know.

Sincerely,

JOHN P. BUYOK
Interstate Streams Engineer

JPB/ht

Summary

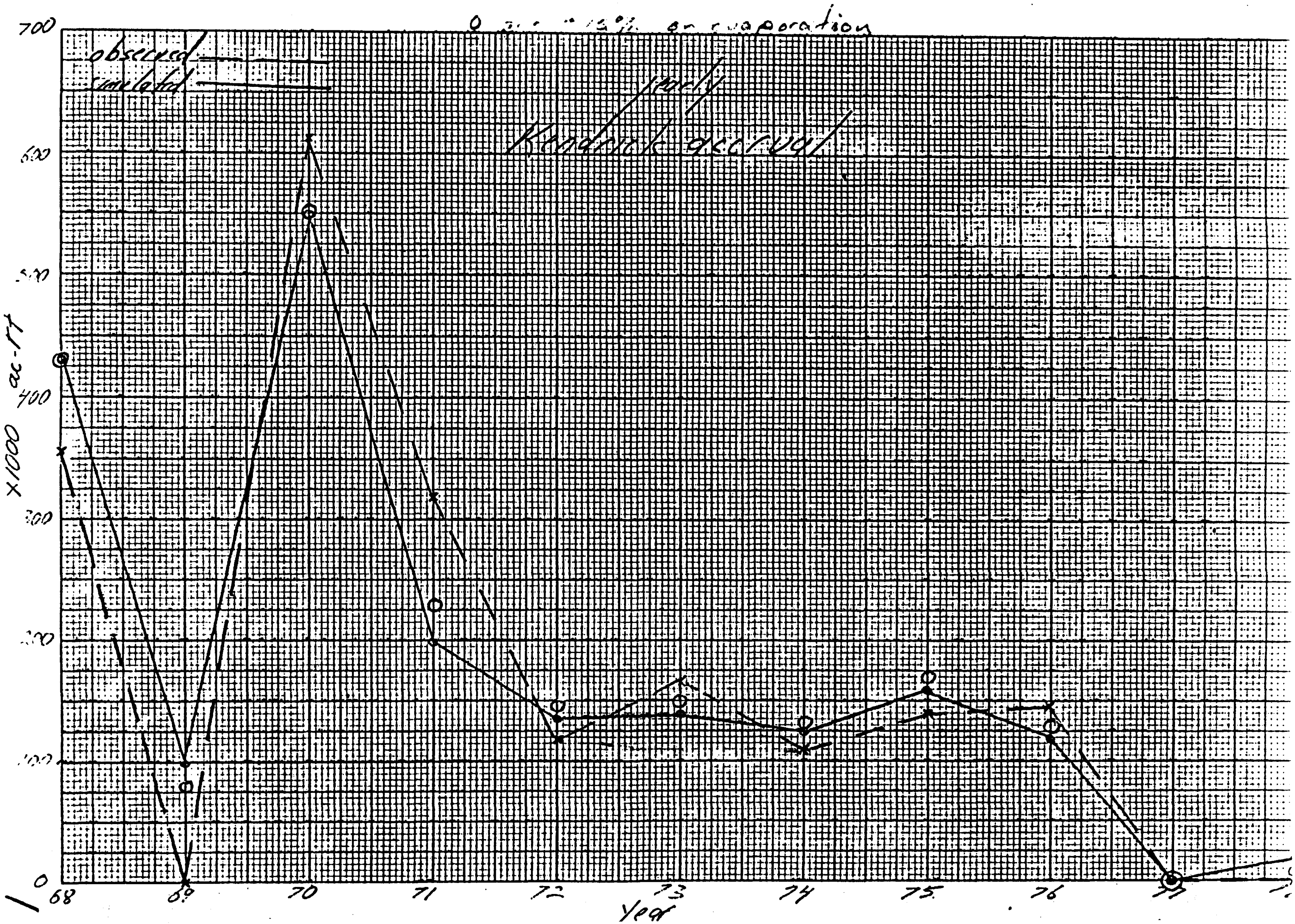
values in 1000 ac-ft units

using actual starting ownerships + storages

	1968 actual	1968 simulated	1973 actual	1973 simulated	1977 actual	1977 simulated
Ownership gain						
Kendrick	360	431	166	125	0	0
Glendo	21	21	106	27	34	22
End of yr. ownership						
Kendrick	576	639	1166	1123	969	986
Glendo	166	173	81	173	124	159
N Platte	481	509	859	833	66	64
Outflow						
Seminoe	703	664	1505	1628	686	723
Alcova	857	723	1611	1426	916	881
Guernsey	1142	1062	2059	2097	1017	1089
Evaporation						
Kendrick	36	30	68	61	82	61
Glendo	17	8	36	10	24	6
NPlatte	73	50	70	51	56	39

K+E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1240



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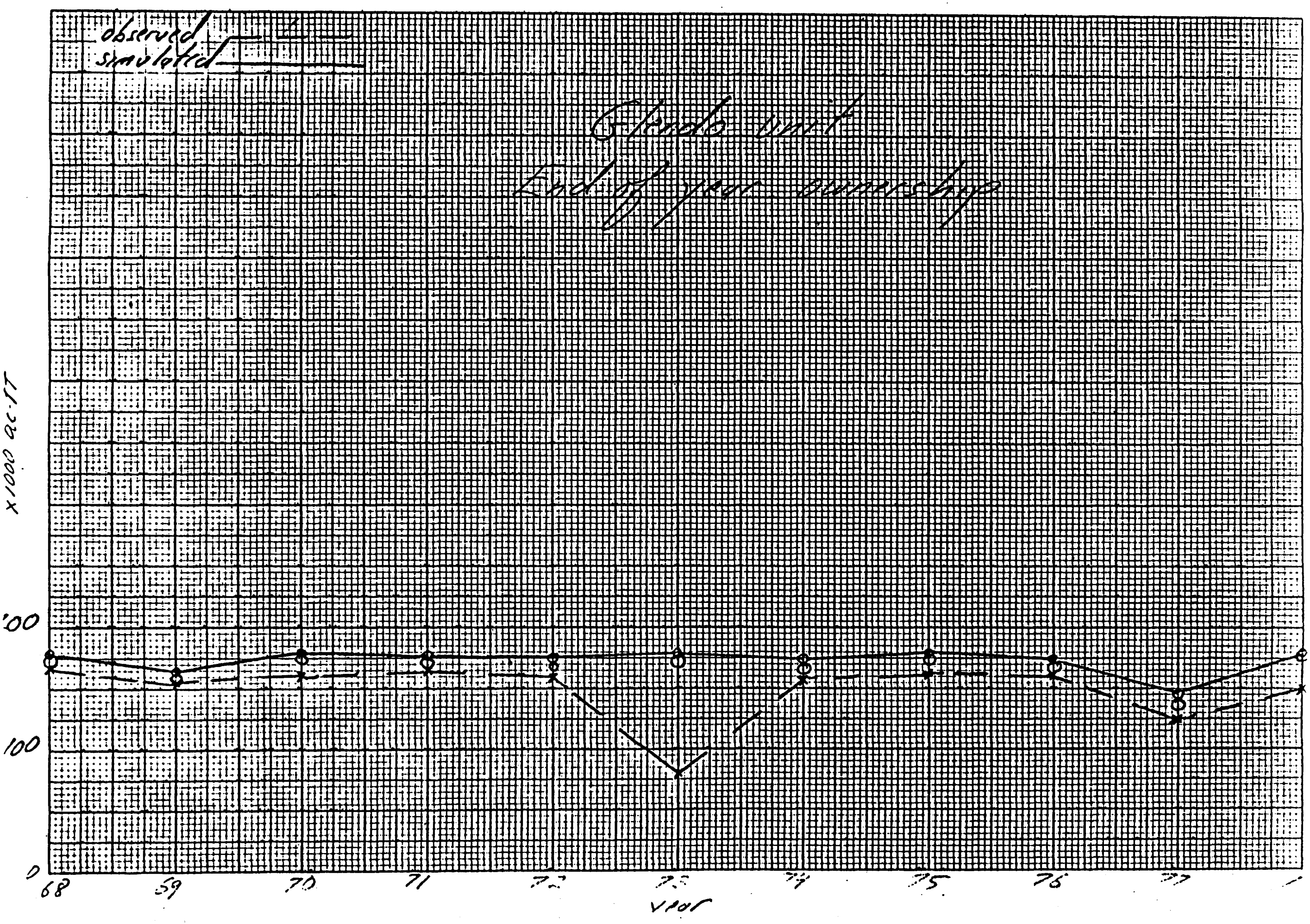
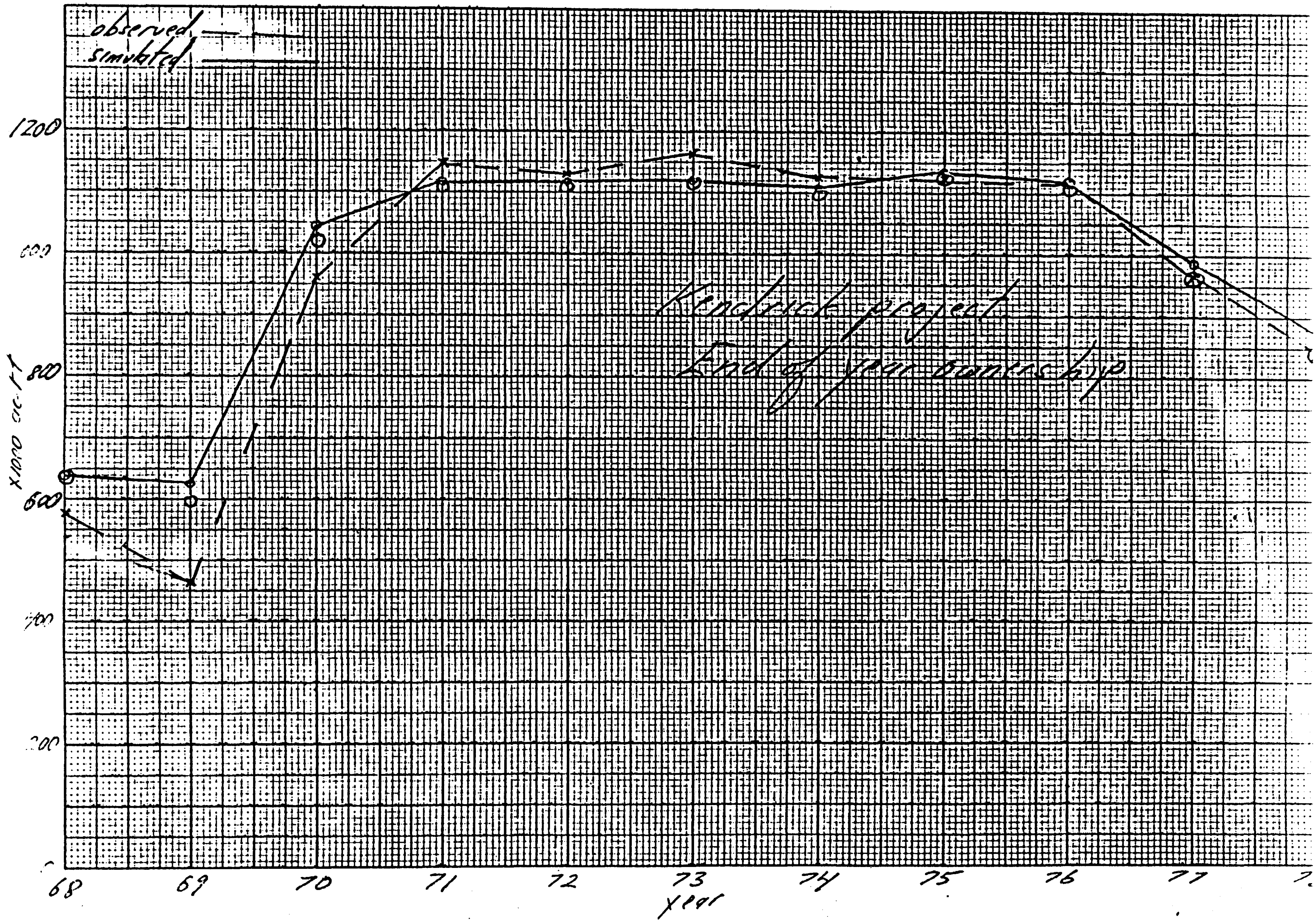
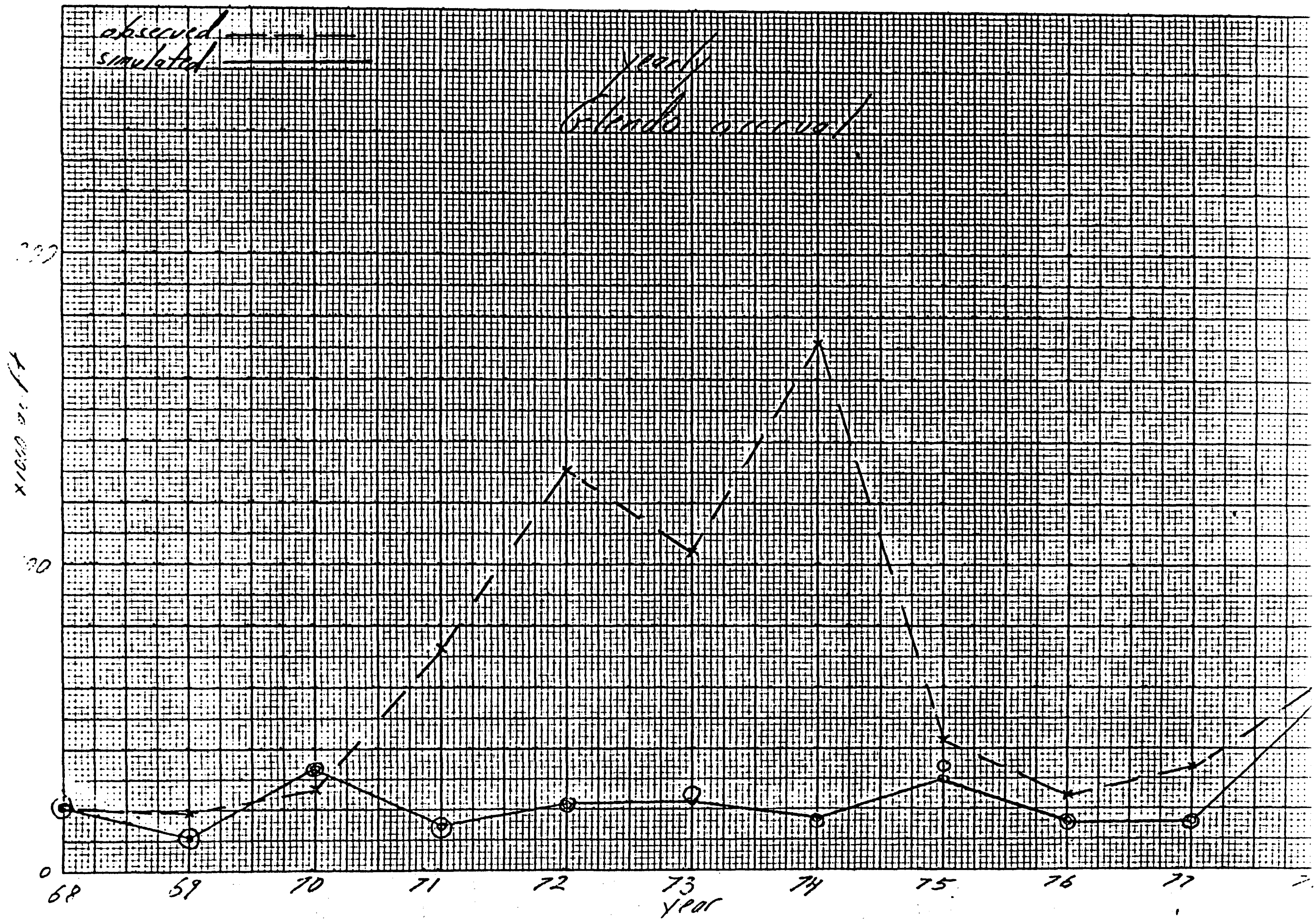



observed
simulated
Kendrick project
End of year ownership
1200
800
600
x1000 acr ft
68
69
70
71
72
73
74
75
76
77
year

K•E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1240



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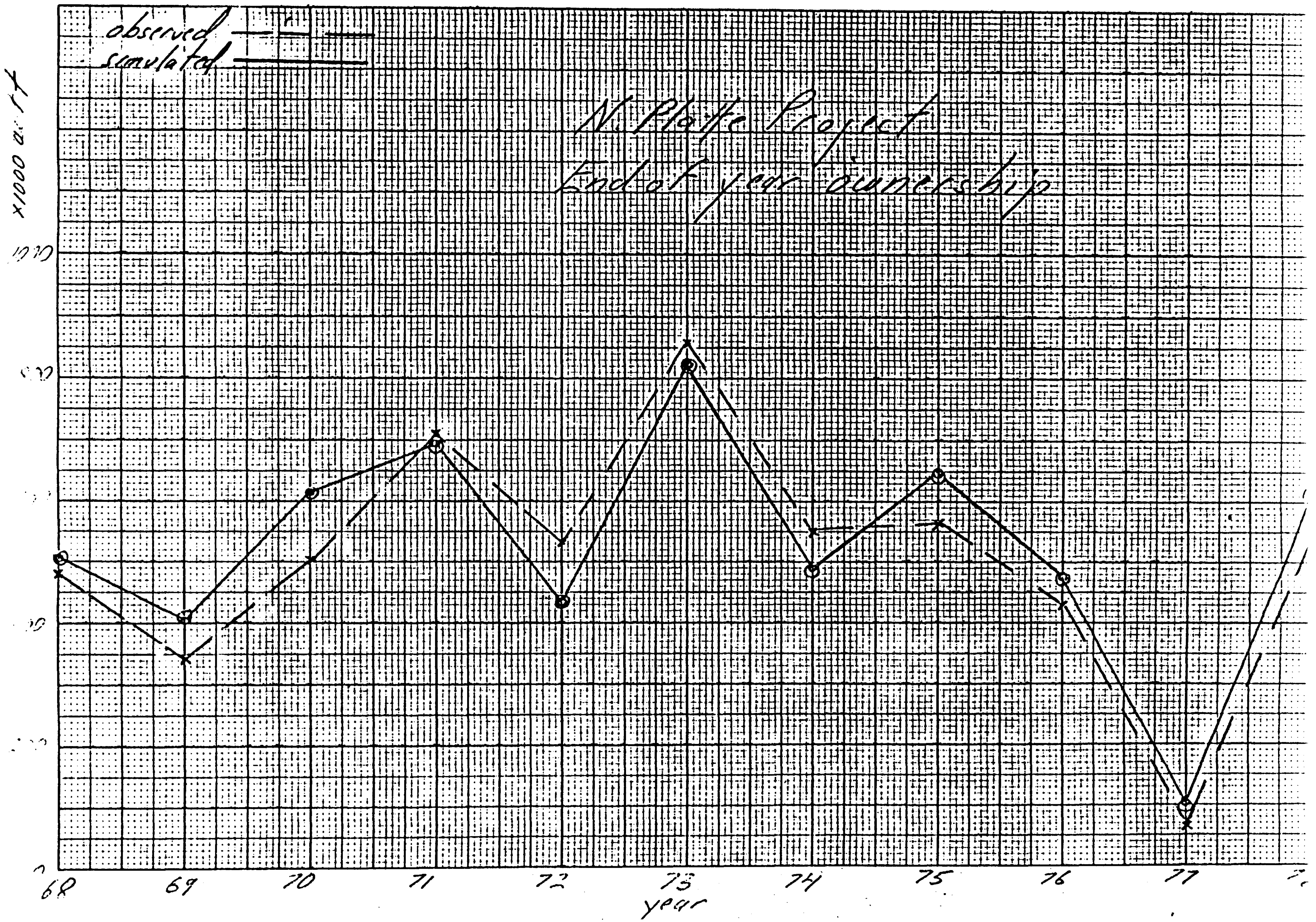
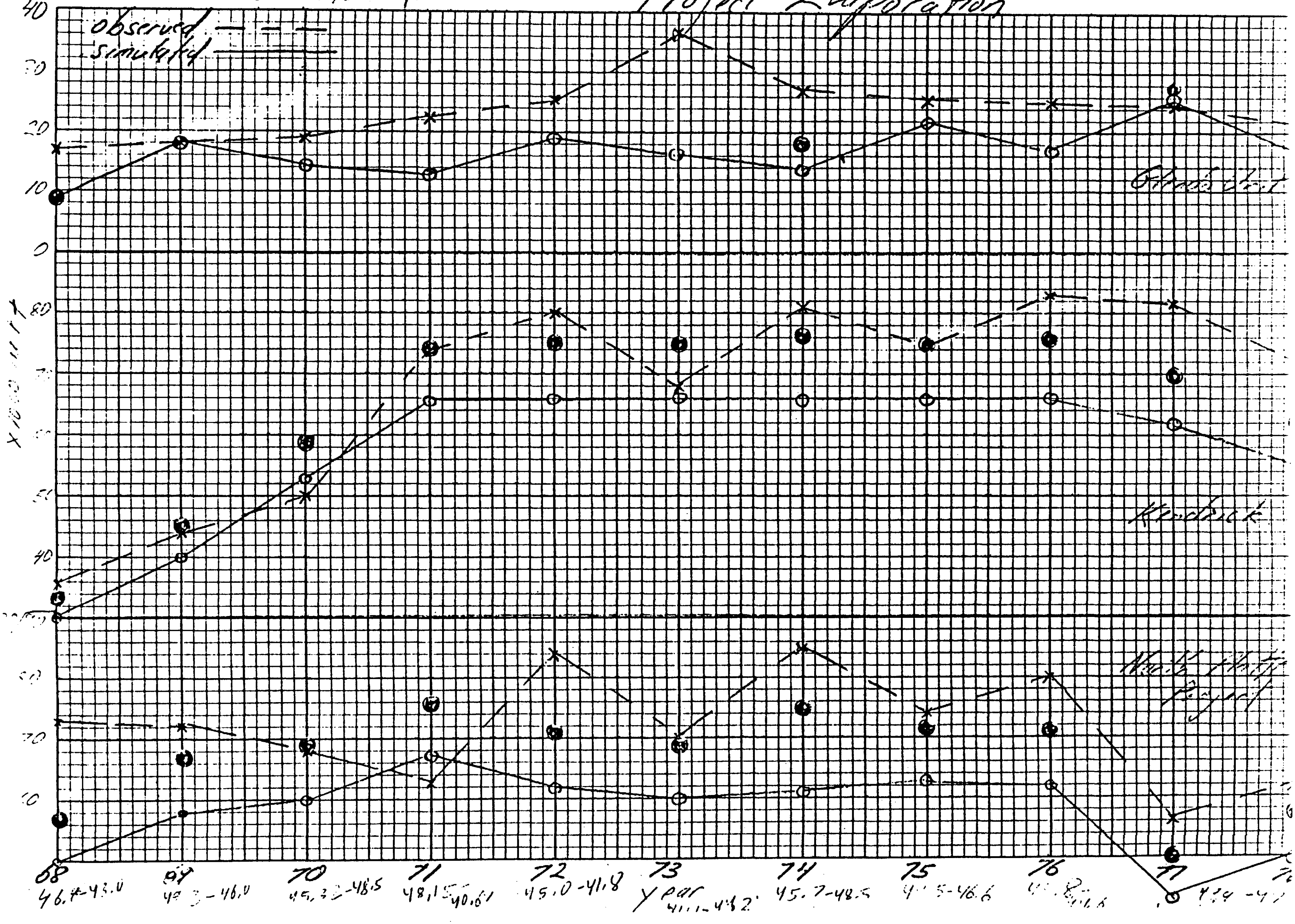
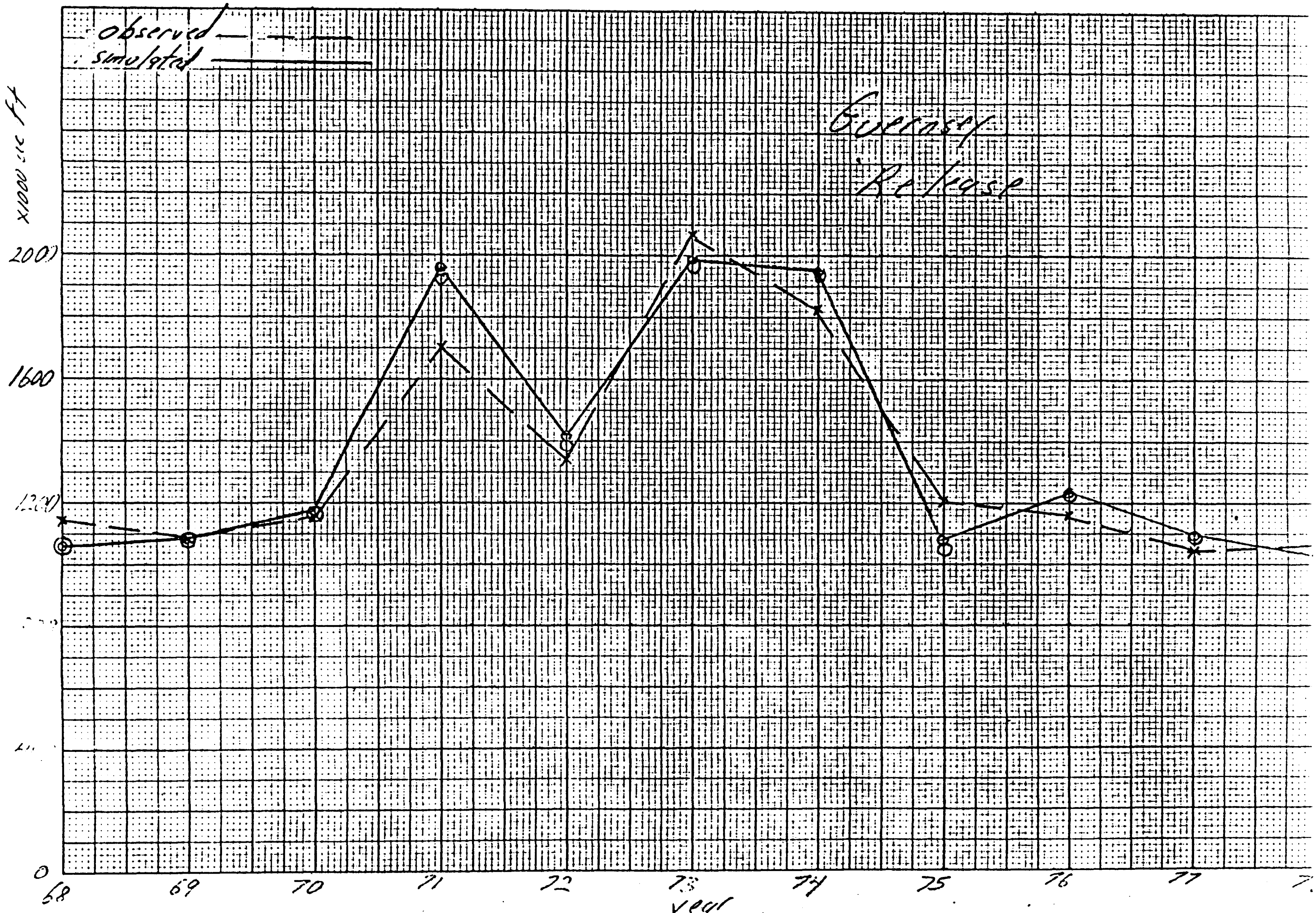


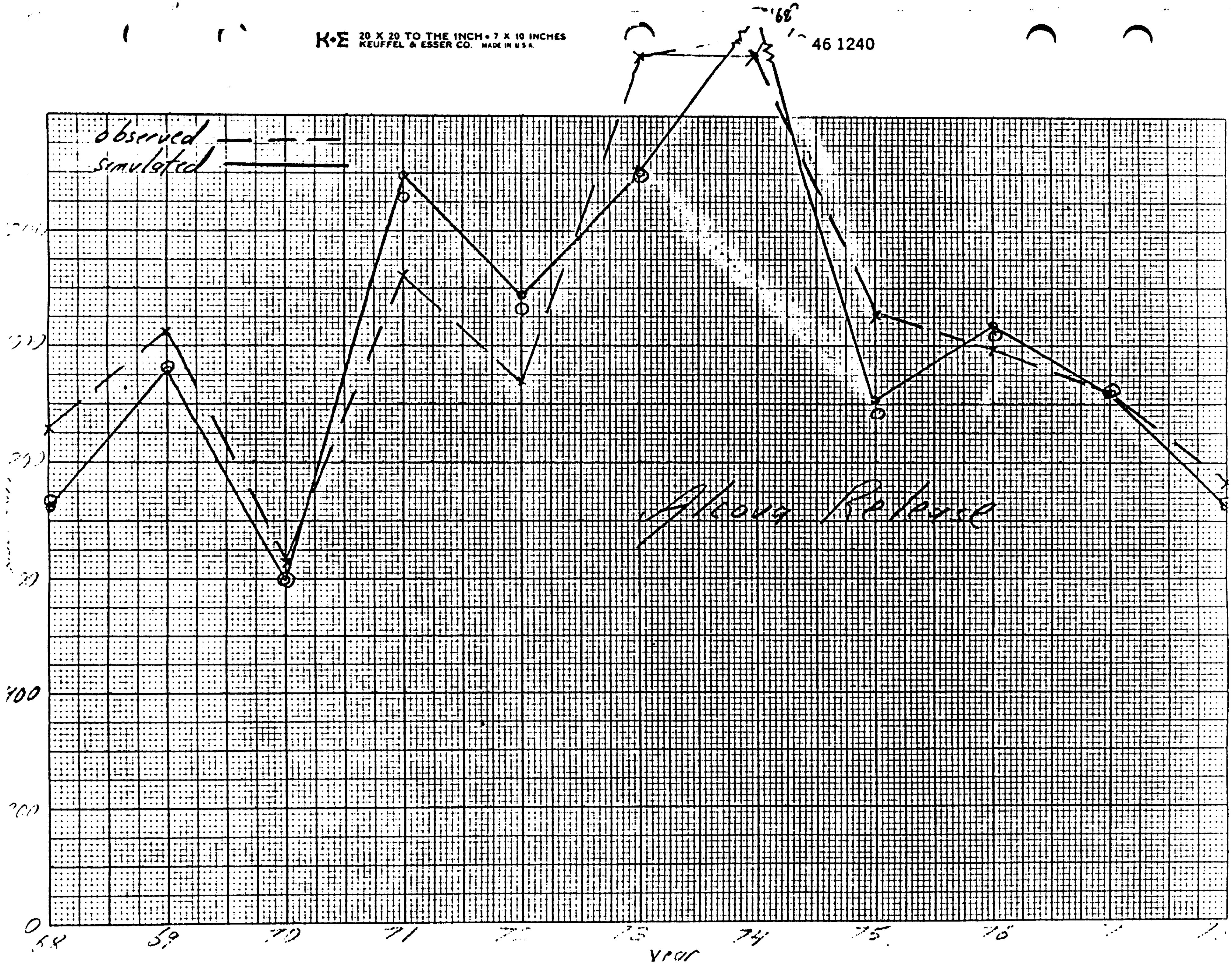
Project Evaporation



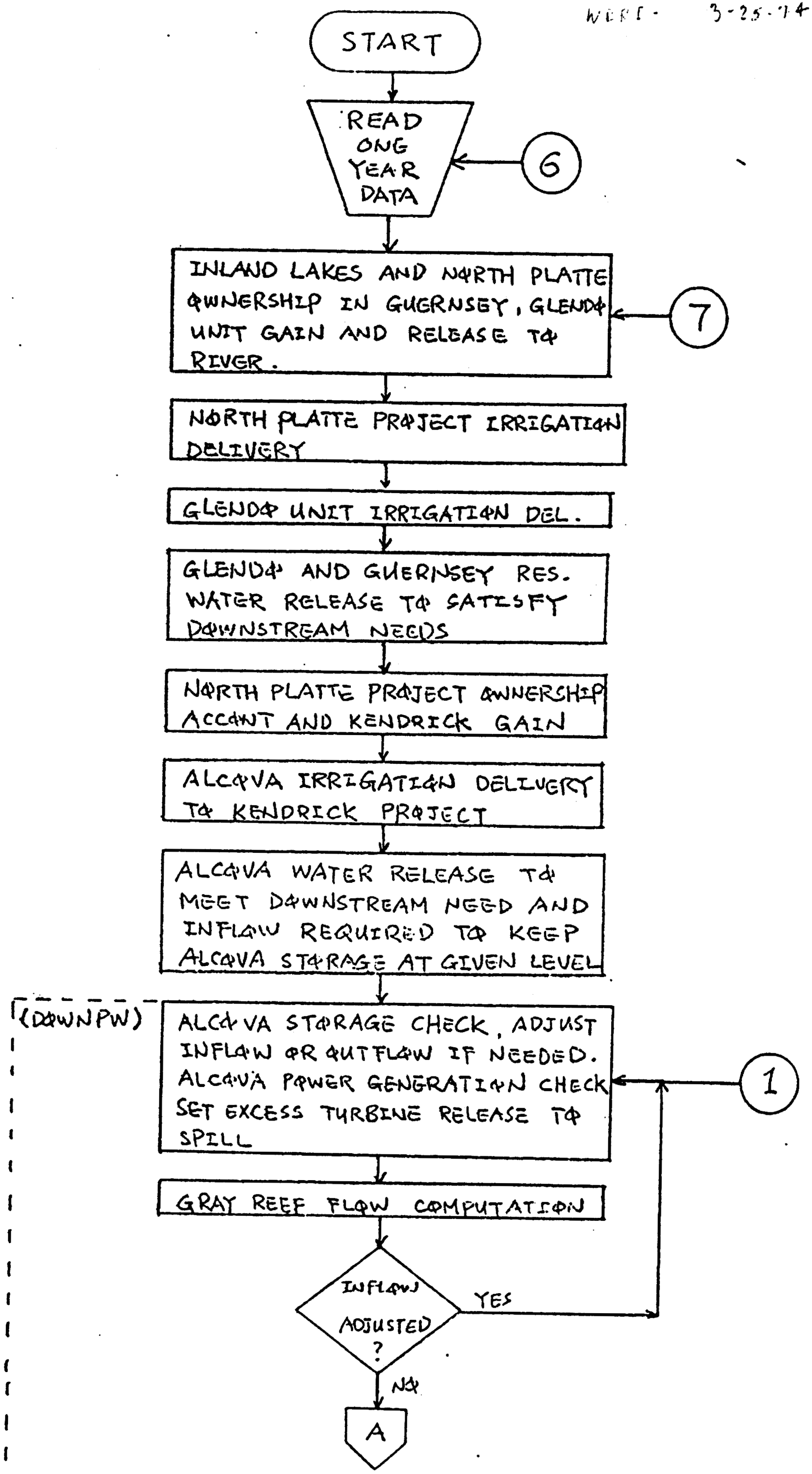
K+E 20 X 20 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 1240

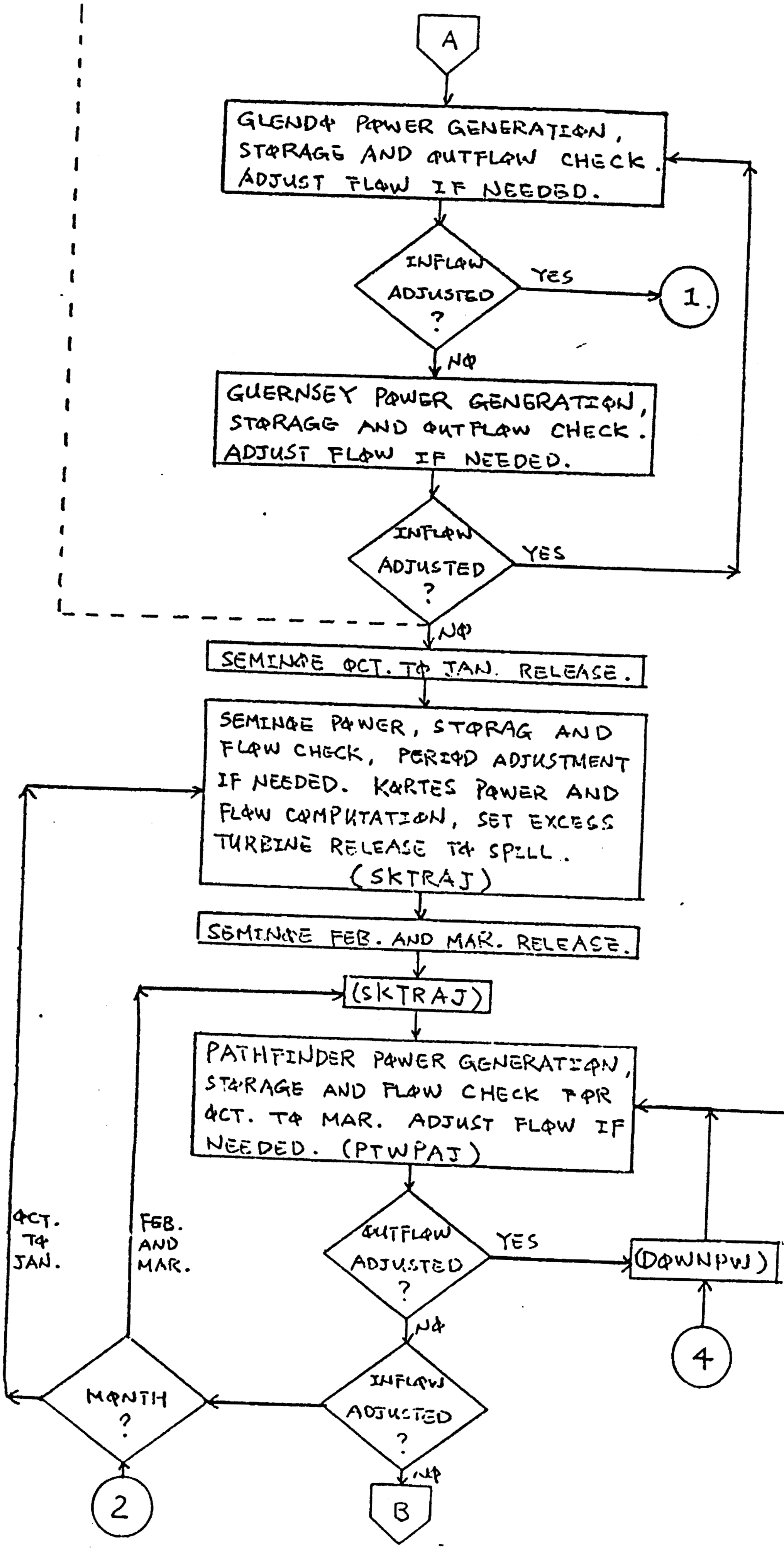


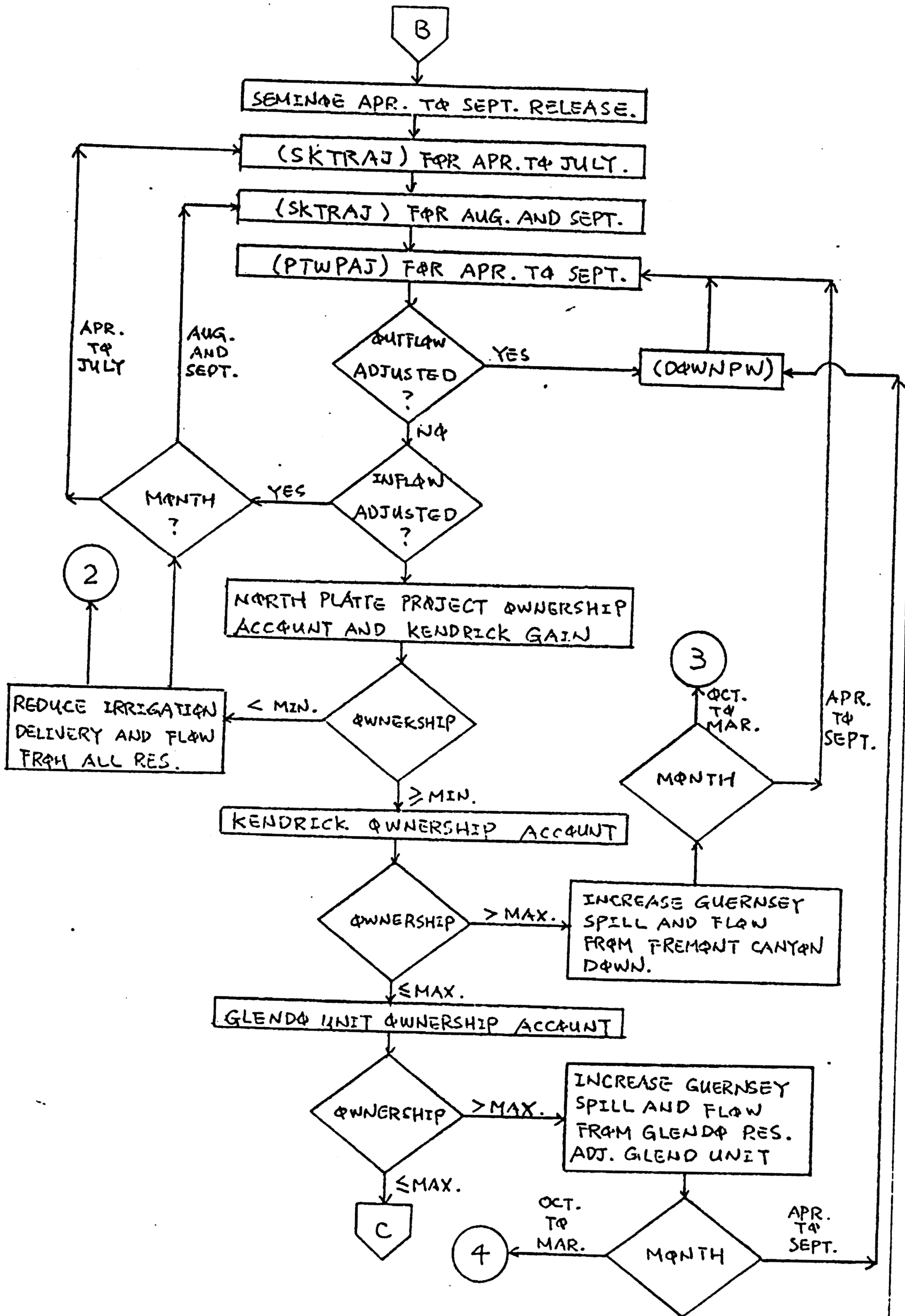
K•E 20 X 20 TO THE INCH • 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 1240

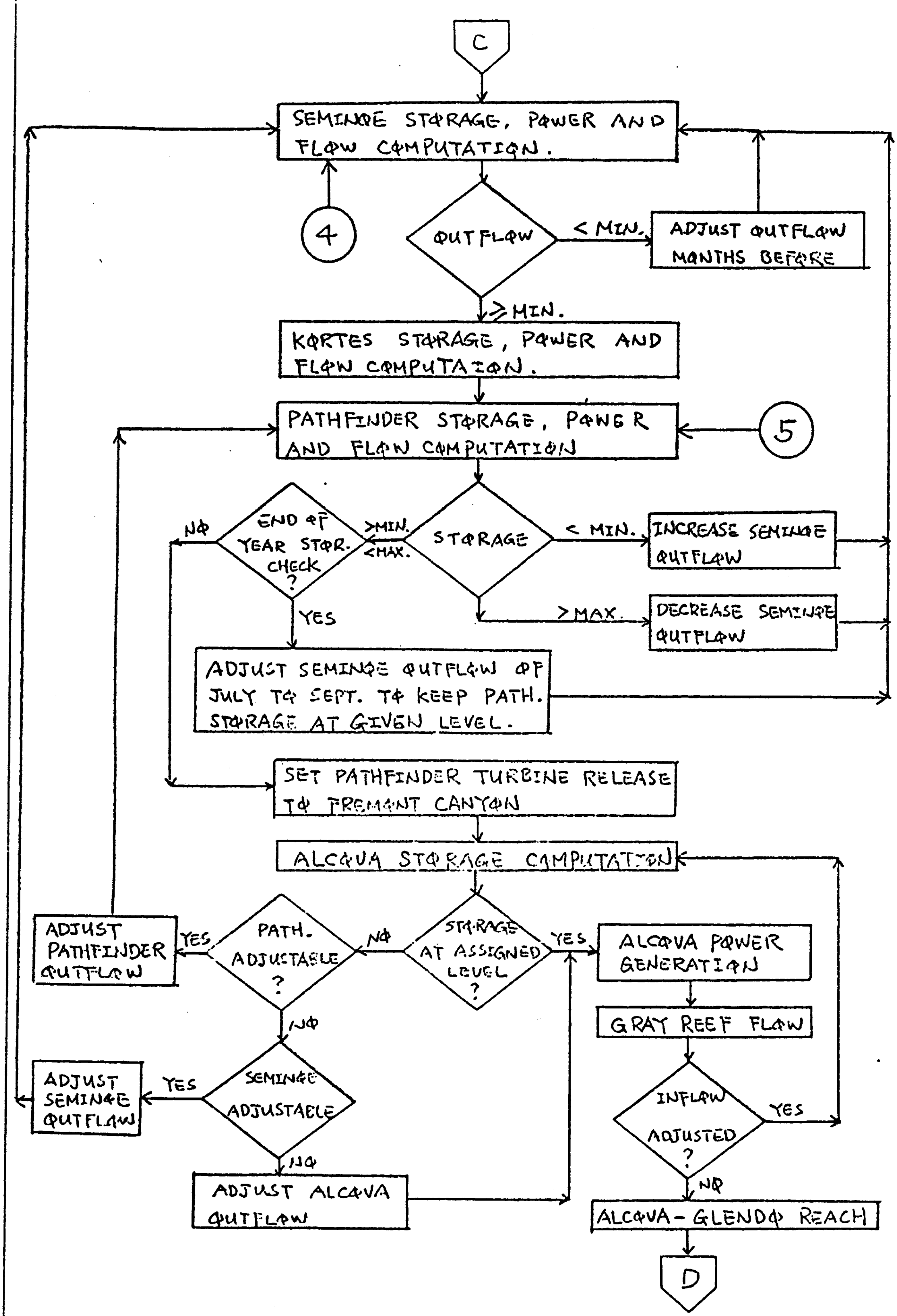


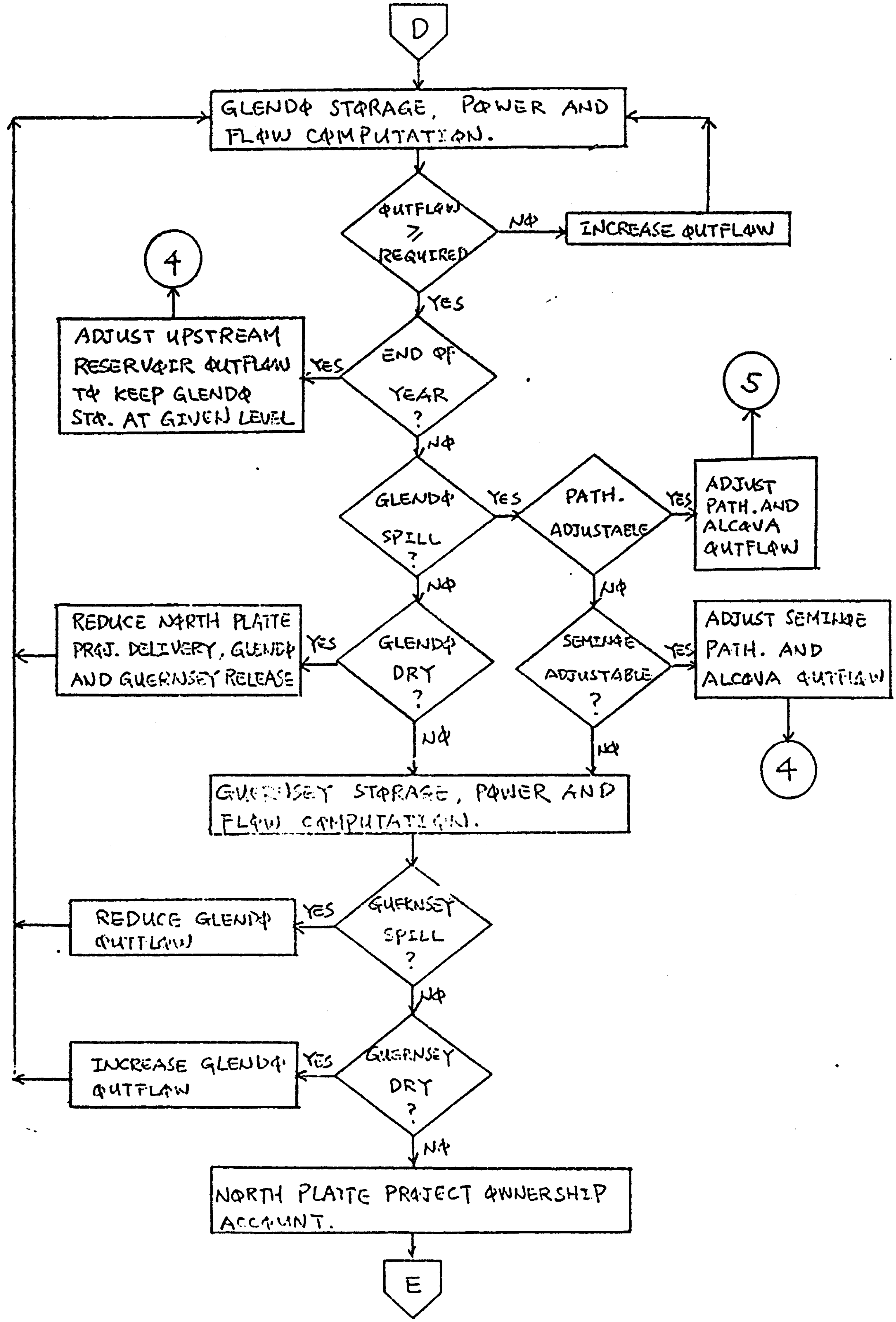
WERI - 3-25-74

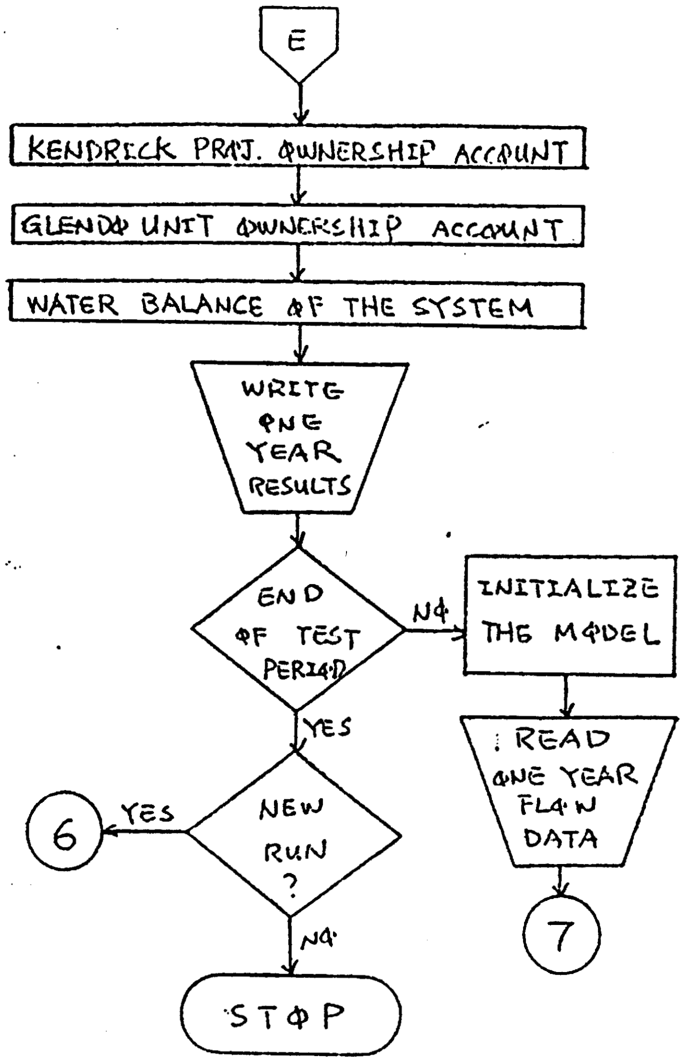

START
READ ONE YEAR DATA
6
INLAND LAKES AND NORTH PLATTE OWNERSHIP IN GUERNSEY, GLENDO UNIT GAIN AND RELEASE TO RIVER.
7
NORTH PLATTE PROJECT IRRIGATION DELIVERY
GLENDO UNIT IRRIGATION DEL.
GLENDO AND GUERNSEY RES. WATER RELEASE TO SATISFY DOWNSTREAM NEEDS
NORTH PLATTE PROJECT OWNERSHIP ACCONT AND KENDRICK GAIN
ALCOVA IRRIGATION DELIVERY TO KENDRICK PROJECT
ALCOVA WATER RELEASE TO MEET DOWNSTREAM NEED AND INFLOW REQUIRED TO KEEP ALCOVA STORAGE AT GIVEN LEVEL
(DOWNPW)
ALCOVA STORAGE CHECK, ADJUST INFLOW OR OUTFLOW IF NEEDED. ALCOVA POWER GENERATION CHECK SET EXCESS TURBINE RELEASE TO SPILL
1
GRAY REEF FLOW COMPUTATION
INFLOW ADJUSTED ?
YES
NO
A


A
GLENDO POWER GENERATION, STORAGE AND OUTFLOW CHECK. ADJUST FLOW IF NEEDED.
INFLOW ADJUSTED ?
YES
1.
NO
GUERNSEY POWER GENERATION, STORAGE AND OUTFLOW CHECK. ADJUST FLOW IF NEEDED.
INFLOW ADJUSTED ?
YES
NO
SEMINOE OCT. TO JAN. RELEASE.
SEMINOE POWER, STORAG AND FLOW CHECK, PERIOD ADJUSTMENT IF NEEDED. KORTES POWER AND FLOW COMPUTATION, SET EXCESS TURBINE RELEASE TO SPILL. (SKTRAJ)
SEMINOE FEB. AND MAR. RELEASE.
(SKTRAJ)
PATHFINDER POWER GENERATION, STORAGE AND FLOW CHECK FOR OCT. TO MAR. ADJUST FLOW IF NEEDED. (PTWPAJ)
3
OUTFLOW ADJUSTED ?
YES
(DOWNPW)
4
NO
OCT. TO JAN.
FEB. AND MAR.
MONTH ?
INFLOW ADJUSTED ?
NO
2
B


B
SEMINOE APR. TO SEPT. RELEASE.
(SKTRAJ) FOR APR. TO JULY.
(SKTRAJ) FOR AUG. AND SEPT.
(PTWPAJ) FOR APR. TO SEPT.
OUTFLOW ADJUSTED ?
YES
(DOWNPW)
NO
INFLOW ADJUSTED ?
YES
MONTH ?
APR. TO JULY
AUG. AND SEPT.
2
NORTH PLATTE PROJECT OWNERSHIP ACCOUNT AND KENDRICK GAIN
OWNERSHIP
< MIN.
REDUCE IRRIGATION DELIVERY AND FLOW FROM ALL RES.
≥ MIN.
KENDRICK OWNERSHIP ACCOUNT
OWNERSHIP
> MAX.
INCREASE GUERNSEY SPILL AND FLOW FROM FREMONT CANYON DOWN.
MONTH
OCT. TO MAR.
3
APR. TO SEPT.
≤ MAX.
GLENDO UNIT OWNERSHIP ACCOUNT
OWNERSHIP
> MAX.
INCREASE GUERNSEY SPILL AND FLOW FROM GLENDO RES. ADJ. GLEND UNIT
≤ MAX.
C
MONTH
OCT. TO MAR.
4
APR. TO SEPT.


C
SEMINOE STORAGE, POWER AND FLOW COMPUTATION.
4
OUTFLOW
< MIN.
ADJUST OUTFLOW MONTHS BEFORE
≥ MIN.
KORTES STORAGE, POWER AND FLOW COMPUTATION.
PATHFINDER STORAGE, POWER AND FLOW COMPUTATION
5
END OF YEAR STOR. CHECK ?
NO
>MIN. <MAX.
STORAGE
< MIN.
INCREASE SEMINOE OUTFLOW
>MAX.
DECREASE SEMINOE OUTFLOW
YES
ADJUST SEMINOE OUTFLOW OF JULY TO SEPT. TO KEEP PATH. STORAGE AT GIVEN LEVEL.
SET PATHFINDER TURBINE RELEASE TO FREMONT CANYON
ALCOVA STORAGE COMPUTATION
ADJUST PATHFINDER OUTFLOW
YES
PATH. ADJUSTABLE ?
NO
STORAGE AT ASSIGNED LEVEL ?
YES
ALCOVA POWER GENERATION
GRAY REEF FLOW
NO
ADJUST SEMINOE OUTFLAW
YES
SEMINOE ADJUSTABLE
INFLOW ADJUSTED ?
YES
NO
ADJUST ALCOVA OUTFLOW
NO
ALCOVA - GLENDO REACH
D


D
GLENDO STORAGE, POWER AND FLOW COMPUTATION.
OUTFLOW ≥ REQUIRED
NO
INCREASE OUTFLOW
YES
4
ADJUST UPSTREAM RESERVOIR OUTFLOW TO KEEP GLENDO STO. AT GIVEN LEVEL
YES
END OF YEAR ?
NO
GLENDO SPILL ?
YES
PATH. ADJUSTABLE
YES
ADJUST PATH. AND ALCOVA OUTFLOW
5
NO
REDUCE NORTH PLATTE PROJ. DELIVERY, GLENDO AND GUERNSEY RELEASE
YES
GLENDO DRY ?
NO
SEMINOE ADJUSTABLE ?
YES
ADJUST SEMINOE PATH. AND ALCOVA OUTFLOW
4
NO
GUERNSEY STORAGE, POWER AND FLOW COMPUTATION.
REDUCE GLENDO OUTFLOW
YES
GUERNSEY SPILL ?
NO
INCREASE GLENDO OUTFLOW
YES
GUERNSEY DRY ?
NO
NORTH PLATTE PROJECT OWNERSHIP ACCOUNT.
E


E
KENDRICK PROJ. OWNERSHIP ACCOUNT
GLENDO UNIT OWNERSHIP ACCOUNT
WATER BALANCE OF THE SYSTEM
WRITE ONE YEAR RESULTS
END OF TEST PERIOD
NO
INITIALIZE THE MODEL
READ ONE YEAR FLOW DATA
7
YES
NEW RUN ?
YES
6
NO
STOP

March 26, 1974

MEMORANDUM

TO : Frank J. Trelease, Director
Wyoming Water Planning Program

FROM : Louis E. Allen, Water Resource Engineer

SUBJECT : Meeting on Platte River Model, March 25, 1974,
1330 to 1700, University of Wyoming, WRRI, Laramie

Those Present: Tsong Wei, Paul Rechard, George Christopulos, Roger Perkins, Clive Walker, Ron Tabler, Lou Allen

Discussion was confined to the river operation model, which starts with the inflow to Seminoe Reservoir and operates the storages, accretions, and decretions through Guernsey Reservoir on a monthly basis. The model operates in such a way that downstream demands are satisfied first. Requirements imposed by Decree appear to be met.

Future work suggested: (1) Expand criteria description; (2) Extend operation to Nebraska State Line; (3) Consider industrial diversion ownerships and priorities; (4) Bring model to daily operation; and (5) Look at alternate operations.

Some written material in rough form on criteria, and a model flow chart, was provided. Additional written material, plus printout, will be forwarded when available.

There was some discussion relative to input-output exchange between this model and the economic model, and to using output from the as-yet-to-be-developed watershed model as input to this operation model. A ground-water model will eventually be incorporated, when it is developed.

Apparently the next emphasis will be on extension to the stateline, daily operation, and then the watershed model.

III. Criteria and operation methods.

1. General criteria and operation methods:

- Generally operate reservoir within the range from min. capacity or dry capacity up to max. capacity.
- From storage control, Seminoe, Pathfinder and Glendo are free reservoirs and Alcova and Guernsey are fixed reservoirs
- Total annual release try to meet downstream demands and carryover storage requirements.
- All release should be made through the available powerplant units to generate max. power.
- ? When spill or shortage occurs first adjust flow in the reservoir within the month to ~~not~~ eliminate or reduce them.
- After adjustments if spill or shortage still exist adjust upstream reservoir or reservoirs if permissible
- Store as much water as possible in upstream reservoirs

Seminoe - Kortes

- Operate reservoir from 1010.8 down to 50,000 A-F or 30,000 AF min. capacity when necessary.
- Lower reservoir sufficiently by end of March to fill without spill during April - July period.
- Release controled by Kortes plant capacity.
- The water year divided to 4 period i.e. Oct - Jan Feb. & Mar. Apr. - July & Aug. & Sept. The spill & shortages are adjusted within each period.
- Min. release 30,000 ac-ft/month ≈ 500 cfs. should be maintained.
- Between Pathfinder & Seminoe, it is generally preferable to maintain balance of storage in Seminoe i.e. operate Seminoe storage higher and Pathfinder Storage lower
- Store water in summer & release in winter to Pathfinder.
- Avoid spill & bypass unless the are absolutely necessary.

Pathfinder –

- Operate reservoir from 1015.9 to 50.0,
- Release as necessary to meet downstream demands.
- ~~Lower~~ Maintain reservoir storage at the end of year to 50 [af] when Seminoe & ~~Pathfinder~~ Pathfinder storage combined become less than 400.
- No way to spill reservoir except by surcharge of reservoir above natural rock overflow spillway.
- Adjust flow from Seminoe if necessary to eliminate spill or shortage.

Alcova - Gray Reef.

- Operate the reservoir at <u>155.0</u> (155.9) for winter level and <u>188.4</u> for Summer level.
- Refill reservoir to summer level during <u>Mar.</u> and lower to winter level during <u>Sept.</u>
- Release to Casper Canal starting <u>May</u> to <u>Sept</u> with max. amount of <u>20,000 AF</u>

- Gray Reef at present takes release from Alcova & release the same amount without any limitation. but later following will be used

max.	900 cfs	for Dec. - Mar.
desirable min.	500 cfs	
min.	330 cfs	
absolute min.	200 cfs.	

Glendo —

- Operate reservoir within the range of 60 up to 523.3 1000 A-F
- Release to meet downstream demands and minimize ~~other~~ releases other than powerplant.
- Lower reservoir to 60. of content by end of each water year.
- Generally no release from Oct – early March.
- Approx. max. release of 10,000 cfs in case of flood 600 Ac-ft/month.
- Release in March to refill Guernsey to power head prior to release to Inland Lake take place. (April)
- Refill the reservoir in ~~su~~ winter & release in summer.

Guernsey –

- Capture winter drainage gain – Oct – Mar.
- Refill to power ~~level~~ head in Mar.
- Release water owed to river then to Inland Lakes in April.
- Operate reservoir at

  35.0 March through June

  20.0 July & Aug.

  Lower to 1.0 at the end of year.
- 45.2 is full, thus 35.0 can provide 10,000 acre foot of flood control space & to capture water in transit from Glendo in case of heavy local rainfall.

North Platte Project.

- Max. ownership 1060.6 + 46K in Inland [illegible] — Where accounted for
  Min. ownership 10.0
- Irrigation demand Mar – Sept.
  (30), (30), 75, 170, 285, 290, 170.
- Water gain
  Total water gain in system less ~~owned~~ owed to river & Glendo Unit gain.
- Evaporation.
  Ownership – Guernsey storage as ev. computation storage.
  Use Path. evaporation eq.
- ownership becomes less than min. reduce delivery to maintain min. ownership.

13

Glendo Unit Project

- Max. Possible Gain in season. 32.6. 40?
- Max. irrigation 18. evenly distributed for July - Sept. 2 why 18? should be 40?
- Water gain - after North Platte gain reaches physical Guernsey reservoir contents, excess water is assigned to Glendo & River
  total gain cannot ~~exceed~~ max. possible gain.
- Evaporation
  System EV - NP. EV - Kendrick EV.

?0
153.7

Kendrick

- Max. ownership 1199.863
- Storage in Alcova to reach Casper Canal (210)
- Irrigation demand. total 70. May - Sept.
  7. 17. 20. 17. 9.
- Water Gain - After N.P. reach Max. ownership. excess water assigned to Kendrick
- Evaporation.
  Ownership storage - Alcova storage
  Use Seminoe eq.

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

State Engineer's Office

STATE OFFICE BUILDING CHEYENNE, WYOMING 82002
WYOMING WATER PLANNING PROGRAM

August 25, 1975

MEMORANDUM

TO: Frank J. Trelease, Director, WWPP

FROM: Louis E. Allen, Water Resources Engineer, WWPP

SUBJECT: North Platte River Model, Comparisons

MODELS: USBR: Western Division Missouri River Basin Fish Flow Analysis with 500 cfs from Kortes - Study #4 (Output headings indicate a minimum Kortes release of 46,000 ac-ft per month)
U.W.: Test Run 1 - Base Run - Operational Rules under Present Conditions (No criteria indicated)

The USBR version is apparently a power maximizing model, with the available run having the constraint of a minimum release from Kortes of 46,000 ac-ft per month from Kortes. The output reflects the Western Division interactions, with power generation in river basins in addition to the North Platte River.

The U.W. version apparently is designed to reflect present conditions of North Platte River operation, with options of exploring the effects of various possible maximizing or minimizing criteria and of increased capacity in Seminoe Reservoir. The model is designed for input-output exchange with other related models either being developed or planned. The available run is a base run with operation rules under present conditions.

The output formats of the two models are similar, but the various accounting line headings and groupings vary enough to make direct comparisons difficult. Such things as ownership accounting can be roughly compared as to consistency, but without the model programs the adequacy of their calculation in the models cannot be assessed.

The studies appear to be consistent, considering the differences in operating criteria with the resulting variations in reservoir levels and evaporation, turbine releases, irrigation deliveries, etc. The ownership accounting appears to be consistent, within the above variations, so far as the two accounting methods can be compared.

Both sets of data terminate after the 1963 water year. Comparisons for the recent (1971-1973 or 1974) water years would be of interest, in view of the high-flow character of these years and the actual spilling of Pathfinder Reservoir in this period.

The U.W. model output format seems to be the easier to follow. The more detailed breakdowns and the downstream order of reporting reservoirs and reaches is a more logical presentation of data.

The U.W. model run provided appears to indicate that the model is adequate as a basis of a comparative analysis for the Seminoe Dam Modifications Studies, providing the recent high flow years are handled satisfactorily by the model.

LEA:dm

August 29, 1975

Mr. Joe D. Hall
Regional Director
U. S. Bureau of Reclamation
Building 20
Denver Federal Center
Denver, Colorado 80225

Reference: LM-730, 510. Kendrick

Dear Mr. Hall:

In response to your letter of August 14 to Mr. Frank J. Trelease, my staff has reviewed the Base Run Study of the North Platte River in Wyoming.

The model run furnished indicates that the model is apparently adequate as a basis of a comparative analysis for the Seminoe Dam Modifications Studies, providing the recent high flow years are handled satisfactorily by the model.

Sincerely,

George L. Christopulos
STATE ENGINEER

GLC:LEA:ew

EVALUATION OF THE
NORTH PLATTE RIVER MANAGEMENT MODEL

Volume 2 of 2

August 9, 1984

Submitted to:

Wyoming Water Research Center

and

Wyoming Water Development Commission

Submitted by:

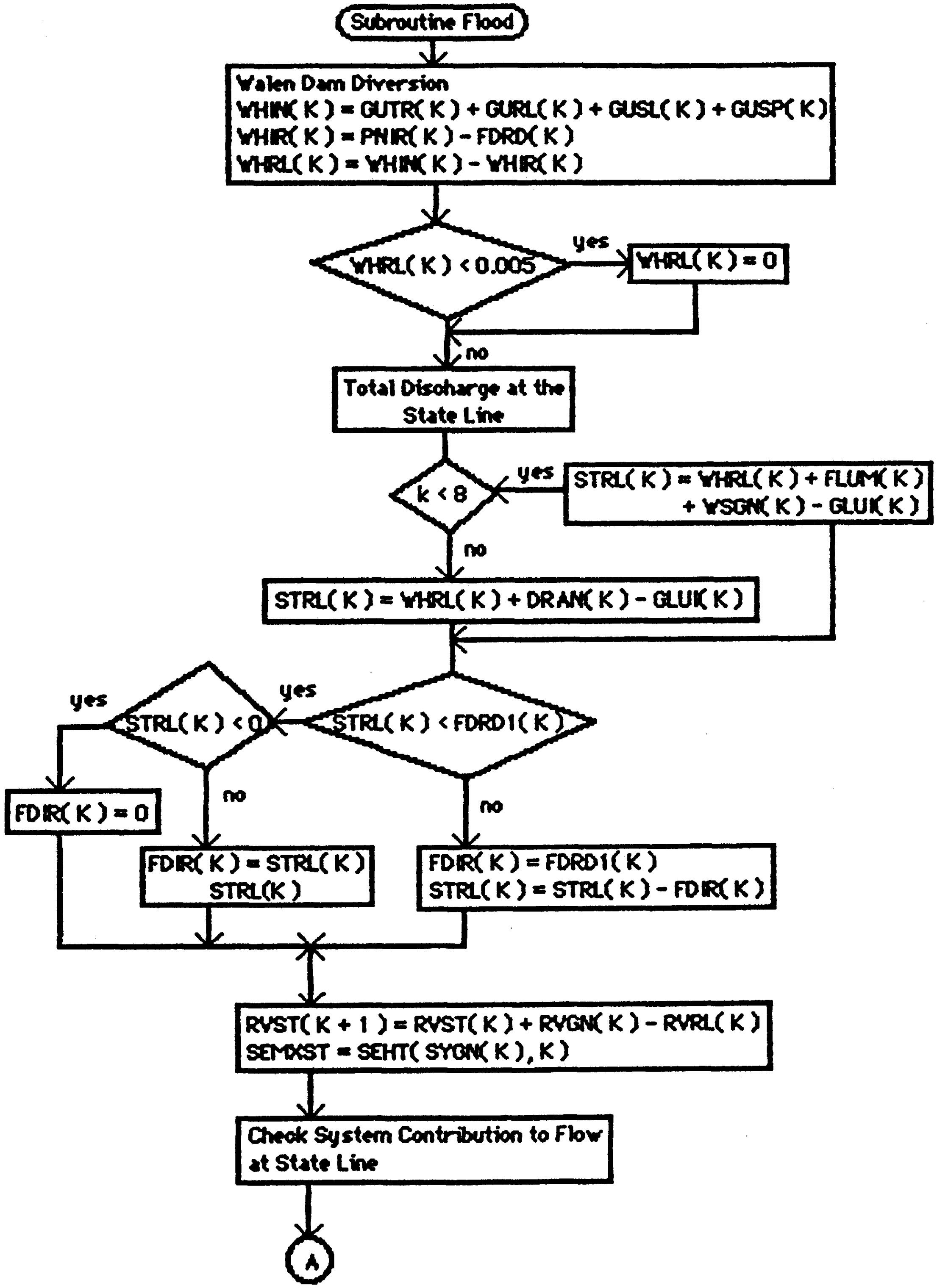
Western Water Consultants, Inc,
P.O. Box 4128
Laramie, Wyoming 82071

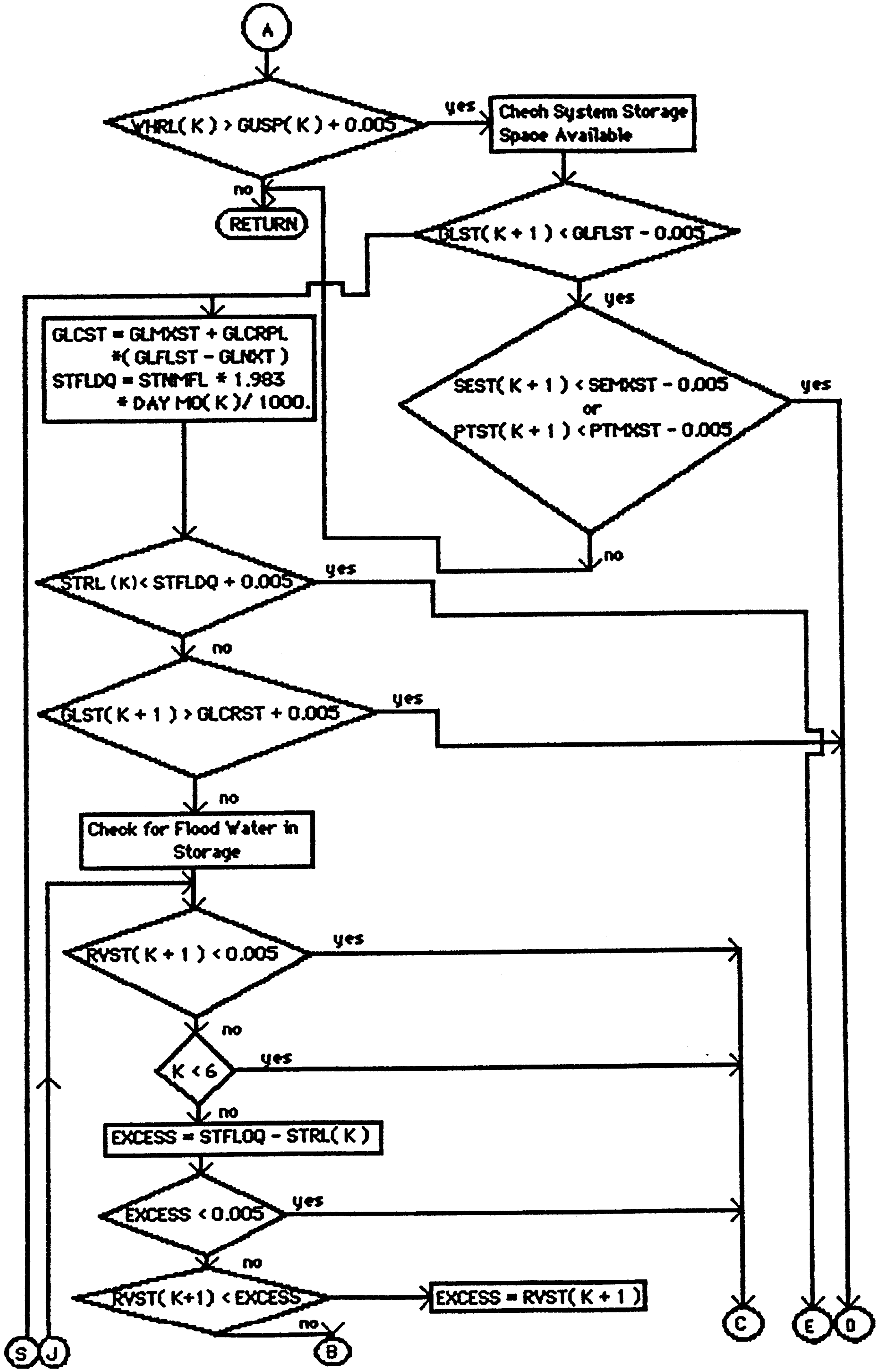
APPENDIX B

SUBROUTINE FLOW CHARTS

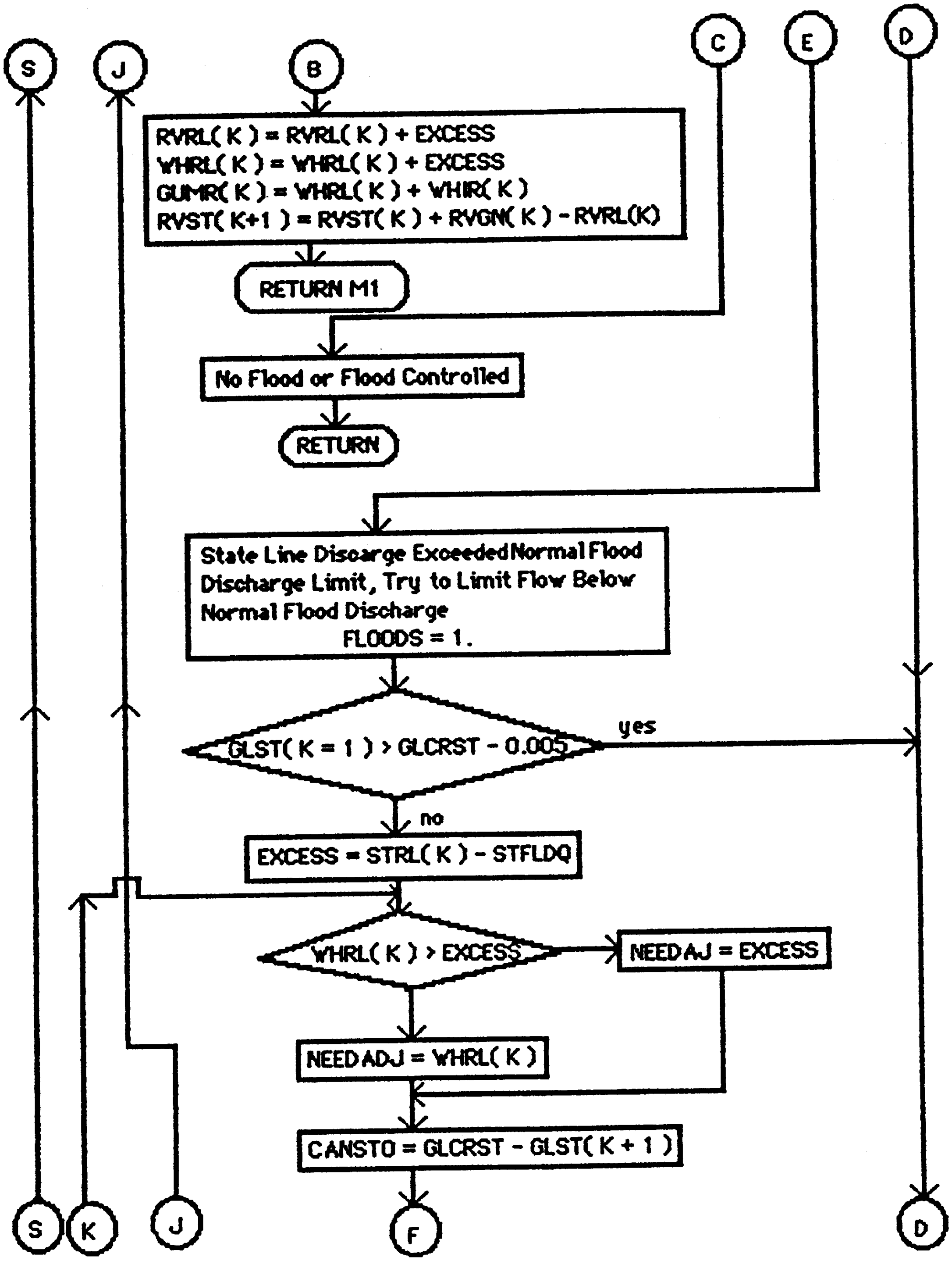
APPENDIX B
TABLE OF CONTENTS

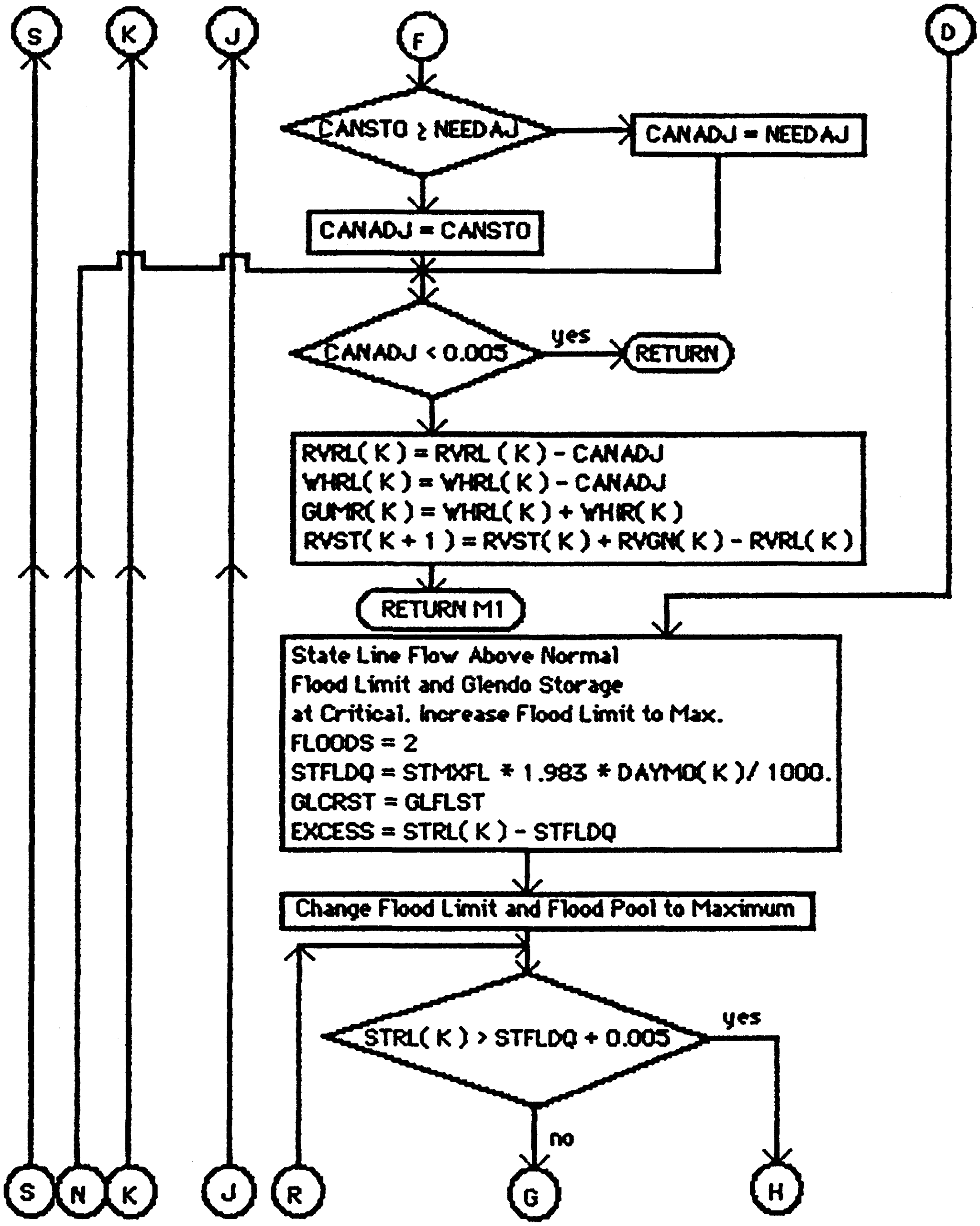
Description: Controls the Flood Passing Through the State Line and Division From Glendo Unit and N. Platte Project Irrigation Water are Diverted at the Whalen Dam.



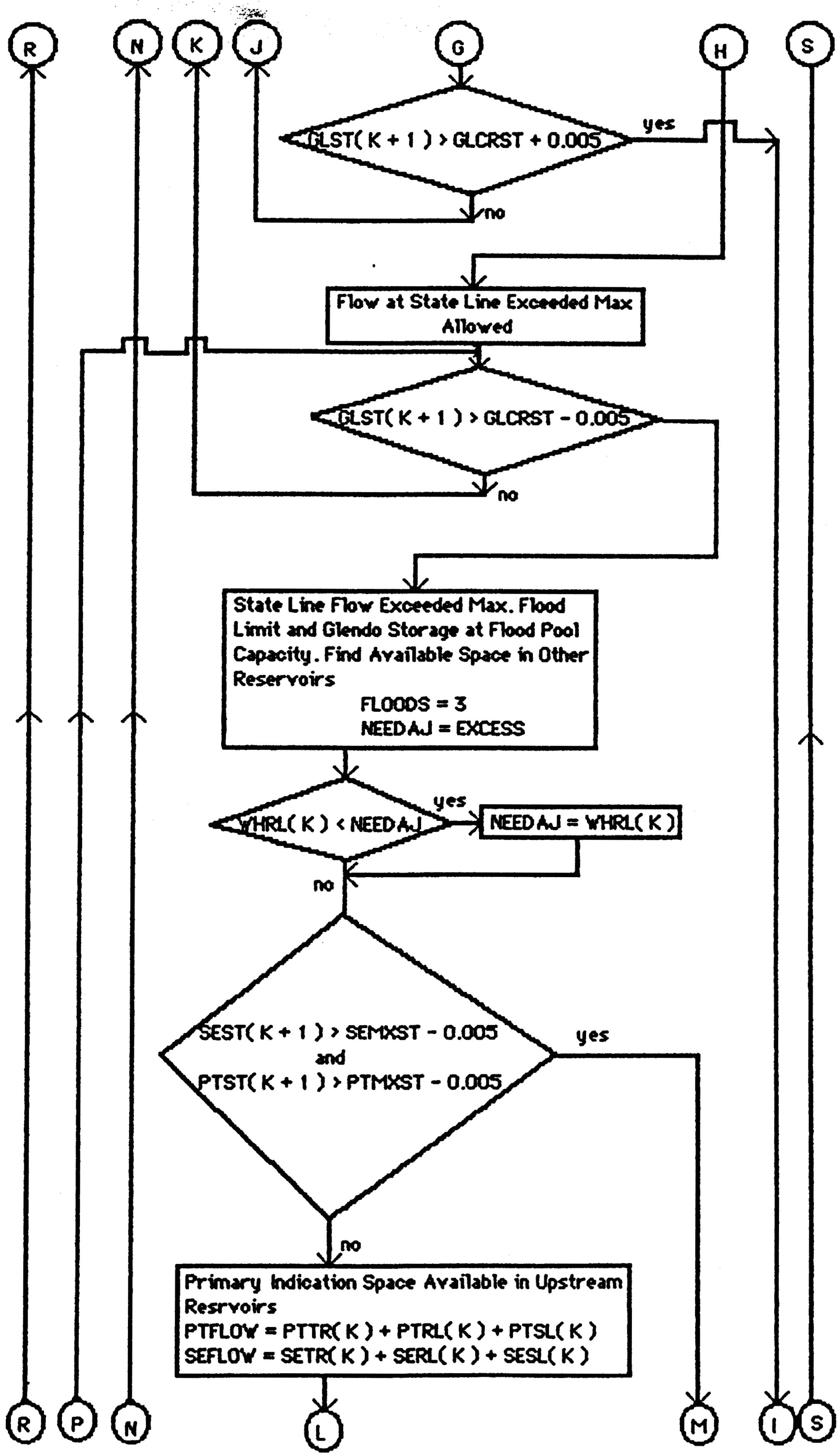


A
VHRL(K) > GUSP(K) + 0.005
yes
Chech System Storage Space Available
no
RETURN
GLST(K + 1) < GLFLST - 0.005
yes
SEST(K + 1) < SEMXST - 0.005 or PTST(K + 1) < PTMXST - 0.005
yes
no
GLCST = GLMXST + GLCRPL *(GLFLST - GLNXT)
STFLDQ = STNMFL * 1.983 * DAY MO(K)/ 1000.
STRL (K)< STFLDQ + 0.005
yes
no
GLST(K + 1) > GLCRST + 0.005
yes
no
Check for Flood Water in Storage
RVST(K + 1) < 0.005
yes
no
K < 6
yes
no
EXCESS = STFLOQ - STRL(K)
EXCESS < 0.005
yes
no
RVST(K+1) < EXCESS
EXCESS = RVST(K + 1)
no
S
J
B
C
E
D

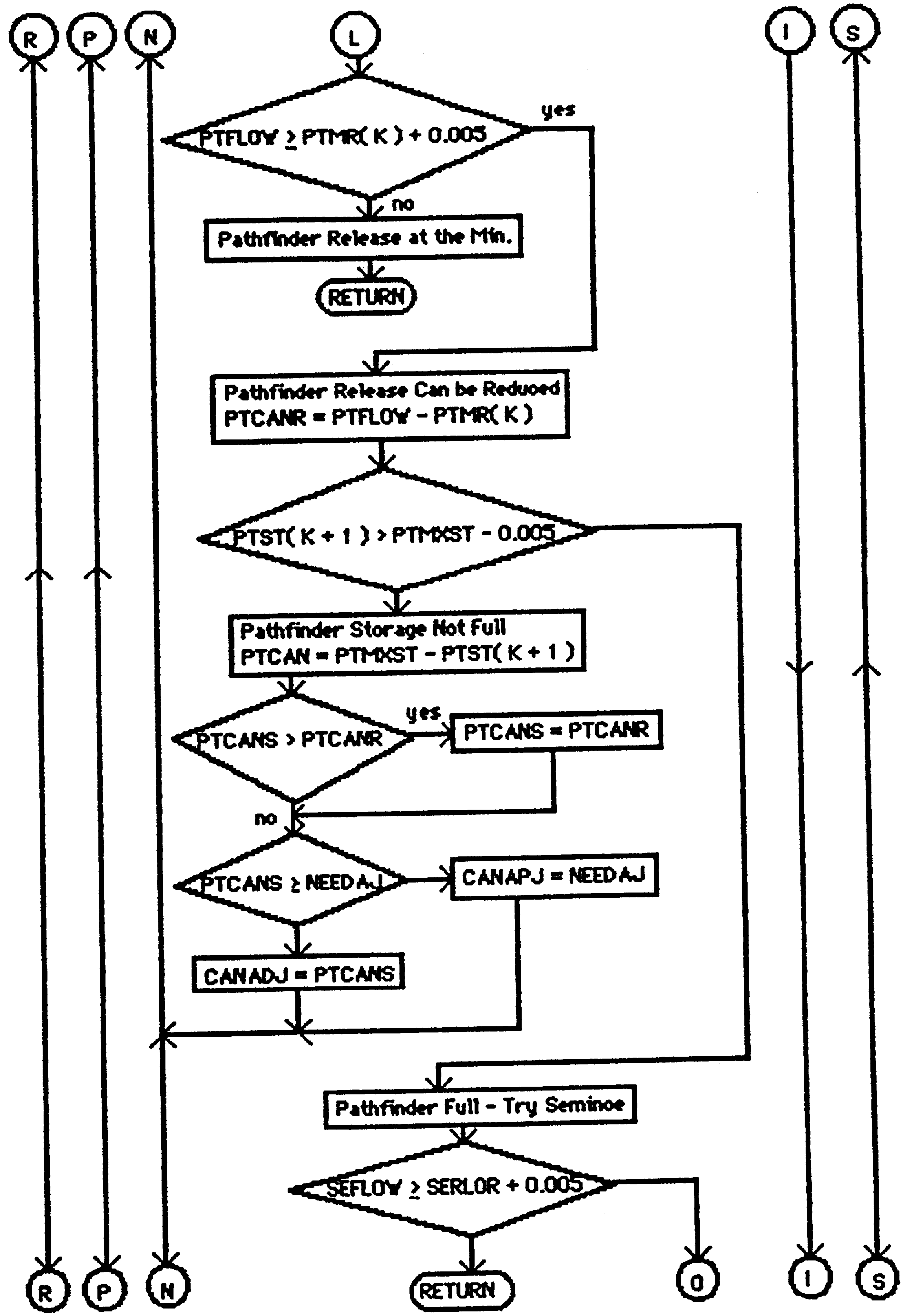

S
J
B
C
E
D
RVRL(K) = RVRL(K) + EXCESS
WHRL(K) = WHRL(K) + EXCESS
GUMR(K) = WHRL(K) + WHIR(K)
RVST(K+1) = RVST(K) + RVGN(K) - RVRL(K)
RETURN M1
No Flood or Flood Controlled
RETURN
State Line Discarge Exceeded Normal Flood Discharge Limit, Try to Limit Flow Below Normal Flood Discharge
FLOODS = 1.
GLST(K = 1) > GLCRST - 0.005
yes
no
EXCESS = STRL(K) - STFLDQ
WHRL(K) > EXCESS
NEEDAJ = EXCESS
NEEDADJ = WHRL(K)
CANSTO = GLCRST - GLST(K + 1)
S
K
J
F
D

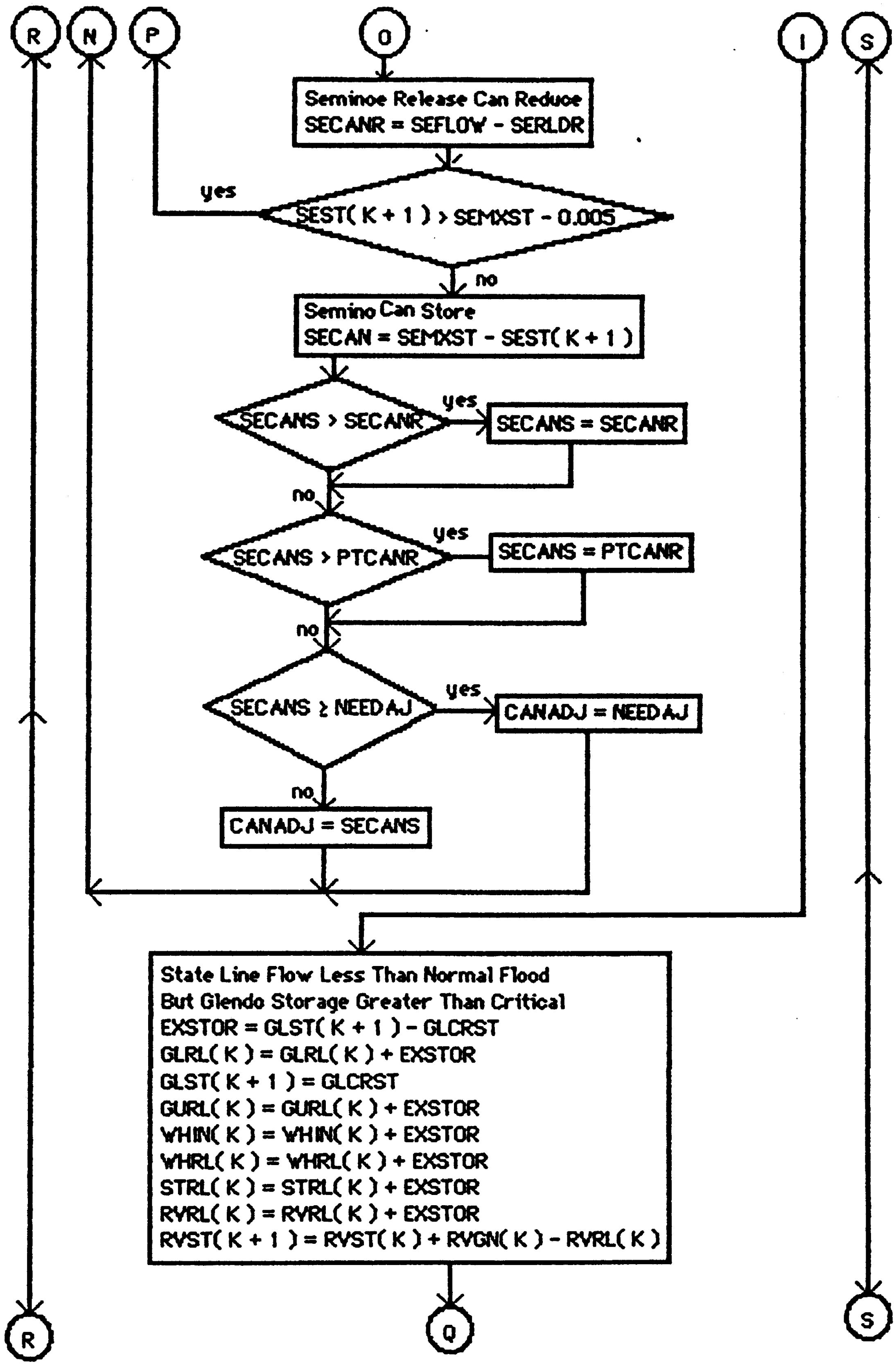


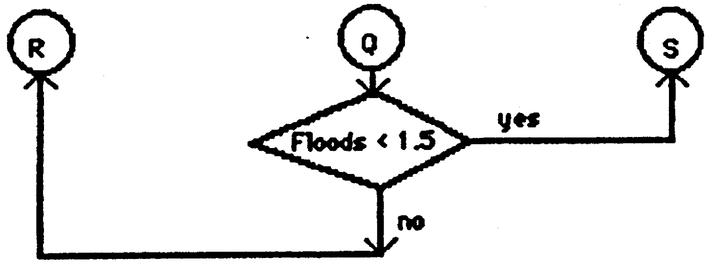
S
K
J
F
D
CANSTO ≥ NEEDAJ
CANADJ = NEEDAJ
CANADJ = CANSTO
CANADJ < 0.005
yes
RETURN
RVRL(K) = RVRL (K) - CANADJ
WHRL(K) = WHRL(K) - CANADJ
GUMR(K) = WHRL(K) + WHIR(K)
RVST(K + 1) = RVST(K) + RVGN(K) - RVRL(K)
RETURN M1
State Line Flow Above Normal
Flood Limit and Glendo Storage
at Critical. Increase Flood Limit to Max.
FLOODS = 2
STFLDQ = STMXFL * 1.983 * DAYMO(K)/ 1000.
GLCRST = GLFLST
EXCESS = STRL(K) - STFLDQ
Change Flood Limit and Flood Pool to Maximum
STRL(K) > STFLDQ + 0.005
yes
no
S
N
K
J
R
G
H



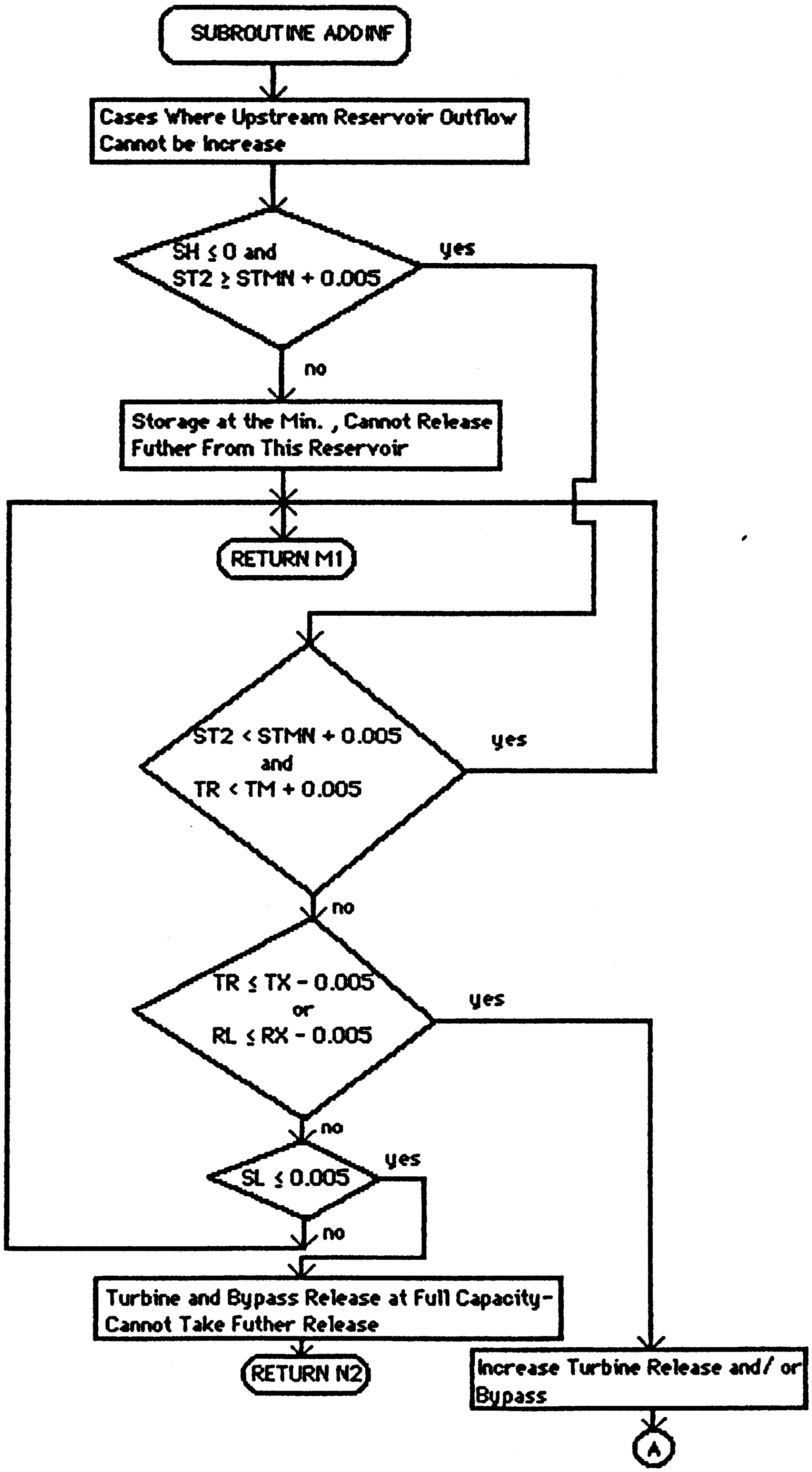
R
N
K
J
G
H
S
GLST(K + 1) > GLCRST + 0.005
yes
no
Flow at State Line Exceeded Max Allowed
GLST(K + 1) > GLCRST - 0.005
no
State Line Flow Exceeded Max. Flood Limit and Glendo Storage at Flood Pool Capacity. Find Available Space in Other Reservoirs
FLOODS = 3
NEEDAJ = EXCESS
WHRL(K) < NEEDAJ
yes
NEEDAJ = WHRL(K)
no
SEST(K + 1) > SEMXST - 0.005
and
PTST(K + 1) > PTMXST - 0.005
yes
no
Primary Indication Space Available in Upstream Resrvoirs
PTFLOW = PTTR(K) + PTRL(K) + PTSL(K)
SEFLOW = SETR(K) + SERL(K) + SESL(K)
R
P
N
L
M
I
S

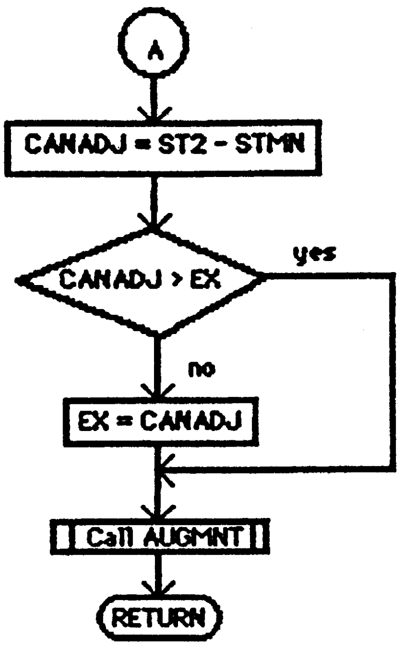

R
P
N
L
I
S
PTFLOW ≥ PTMR(K) + 0.005
yes
no
Pathfinder Release at the Min.
RETURN
Pathfinder Release Can be Reduced
PTCANR = PTFLOW - PTMR(K)
PTST(K + 1) > PTMXST - 0.005
Pathfinder Storage Not Full
PTCAN = PTMXST - PTST(K + 1)
PTCANS > PTCANR
yes
PTCANS = PTCANR
no
PTCANS ≥ NEEDAJ
CANAPJ = NEEDAJ
CANADJ = PTCANS
Pathfinder Full - Try Seminoe
SEFLOW ≥ SERLOR + 0.005
RETURN
O


R
N
P
O
I
S
Seminoe Release Can Reduce
SECANR = SEFLOW - SERLDR
yes
SEST(K + 1) > SEMXST - 0.005
no
Semino Can Store
SECAN = SEMXST - SEST(K + 1)
SECANS > SECANR
yes
SECANS = SECANR
no
SECANS > PTCANR
yes
SECANS = PTCANR
no
SECANS ≥ NEEDAJ
yes
CANADJ = NEEDAJ
no
CANADJ = SECANS
State Line Flow Less Than Normal Flood
But Glendo Storage Greater Than Critical
EXSTOR = GLST(K + 1) - GLCRST
GLRL(K) = GLRL(K) + EXSTOR
GLST(K + 1) = GLCRST
GURL(K) = GURL(K) + EXSTOR
WHIN(K) = WHIN(K) + EXSTOR
WHRL(K) = WHRL(K) + EXSTOR
STRL(K) = STRL(K) + EXSTOR
RVRL(K) = RVRL(K) + EXSTOR
RVST(K + 1) = RVST(K) + RVGN(K) - RVRL(K)
R
Q
S

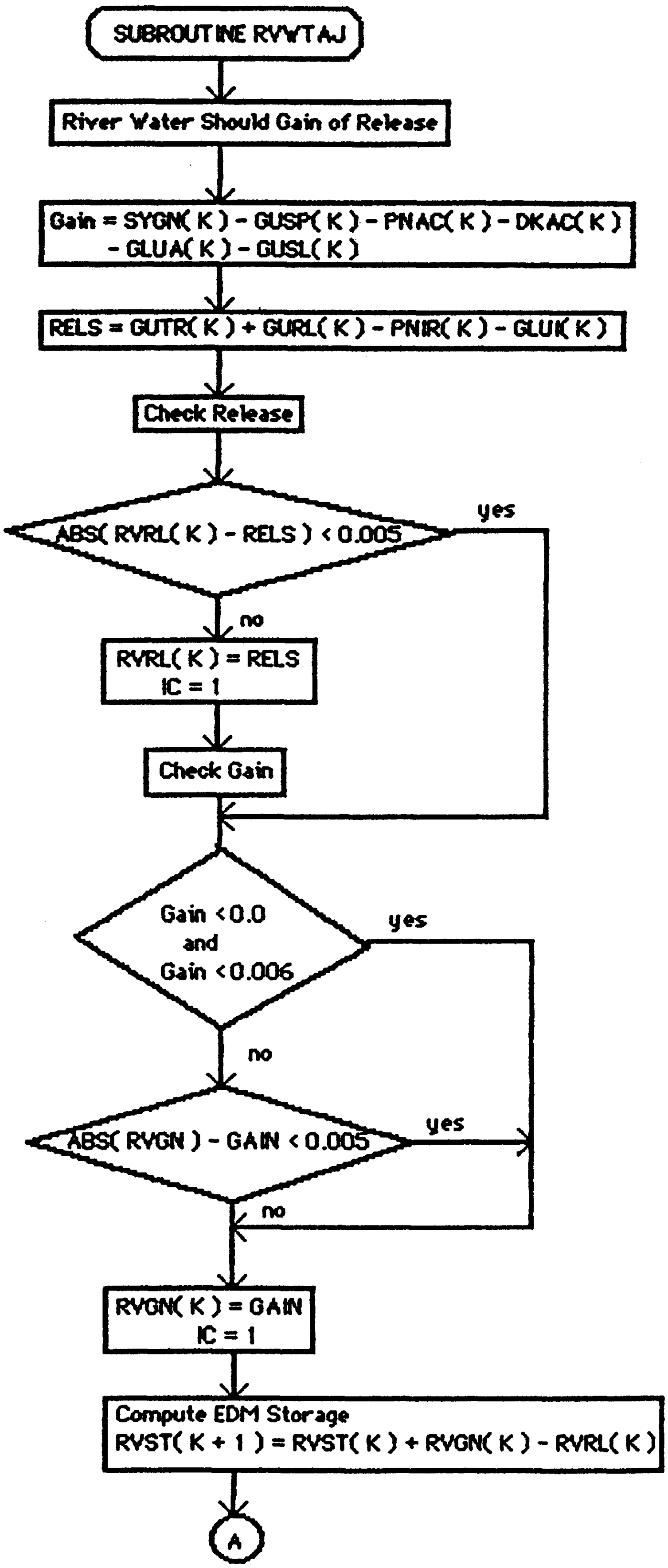

R
Q
S
Floods < 1.5
yes
no

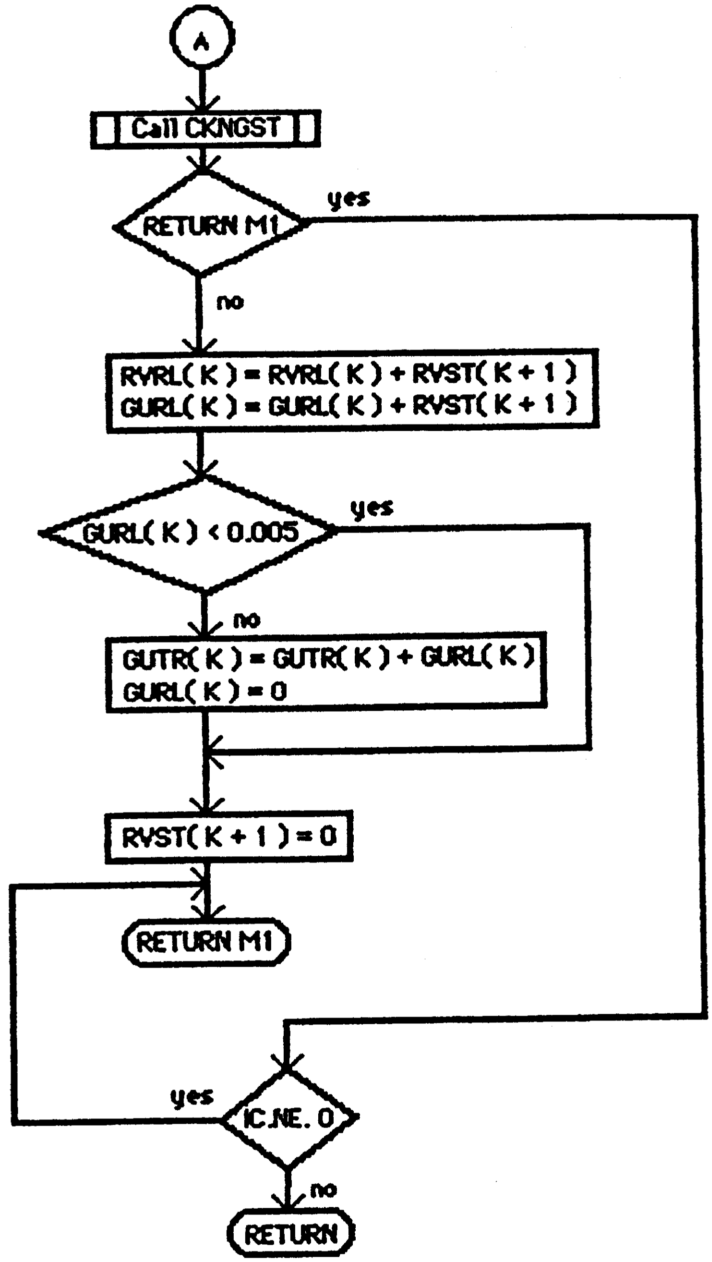
Description: Increase the Outflow of an Upstream Reservoir to Maintain Storage of Computing Reservoir at a Desired Level.
Return 1 To Futher Upstream Reservoir
Return 2 To the Computing Reservoir for Reducing Flow

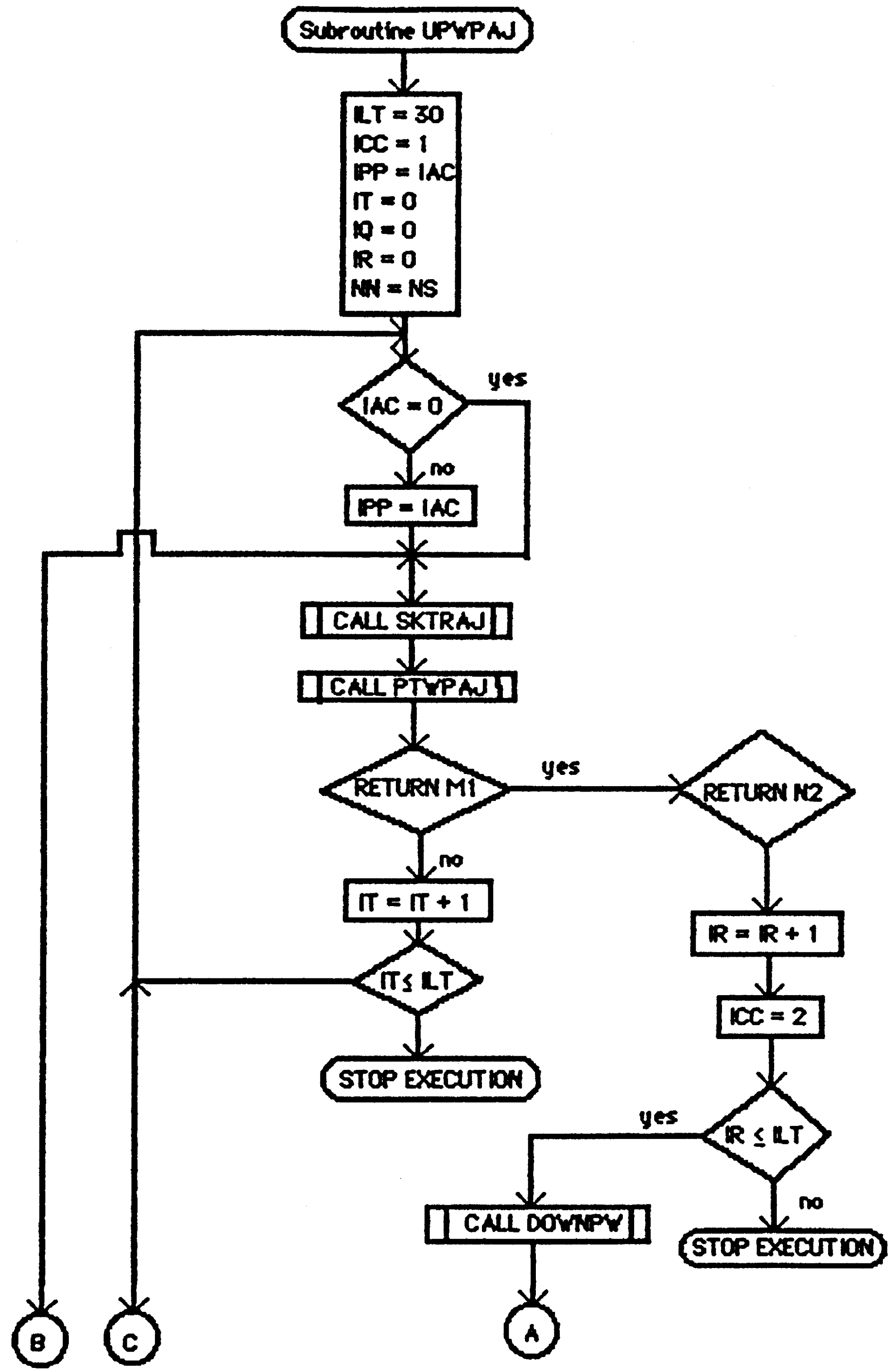


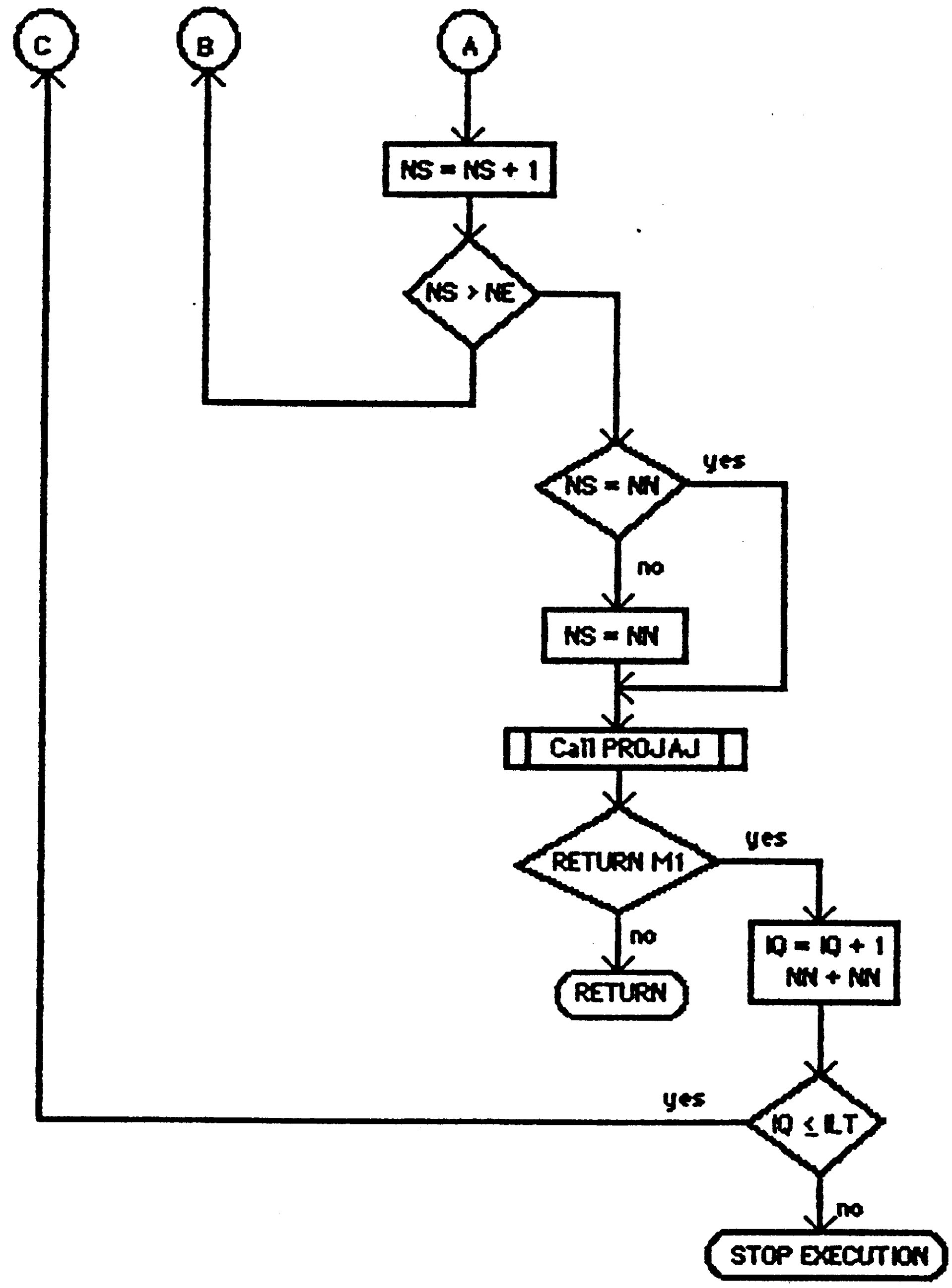

A
CANADJ = ST2 - STMN
CANADJ > EX
yes
no
EX = CANADJ
Call AUGMNT
RETURN

Description: Adjustment of River Gain and Release IC =≠ No Adjustment made, IC = 1 Adjusted

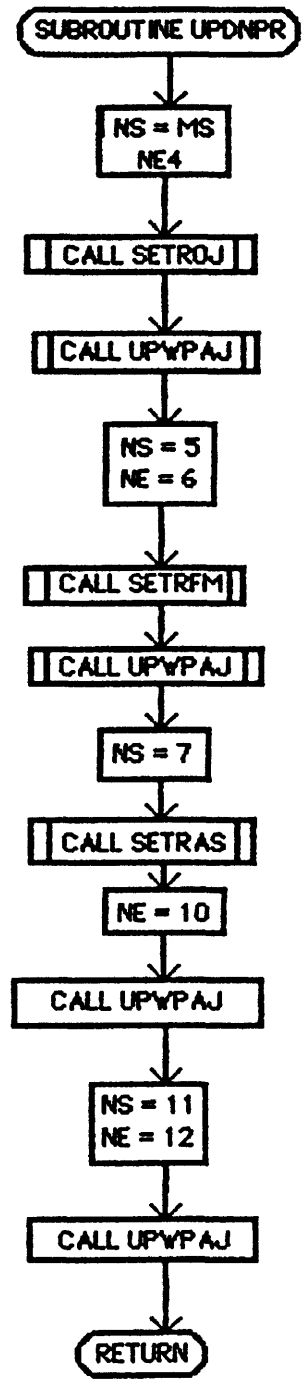



A
Call CKNGST
RETURN M1
yes
no
RVRL(K) = RVRL(K) + RVST(K + 1)
GURL(K) = GURL(K) + RVST(K + 1)
GURL(K) < 0.005
yes
no
GUTR(K) = GUTR(K) + GURL(K)
GURL(K) = 0
RVST(K + 1) = 0
RETURN M1
yes
IC.NE. 0
no
RETURN

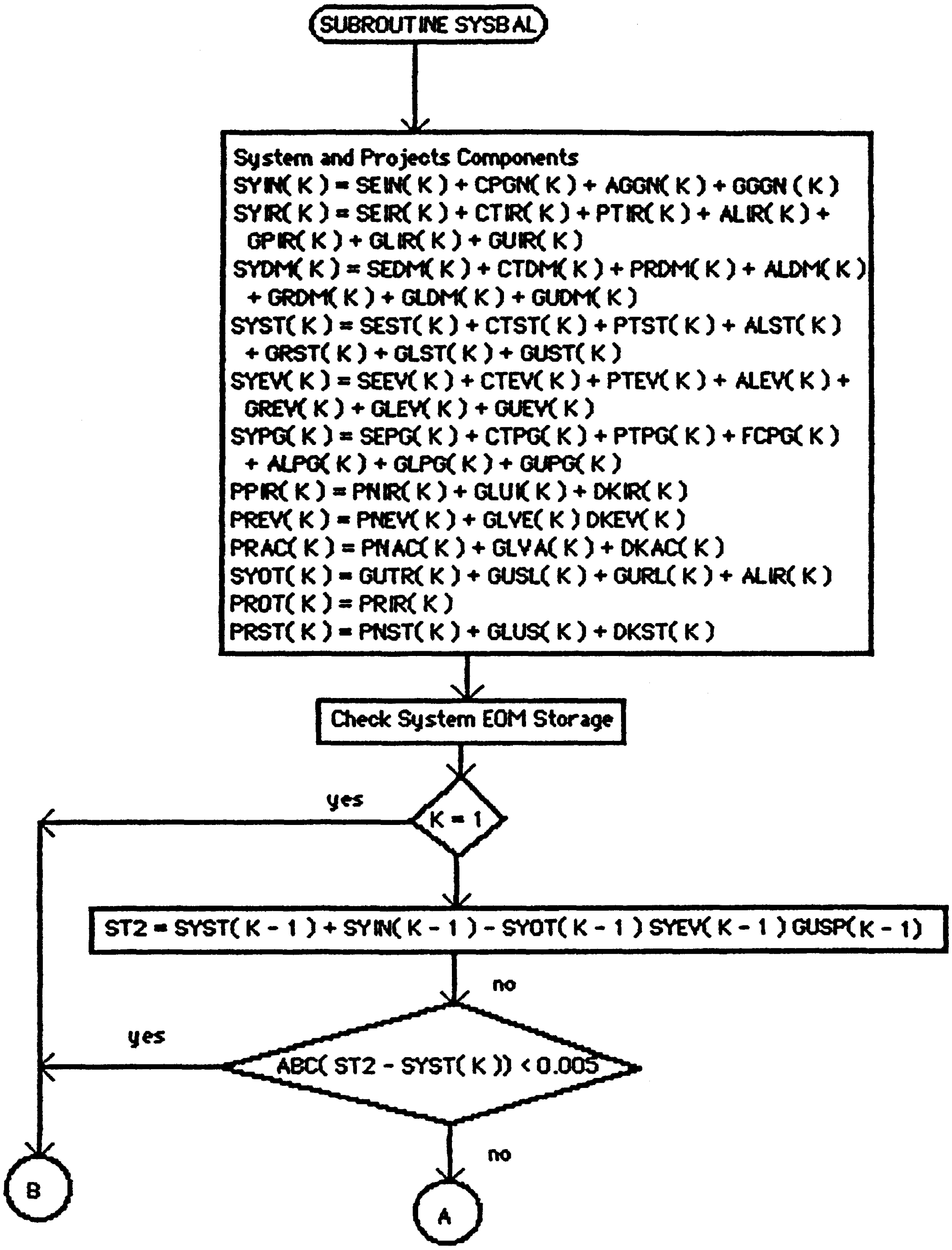

Subroutine UPWPAJ
ILT = 30
ICC = 1
IPP = IAC
IT = 0
IQ = 0
IR = 0
NN = NS
IAC = 0
yes
no
IPP = IAC
CALL SKTRAJ
CALL PTWPAJ
RETURN M1
yes
RETURN N2
no
IT = IT + 1
IT ≤ ILT
STOP EXECUTION
IR = IR + 1
ICC = 2
yes
IR ≤ ILT
no
CALL DOWNPW
STOP EXECUTION
B
C
A

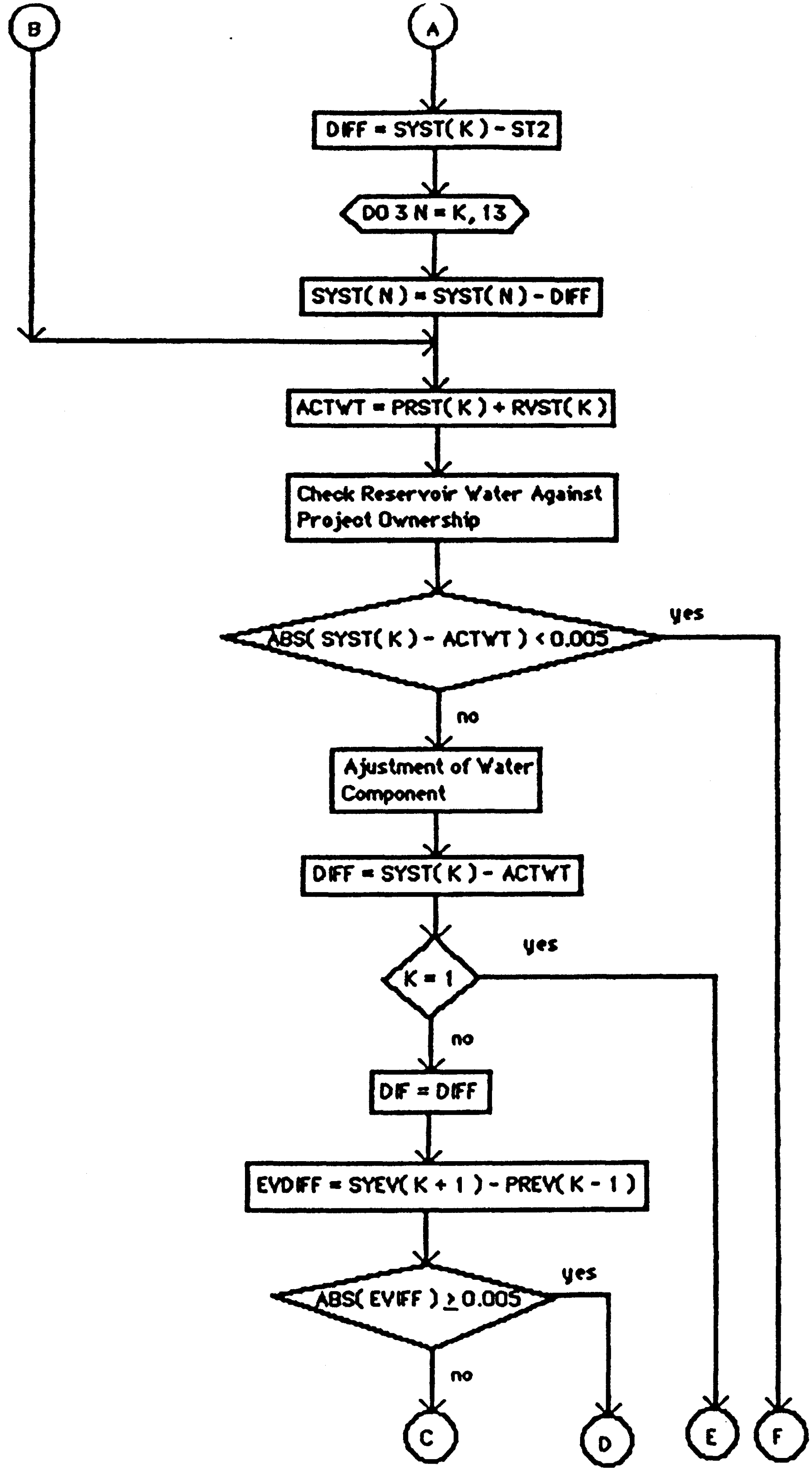

C
B
A
NS = NS + 1
NS > NE
NS = NN
yes
no
NS = NN
Call PROJAJ
RETURN M1
yes
no
RETURN
IQ = IQ + 1
NN + NN
yes
IQ ≤ ILT
no
STOP EXECUTION

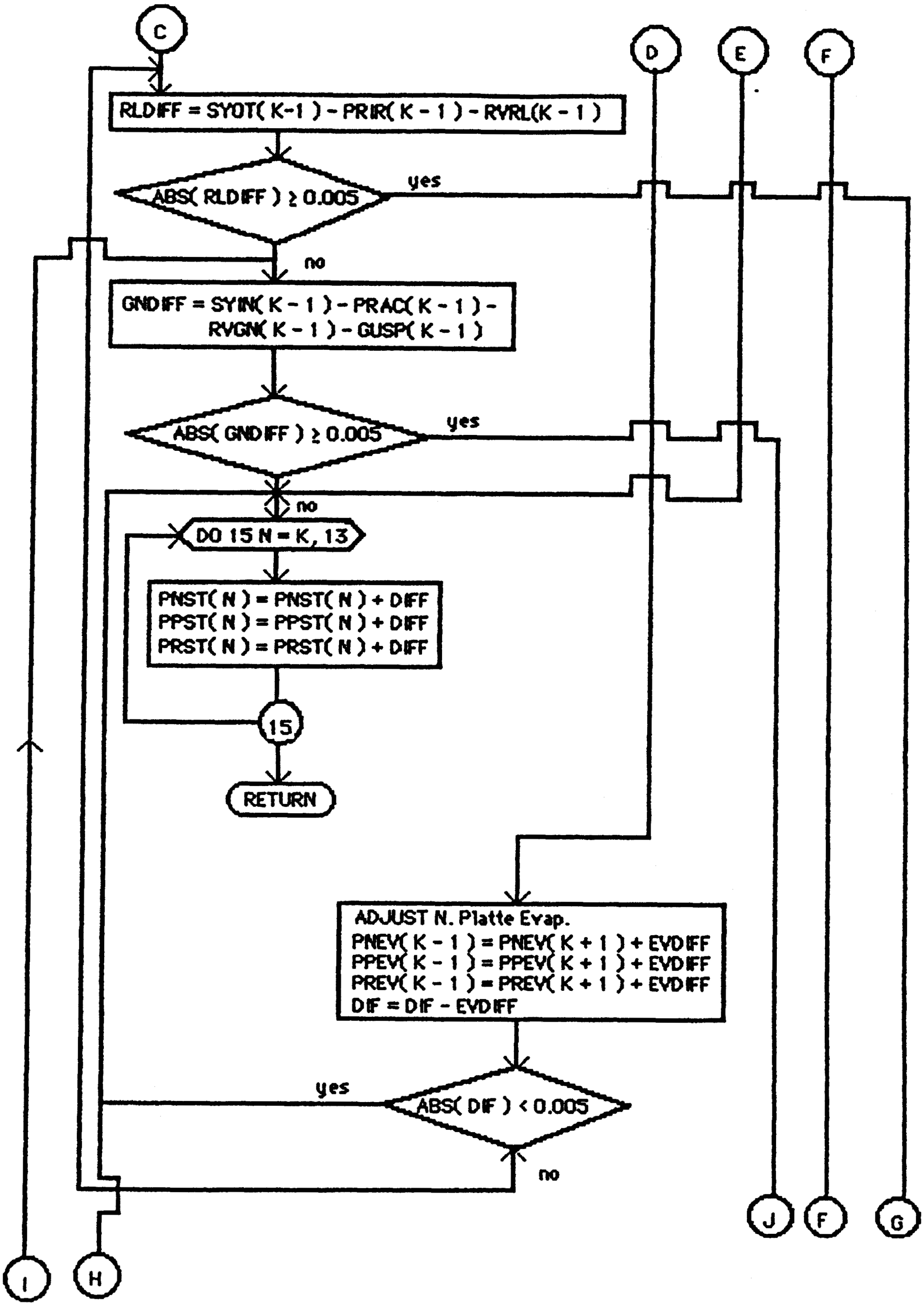
Desoription: Adjust and Compute Water Use and Power Generation for the Upstream Reservors- Recalculate Downstream Reservoirs when Pathfinder Operation Required to Change Downstream Flow and Finally Check the Storage Ownership and Total Delivery of Irrigation Projects

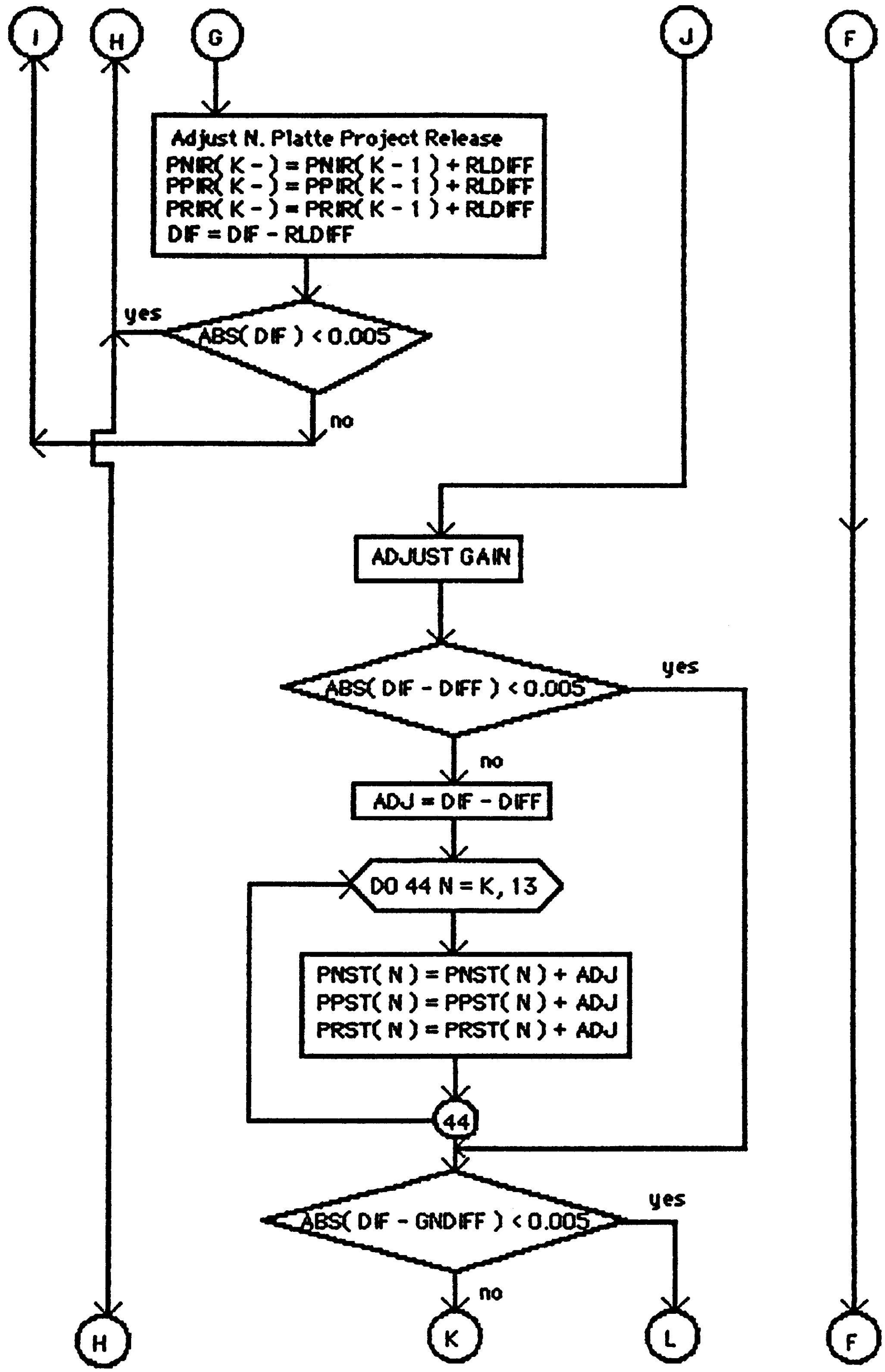


Description: Water Balance of the System

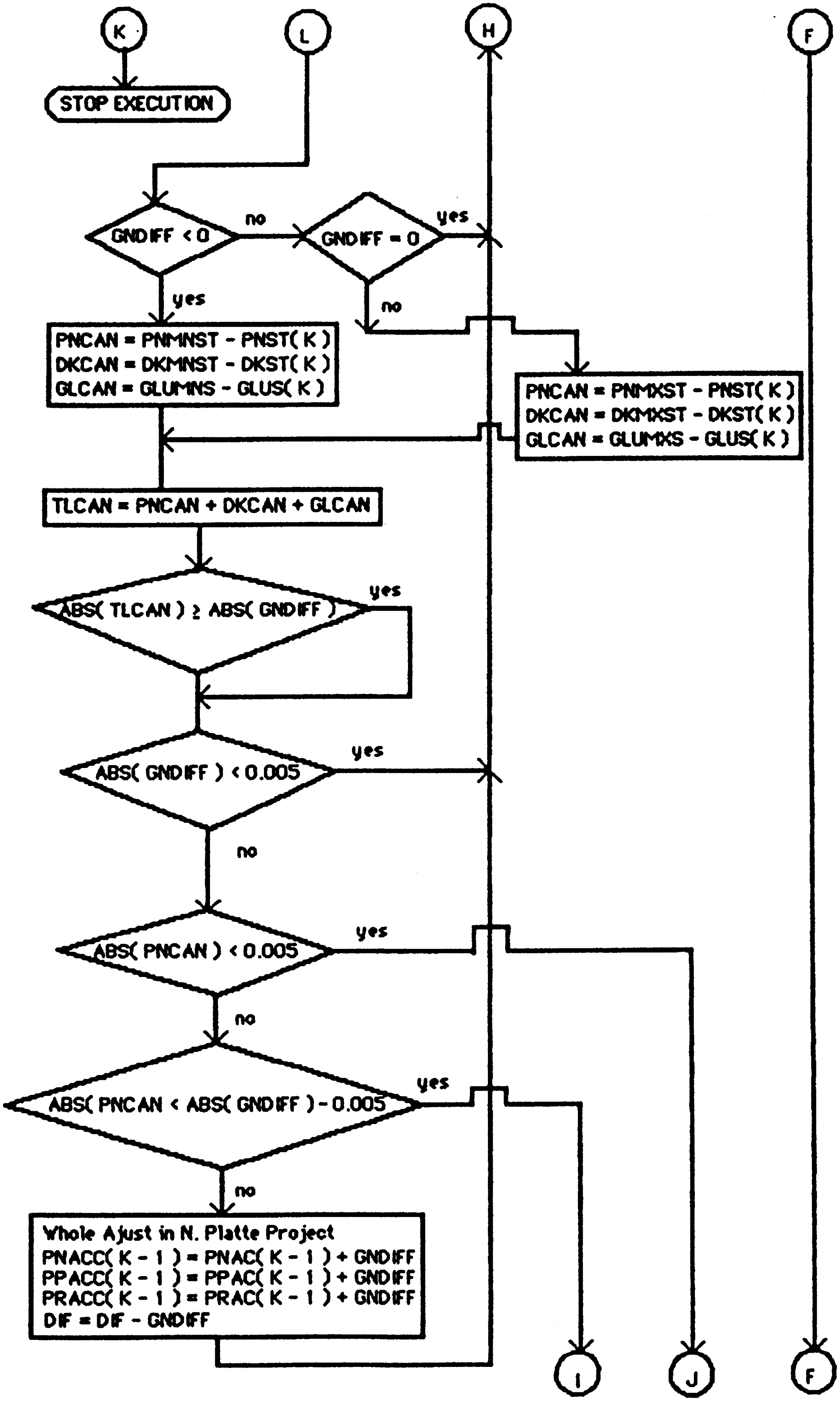


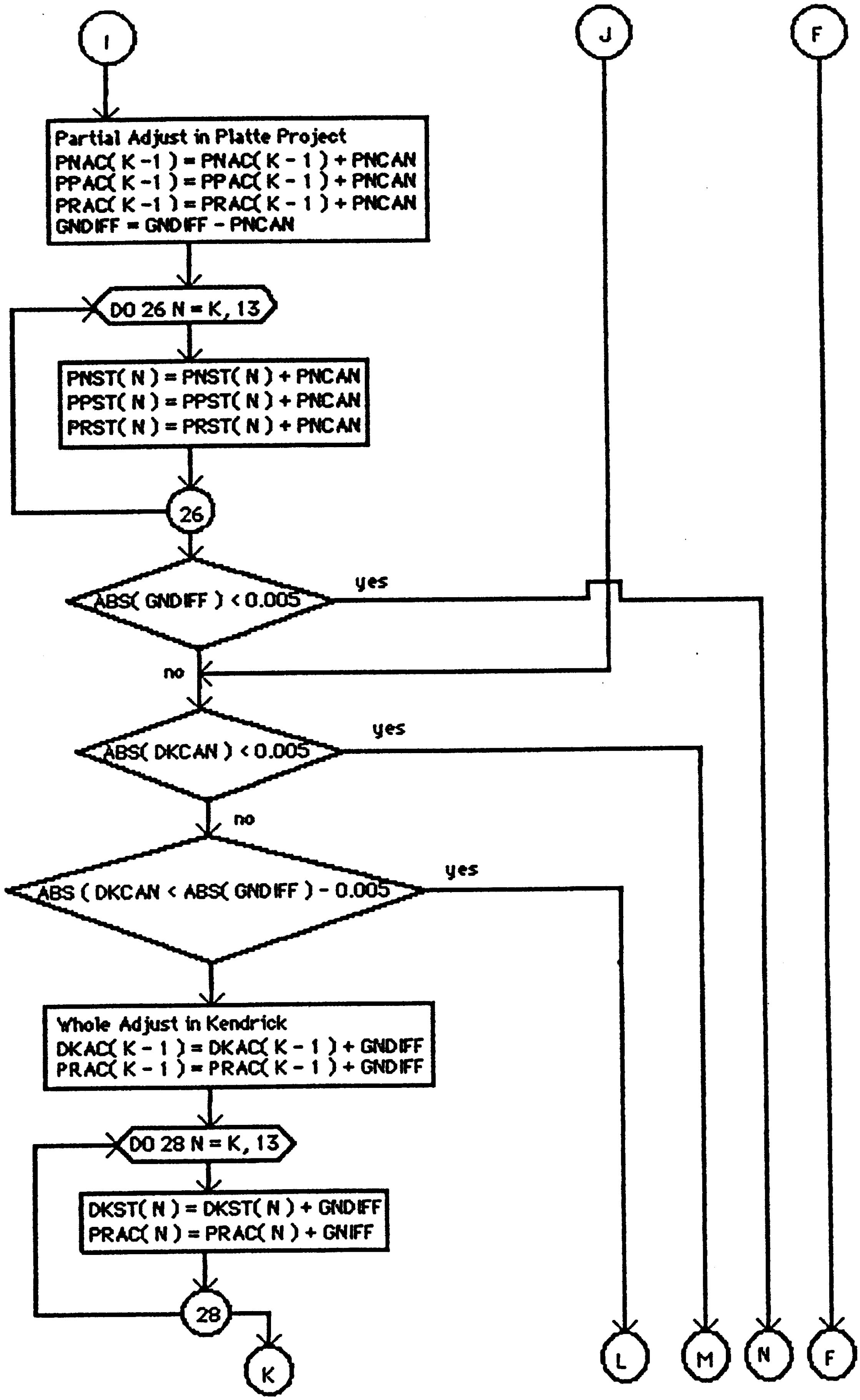

B
A
DIFF = SYST(K) - ST2
DO 3 N = K, 13
SYST(N) = SYST(N) - DIFF
ACTWT = PRST(K) + RVST(K)
Check Reservoir Water Against Project Ownership
ABS(SYST(K) - ACTWT) < 0.005
yes
no
Ajustment of Water Component
DIFF = SYST(K) - ACTWT
K = 1
yes
no
DIF = DIFF
EVDIFF = SYEV(K + 1) - PREV(K - 1)
ABS(EVIFF) ≥ 0.005
yes
no
C
D
E
F

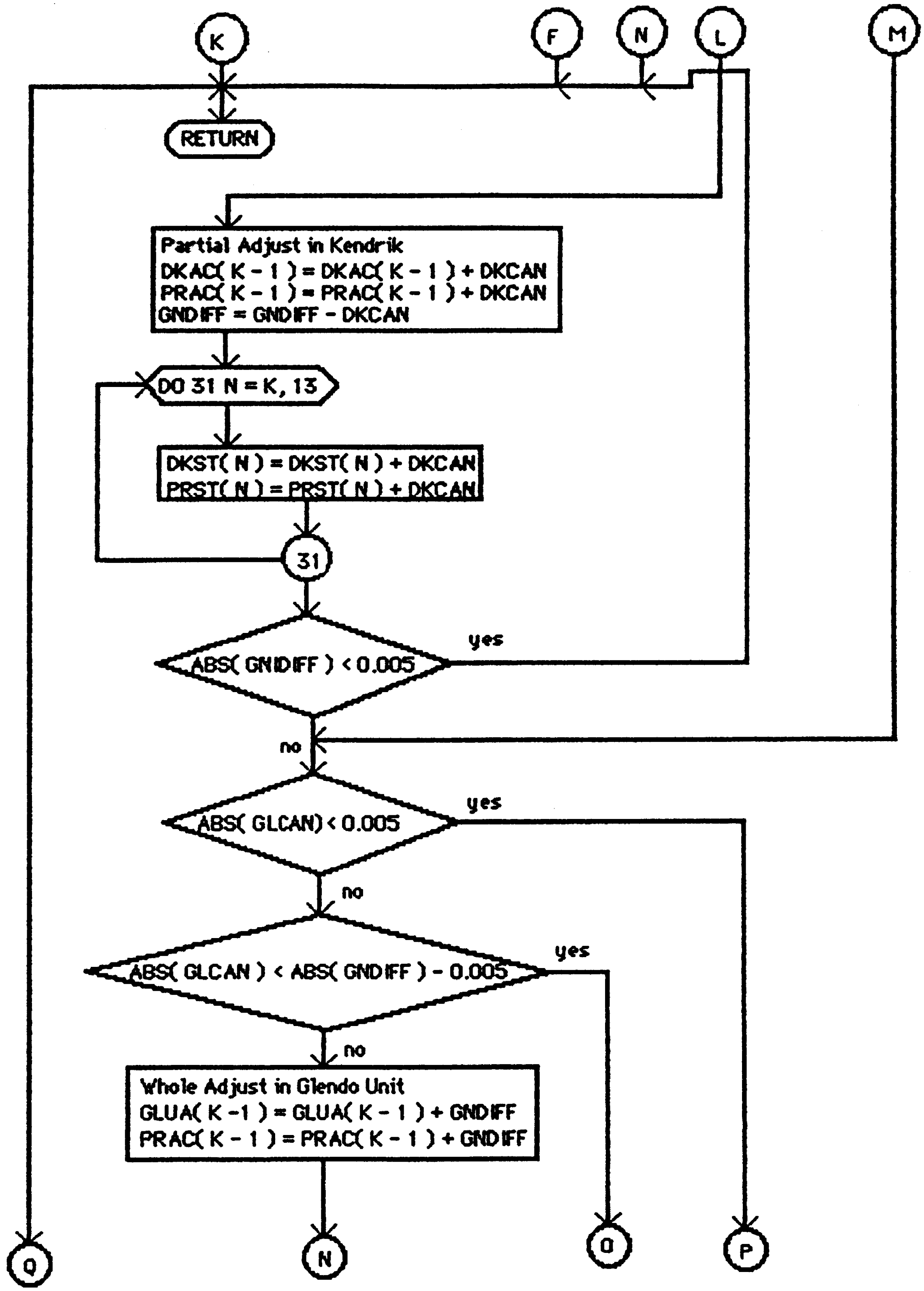

C
D
E
F
RLDIFF = SYOT(K-1) - PRIR(K - 1) - RVRL(K - 1)
ABS(RLDIFF) ≥ 0.005
yes
no
GNDIFF = SYIN(K - 1) - PRAC(K - 1) -
RVGN(K - 1) - GUSP(K - 1)
ABS(GNDIFF) ≥ 0.005
yes
no
DO 15 N = K, 13
PNST(N) = PNST(N) + DIFF
PPST(N) = PPST(N) + DIFF
PRST(N) = PRST(N) + DIFF
15
RETURN
ADJUST N. Platte Evap.
PNEV(K - 1) = PNEV(K + 1) + EVDIFF
PPEV(K - 1) = PPEV(K + 1) + EVDIFF
PREV(K - 1) = PREV(K + 1) + EVDIFF
DIF = DIF - EVDIFF
ABS(DIF) < 0.005
yes
no
J
F
G
I
H



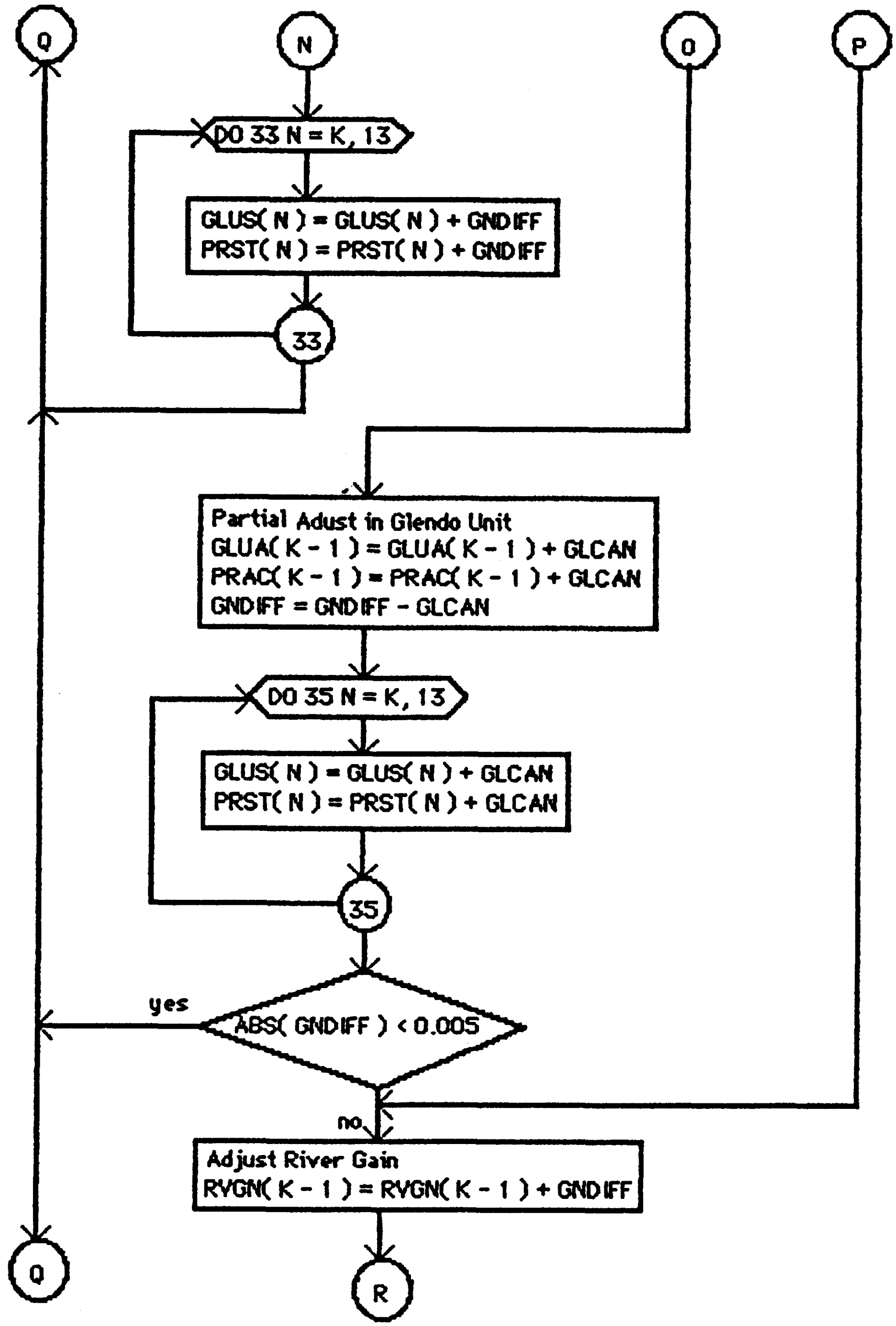
I
H
G
J
F
Adjust N. Platte Project Release
PNIR(K -) = PNIR(K - 1) + RLDIFF
PPIR(K -) = PPIR(K - 1) + RLDIFF
PRIR(K -) = PRIR(K - 1) + RLDIFF
DIF = DIF - RLDIFF
yes
ABS(DIF) < 0.005
no
ADJUST GAIN
ABS(DIF - DIFF) < 0.005
yes
no
ADJ = DIF - DIFF
DO 44 N = K, 13
PNST(N) = PNST(N) + ADJ
PPST(N) = PPST(N) + ADJ
PRST(N) = PRST(N) + ADJ
44
ABS(DIF - GNDIFF) < 0.005
yes
no
H
K
L
F

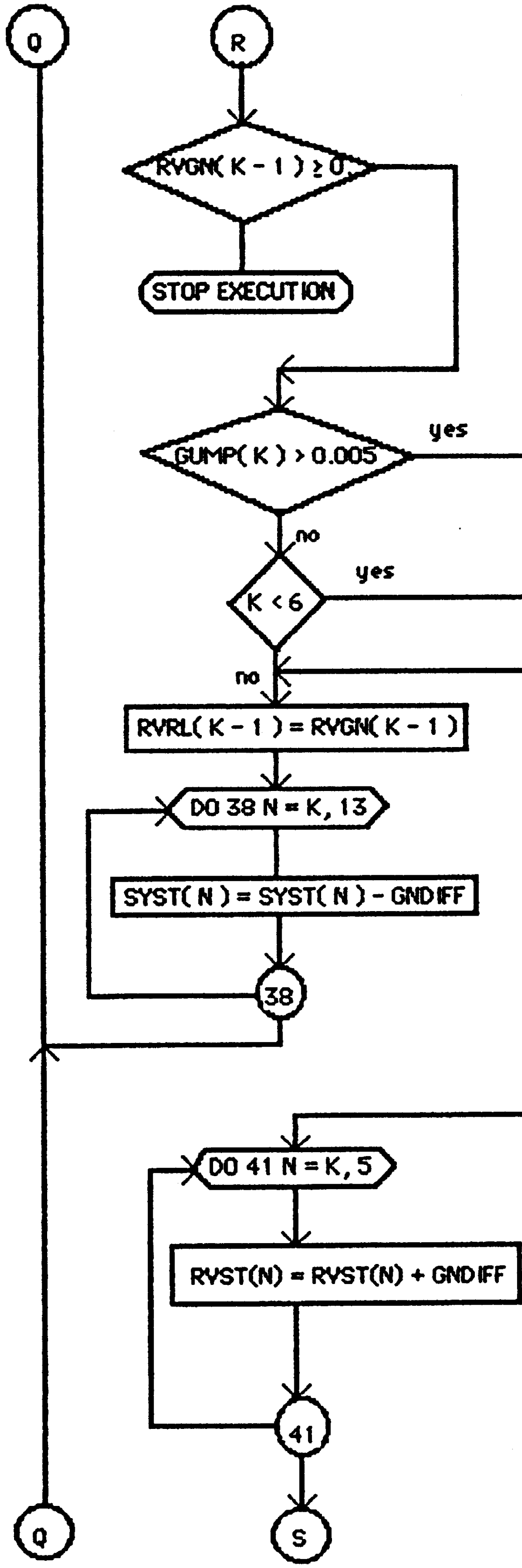

K
L
H
F
STOP EXECUTION
GNDIFF < 0
no
GNDIFF = 0
yes
yes
no
PNCAN = PNMNST - PNST(K)
DKCAN = DKMNST - DKST(K)
GLCAN = GLUMNS - GLUS(K)
PNCAN = PNMXST - PNST(K)
DKCAN = DKMXST - DKST(K)
GLCAN = GLUMXS - GLUS(K)
TLCAN = PNCAN + DKCAN + GLCAN
ABS(TLCAN) ≥ ABS(GNDIFF)
yes
ABS(GNDIFF) < 0.005
yes
no
ABS(PNCAN) < 0.005
yes
no
ABS(PNCAN < ABS(GNDIFF) - 0.005
yes
no
Whole Ajust in N. Platte Project
PNACC(K - 1) = PNAC(K - 1) + GNDIFF
PPACC(K - 1) = PPAC(K - 1) + GNDIFF
PRACC(K - 1) = PRAC(K - 1) + GNDIFF
DIF = DIF - GNDIFF
I
J
F

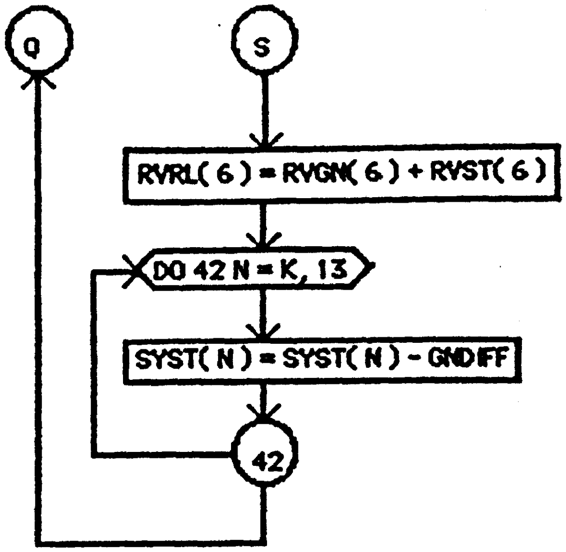

I
J
F
Partial Adjust in Platte Project
PNAC(K -1) = PNAC(K - 1) + PNCAN
PPAC(K -1) = PPAC(K - 1) + PNCAN
PRAC(K -1) = PRAC(K - 1) + PNCAN
GNDIFF = GNDIFF - PNCAN
DO 26 N = K, 13
PNST(N) = PNST(N) + PNCAN
PPST(N) = PPST(N) + PNCAN
PRST(N) = PRST(N) + PNCAN
26
ABS(GNDIFF) < 0.005
yes
no
ABS(DKCAN) < 0.005
yes
no
ABS (DKCAN < ABS(GNDIFF) - 0.005
yes
Whole Adjust in Kendrick
DKAC(K - 1) = DKAC(K - 1) + GNDIFF
PRAC(K - 1) = PRAC(K - 1) + GNDIFF
DO 28 N = K, 13
DKST(N) = DKST(N) + GNDIFF
PRAC(N) = PRAC(N) + GNIFF
28
K
L
M
N
F



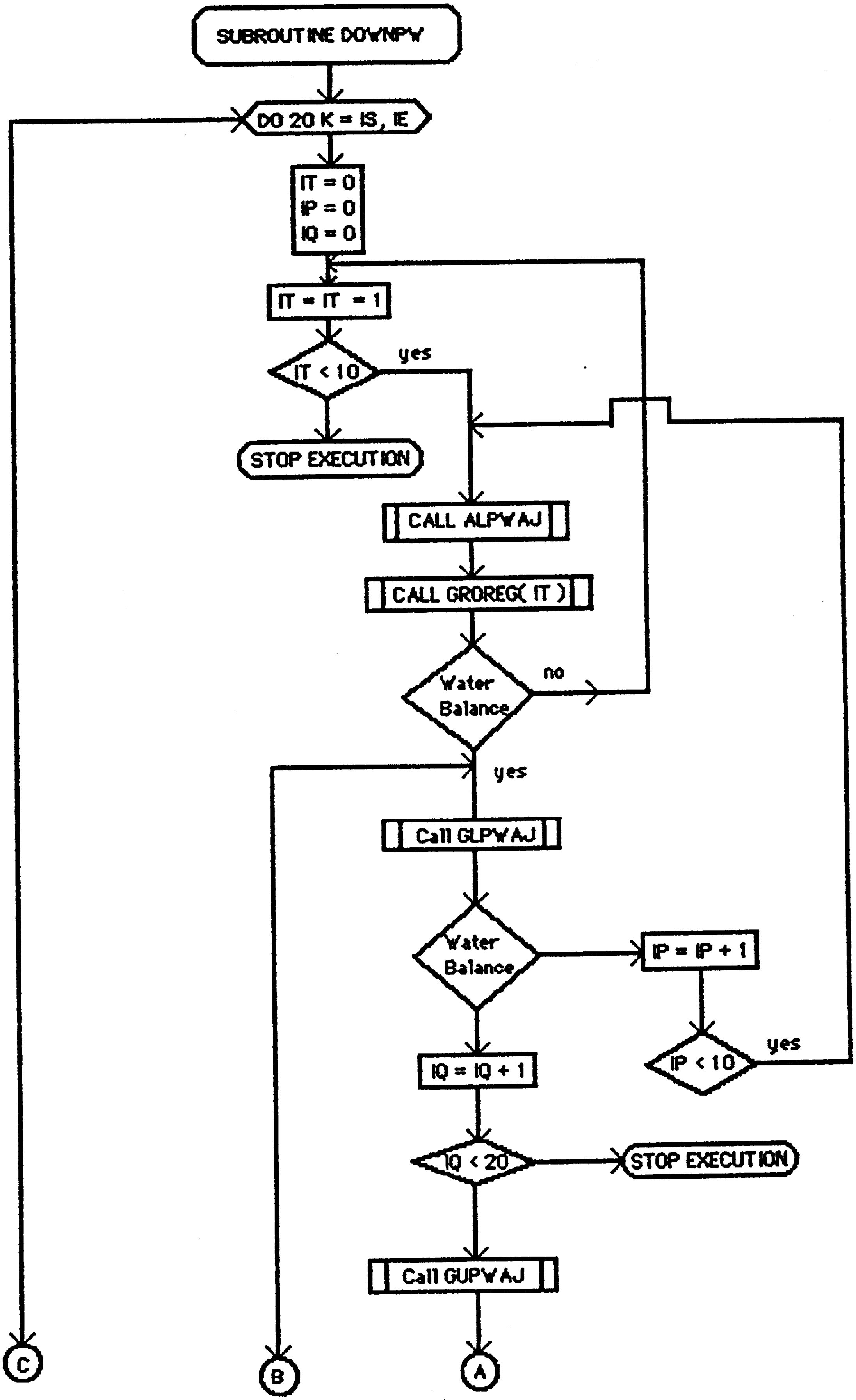
K
F
N
L
M
RETURN
Partial Adjust in Kendrik
DKAC(K - 1) = DKAC(K - 1) + DKCAN
PRAC(K - 1) = PRAC(K - 1) + DKCAN
GNDIFF = GNDIFF - DKCAN
DO 31 N = K, 13
DKST(N) = DKST(N) + DKCAN
PRST(N) = PRST(N) + DKCAN
31
ABS(GNDIFF) < 0.005
yes
no
ABS(GLCAN) < 0.005
yes
no
ABS(GLCAN) < ABS(GNDIFF) - 0.005
yes
no
Whole Adjust in Glendo Unit
GLUA(K -1) = GLUA(K - 1) + GNDIFF
PRAC(K - 1) = PRAC(K - 1) + GNDIFF
Q
N
O
P

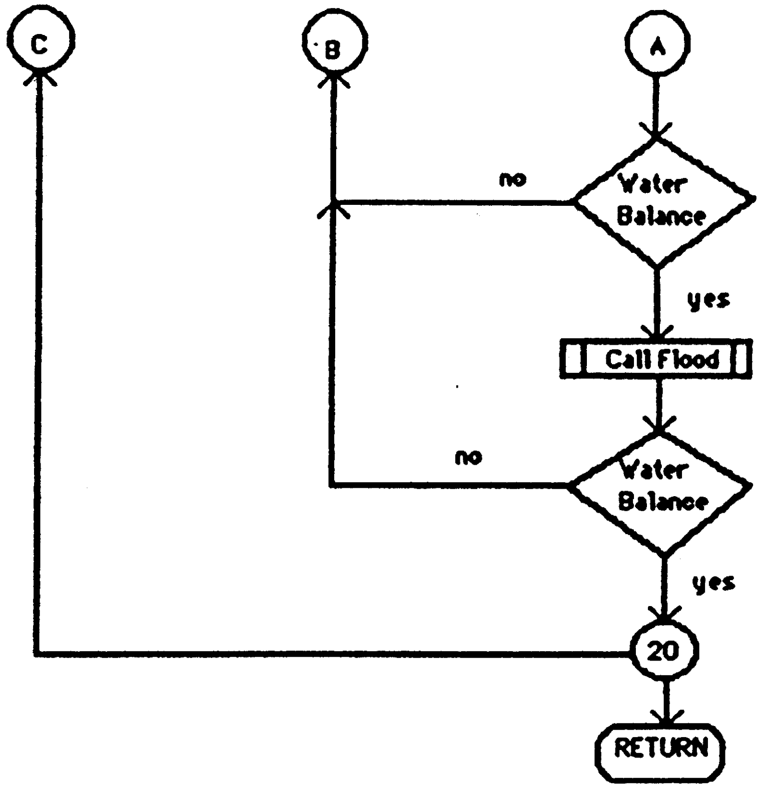

Q
N
O
P
DO 33 N = K, 13
GLUS(N) = GLUS(N) + GNDIFF
PRST(N) = PRST(N) + GNDIFF
33
Partial Adust in Glendo Unit
GLUA(K - 1) = GLUA(K - 1) + GLCAN
PRAC(K - 1) = PRAC(K - 1) + GLCAN
GNDIFF = GNDIFF - GLCAN
DO 35 N = K, 13
GLUS(N) = GLUS(N) + GLCAN
PRST(N) = PRST(N) + GLCAN
35
ABS(GNDIFF) < 0.005
yes
no
Adjust River Gain
RVGN(K - 1) = RVGN(K - 1) + GNDIFF
Q
R


Q
R
RVGN(K - 1) ≥ 0
STOP EXECUTION
yes
GUMP(K) > 0.005
no
yes
K < 6
no
RVRL(K - 1) = RVGN(K - 1)
DO 38 N = K, 13
SYST(N) = SYST(N) - GNDIFF
38
DO 41 N = K, 5
RVST(N) = RVST(N) + GNDIFF
41
Q
S

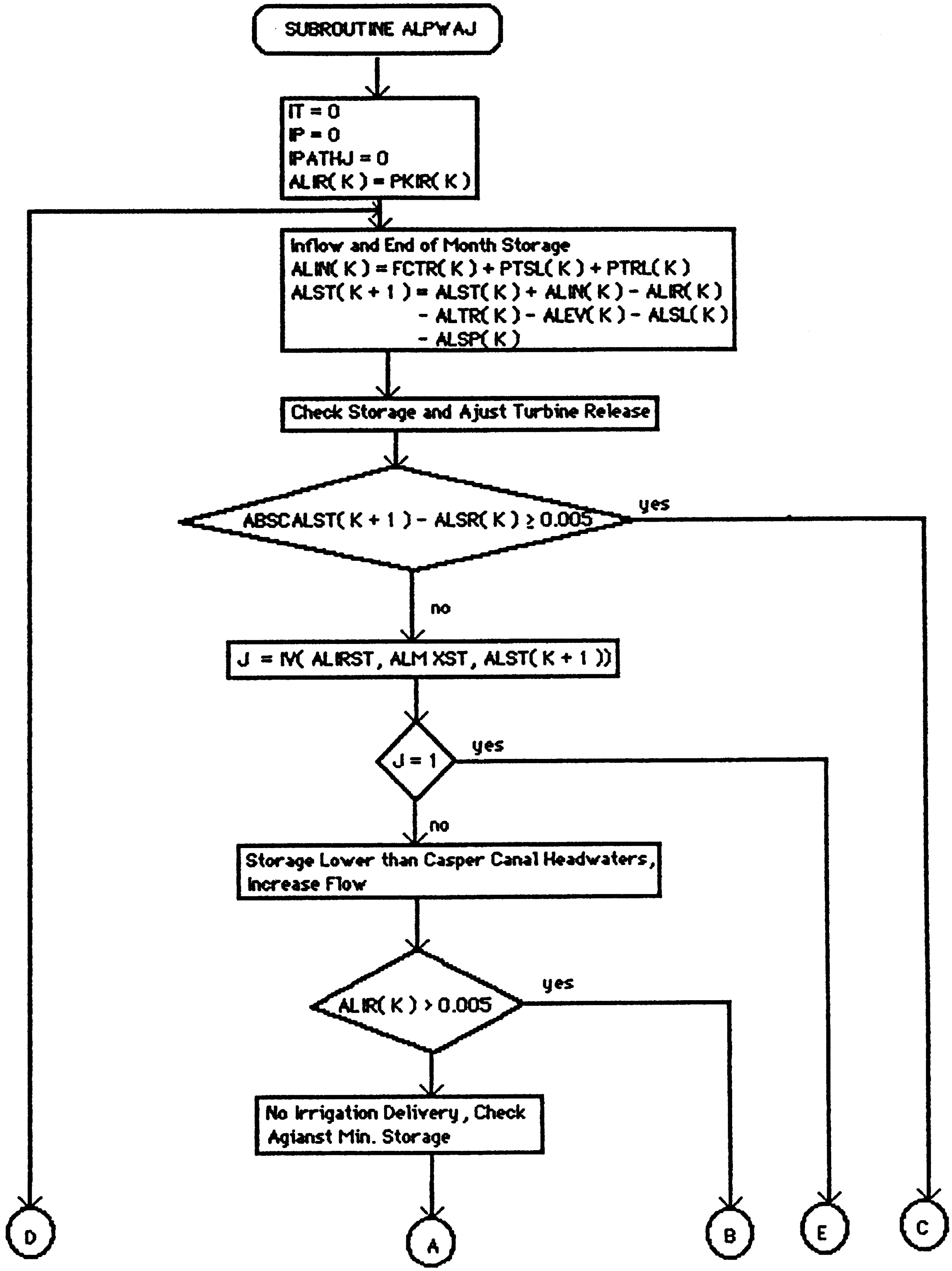

Q
S
RVRL(6) = RVGN(6) + RVST(6)
DO 42 N = K, 13
SYST(N) = SYST(N) - GNDIFF
42

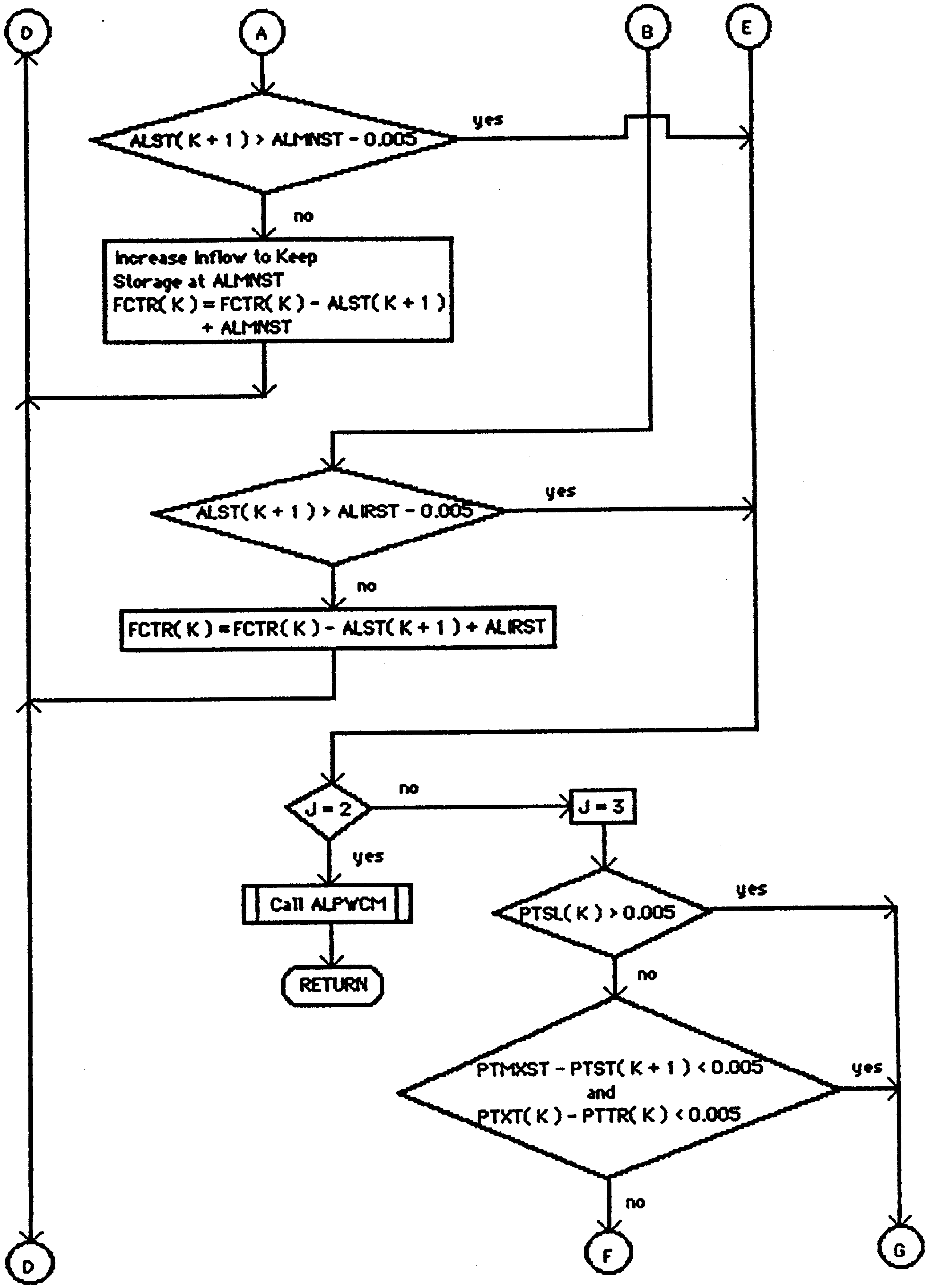
Decsription: Adjustment of Water Use and Computation of Power Generation for the Downstream Reservoirs (Includes Alcova, Gray Reef, Glendo, and Guernsey). Set North Platte Projeot Ownershio in Guernsey.

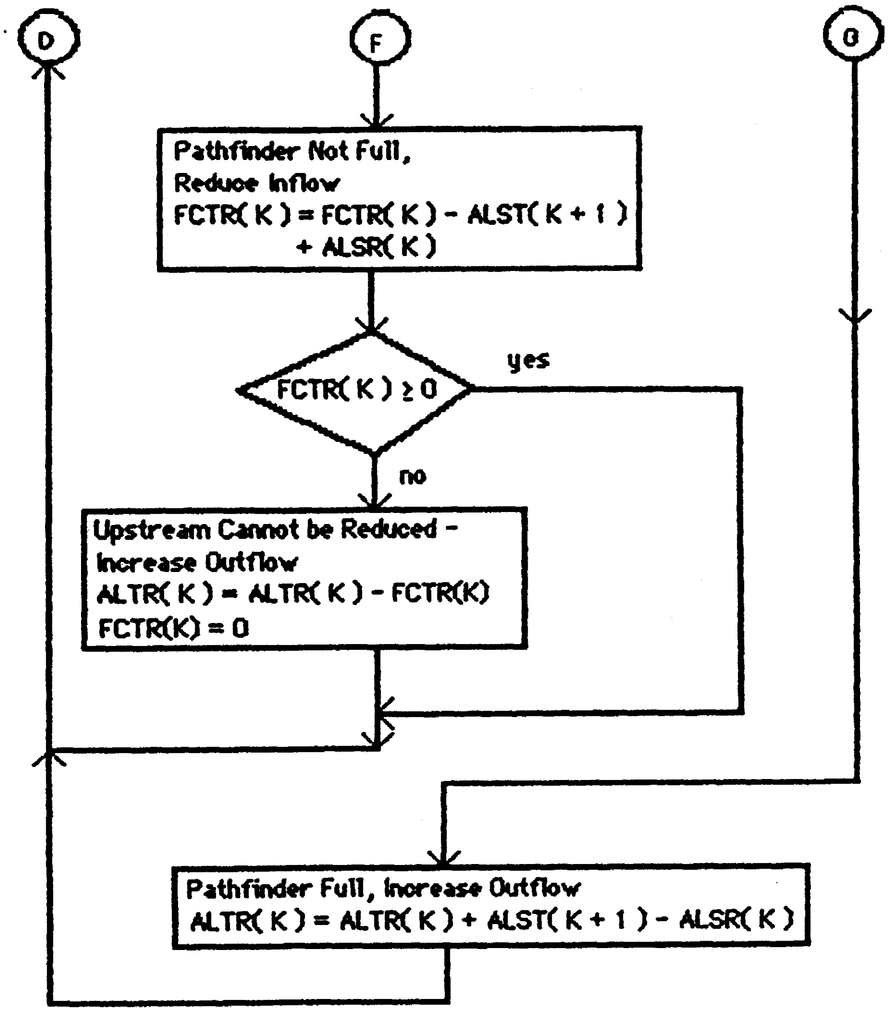



C
B
A
no
Water Balance
yes
Call Flood
no
Water Balance
yes
20
RETURN

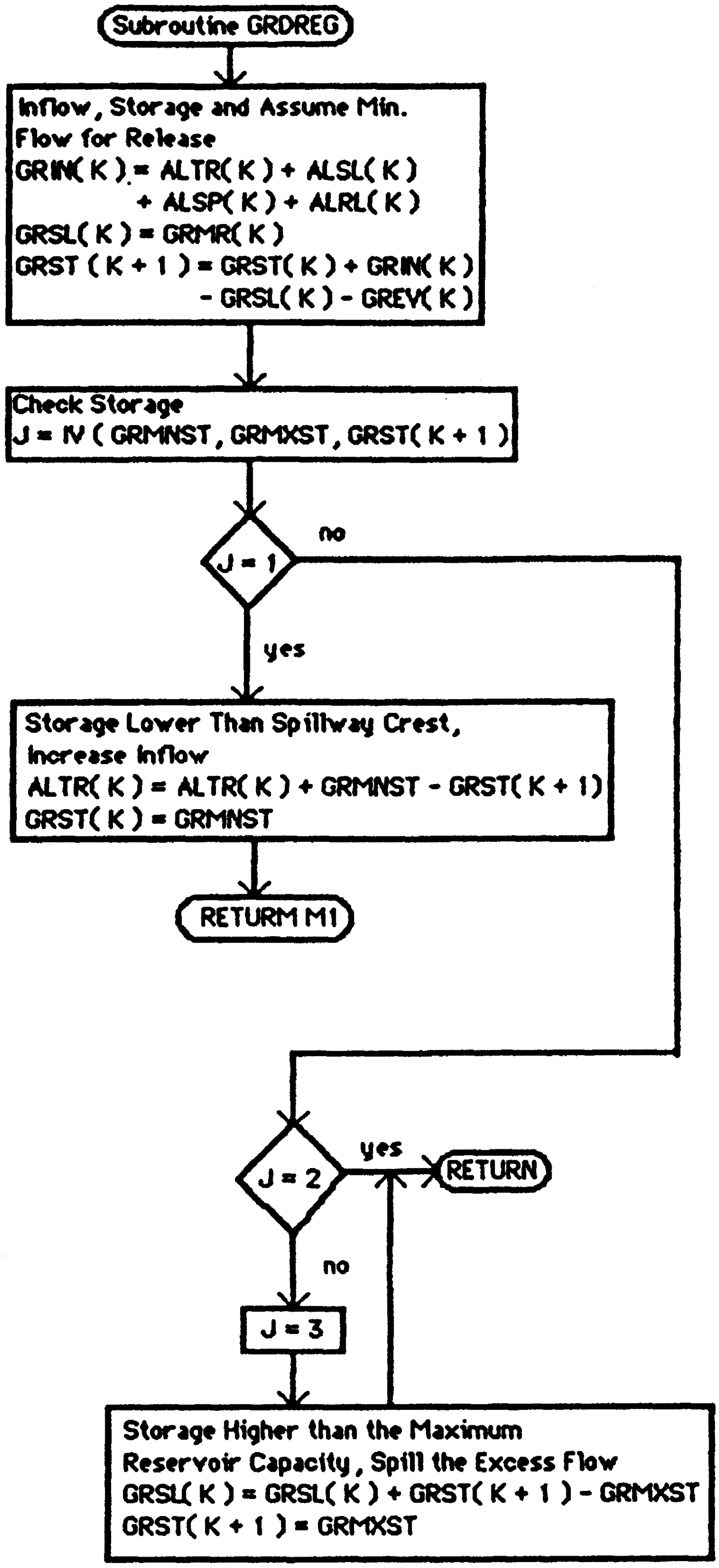
Description: Compute Alcova Inflow and Storage, Adjust Fremont Canyon and Alcova Turbine Release According to Reservoir Storage in Alcova and Pathfinder, Calculate Power Generation in Alcova

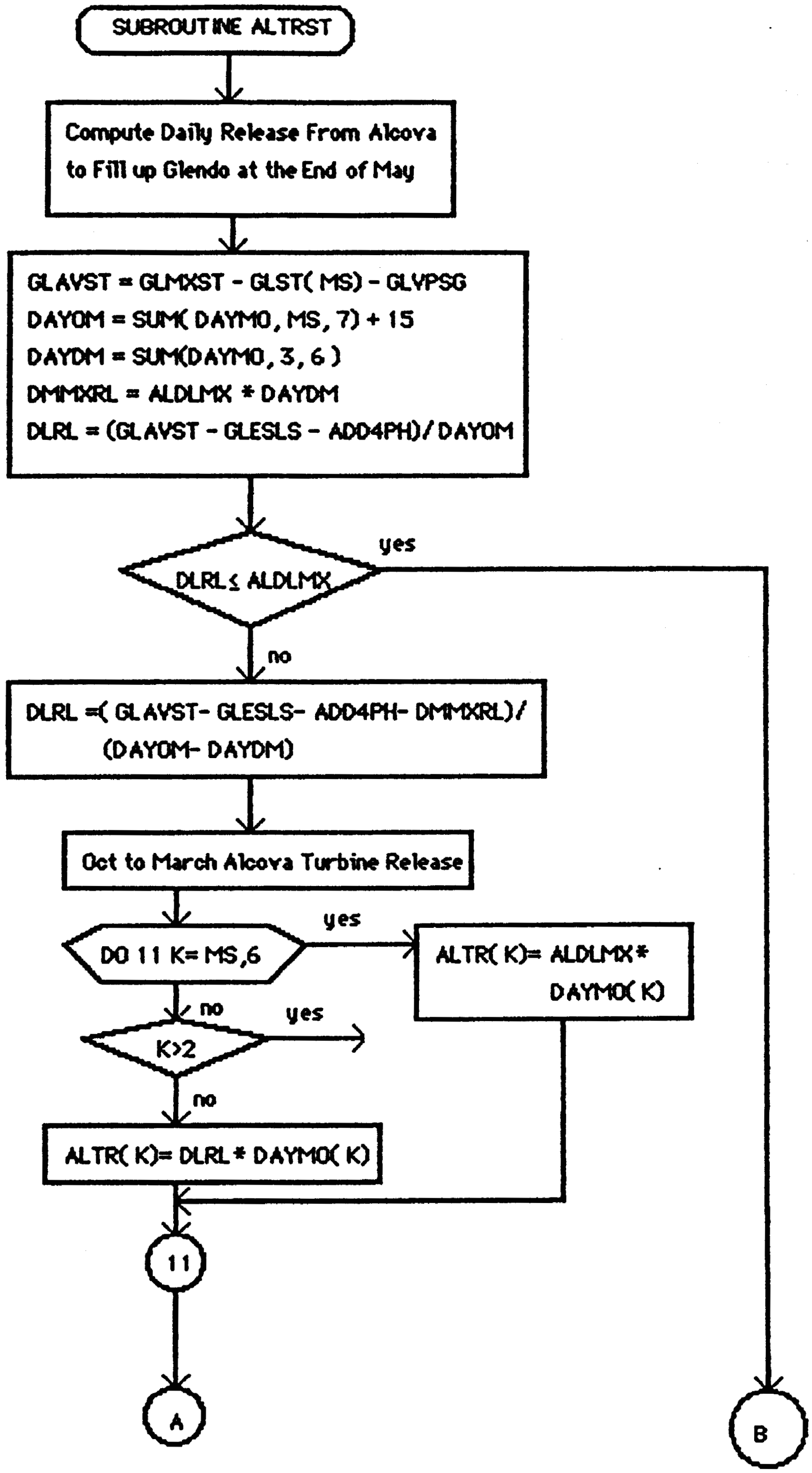


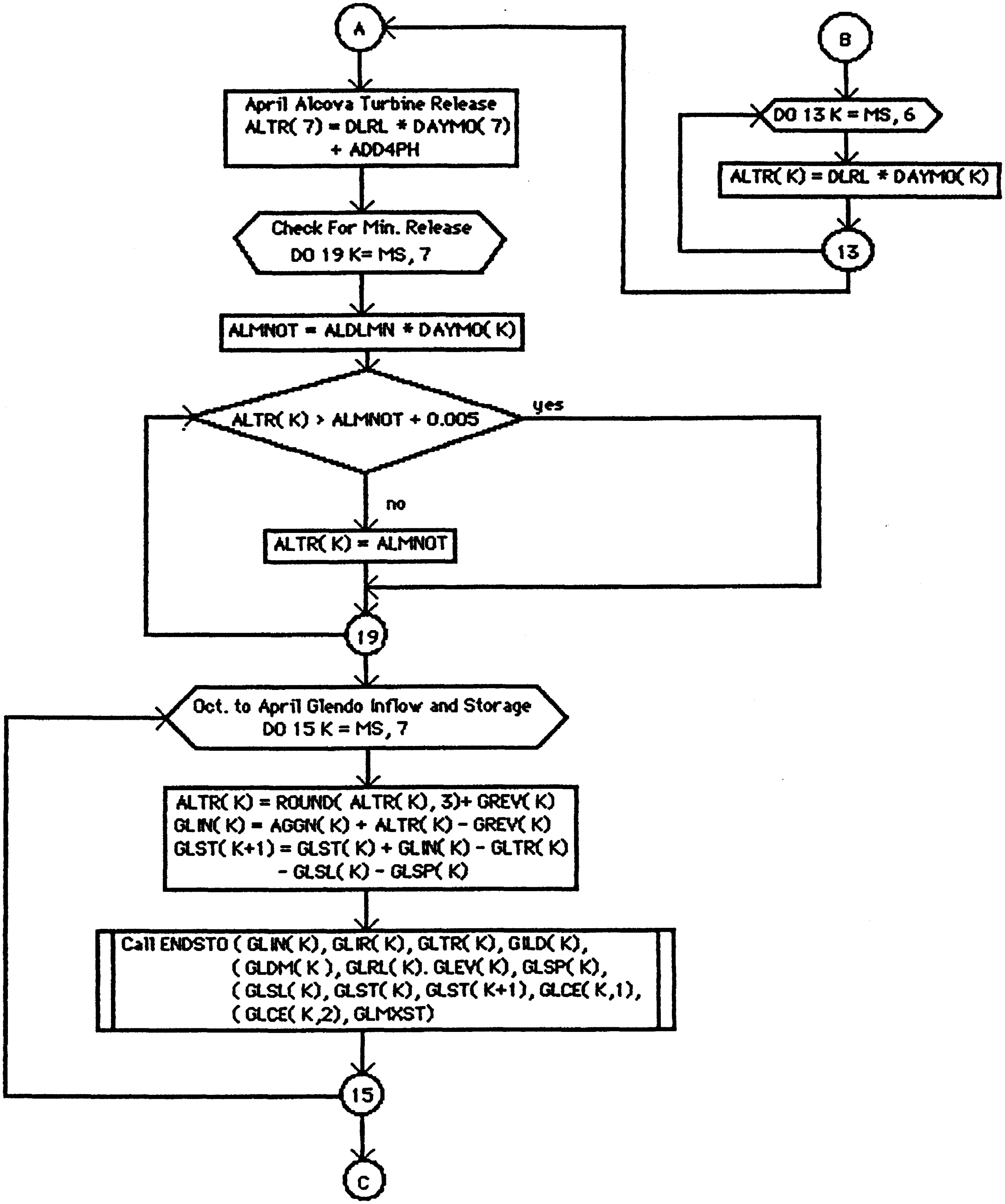

D
A
B
E
ALST(K + 1) > ALMNST - 0.005
yes
no
Increase Inflow to Keep
Storage at ALMNST
FCTR(K) = FCTR(K) - ALST(K + 1)
+ ALMNST
ALST(K + 1) > ALIRST - 0.005
yes
no
FCTR(K) = FCTR(K) - ALST(K + 1) + ALIRST
J = 2
no
J = 3
yes
Call ALPWCM
RETURN
PTSL(K) > 0.005
yes
no
PTMXST - PTST(K + 1) < 0.005
and
PTXT(K) - PTTR(K) < 0.005
yes
no
D
F
G

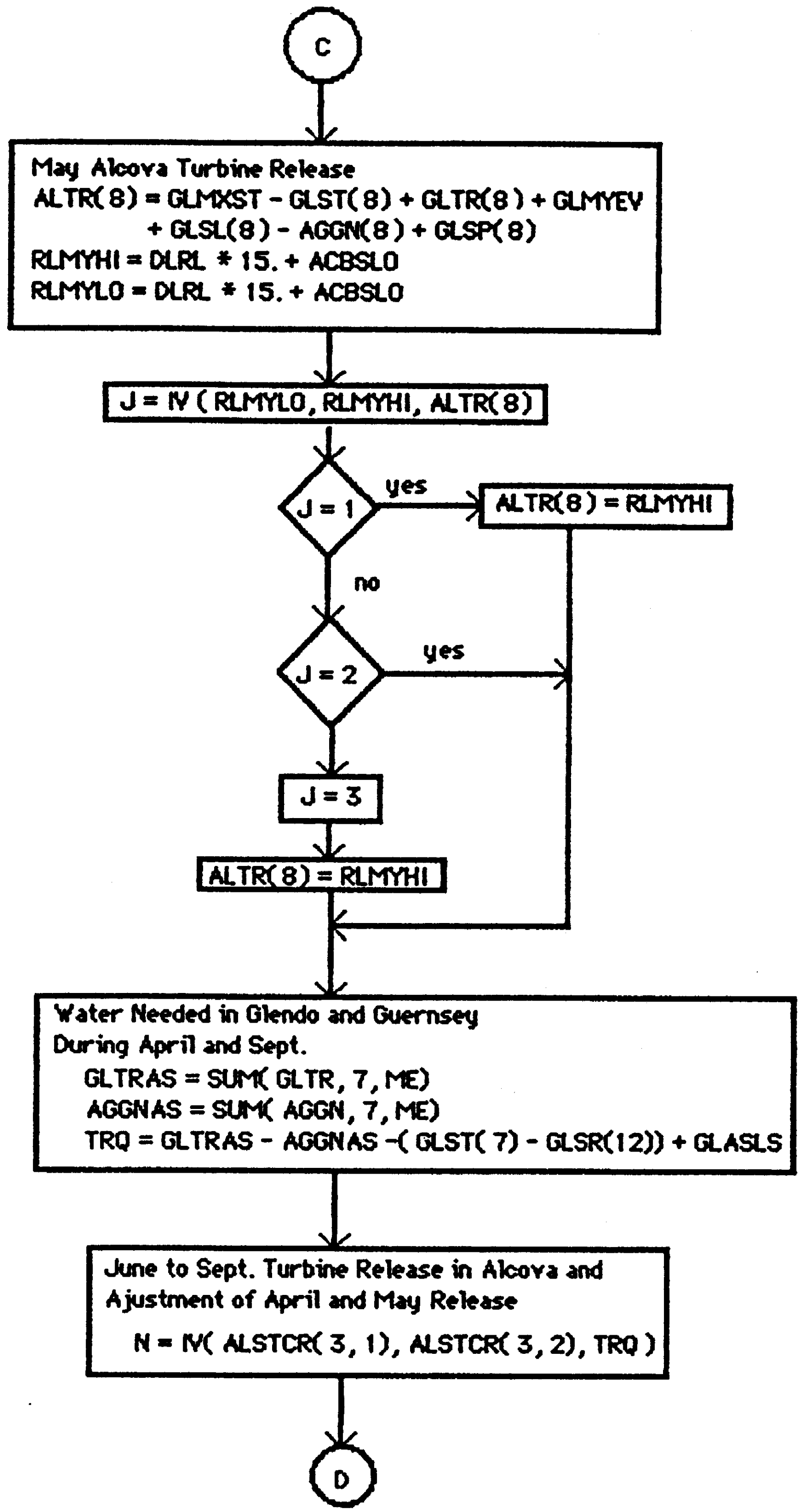

D
F
G
Pathfinder Not Full,
Reduce Inflow
FCTR(K) = FCTR(K) - ALST(K + 1)
+ ALSR(K)
FCTR(K) ≥ 0
yes
no
Upstream Cannot be Reduced -
Increase Outflow
ALTR(K) = ALTR(K) - FCTR(K)
FCTR(K) = 0
Pathfinder Full, Increase Outflow
ALTR(K) = ALTR(K) + ALST(K + 1) - ALSR(K)

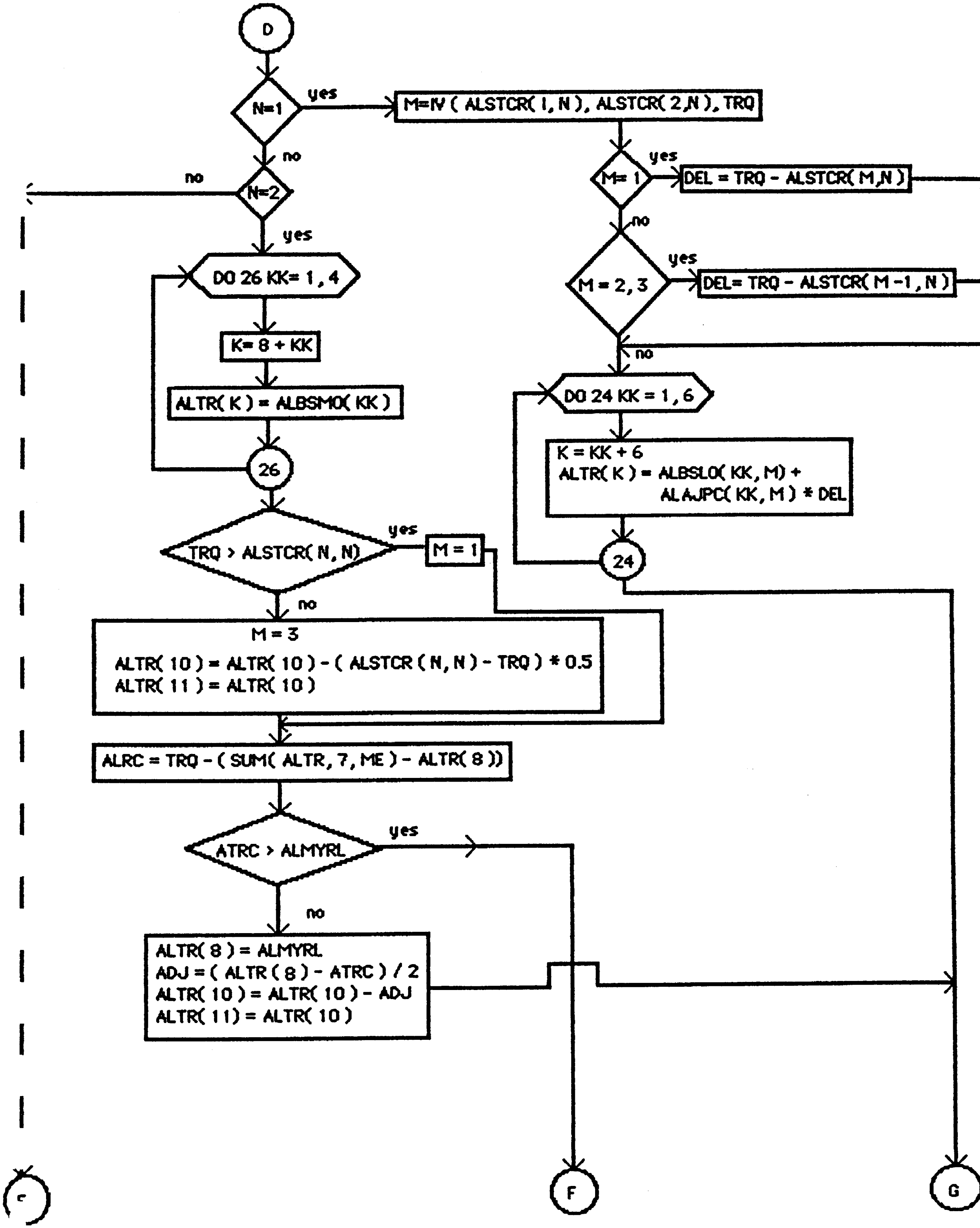
Description: Regulation Downstream Flow at Gray Reef to Keep Minimun Discharge

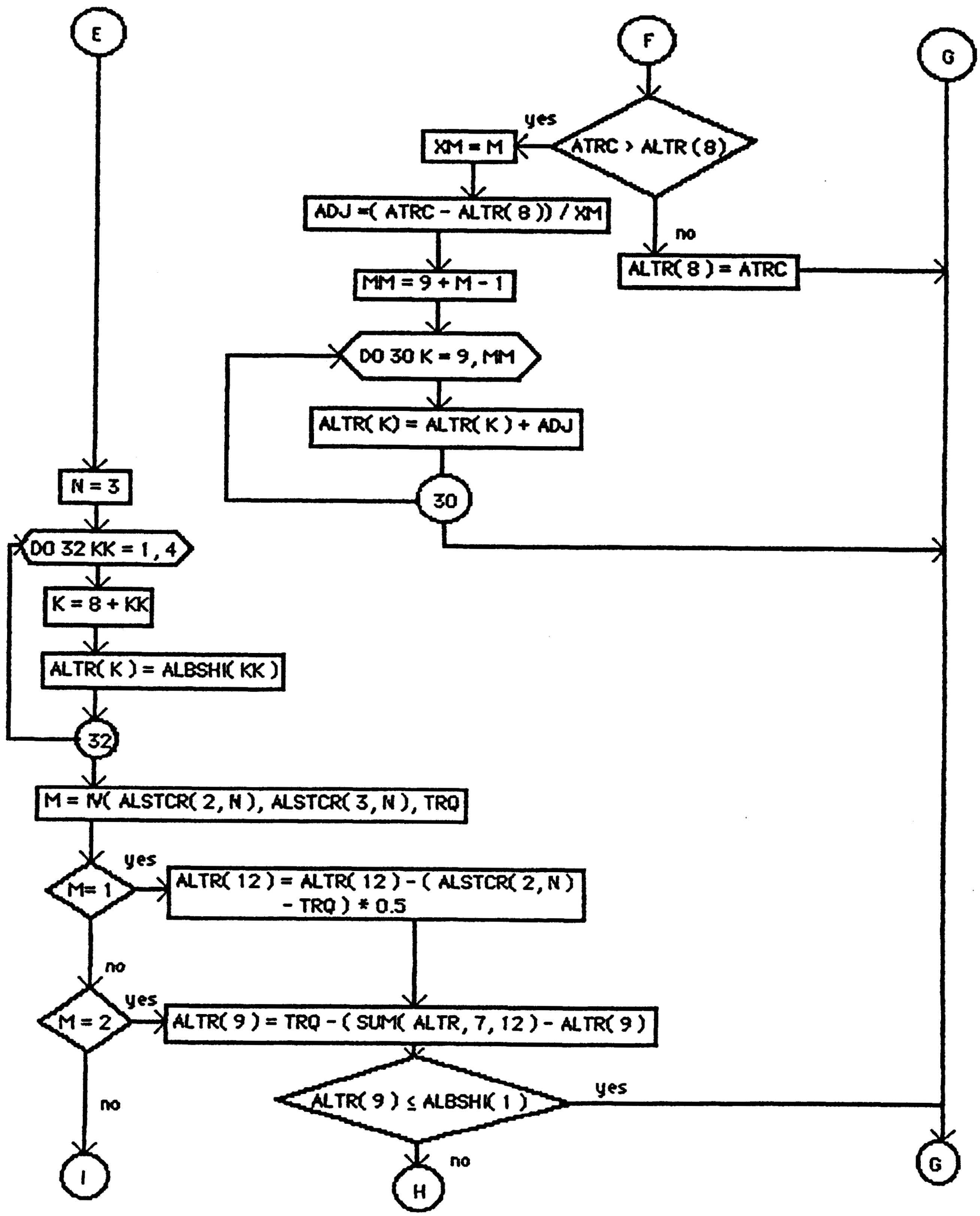


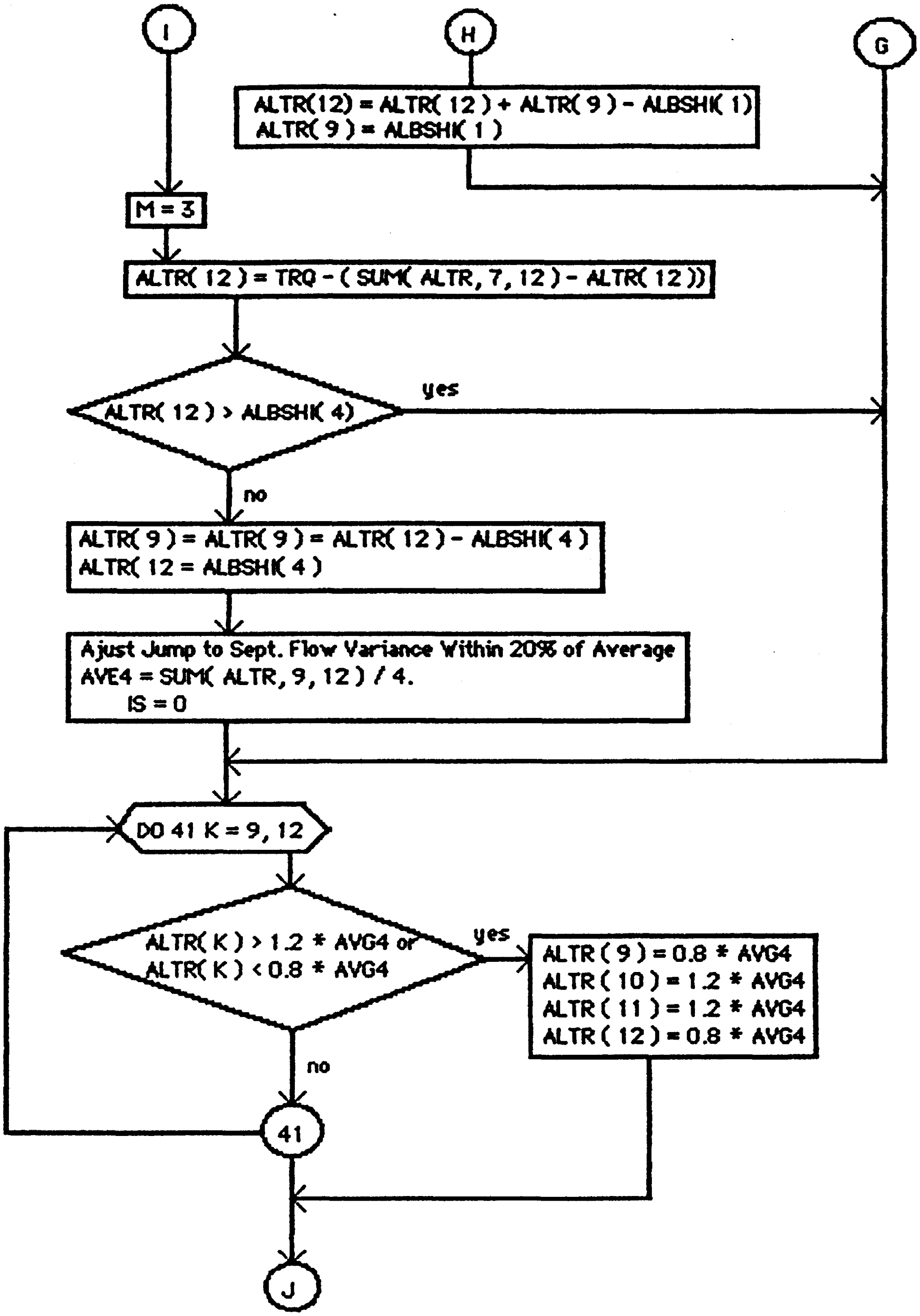

SUBROUTINE ALTRST
Compute Daily Release From Alcova to Fill up Glendo at the End of May
GLAVST = GLMXST - GLST(MS) - GLVPSG
DAYOM = SUM(DAYMO, MS, 7) + 15
DAYDM = SUM(DAYMO, 3, 6)
DMMXRL = ALDLMX * DAYDM
DLRL = (GLAVST - GLESLS - ADD4PH)/ DAYOM
DLRL ≤ ALDLMX
yes
no
DLRL =(GLAVST- GLESLS- ADD4PH- DMMXRL)/ (DAYOM- DAYDM)
Oct to March Alcova Turbine Release
DO 11 K= MS,6
yes
ALTR(K)= ALDLMX* DAYMO(K)
no
K>2
yes
no
ALTR(K)= DLRL * DAYMO(K)
11
A
B

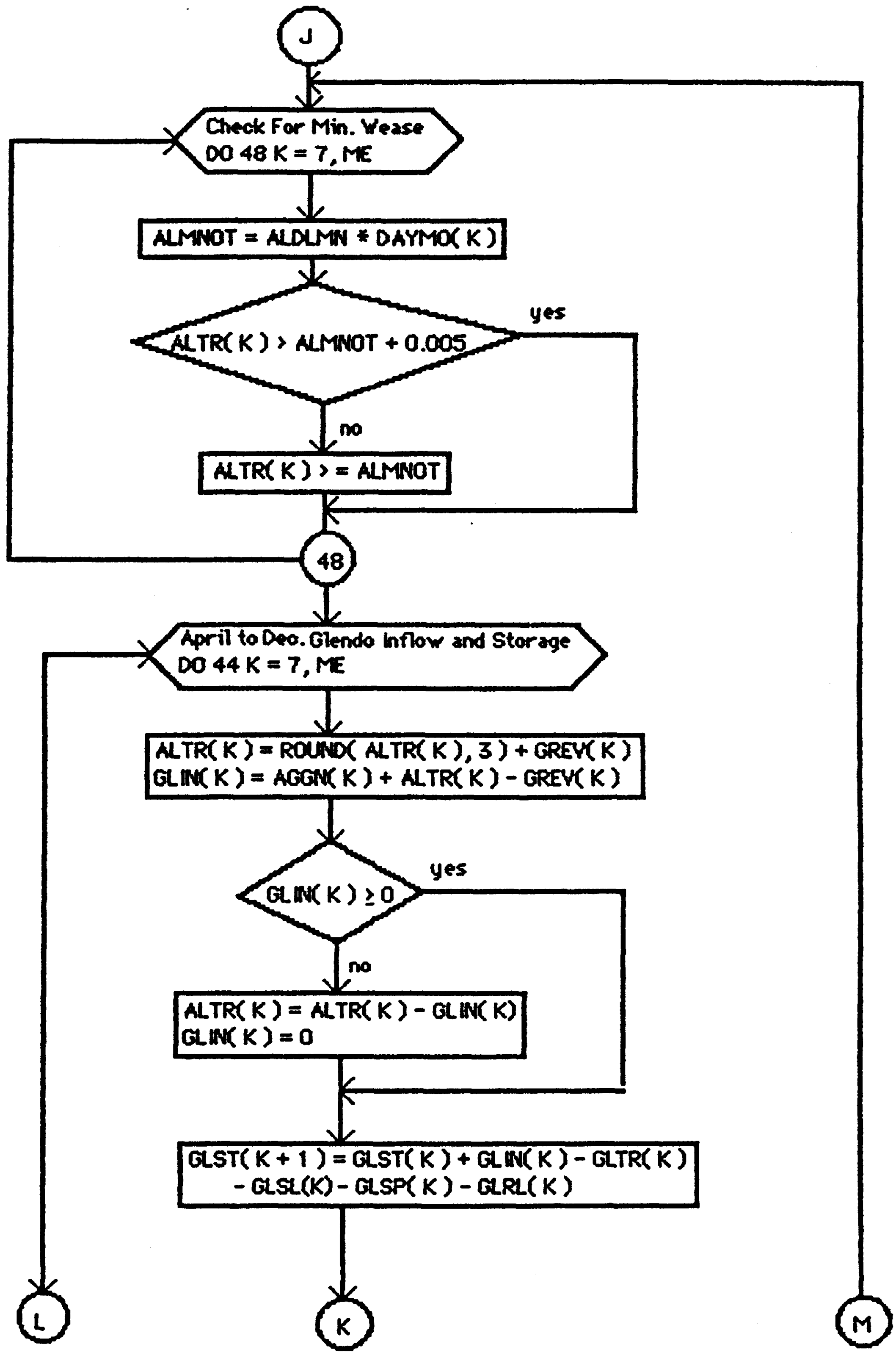

A
B
April Alcova Turbine Release
ALTR(7) = DLRL * DAYMO(7)
+ ADD4PH
DO 13 K = MS, 6
ALTR(K) = DLRL * DAYMO(K)
13
Check For Min. Release
DO 19 K= MS, 7
ALMNOT = ALDLMN * DAYMO(K)
ALTR(K) > ALMNOT + 0.005
yes
no
ALTR(K) = ALMNOT
19
Oct. to April Glendo Inflow and Storage
DO 15 K = MS, 7
ALTR(K) = ROUND(ALTR(K), 3)+ GREV(K)
GLIN(K) = AGGN(K) + ALTR(K) - GREV(K)
GLST(K+1) = GLST(K) + GLIN(K) - GLTR(K)
- GLSL(K) - GLSP(K)
Call ENDSTO (GLIN(K), GLIR(K), GLTR(K), GILD(K),
(GLDM(K), GLRL(K). GLEV(K), GLSP(K),
(GLSL(K), GLST(K), GLST(K+1), GLCE(K,1),
(GLCE(K,2), GLMXST)
15
C

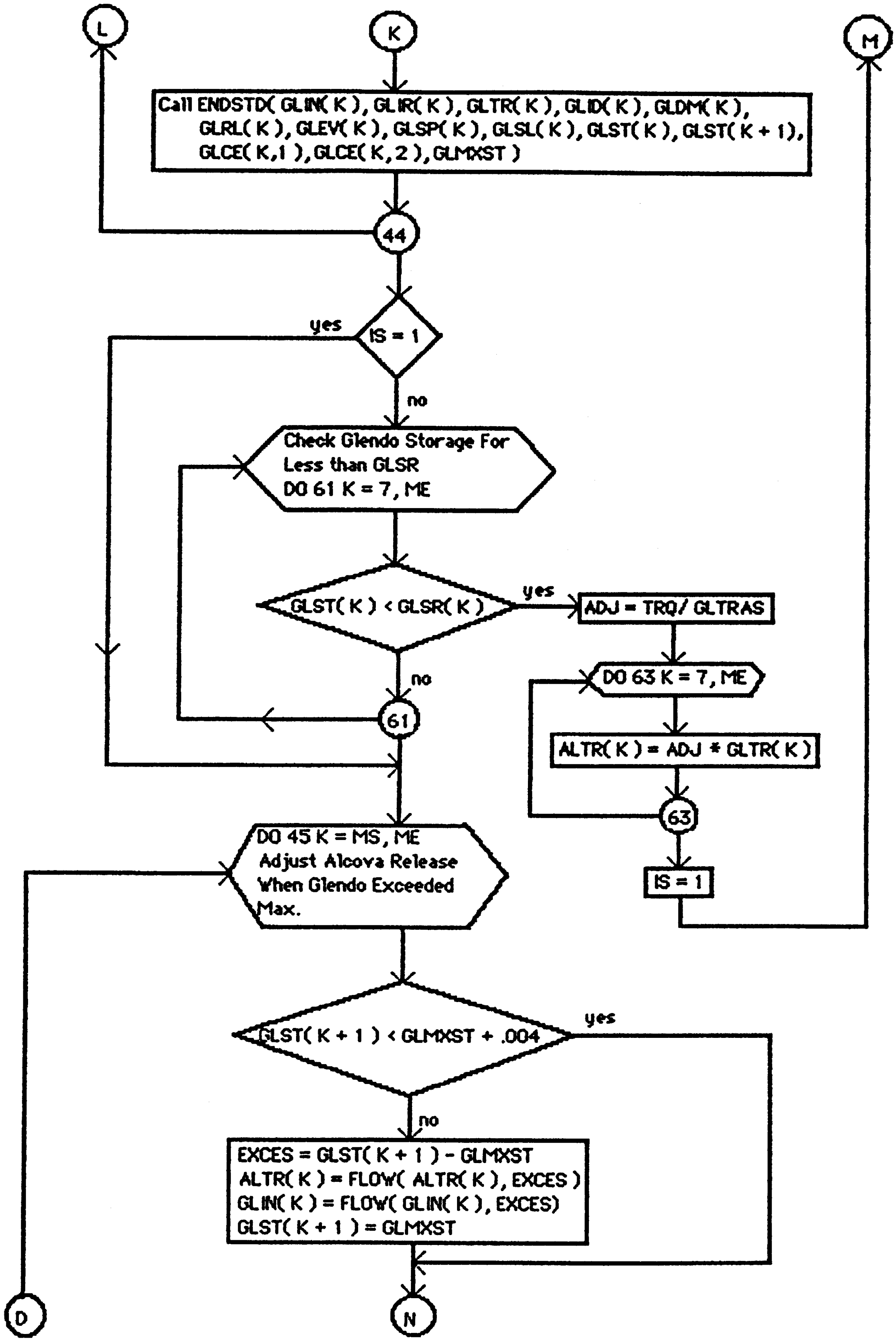

C
May Alcova Turbine Release
ALTR(8) = GLMXST - GLST(8) + GLTR(8) + GLMYEV
+ GLSL(8) - AGGN(8) + GLSP(8)
RLMYHI = DLRL * 15. + ACBSLO
RLMYLO = DLRL * 15. + ACBSLO
J = IV (RLMYLO, RLMYHI, ALTR(8))
J = 1
yes
ALTR(8) = RLMYHI
no
J = 2
yes
J = 3
ALTR(8) = RLMYHI
Water Needed in Glendo and Guernsey
During April and Sept.
GLTRAS = SUM(GLTR, 7, ME)
AGGNAS = SUM(AGGN, 7, ME)
TRQ = GLTRAS - AGGNAS -(GLST(7) - GLSR(12)) + GLASLS
June to Sept. Turbine Release in Alcova and
Ajustment of April and May Release
N = IV(ALSTCR(3, 1), ALSTCR(3, 2), TRQ)
D

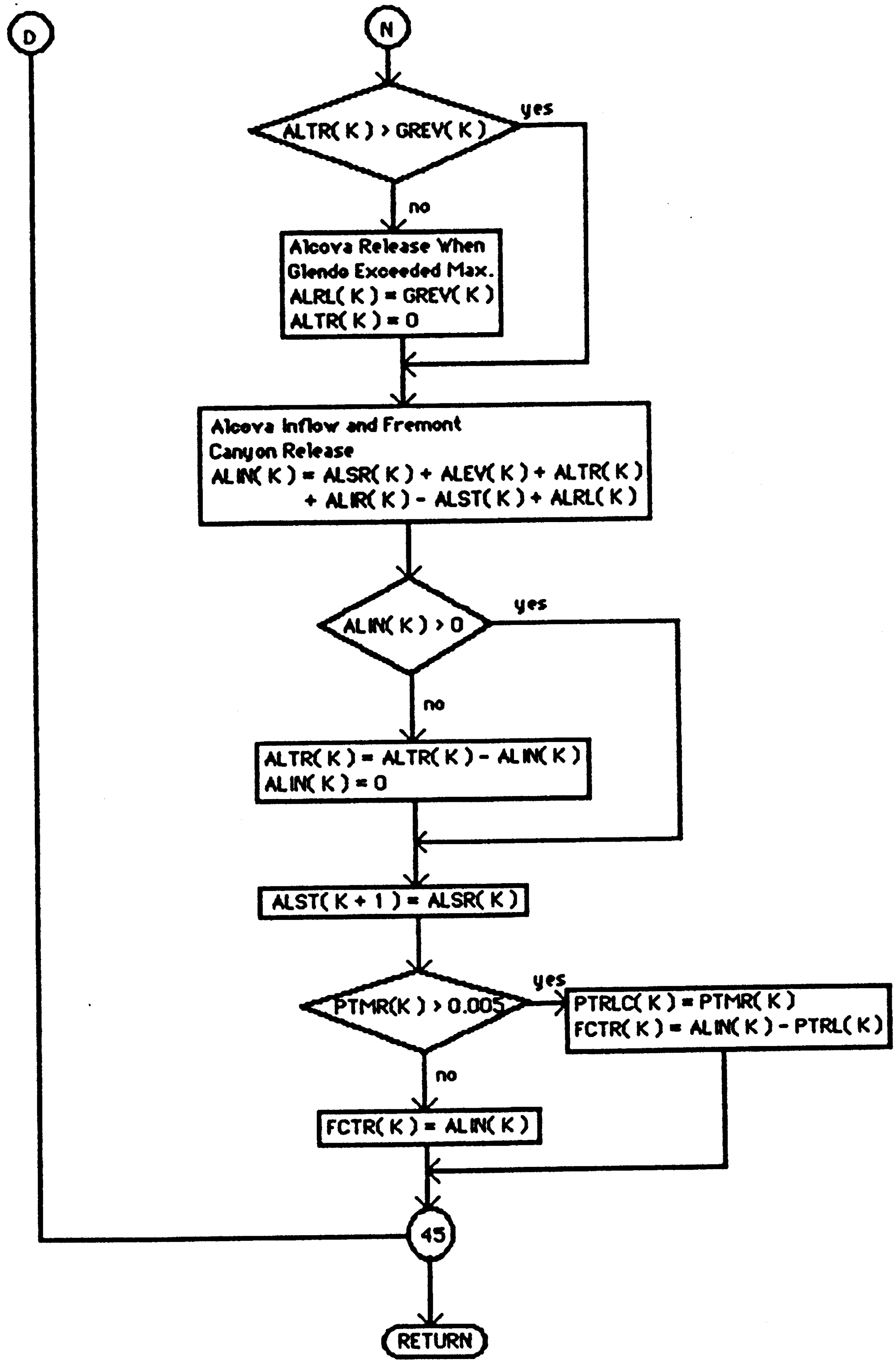

D
N=1
yes
no
M=IV (ALSTCR(I, N), ALSTCR(2,N), TRQ
M= 1
DEL = TRQ - ALSTCR(M,N)
no
N=2
yes
DO 26 KK= 1 , 4
K= 8 + KK
ALTR(K) = ALBSMO(KK)
26
M = 2, 3
DEL= TRQ - ALSTCR(M -1 , N)
DO 24 KK = 1 , 6
K = KK + 6
ALTR(K) = ALBSLO(KK, M) +
ALAJPC(KK, M) * DEL
24
TRQ > ALSTCR(N, N)
M = 1
M = 3
ALTR(10) = ALTR(10) - (ALSTCR (N, N) - TRQ) * 0.5
ALTR(11) = ALTR(10)
ALRC = TRQ - (SUM(ALTR, 7, ME) - ALTR(8))
ATRC > ALMYRL
ALTR(8) = ALMYRL
ADJ = (ALTR (8) - ATRC) / 2
ALTR(10) = ALTR(10) - ADJ
ALTR(11) = ALTR(10)
F
G


E
F
G
ATRC > ALTR (8)
yes
XM = M
no
ADJ =(ATRC - ALTR(8)) / XM
ALTR(8) = ATRC
MM = 9 + M - 1
DO 30 K = 9, MM
ALTR(K) = ALTR(K) + ADJ
30
N = 3
DO 32 KK = 1 , 4
K = 8 + KK
ALTR(K) = ALBSHK(KK)
32
M = IV(ALSTCR(2, N), ALSTCR(3, N), TRQ
M= 1
yes
ALTR(12) = ALTR(12) - (ALSTCR(2, N) - TRQ) * 0.5
no
M = 2
yes
ALTR(9) = TRQ - (SUM(ALTR, 7, 12) - ALTR(9)
ALTR(9) ≤ ALBSHK(1)
yes
no
no
I
H
G

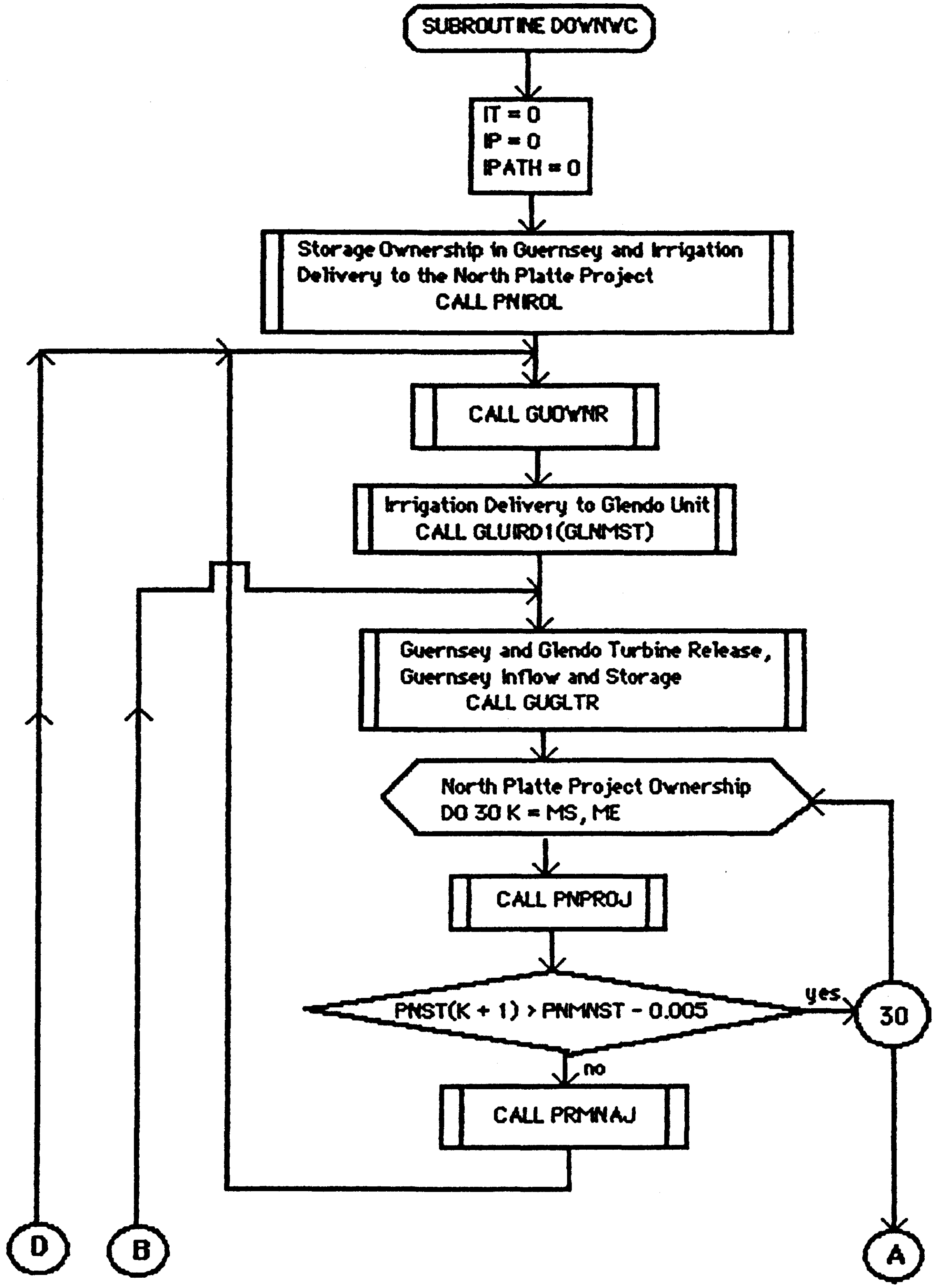

I
H
G
ALTR(12) = ALTR(12) + ALTR(9) - ALBSHK(1)
ALTR(9) = ALBSHK(1)
M = 3
ALTR(12) = TRQ - (SUM(ALTR, 7, 12) - ALTR(12))
ALTR(12) > ALBSHK(4)
yes
no
ALTR(9) = ALTR(9) = ALTR(12) - ALBSHK(4)
ALTR(12 = ALBSHK(4)
Ajust Jump to Sept. Flow Variance Within 20% of Average
AVE4 = SUM(ALTR, 9, 12) / 4.
IS = 0
DO 41 K = 9, 12
ALTR(K) > 1.2 * AVG4 or
ALTR(K) < 0.8 * AVG4
yes
ALTR (9) = 0.8 * AVG4
ALTR (10) = 1.2 * AVG4
ALTR (11) = 1.2 * AVG4
ALTR (12) = 0.8 * AVG4
no
41
J

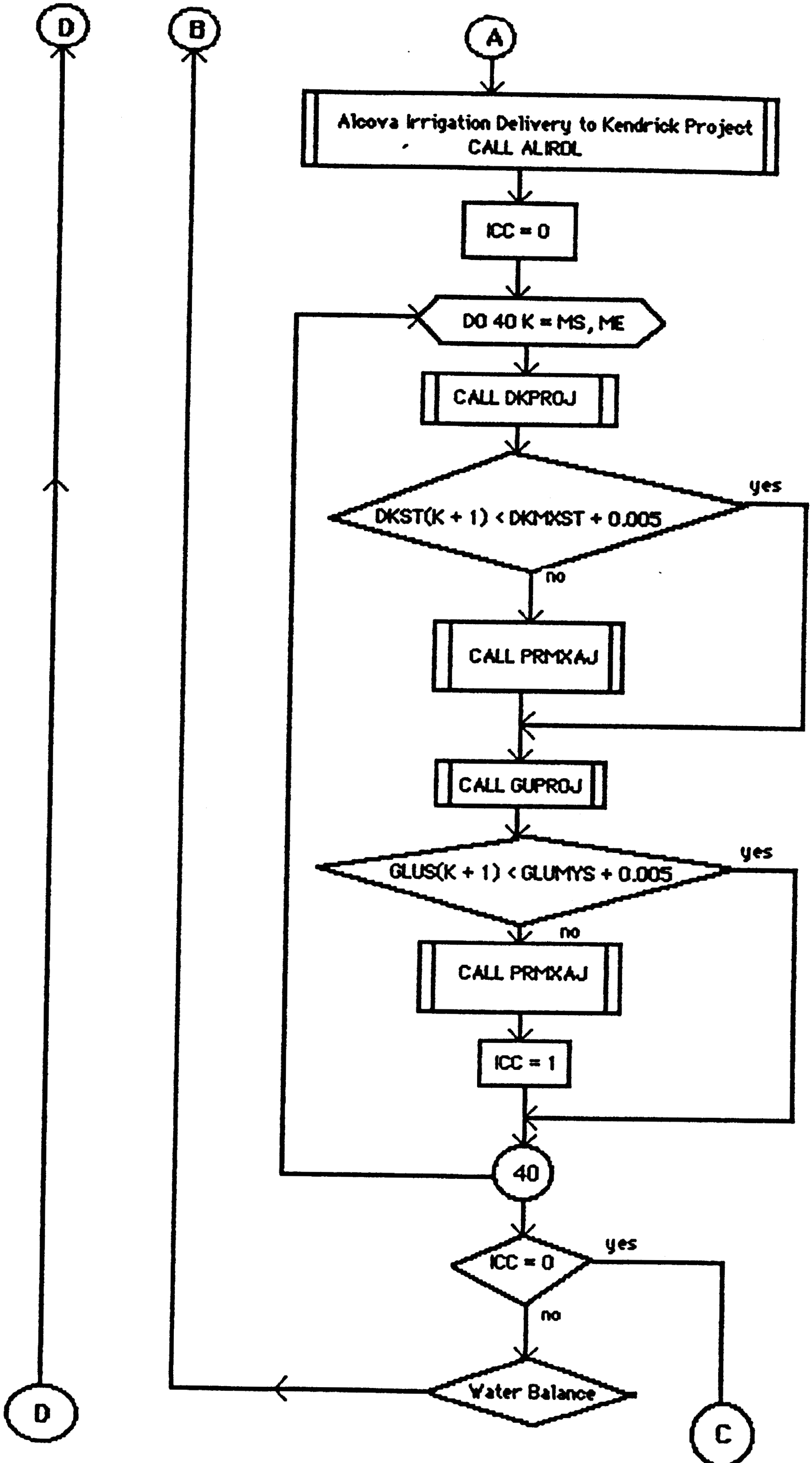

J
Check For Min. Wease
DO 48 K = 7, ME
ALMNOT = ALDLMN * DAYMO(K)
ALTR(K) > ALMNOT + 0.005
yes
no
ALTR(K) > = ALMNOT
48
April to Dec. Glendo Inflow and Storage
DO 44 K = 7, ME
ALTR(K) = ROUND(ALTR(K), 3) + GREV(K)
GLIN(K) = AGGN(K) + ALTR(K) - GREV(K)
GLIN(K) ≥ 0
yes
no
ALTR(K) = ALTR(K) - GLIN(K)
GLIN(K) = 0
GLST(K + 1) = GLST(K) + GLIN(K) - GLTR(K)
- GLSL(K) - GLSP(K) - GLRL(K)
L
K
M


L
K
M
Call ENDSTD(GLIN(K), GLIR(K), GLTR(K), GLID(K), GLDM(K),
GLRL(K), GLEV(K), GLSP(K), GLSL(K), GLST(K), GLST(K + 1),
GLCE(K,1), GLCE(K,2), GLMXST)
44
yes
IS = 1
no
Check Glendo Storage For
Less than GLSR
DO 61 K = 7, ME
GLST(K) < GLSR(K)
yes
ADJ = TRQ/ GLTRAS
no
DO 63 K = 7, ME
61
ALTR(K) = ADJ * GLTR(K)
63
DO 45 K = MS, ME
Adjust Alcova Release
When Glendo Exceeded
Max.
IS = 1
GLST(K + 1) < GLMXST + .004
yes
no
EXCES = GLST(K + 1) - GLMXST
ALTR(K) = FLOW(ALTR(K), EXCES)
GLIN(K) = FLOW(GLIN(K), EXCES)
GLST(K + 1) = GLMXST
D
N

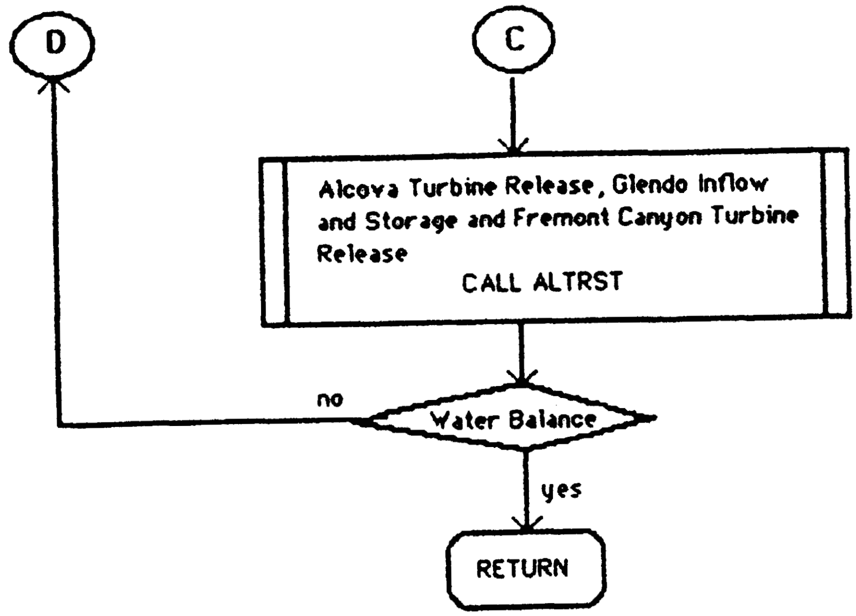

D
N
ALTR(K) > GREV(K)
yes
no
Alcova Release When
Glendo Exceeded Max.
ALRL(K) = GREV(K)
ALTR(K) = 0
Alcova Inflow and Fremont
Canyon Release
ALIN(K) = ALSR(K) + ALEV(K) + ALTR(K)
+ ALIR(K) - ALST(K) + ALRL(K)
ALIN(K) > 0
yes
no
ALTR(K) = ALTR(K) - ALIN(K)
ALIN(K) = 0
ALST(K + 1) = ALSR(K)
PTMR(K) > 0.005
yes
PTRLC(K) = PTMR(K)
FCTR(K) = ALIN(K) - PTRL(K)
no
FCTR(K) = ALIN(K)
45
RETURN

DESCRIPTION: Controls the Computation of Water Component For the Downstream Reservoirs (Alcova, Glendo, and Guernsey)

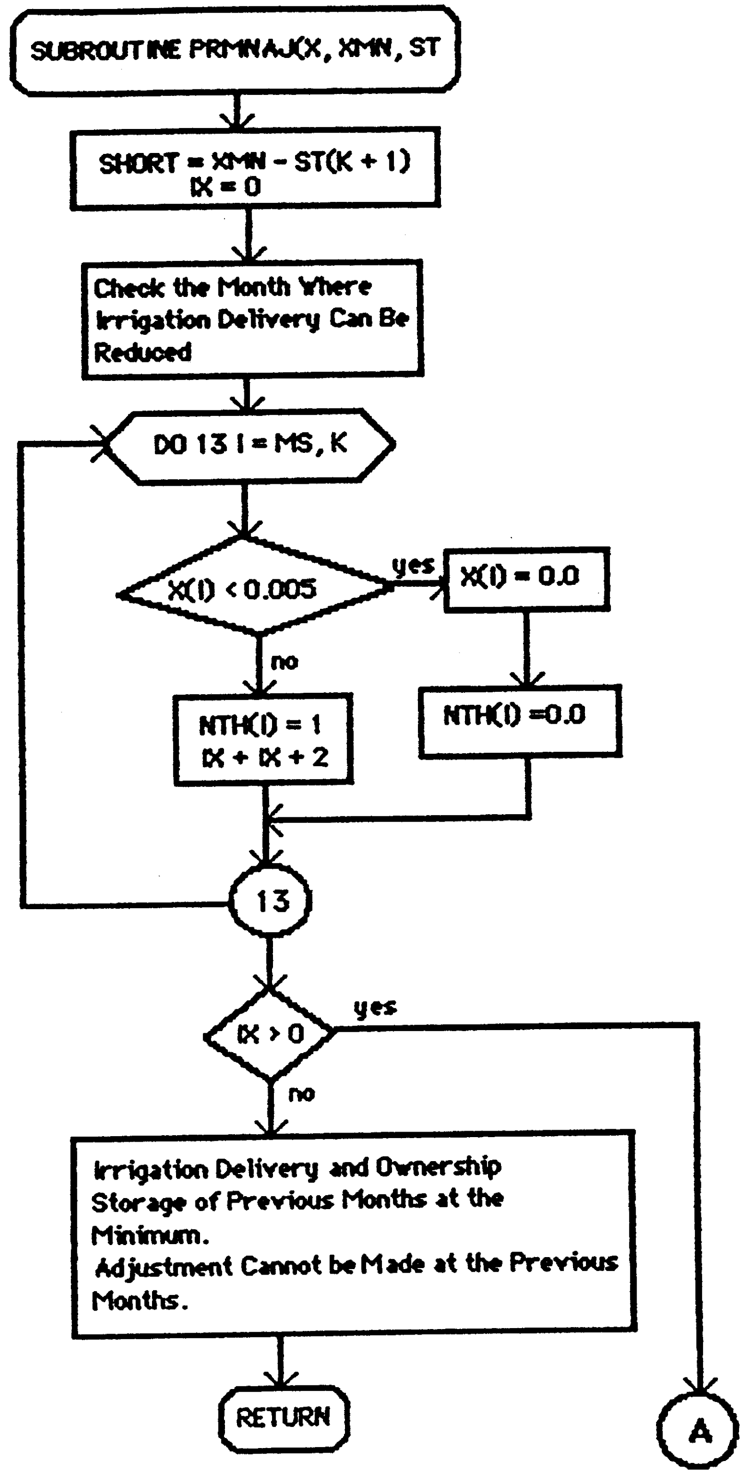


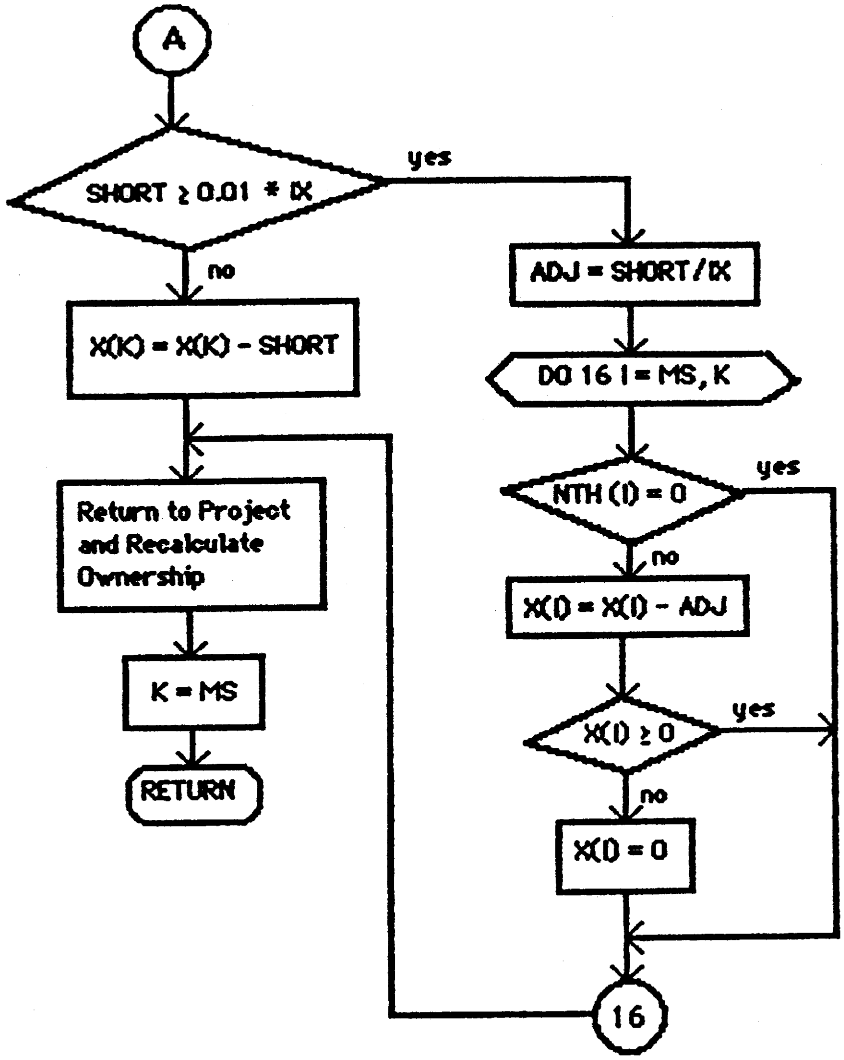


D
B
A
Alcova Irrigation Delivery to Kendrick Project
CALL ALIRDL
ICC = 0
DO 40 K = MS, ME
CALL DKPROJ
DKST(K + 1) < DKMXST + 0.005
yes
no
CALL PRMXAJ
CALL GUPROJ
GLUS(K + 1) < GLUMYS + 0.005
yes
no
CALL PRMXAJ
ICC = 1
40
ICC = 0
yes
no
Water Balance
D
C

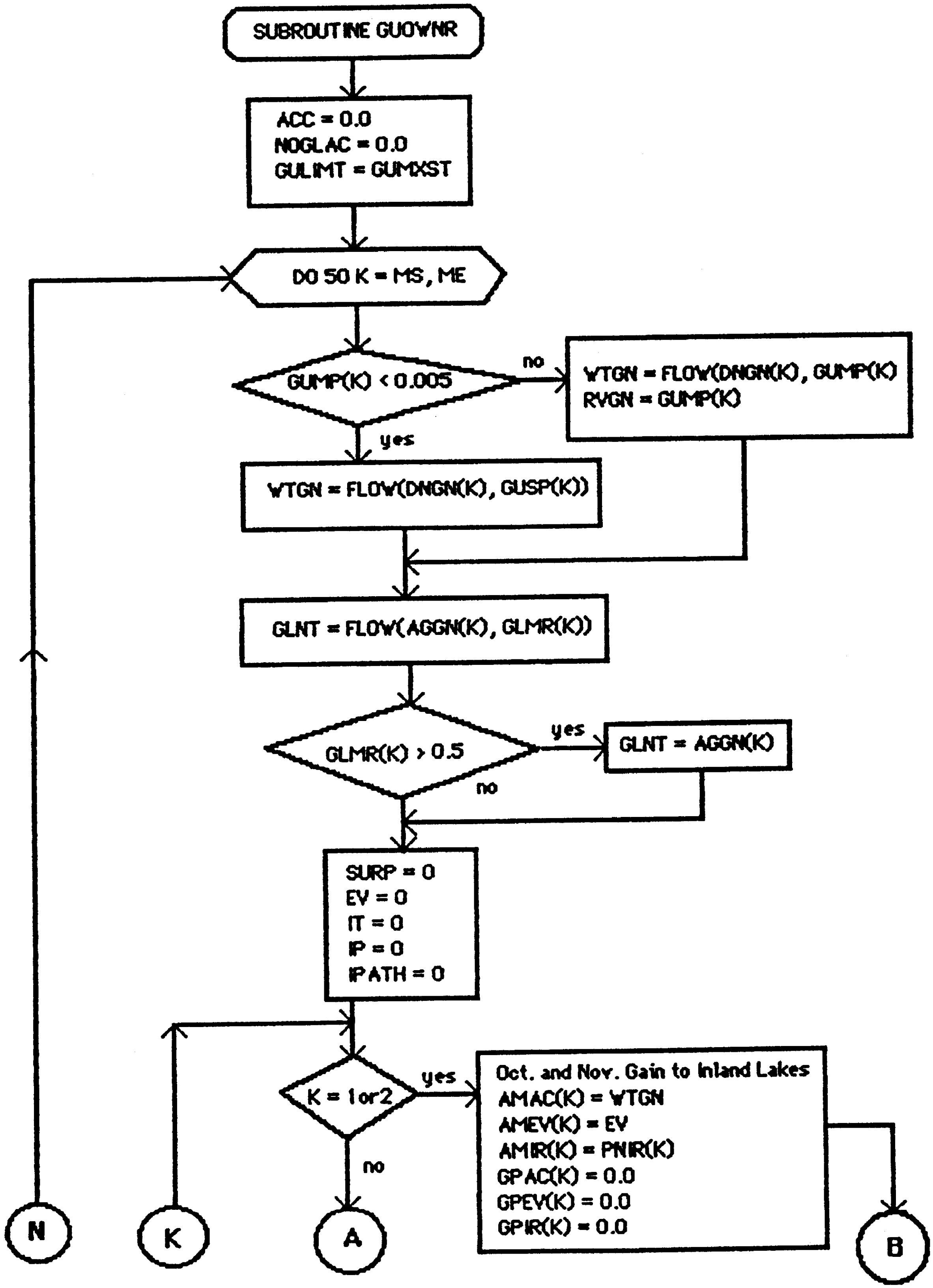

D
C
Alcova Turbine Release, Glendo Inflow and Storage and Fremont Canyon Turbine Release
CALL ALTRST
no
Water Balance
yes
RETURN

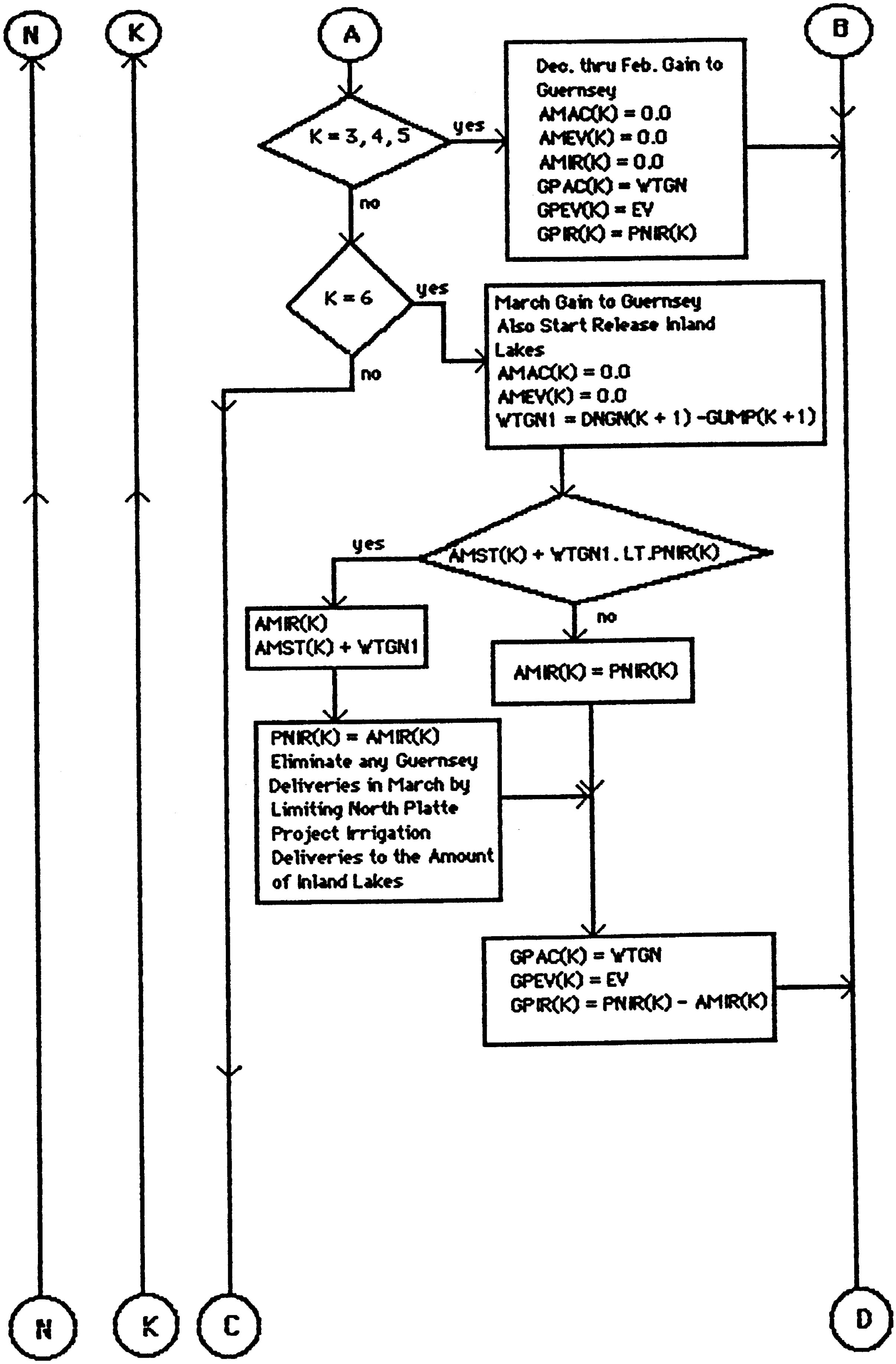
Description: Adjustment of Irrigation Delivery When the Project Ownership is Lower than Minimum Allowed.

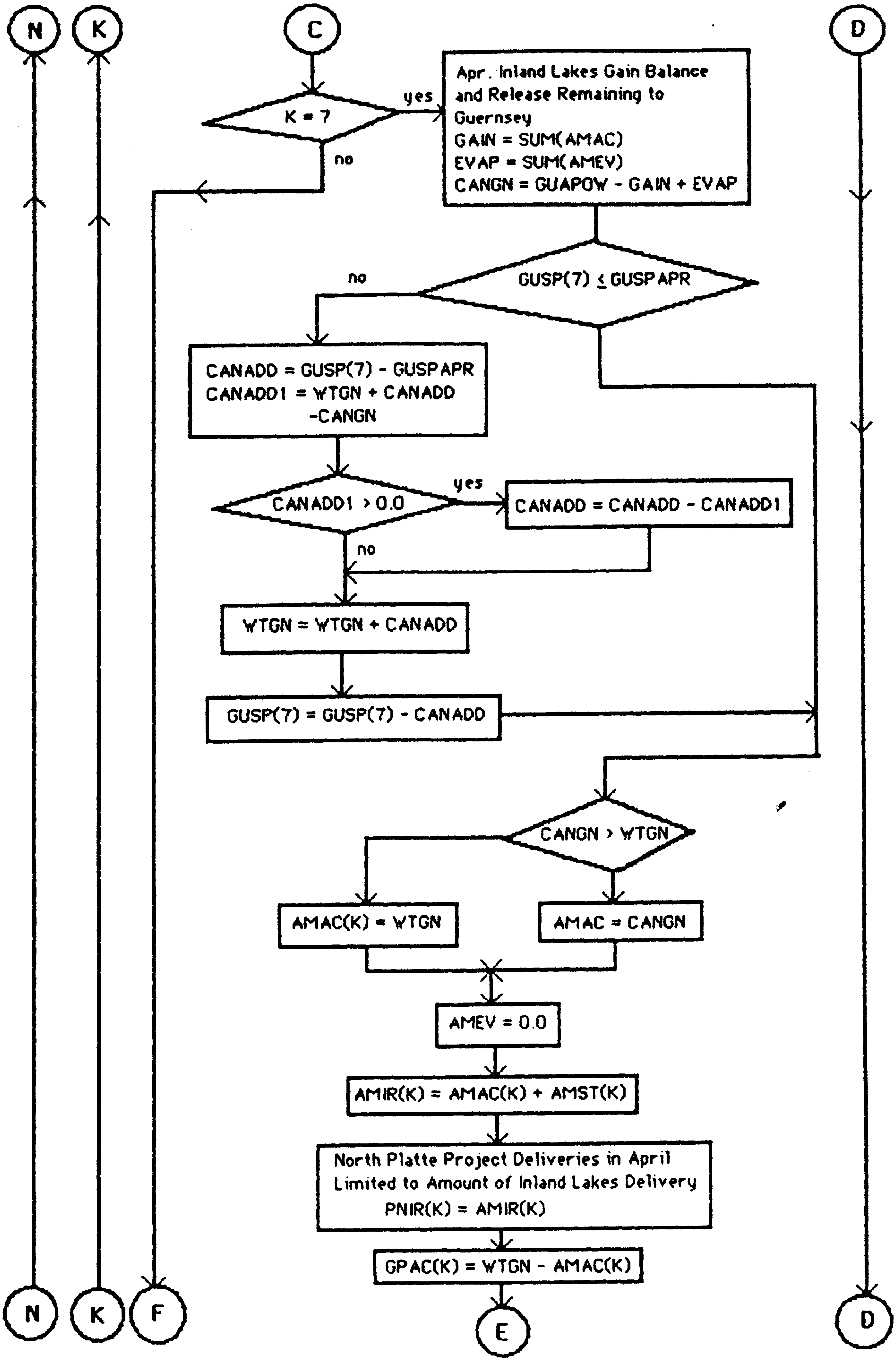


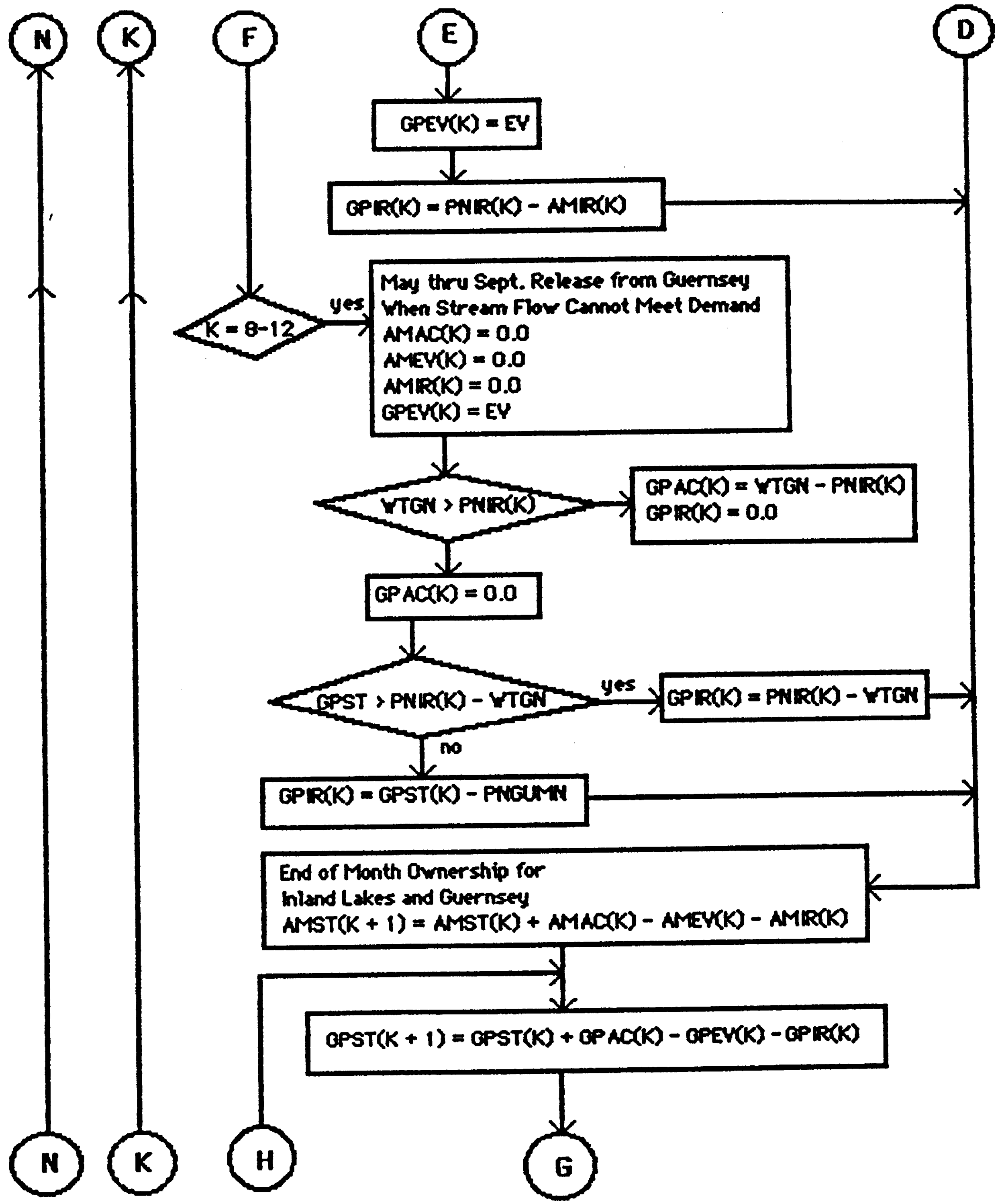

A
SHORT ≥ 0.01 * IX
yes
no
ADJ = SHORT / IX
X(K) = X(K) - SHORT
DO 16 I = MS, K
NTH (I) = 0
yes
Return to Project
and Recalculate
Ownership
no
X(I) = X(I) - ADJ
K = MS
X(I) ≥ 0
yes
RETURN
no
X(I) = 0
16

Description: From the Water Gain Below Alcova Determine Ownership of Inland Lakes and Guernsey, Water Accrued to Glendo Unit and Credited As Owed to River.

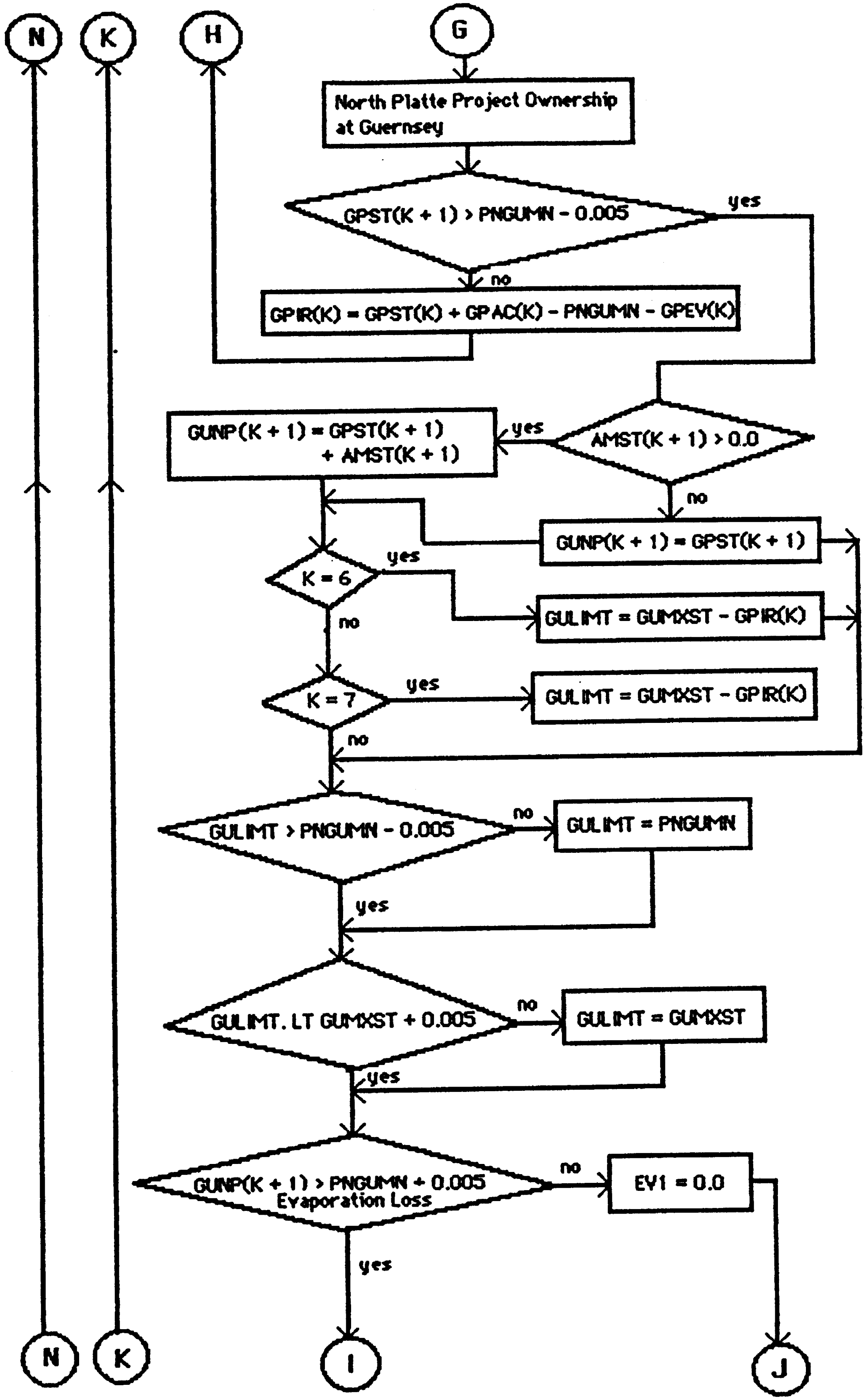



N
K
A
B
K = 3, 4, 5
yes
no
Dec. thru Feb. Gain to Guernsey
AMAC(K) = 0.0
AMEV(K) = 0.0
AMIR(K) = 0.0
GPAC(K) = WTGN
GPEV(K) = EV
GPIR(K) = PNIR(K)
K = 6
yes
no
March Gain to Guernsey
Also Start Release Inland Lakes
AMAC(K) = 0.0
AMEV(K) = 0.0
WTGN1 = DNGN(K + 1) -GUMP(K + 1)
AMST(K) + WTGN1 . LT.PNIR(K)
yes
no
AMIR(K)
AMST(K) + WTGN1
AMIR(K) = PNIR(K)
PNIR(K) = AMIR(K)
Eliminate any Guernsey Deliveries in March by Limiting North Platte Project Irrigation Deliveries to the Amount of Inland Lakes
GPAC(K) = WTGN
GPEV(K) = EV
GPIR(K) = PNIR(K) - AMIR(K)
N
K
C
D

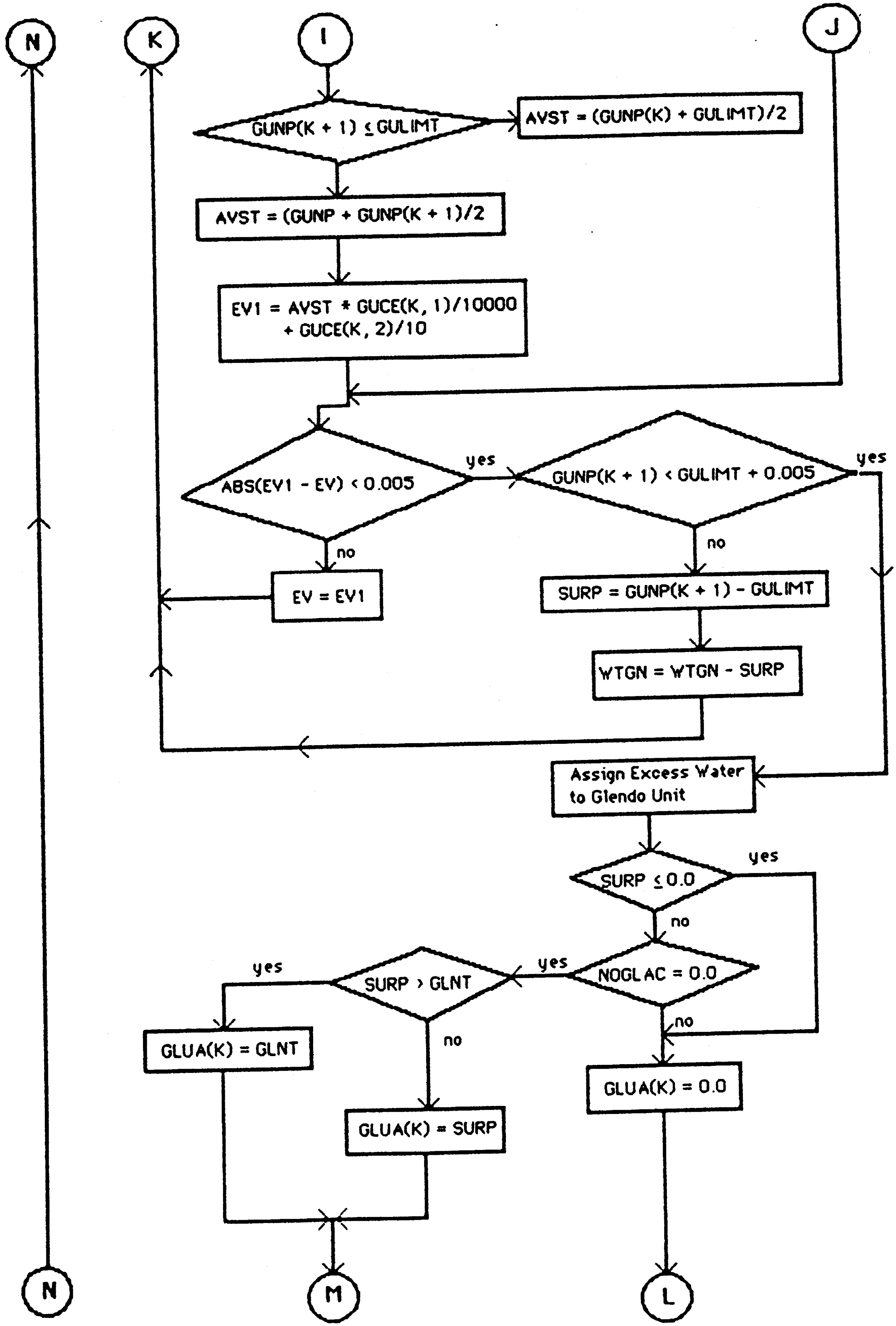

N
K
C
D
K = 7
yes
no
Apr. Inland Lakes Gain Balance and Release Remaining to Guernsey
GAIN = SUM(AMAC)
EVAP = SUM(AMEV)
CANGN = GUAPOW - GAIN + EVAP
GUSP(7) ≤ GUSPAPR
no
CANADD = GUSP(7) - GUSPAPR
CANADD1 = WTGN + CANADD -CANGN
CANADD1 > 0.0
yes
CANADD = CANADD - CANADD1
no
WTGN = WTGN + CANADD
GUSP(7) = GUSP(7) - CANADD
CANGN > WTGN
AMAC(K) = WTGN
AMAC = CANGN
AMEV = 0.0
AMIR(K) = AMAC(K) + AMST(K)
North Platte Project Deliveries in April Limited to Amount of Inland Lakes Delivery
PNIR(K) = AMIR(K)
GPAC(K) = WTGN - AMAC(K)
N
K
F
E
D

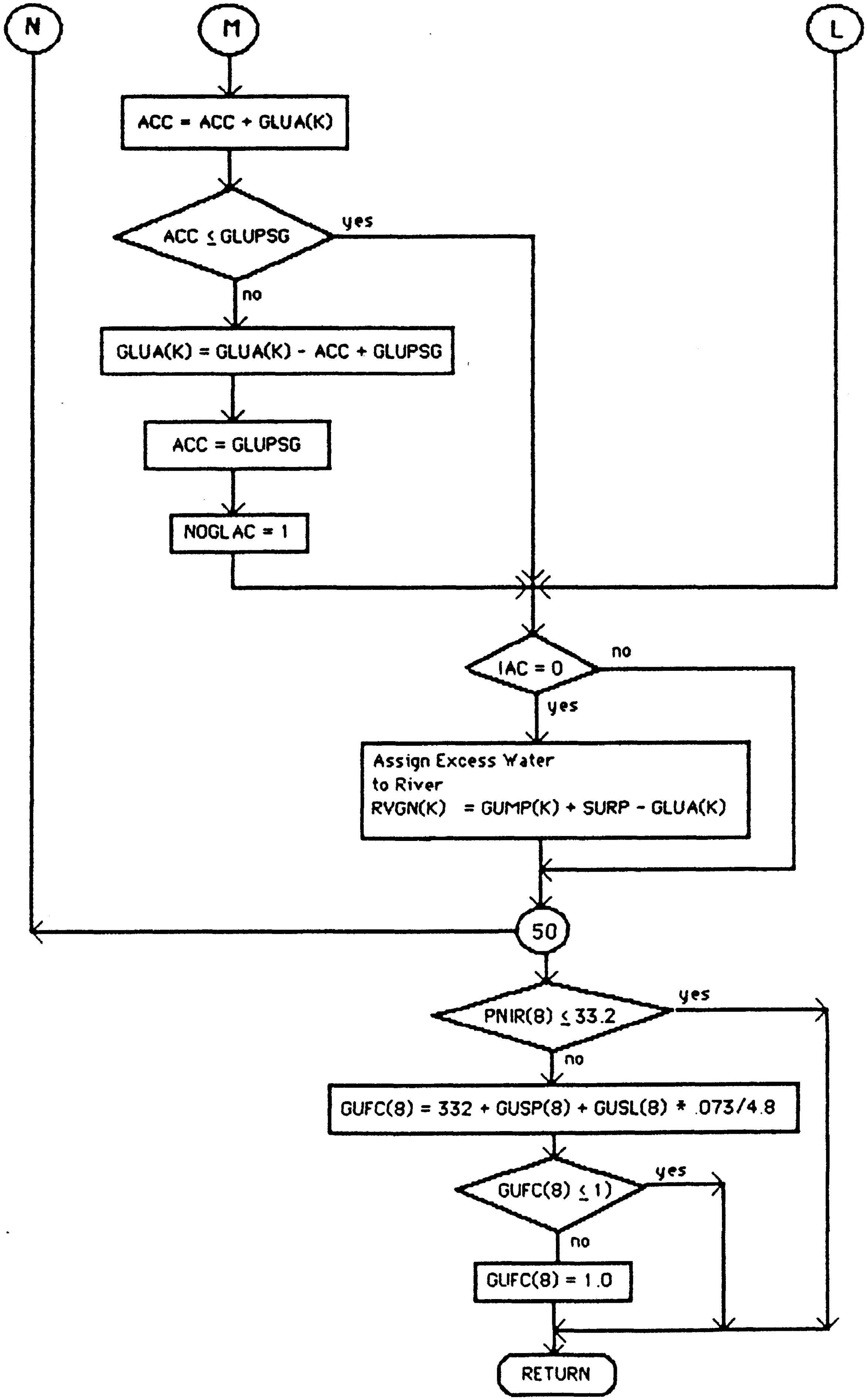


N
K
F
E
D
GPEV(K) = EV
GPIR(K) = PNIR(K) - AMIR(K)
K = 8-12
yes
May thru Sept. Release from Guernsey
When Stream Flow Cannot Meet Demand
AMAC(K) = 0.0
AMEV(K) = 0.0
AMIR(K) = 0.0
GPEV(K) = EV
WTGN > PNIR(K)
GPAC(K) = WTGN - PNIR(K)
GPIR(K) = 0.0
GPAC(K) = 0.0
GPST > PNIR(K) - WTGN
yes
GPIR(K) = PNIR(K) - WTGN
no
GPIR(K) = GPST(K) - PNGUMN
End of Month Ownership for
Inland Lakes and Guernsey
AMST(K + 1) = AMST(K) + AMAC(K) - AMEV(K) - AMIR(K)
GPST(K + 1) = GPST(K) + GPAC(K) - GPEV(K) - GPIR(K)
N
K
H
G

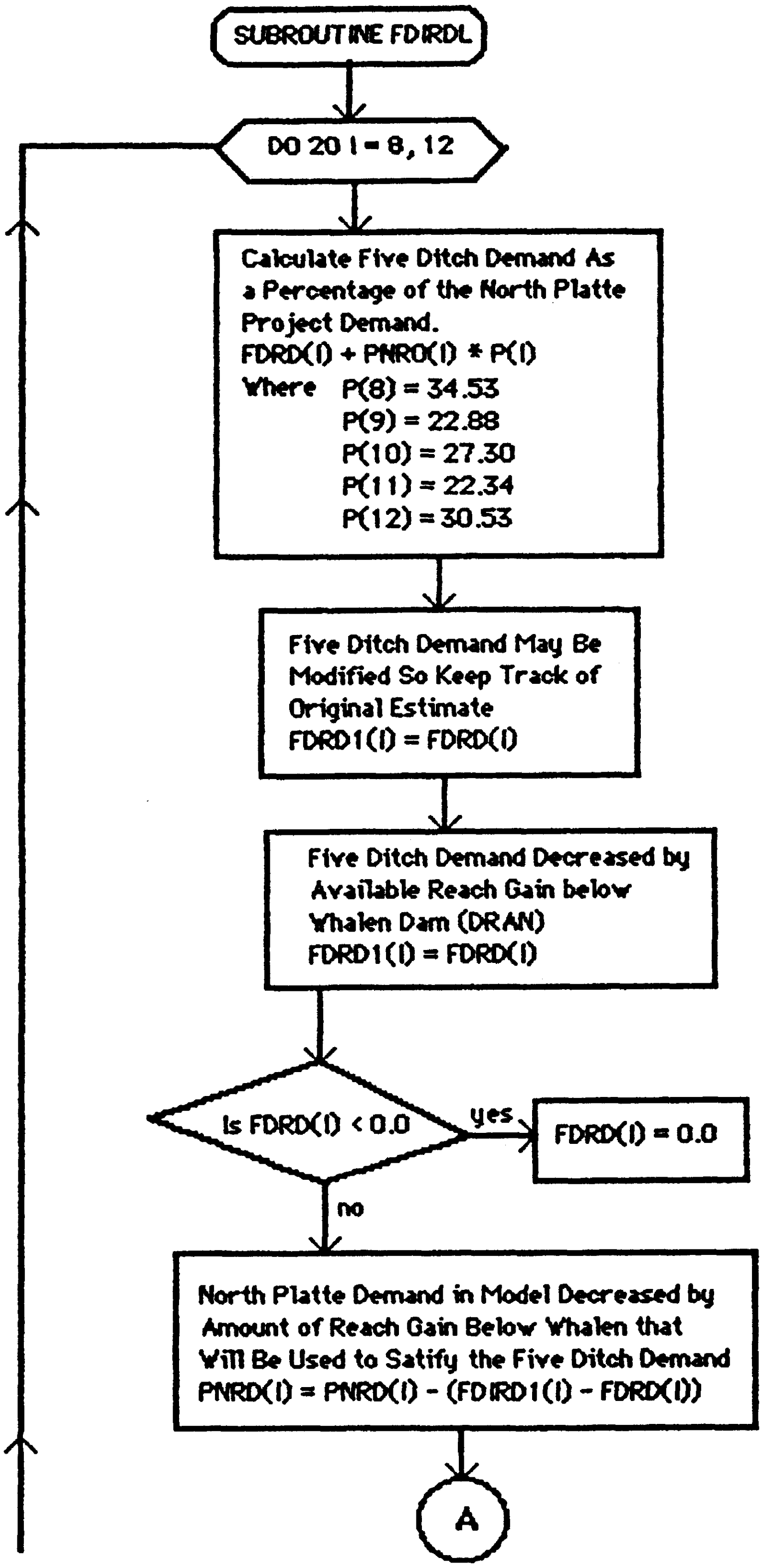


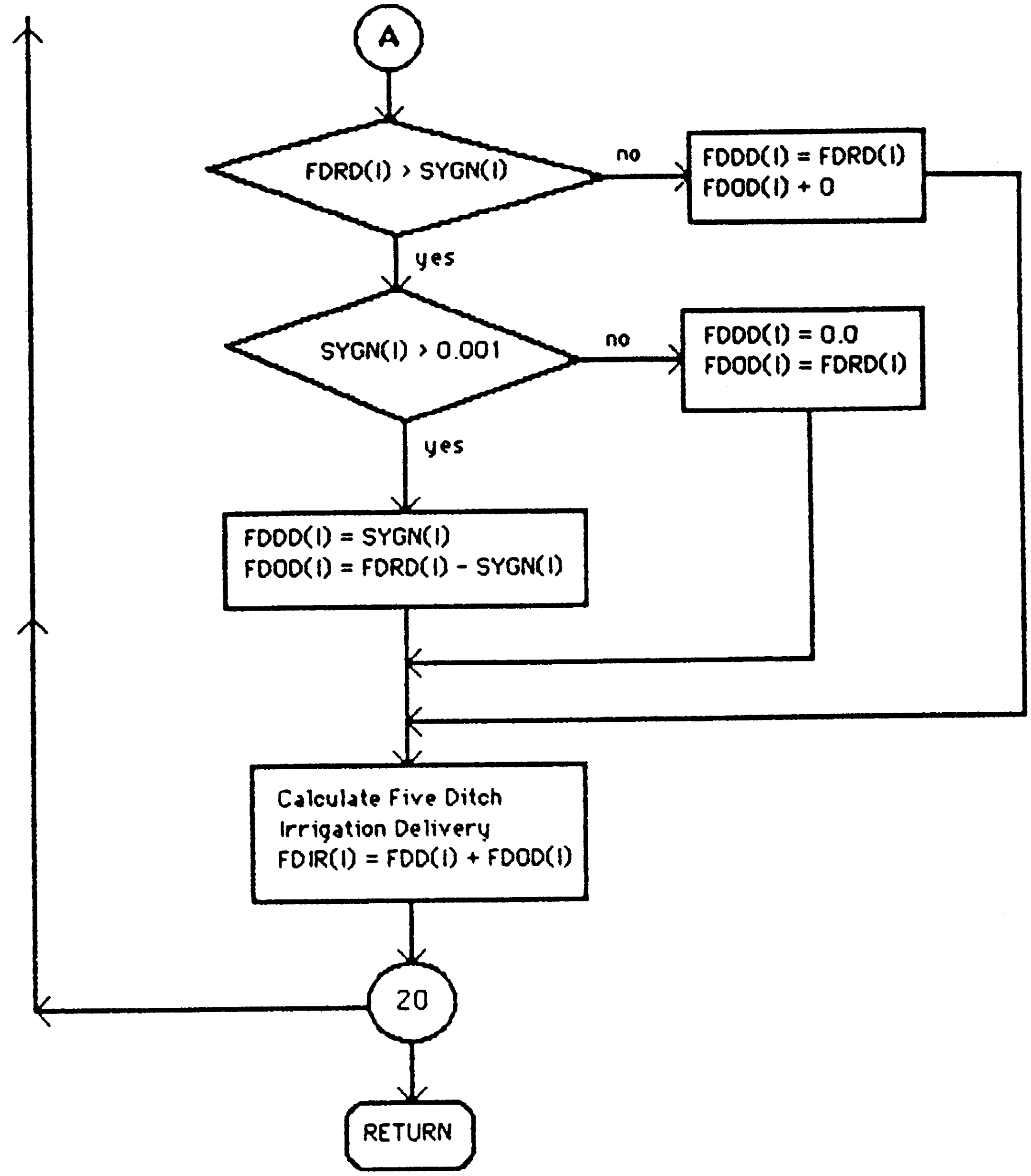
N
K
H
G
North Platte Project Ownership at Guernsey
GPST(K + 1) > PNGUMN - 0.005
yes
no
GPIR(K) = GPST(K) + GPAC(K) - PNGUMN - GPEV(K)
GUNP(K + 1) = GPST(K + 1) + AMST(K + 1)
yes
AMST(K + 1) > 0.0
no
GUNP(K + 1) = GPST(K + 1)
K = 6
yes
GULIMT = GUMXST - GPIR(K)
no
K = 7
yes
GULIMT = GUMXST - GPIR(K)
no
GULIMT > PNGUMN - 0.005
no
GULIMT = PNGUMN
yes
GULIMT. LT GUMXST + 0.005
no
GULIMT = GUMXST
yes
GUNP(K + 1) > PNGUMN + 0.005
Evaporation Loss
no
EV1 = 0.0
yes
N
K
I
J

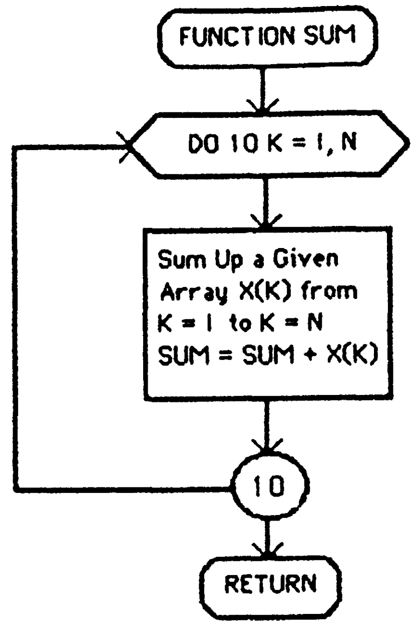

N
K
I
J
GUNP(K + 1) ≤ GULIMT
AVST = (GUNP(K) + GULIMT)/2
AVST = (GUNP + GUNP(K + 1)/2
EV1 = AVST * GUCE(K, 1)/10000 + GUCE(K, 2)/10
ABS(EV1 - EV) < 0.005
yes
GUNP(K + 1) < GULIMT + 0.005
yes
no
no
EV = EV1
SURP = GUNP(K + 1) - GULIMT
WTGN = WTGN - SURP
Assign Excess Water to Glendo Unit
SURP ≤ 0.0
yes
no
yes
SURP > GLNT
yes
NOGLAC = 0.0
no
GLUA(K) = GLNT
no
GLUA(K) = 0.0
GLUA(K) = SURP
N
M
L


N
M
L
ACC = ACC + GLUA(K)
ACC ≤ GLUPSG
yes
no
GLUA(K) = GLUA(K) - ACC + GLUPSG
ACC = GLUPSG
NOGLAC = 1
IAC = 0
no
yes
Assign Excess Water
to River
RVGN(K) = GUMP(K) + SURP - GLUA(K)
50
PNIR(8) ≤ 33.2
yes
no
GUFC(8) = 332 + GUSP(8) + GUSL(8) * .073/4.8
GUFC(8) ≤ 1)
yes
no
GUFC(8) = 1.0
RETURN

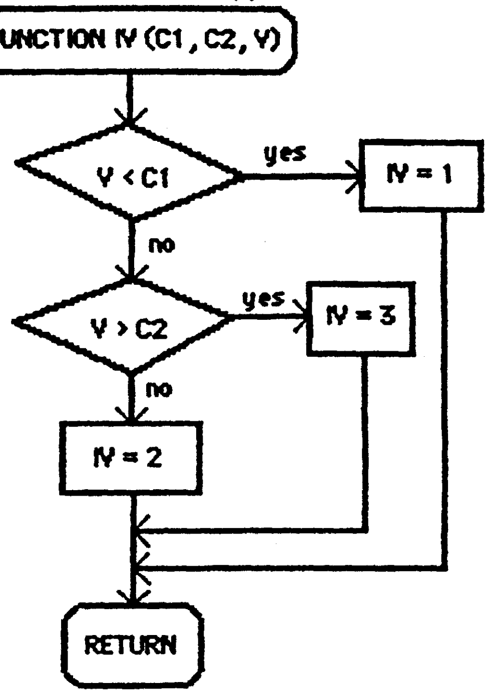
Description: Irrigation Delivery to the Five Ditches with Highest Priority.
P is Percentage of North Platte Demand Assigned to the Five Ditches



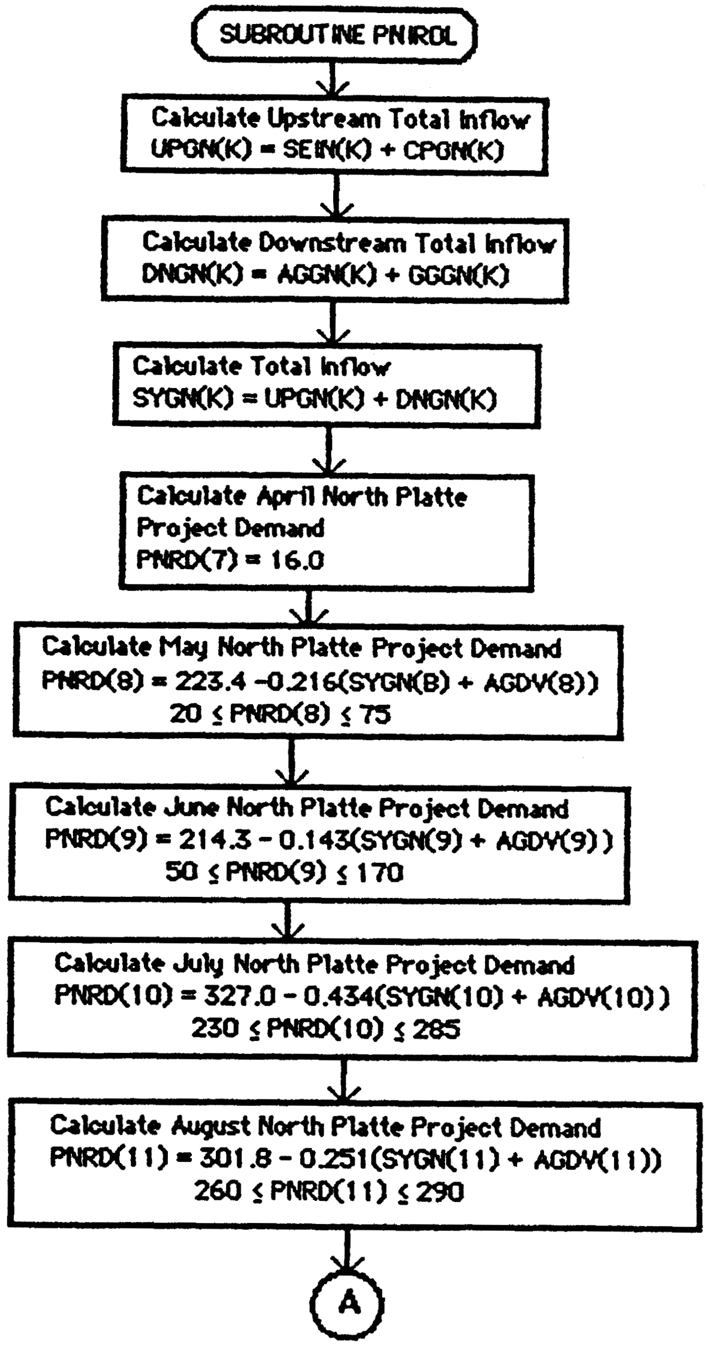

A
FDRD(I) > SYGN(I)
no
FDDD(I) = FDRD(I)
FDOD(I) + 0
yes
SYGN(I) > 0.001
no
FDDD(I) = 0.0
FDOD(I) = FDRD(I)
yes
FDDD(I) = SYGN(I)
FDOD(I) = FDRD(I) - SYGN(I)
Calculate Five Ditch
Irrigation Delivery
FDIR(I) = FDD(I) + FDOD(I)
20
RETURN

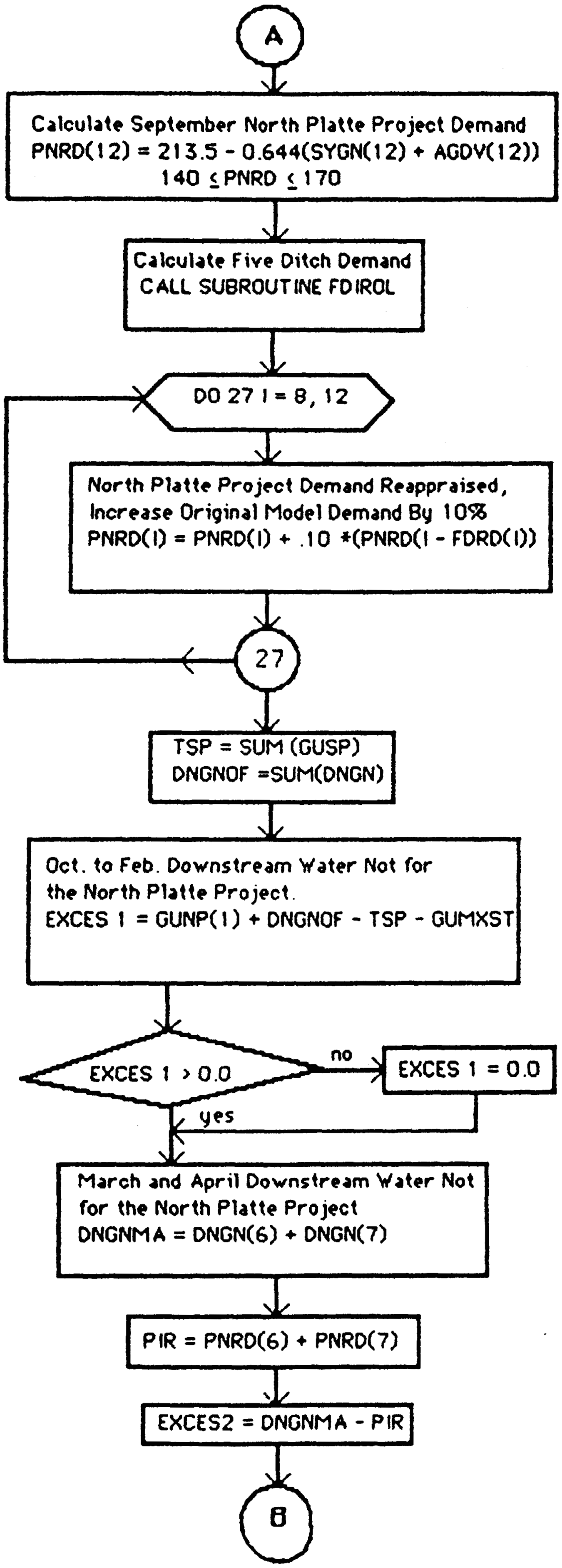

FUNCTION SUM
DO 10 K = 1, N
Sum Up a Given
Array X(K) from
K = 1 to K = N
SUM = SUM + X(K)
10
RETURN

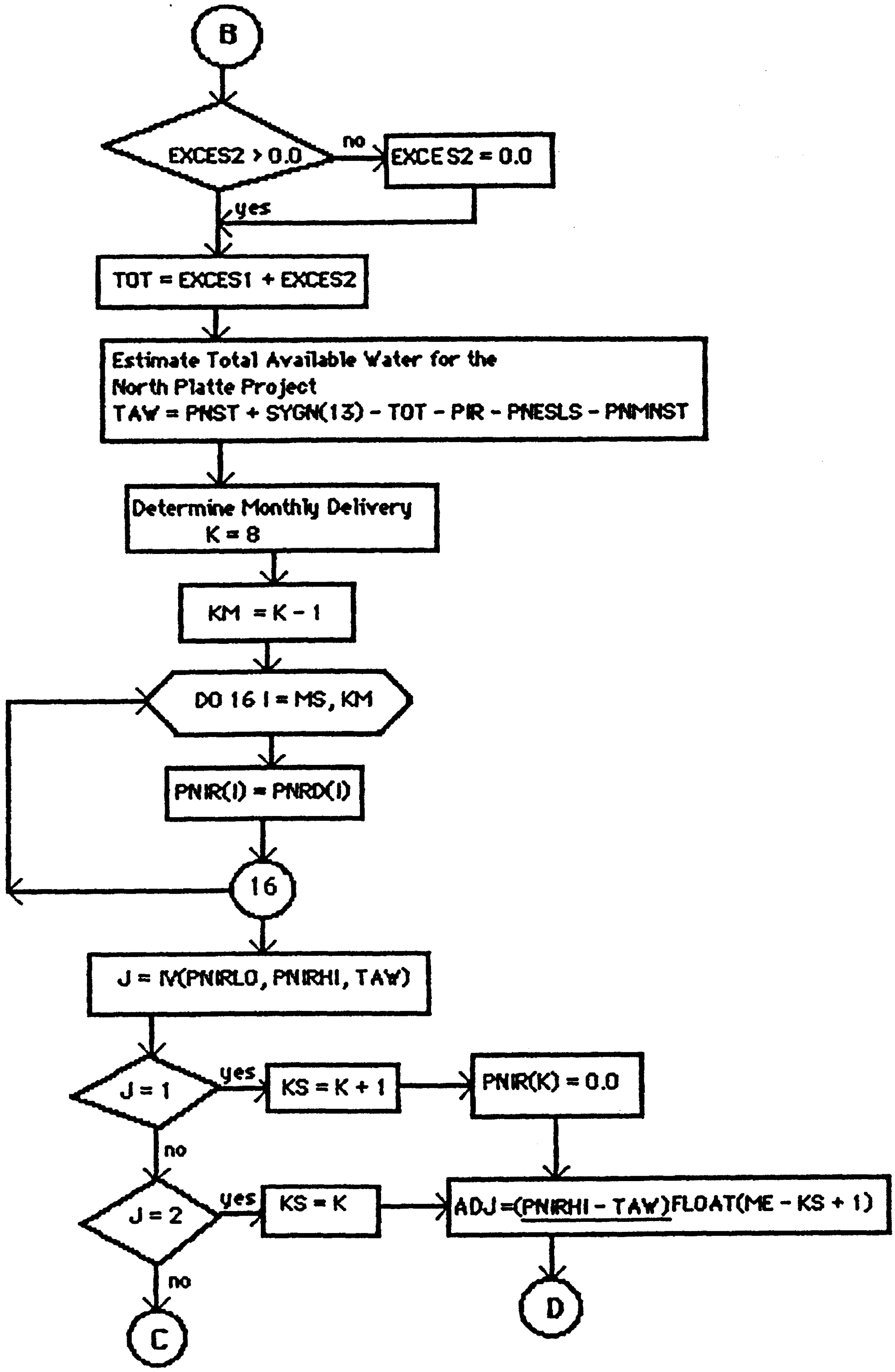
Description: Provide the Region where a Given Value Y belongs in the Given Criteria. C1 (Lower Limit) and C2 (Upper Limit) IY = 1 -- Below Lower Limit IY = 2 -- Between Limits IY = 3 -- Above Upper Limit

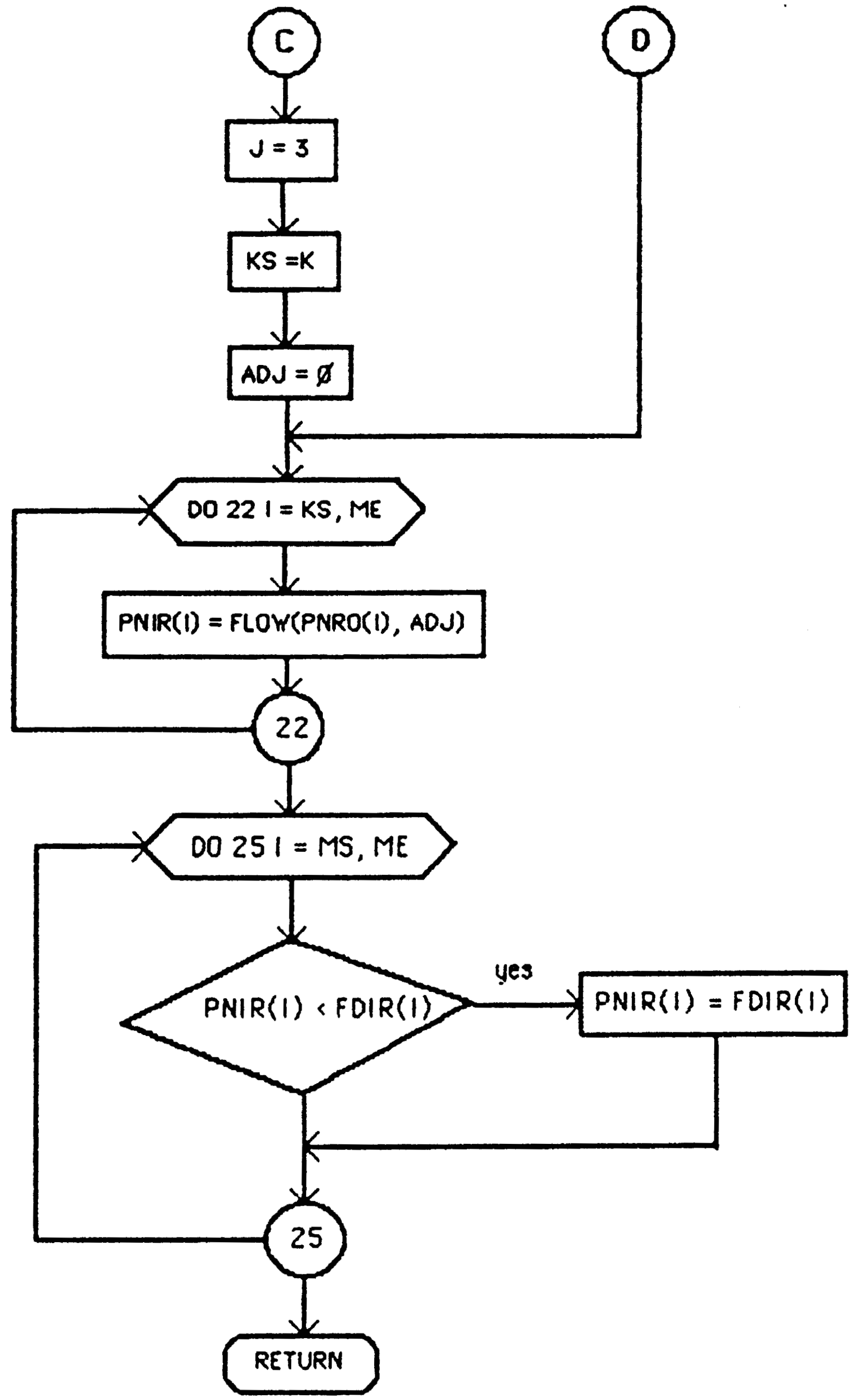


Description: Irrigation Delivery to the North Platte Project is Determined As Follows. The Demand on the North Platte Project in each Month is given as Input, however from May thru September are Adjusted According to the Water Available with Maximum Amount of Delivery During that Period Cannot Exceed the Demand.

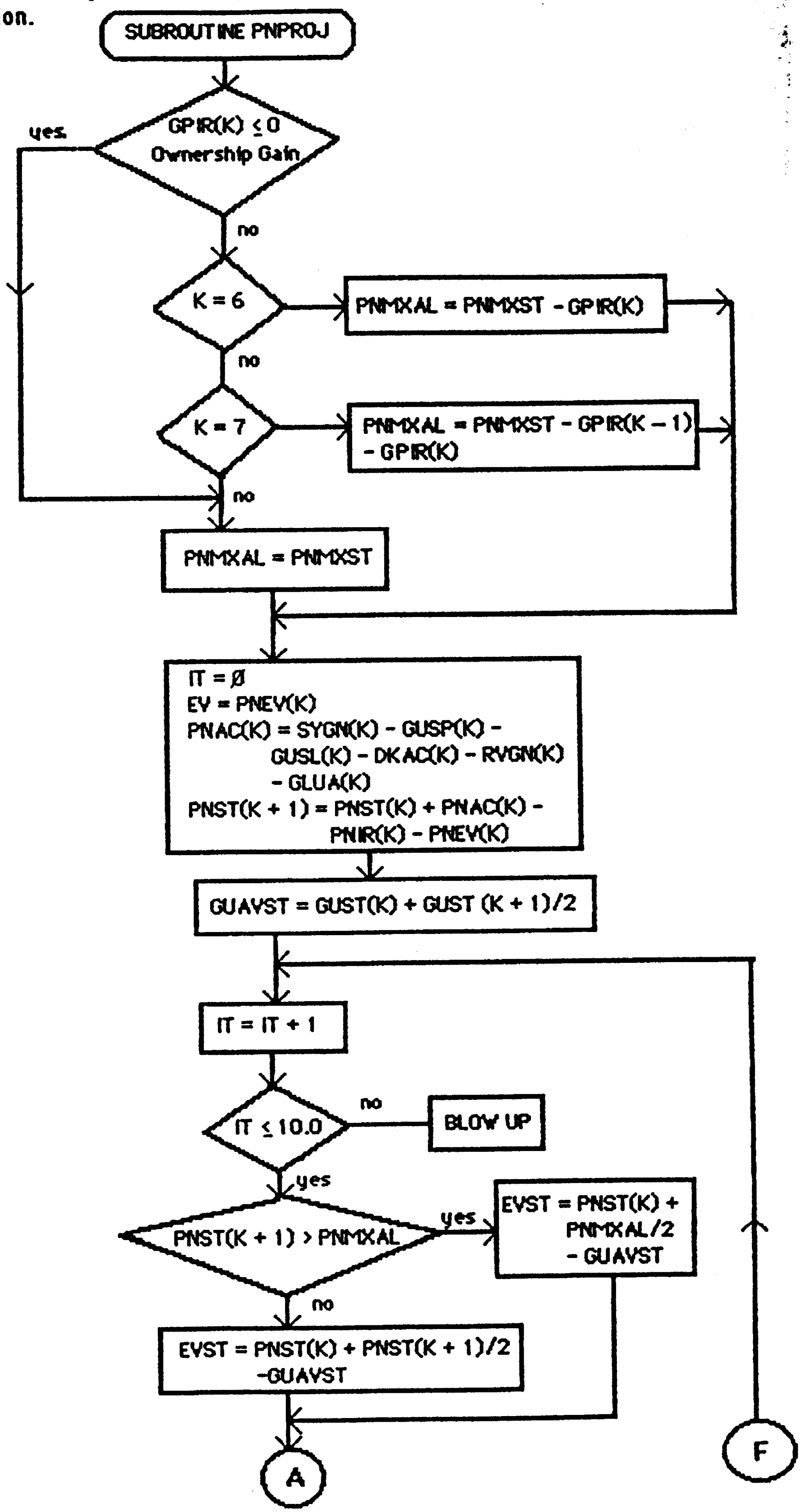


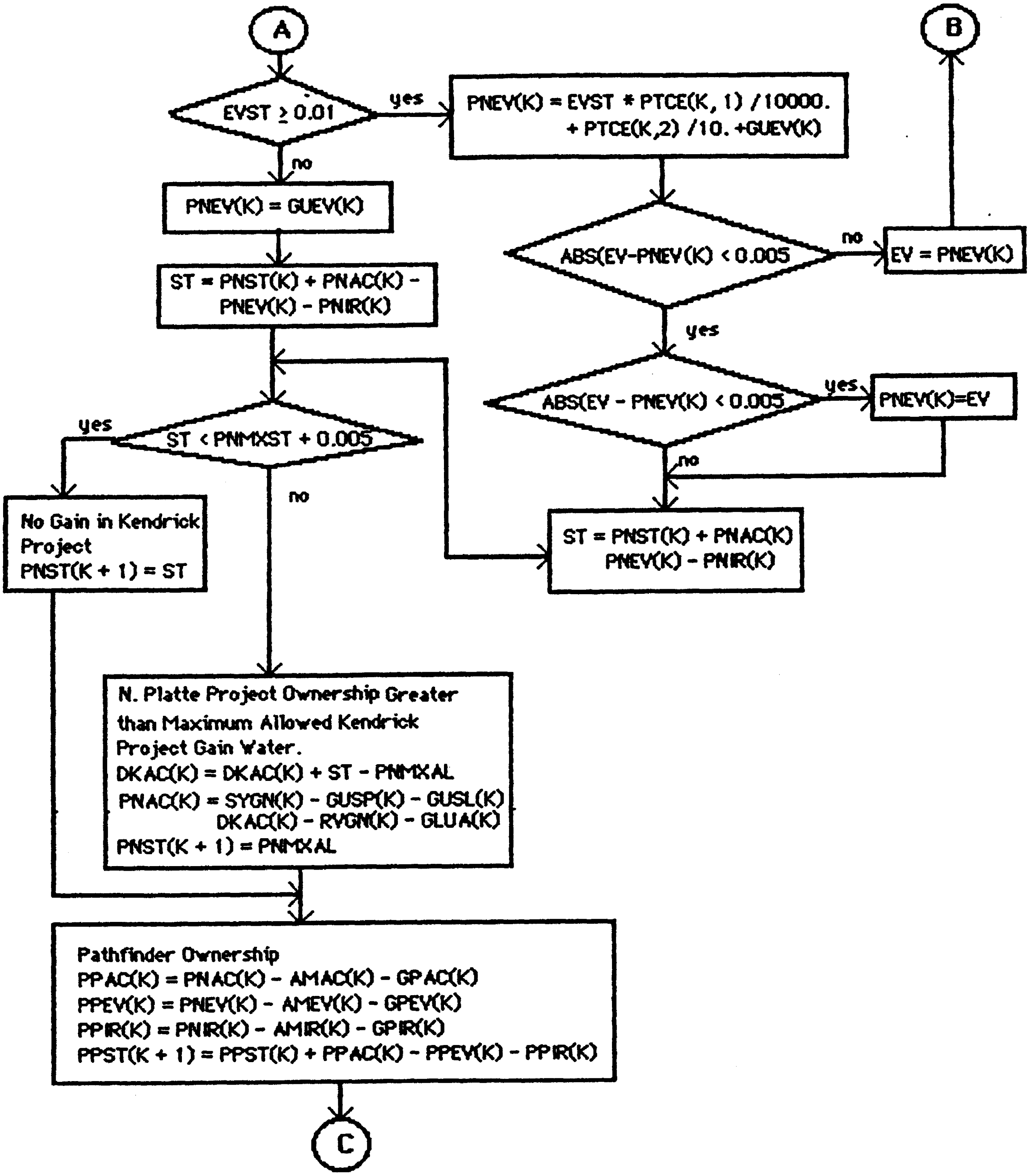

A
Calculate September North Platte Project Demand
PNRD(12) = 213.5 - 0.644(SYGN(12) + AGDV(12))
140 ≤ PNRD ≤ 170
Calculate Five Ditch Demand
CALL SUBROUTINE FDIROL
DO 27 I = 8, 12
North Platte Project Demand Reappraised,
Increase Original Model Demand By 10%
PNRD(I) = PNRD(I) + .10 *(PNRD(I - FDRD(I))
27
TSP = SUM (GUSP)
DNGNOF =SUM(DNGN)
Oct. to Feb. Downstream Water Not for
the North Platte Project.
EXCES 1 = GUNP(1) + DNGNOF - TSP - GUMXST
EXCES 1 > 0.0
no
EXCES 1 = 0.0
yes
March and April Downstream Water Not
for the North Platte Project
DNGNMA = DNGN(6) + DNGN(7)
PIR = PNRD(6) + PNRD(7)
EXCES2 = DNGNMA - PIR
B

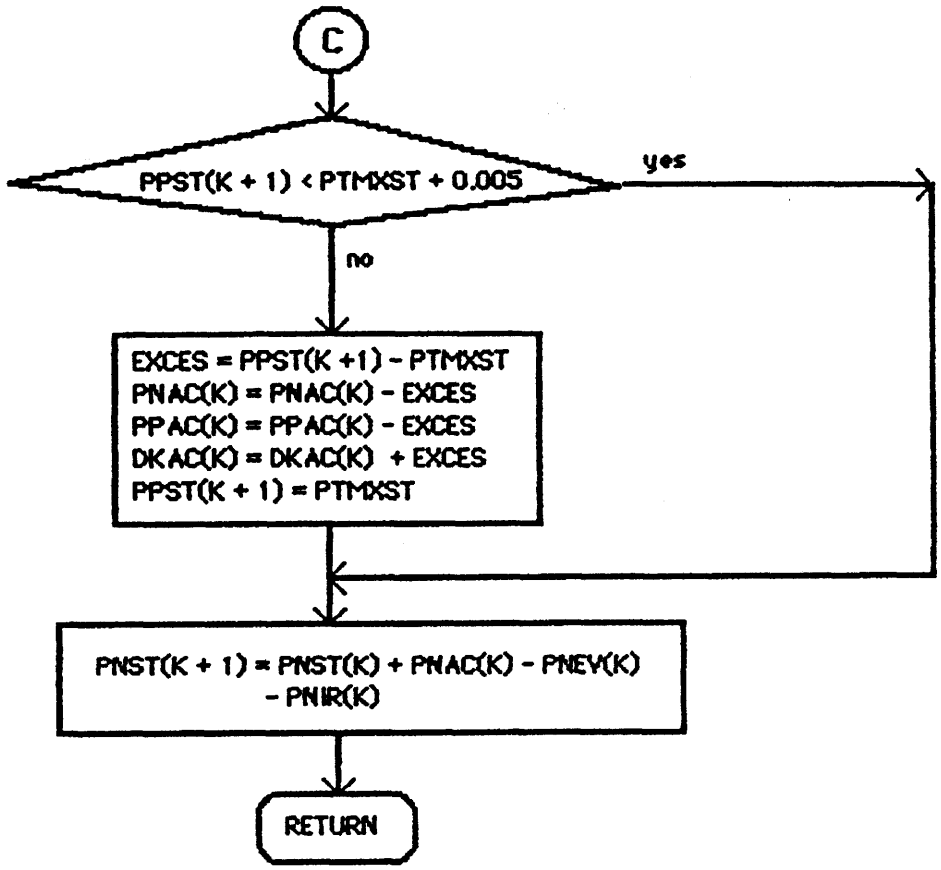

B
EXCES2 > 0.0
no
EXCES2 = 0.0
yes
TOT = EXCES1 + EXCES2
Estimate Total Available Water for the
North Platte Project
TAW = PNST + SYGN(13) - TOT - PIR - PNESLS - PNMNST
Determine Monthly Delivery
K = 8
KM = K - 1
DO 16 I = MS, KM
PNIR(I) = PNRD(I)
16
J = IV(PNIRLO, PNIRHI, TAW)
J = 1
yes
KS = K + 1
PNIR(K) = 0.0
no
J = 2
yes
KS = K
ADJ =(PNIRHI - TAW)FLOAT(ME - KS + 1)
no
C
D


C
D
J = 3
KS =K
ADJ = Ø
DO 22 I = KS, ME
PNIR(I) = FLOW(PNRO(I), ADJ)
22
DO 25 I = MS, ME
PNIR(I) < FDIR(I)
yes
PNIR(I) = FDIR(I)
25
RETURN

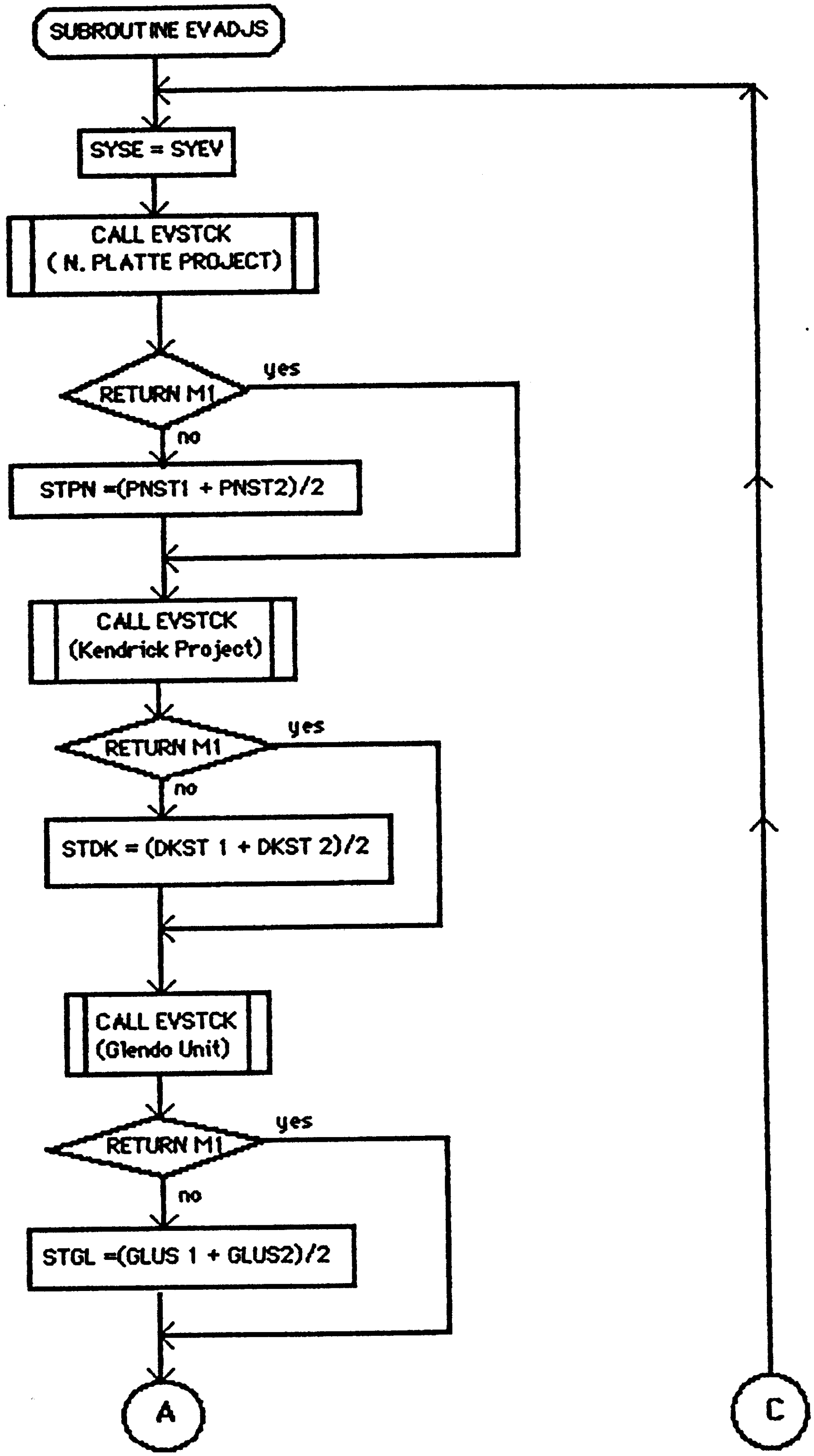
Description: North Platte Project Ownership and Kendrick Project Ownership Gain Calculation.

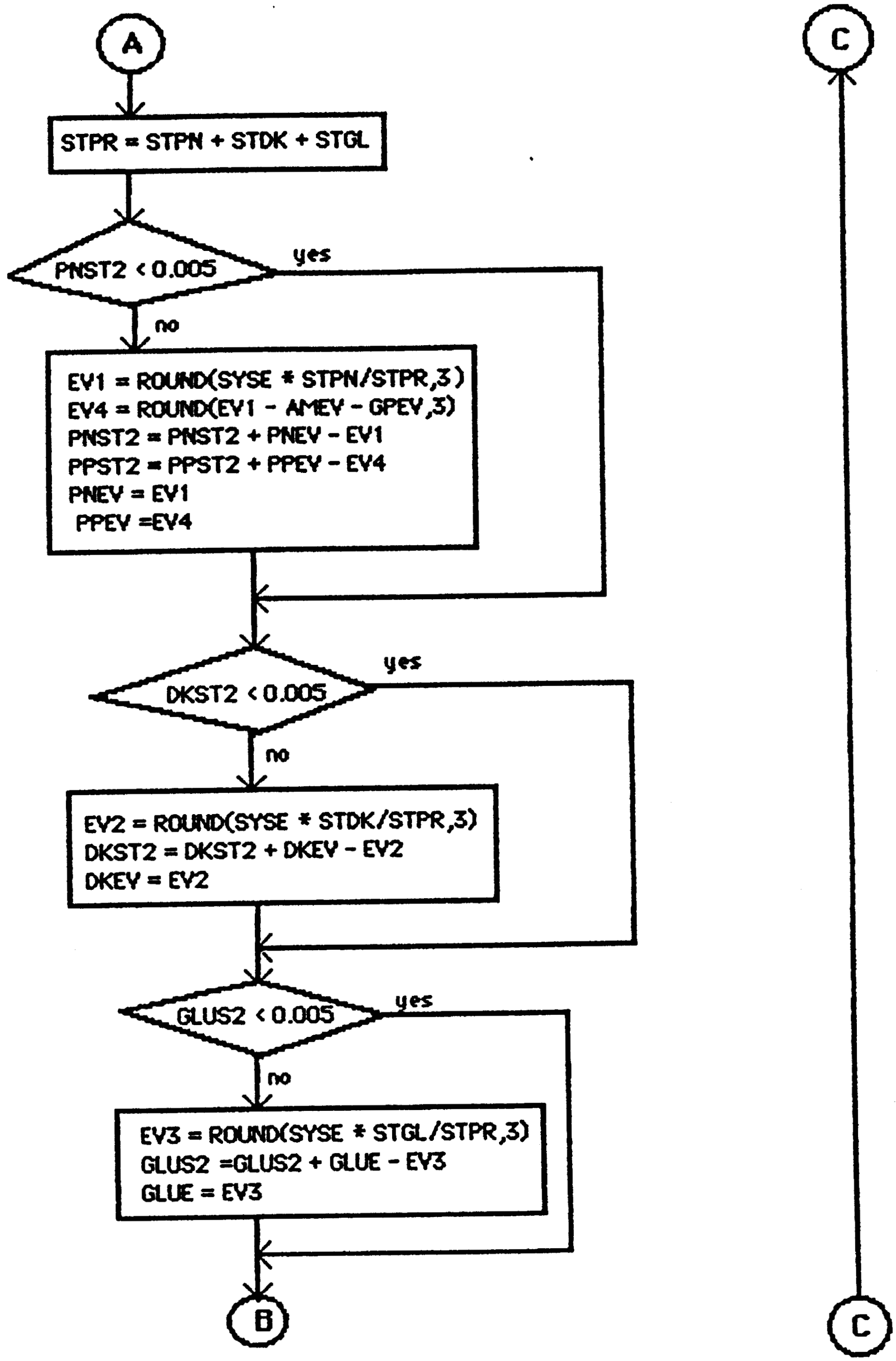


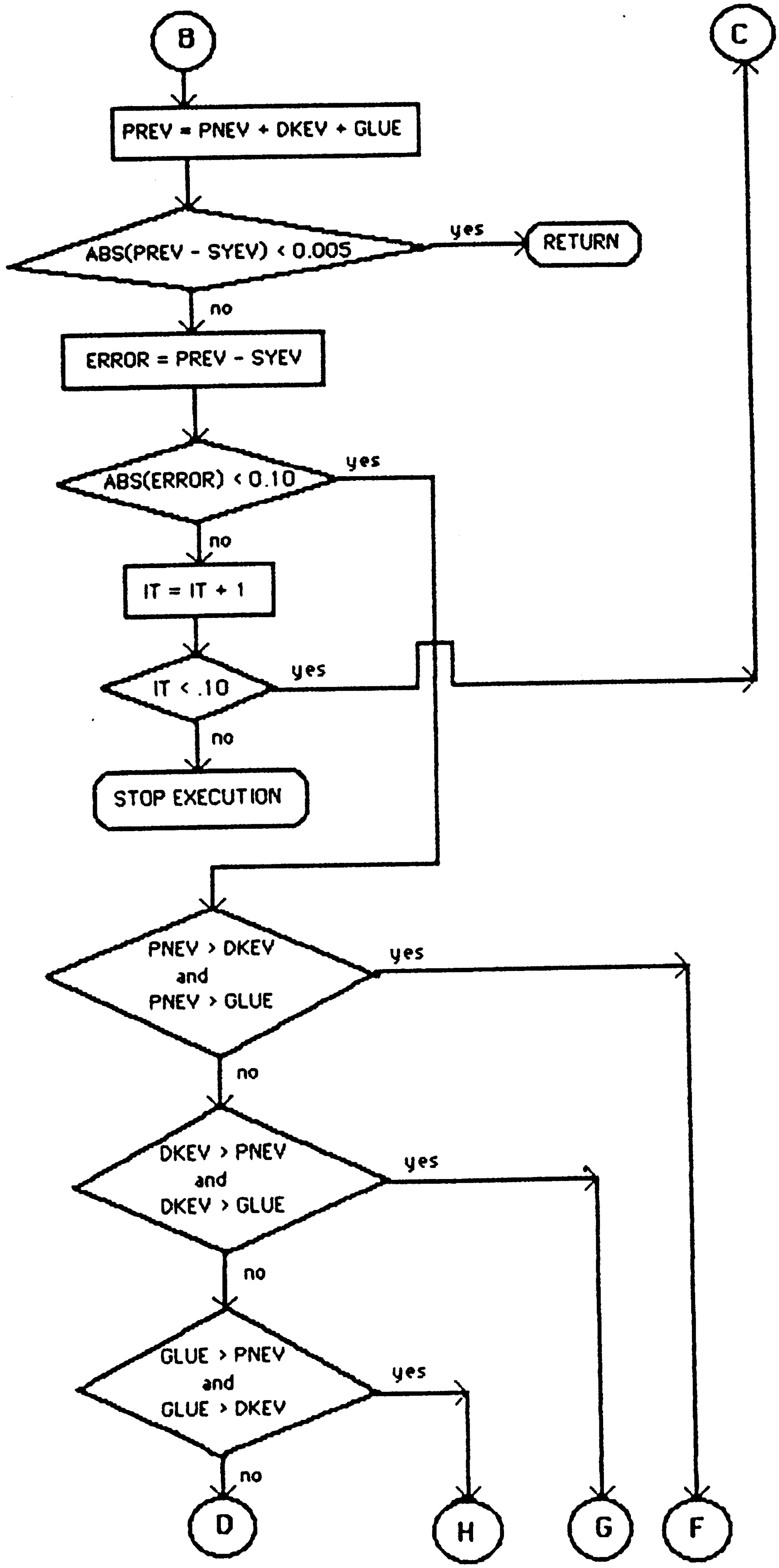

A
B
EVST ≥ 0.01
yes
no
PNEV(K) = EVST * PTCE(K, 1) /10000.
+ PTCE(K,2) /10. +GUEV(K)
PNEV(K) = GUEV(K)
ABS(EV-PNEV(K) < 0.005
no
EV = PNEV(K)
ST = PNST(K) + PNAC(K) -
PNEV(K) - PNIR(K)
yes
ABS(EV - PNEV(K) < 0.005
yes
PNEV(K)=EV
yes
ST < PNMXST + 0.005
no
no
No Gain in Kendrick
Project
PNST(K + 1) = ST
ST = PNST(K) + PNAC(K)
PNEV(K) - PNIR(K)
N. Platte Project Ownership Greater
than Maximum Allowed Kendrick
Project Gain Water.
DKAC(K) = DKAC(K) + ST - PNMXAL
PNAC(K) = SYGN(K) - GUSP(K) - GUSL(K)
DKAC(K) - RVGN(K) - GLUA(K)
PNST(K + 1) = PNMXAL
Pathfinder Ownership
PPAC(K) = PNAC(K) - AMAC(K) - GPAC(K)
PPEV(K) = PNEV(K) - AMEV(K) - GPEV(K)
PPIR(K) = PNIR(K) - AMIR(K) - GPIR(K)
PPST(K + 1) = PPST(K) + PPAC(K) - PPEV(K) - PPIR(K)
C

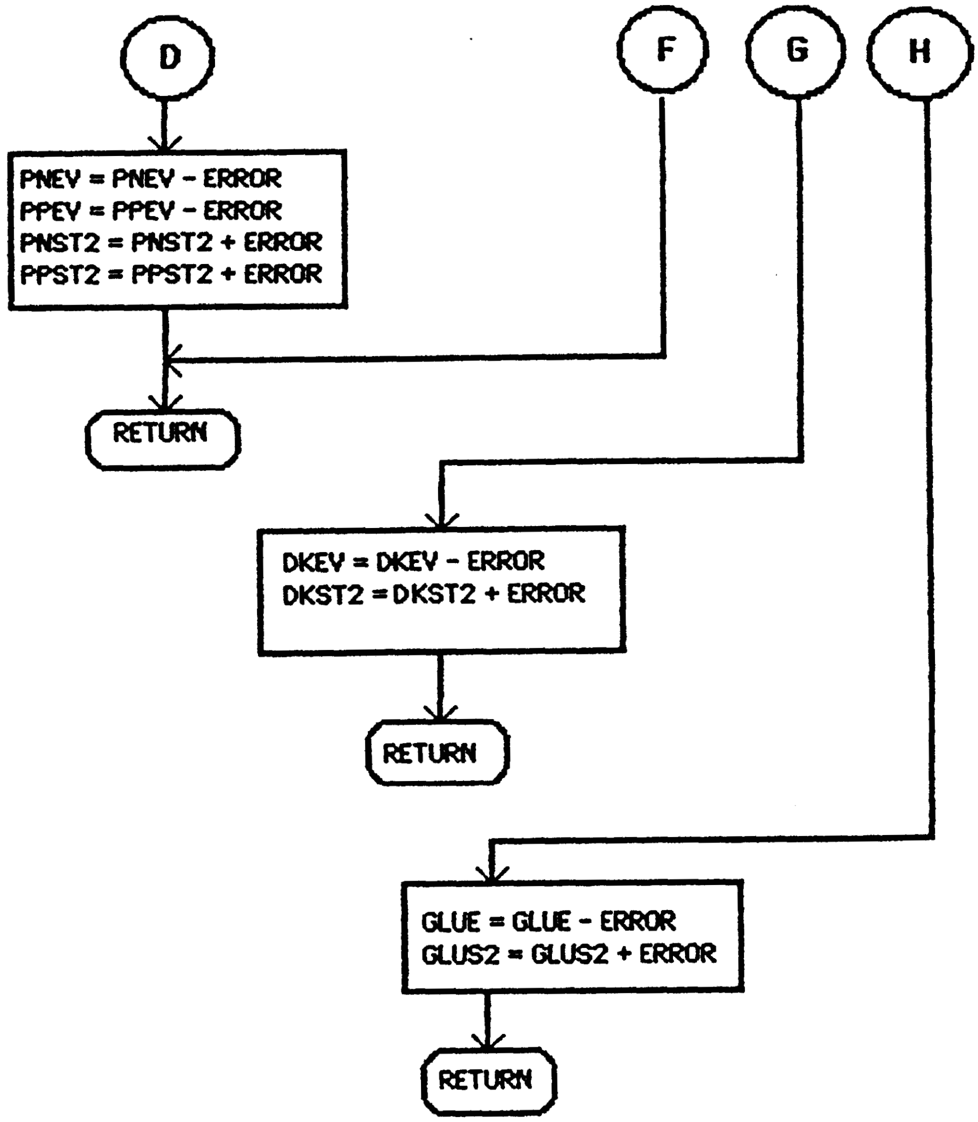

C
PPST(K + 1) < PTMXST + 0.005
yes
no
EXCES = PPST(K +1) - PTMXST
PNAC(K) = PNAC(K) - EXCES
PPAC(K) = PPAC(K) - EXCES
DKAC(K) = DKAC(K) + EXCES
PPST(K + 1) = PTMXST
PNST(K + 1) = PNST(K) + PNAC(K) - PNEV(K) - PNIR(K)
RETURN

Description: Check Projects Evaporation against System Evaporation. The Evaporation is Redistributed in Proportion of Average Ownership of each Project.

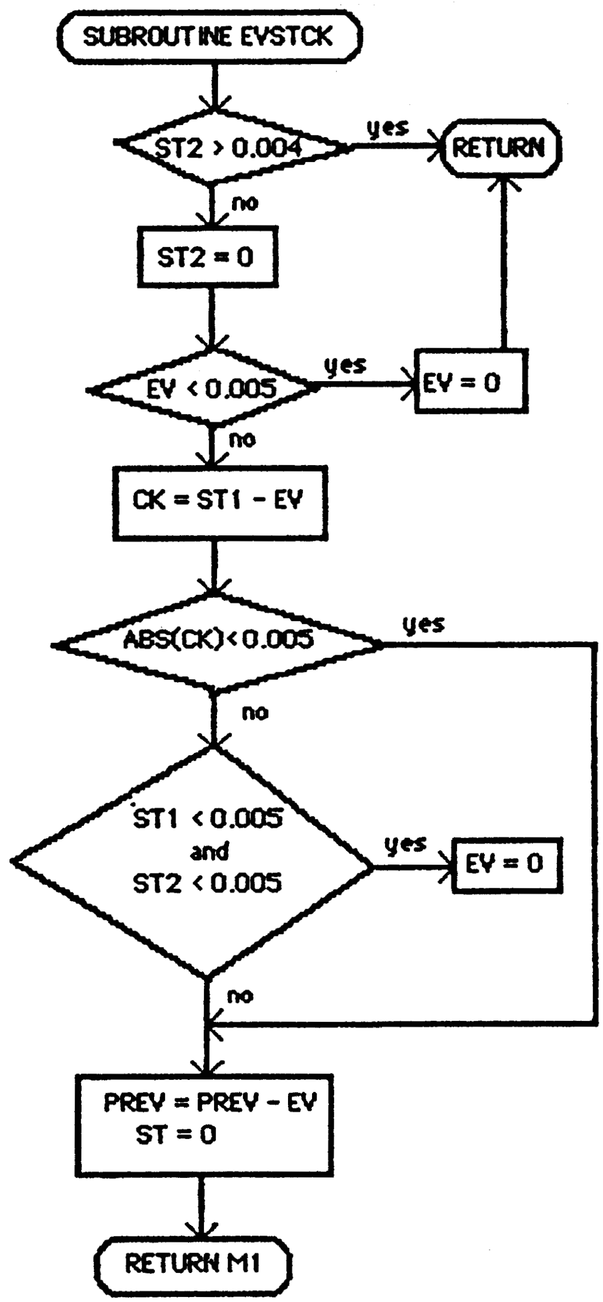



A
STPR = STPN + STDK + STGL
PNST2 < 0.005
yes
no
EV1 = ROUND(SYSE * STPN/STPR,3)
EV4 = ROUND(EV1 - AMEV - GPEV,3)
PNST2 = PNST2 + PNEV - EV1
PPST2 = PPST2 + PPEV - EV4
PNEV = EV1
PPEV =EV4
DKST2 < 0.005
yes
no
EV2 = ROUND(SYSE * STDK/STPR,3)
DKST2 = DKST2 + DKEV - EV2
DKEV = EV2
GLUS2 < 0.005
yes
no
EV3 = ROUND(SYSE * STGL/STPR,3)
GLUS2 =GLUS2 + GLUE - EV3
GLUE = EV3
B
C
C

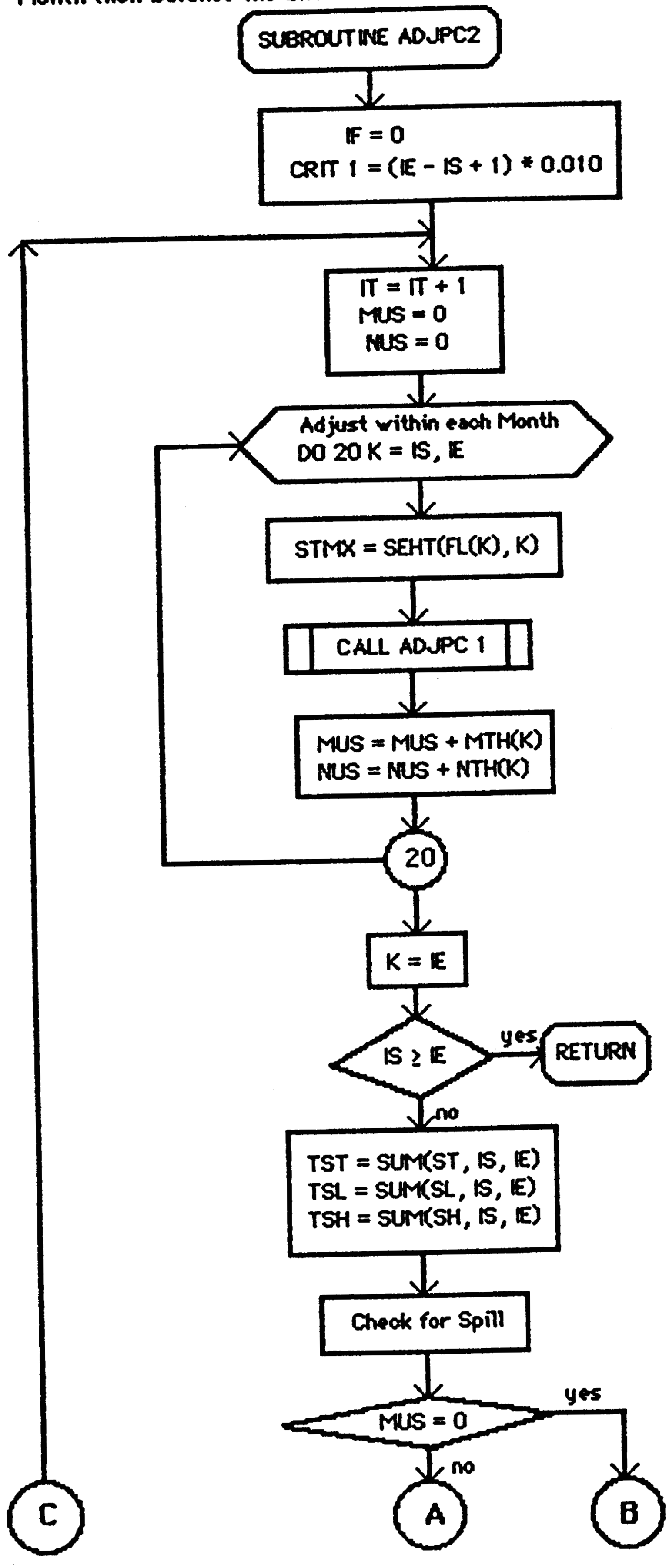

B
PREV = PNEV + DKEV + GLUE
ABS(PREV - SYEV) < 0.005
yes
RETURN
no
ERROR = PREV - SYEV
ABS(ERROR) < 0.10
yes
no
IT = IT + 1
IT < .10
yes
no
STOP EXECUTION
C
PNEV > DKEV
and
PNEV > GLUE
yes
no
DKEV > PNEV
and
DKEV > GLUE
yes
no
GLUE > PNEV
and
GLUE > DKEV
yes
no
D
H
G
F

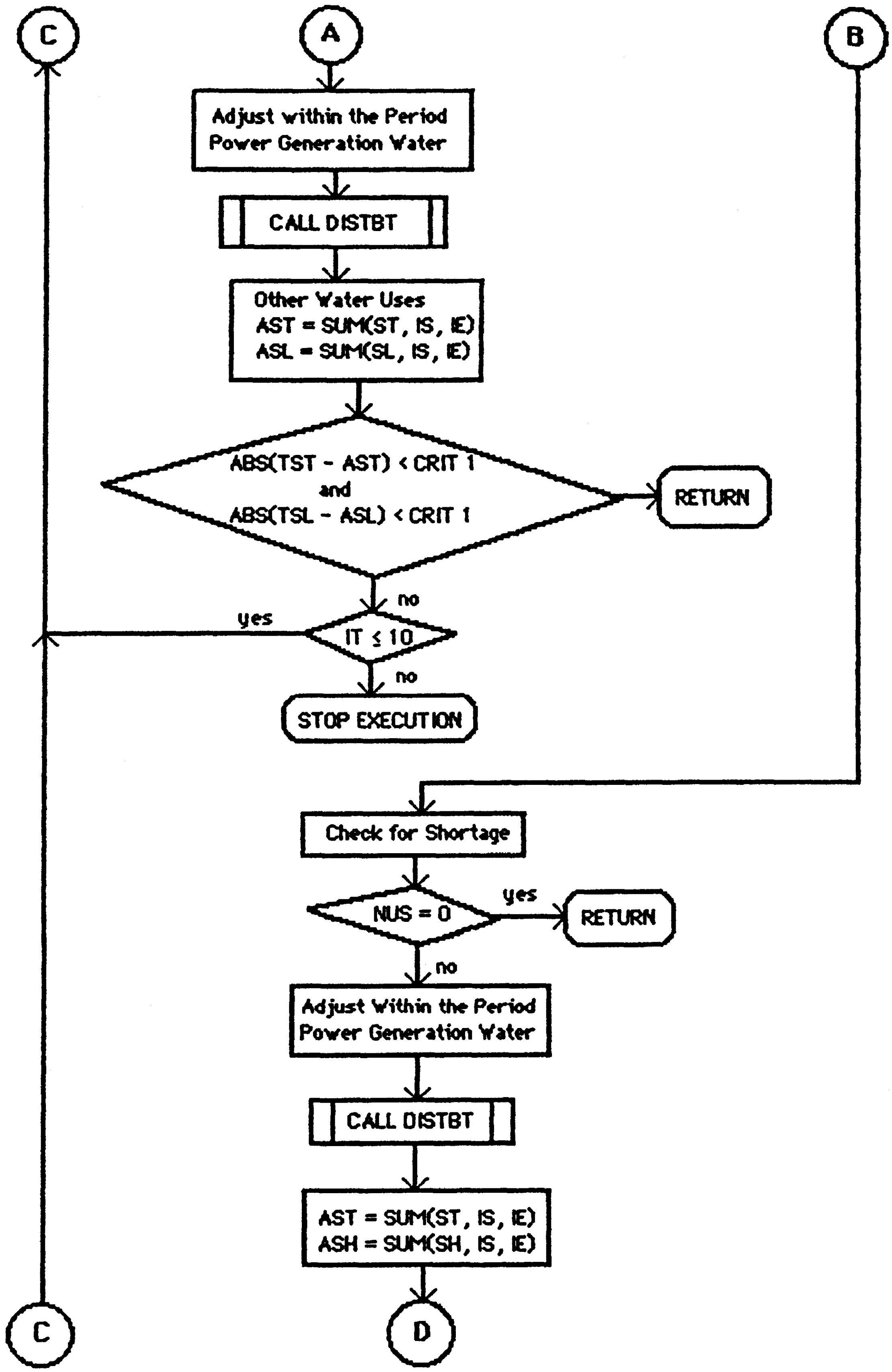

D
F
G
H
PNEV = PNEV - ERROR
PPEV = PPEV - ERROR
PNST2 = PNST2 + ERROR
PPST2 = PPST2 + ERROR
RETURN
DKEV = DKEV - ERROR
DKST2 = DKST2 + ERROR
RETURN
GLUE = GLUE - ERROR
GLUS2 = GLUS2 + ERROR
RETURN

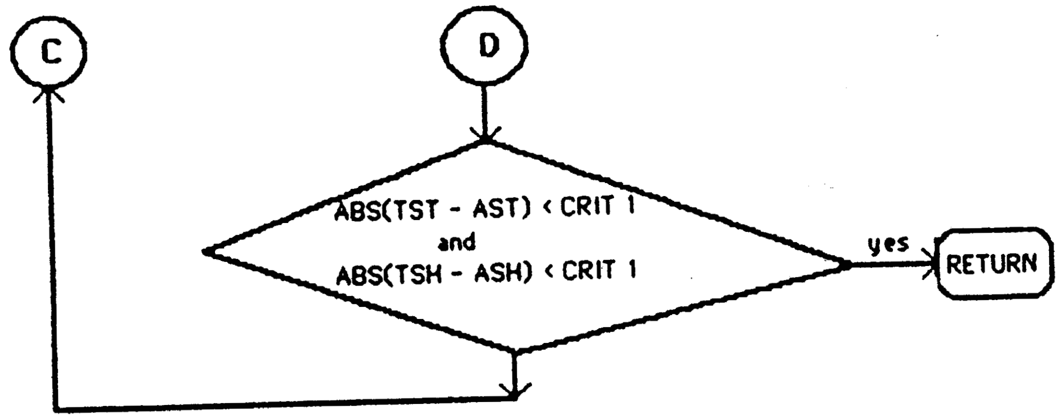
Description: Check Ownership for Evaporation Distribution.



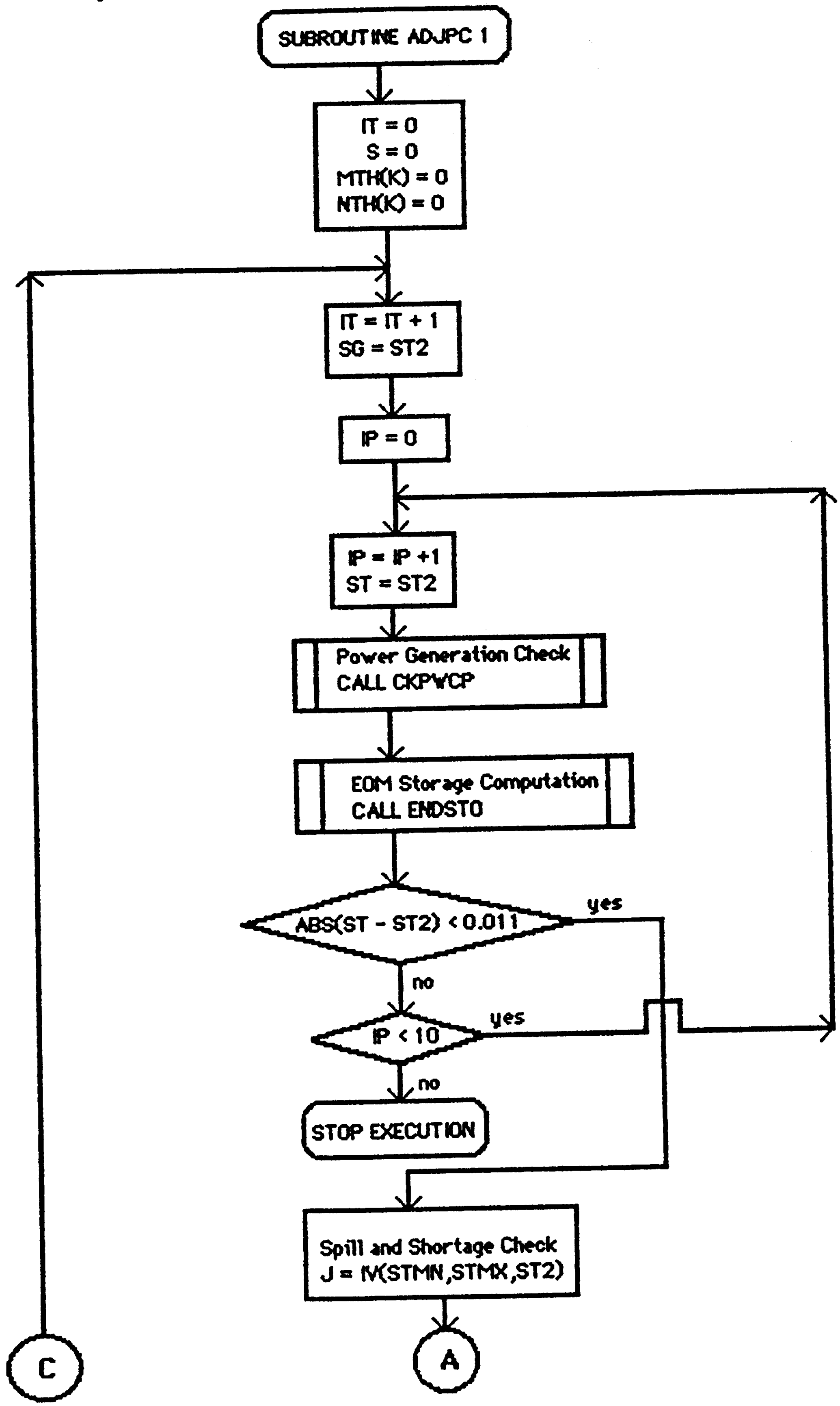
Description: Considers Several Months of a Period as a Whole and Adjust the Water Use Whenever Spill and Shortage Occur. If First Adjust Within Each Month then Balance the Entire Period.

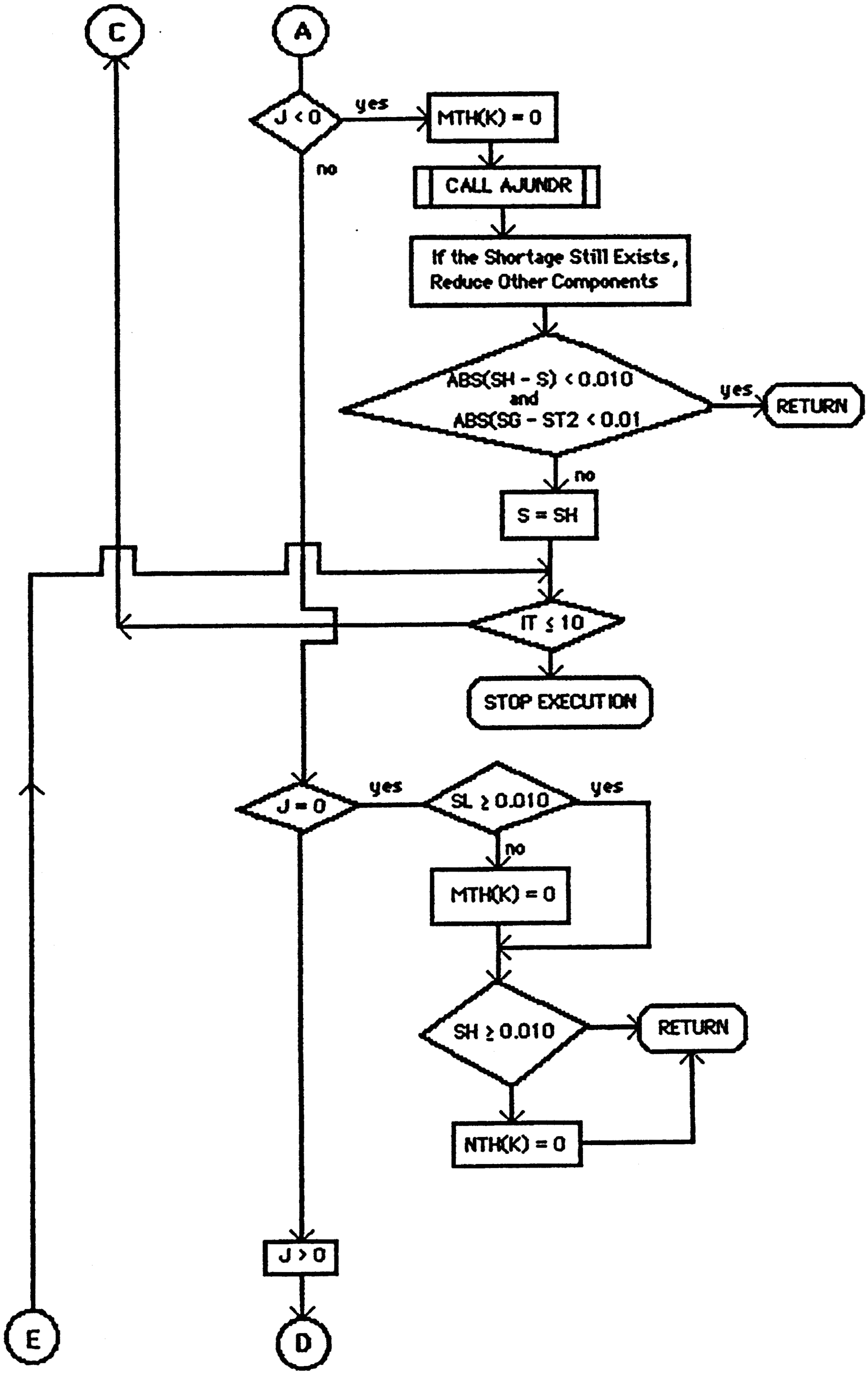


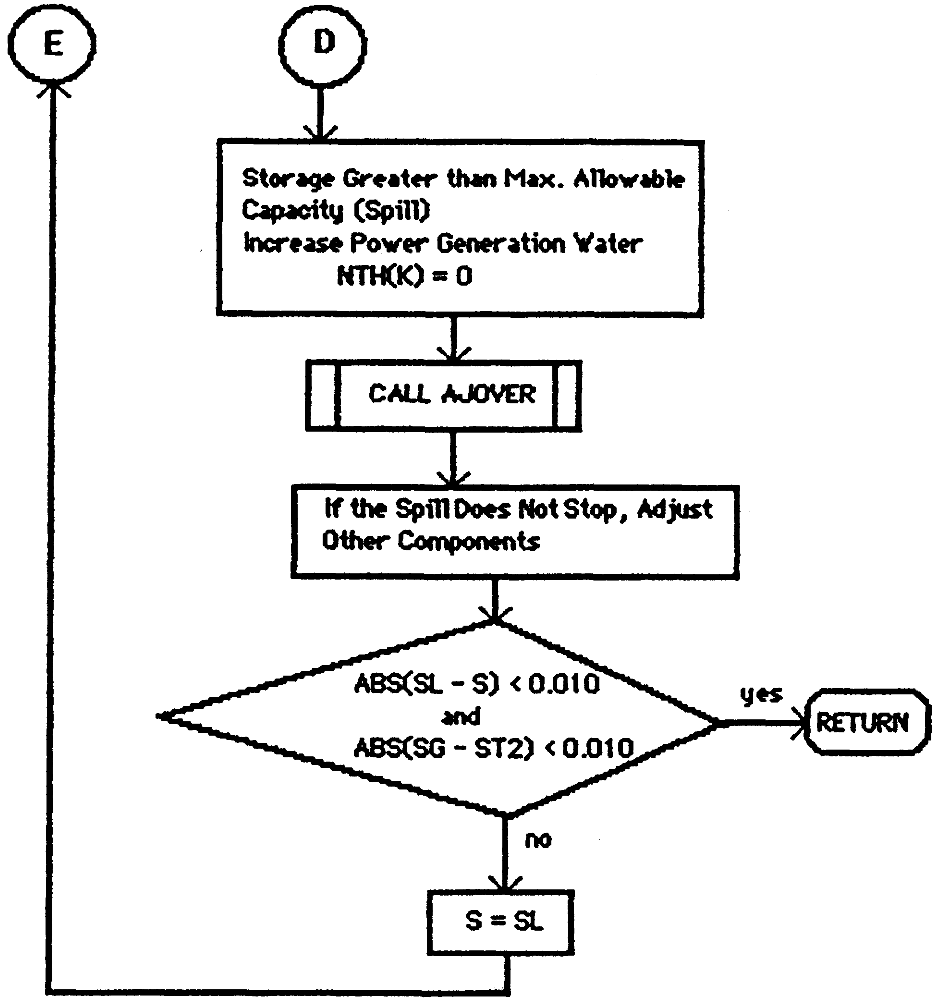

C
A
B
Adjust within the Period
Power Generation Water
CALL DISTBT
Other Water Uses
AST = SUM(ST, IS, IE)
ASL = SUM(SL, IS, IE)
ABS(TST - AST) < CRIT 1
and
ABS(TSL - ASL) < CRIT 1
RETURN
no
yes
IT ≤ 10
no
STOP EXECUTION
Check for Shortage
NUS = 0
yes
RETURN
no
Adjust Within the Period
Power Generation Water
CALL DISTBT
AST = SUM(ST, IS, IE)
ASH = SUM(SH, IS, IE)
C
D


C
D
ABS(TST - AST) < CRIT 1
and
ABS(TSH - ASH) < CRIT 1
yes
RETURN

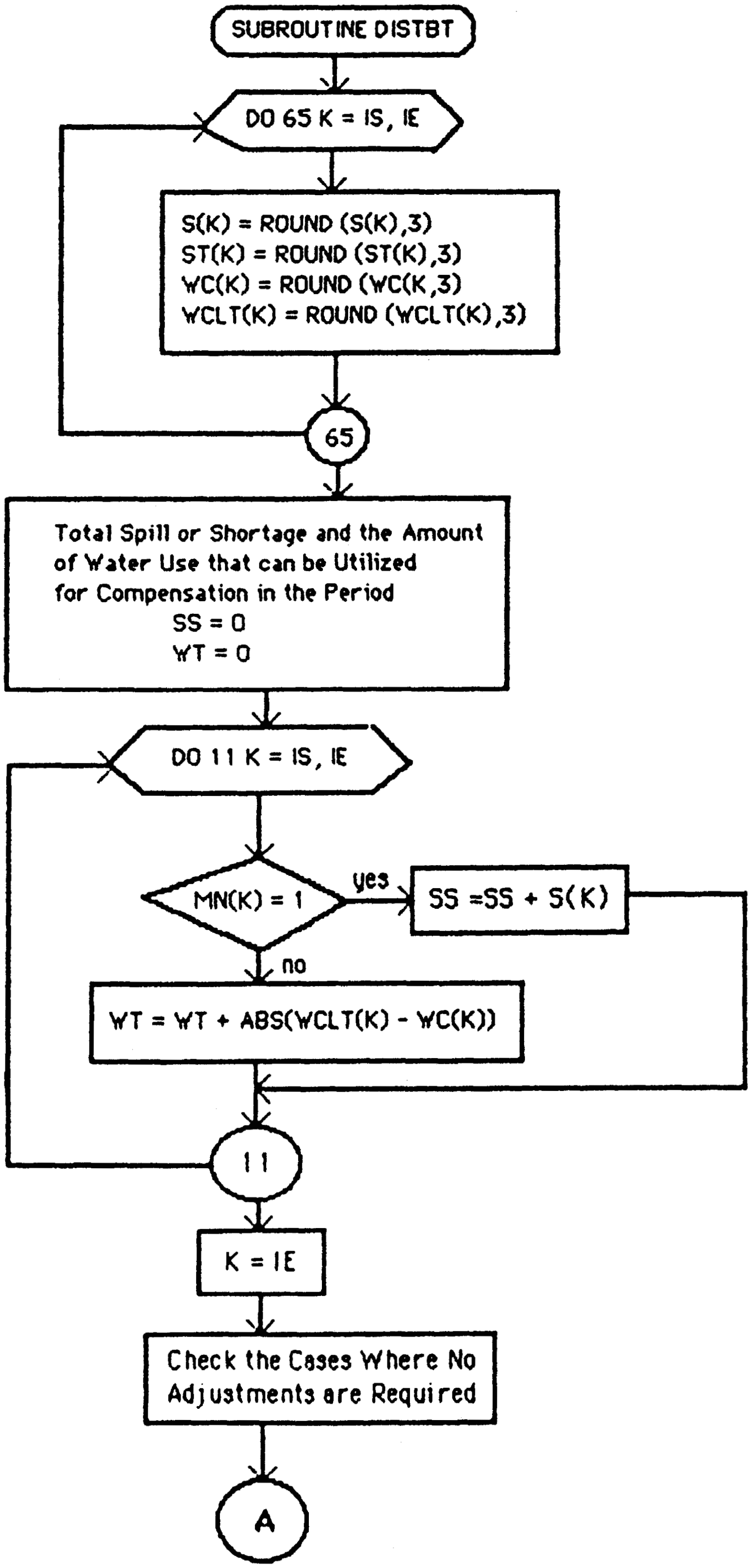
Description: Program Checks Generated Power with Plant Capacity and Computes the EOM Storage. If Spill or Shortage Occur Water Use Components are Adjusted within the Month to Eliminate or Minimize them.

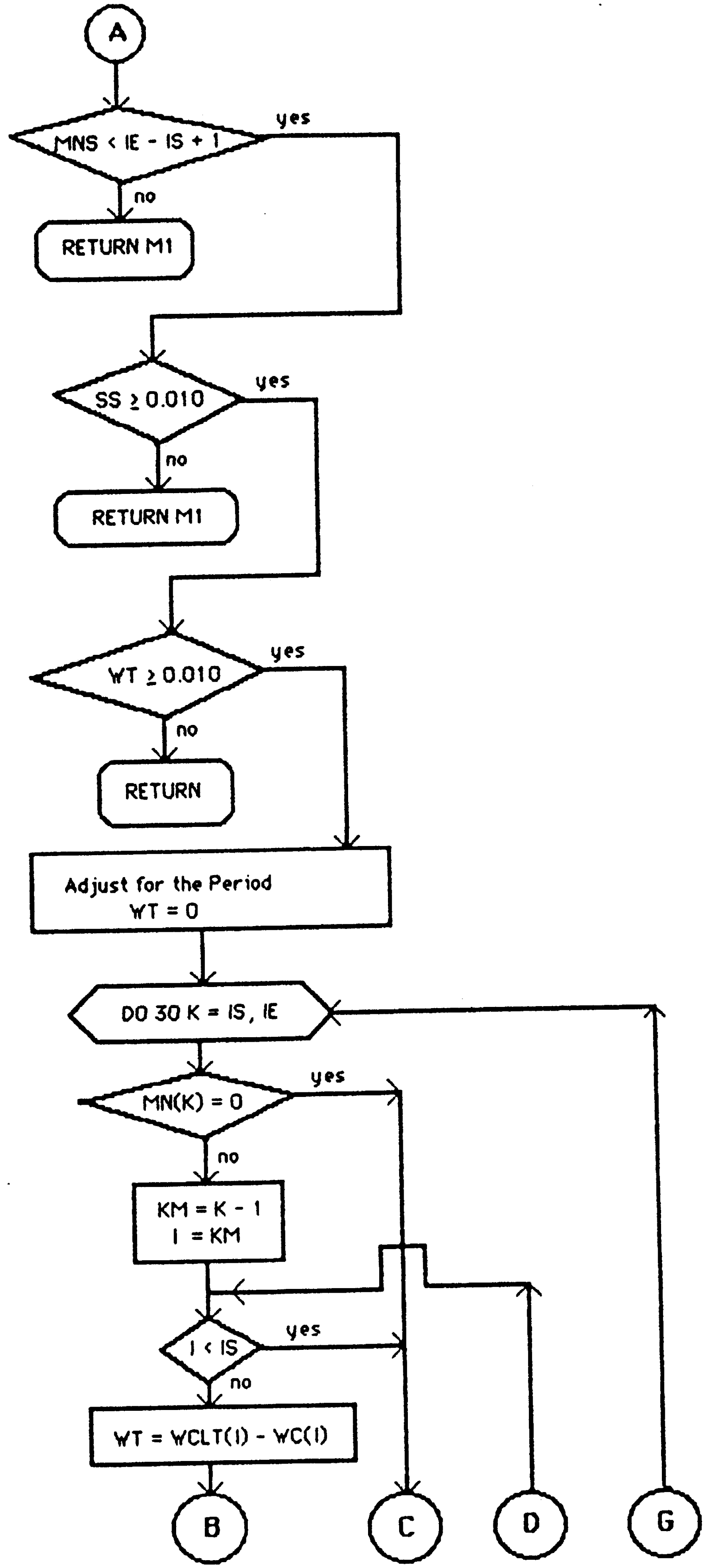


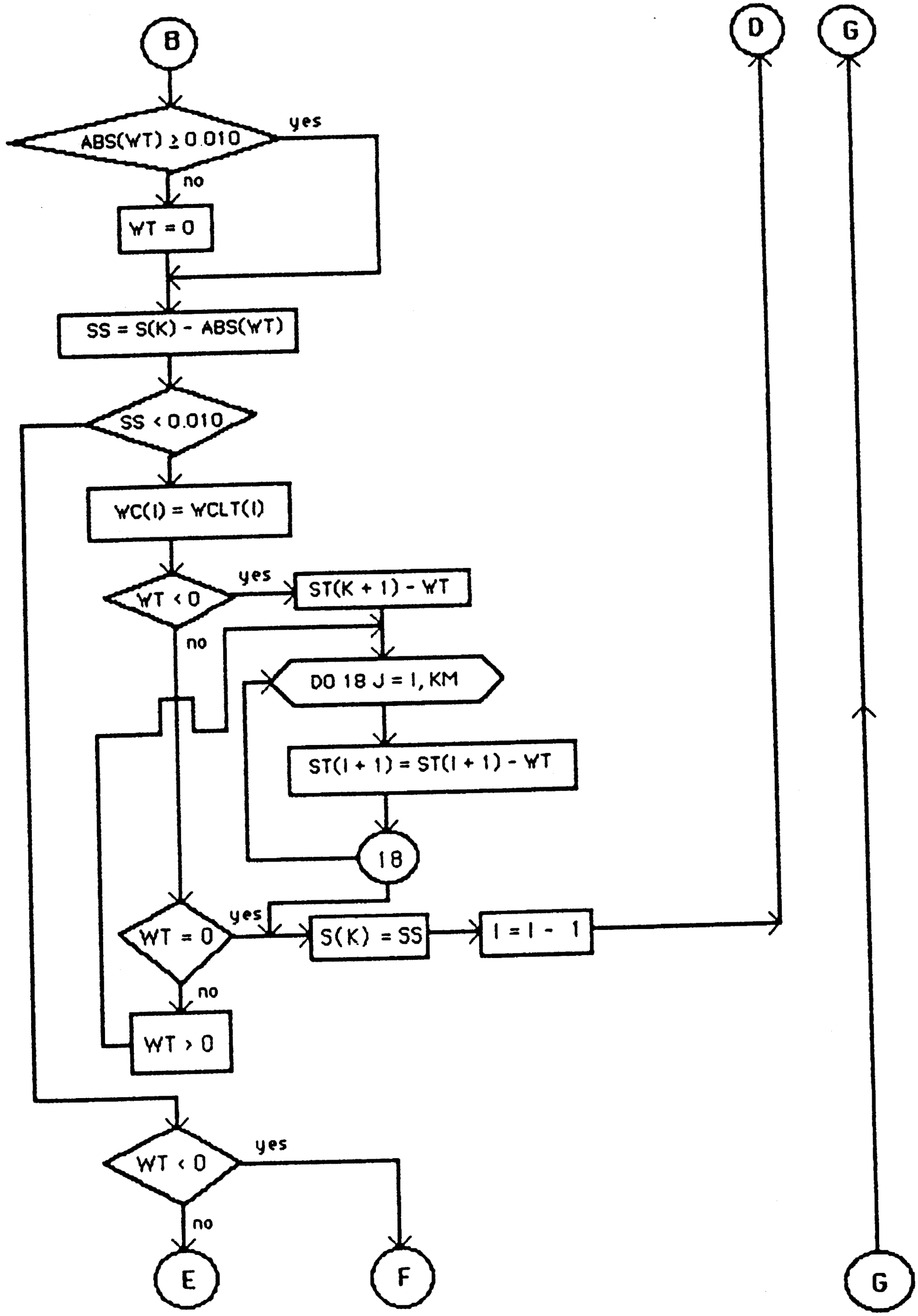

C
A
J < 0
yes
MTH(K) = 0
no
CALL AJUNDR
If the Shortage Still Exists, Reduce Other Components
ABS(SH - S) < 0.010 and ABS(SG - ST2 < 0.01
yes
RETURN
no
S = SH
IT ≤ 10
STOP EXECUTION
J = 0
yes
SL ≥ 0.010
yes
no
MTH(K) = 0
SH ≥ 0.010
RETURN
NTH(K) = 0
J > 0
E
D

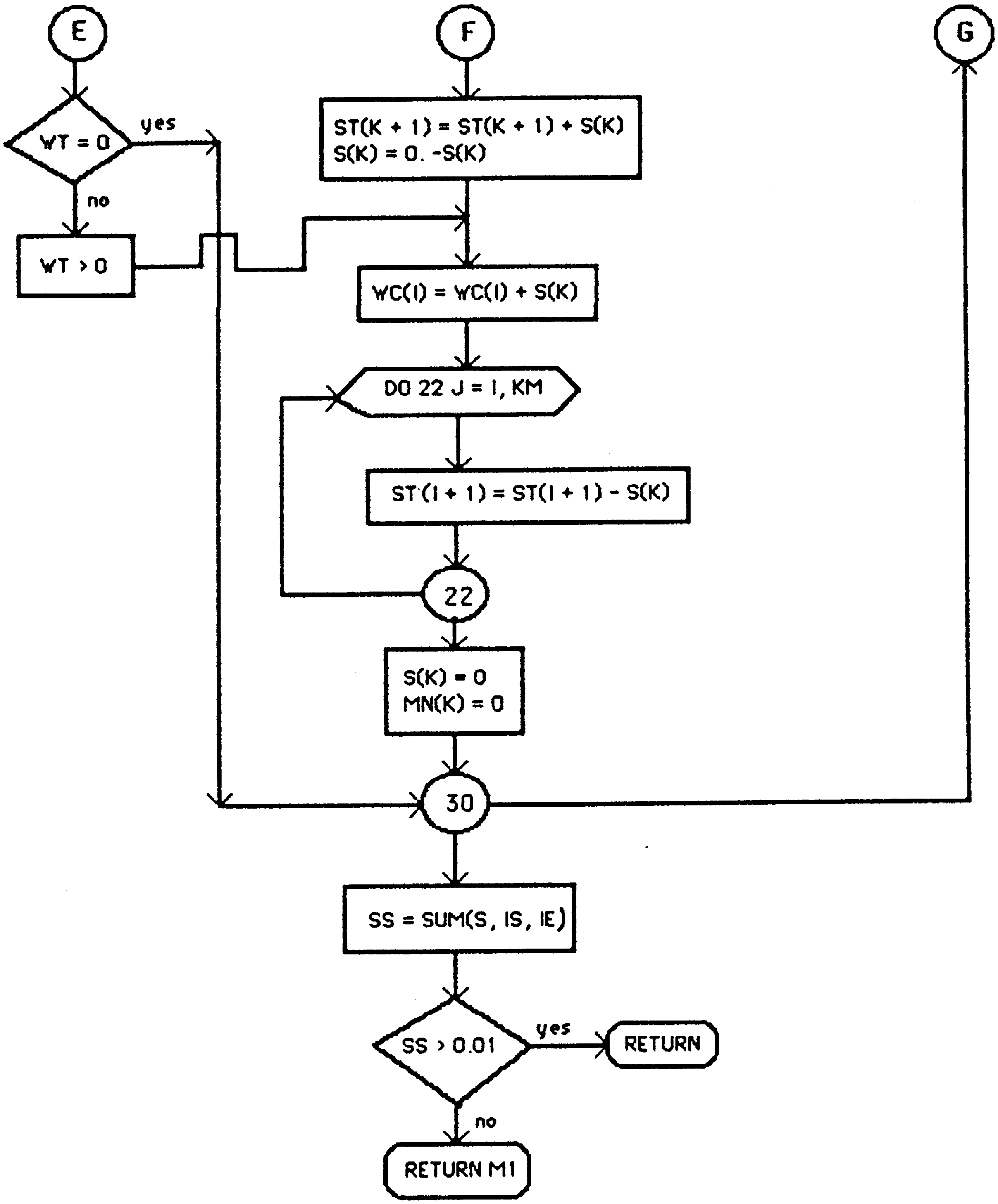

E
D
Storage Greater than Max. Allowable Capacity (Spill)
Increase Power Generation Water
NTH(K) = 0
CALL AJOVER
If the Spill Does Not Stop, Adjust Other Components
ABS(SL - S) < 0.010
and
ABS(SG - ST2) < 0.010
yes
RETURN
no
S = SL

Description: In a Given Period, Some of the Months Have Spill that Storage Exceeded the Max. Capacity of Reservoir Shortage that Storage Lower than Min. Allowed. This Program Selects a Water Use Component and Increases or Decreases the Water Use but not Exceed the Required Limits to Reduce or Eliminate the Spill or Shortage in the Period.

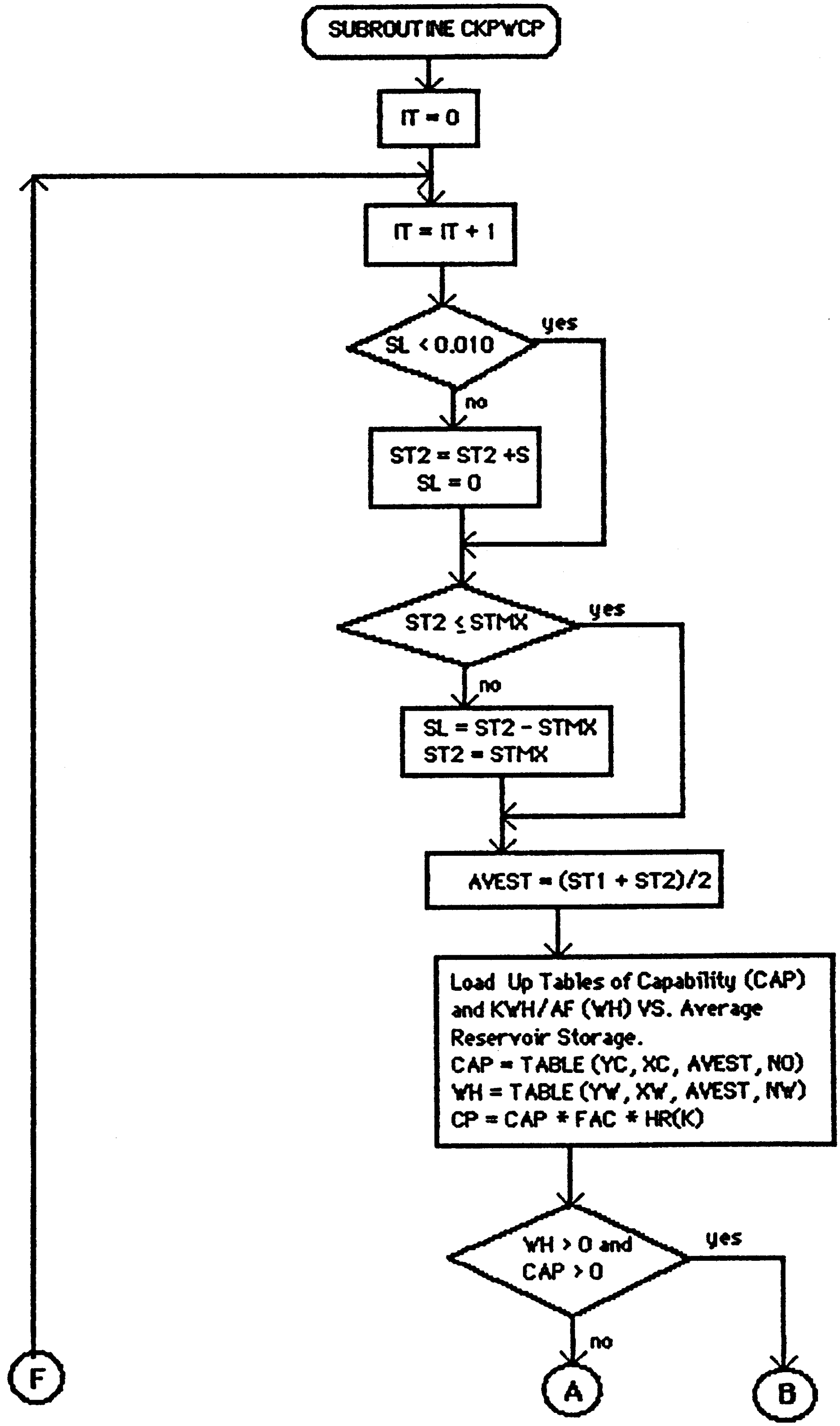


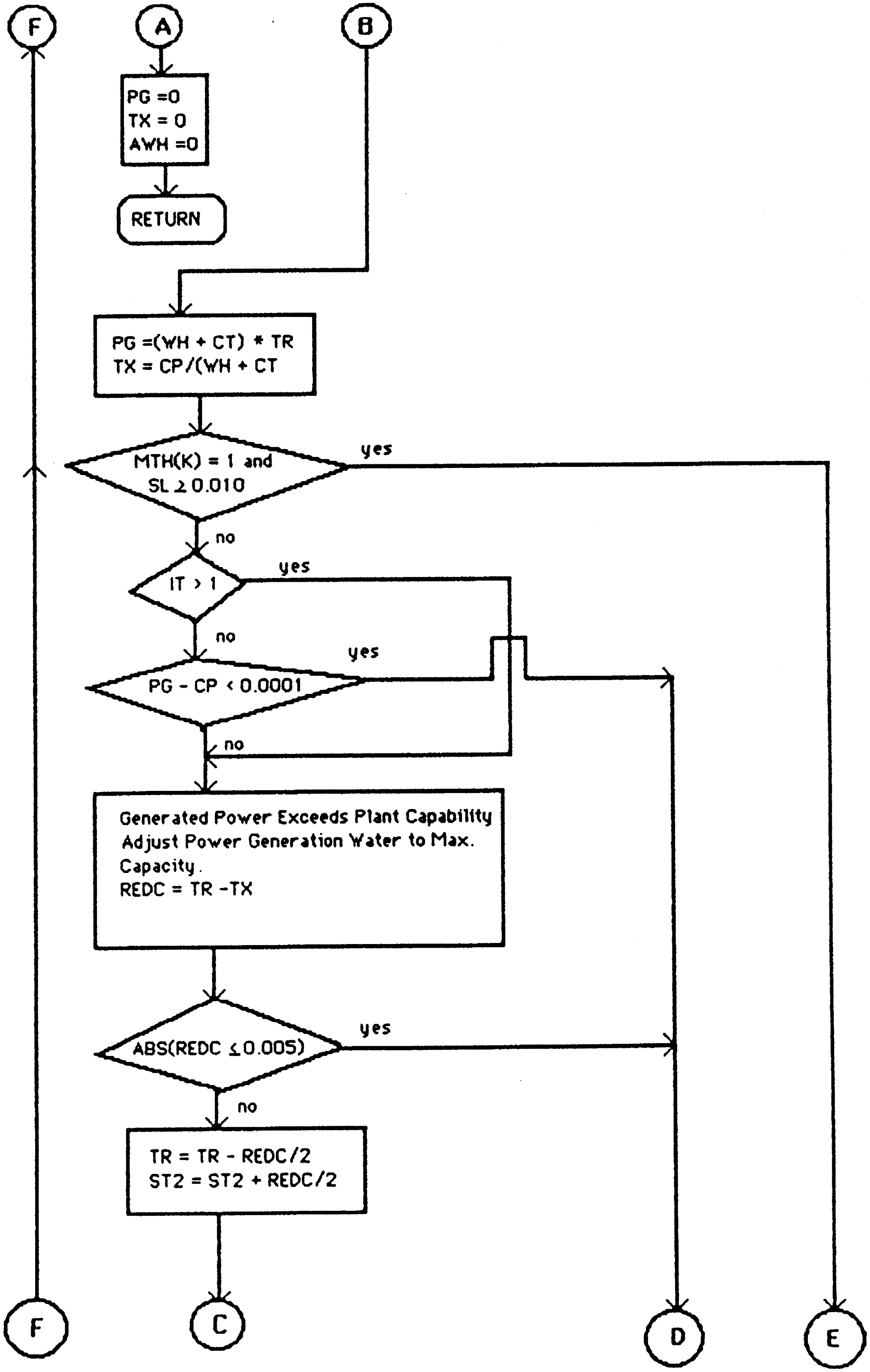

A
MNS < IE - IS + 1
yes
no
RETURN M1
SS ≥ 0.010
yes
no
RETURN M1
WT ≥ 0.010
yes
no
RETURN
Adjust for the Period
WT = 0
DO 30 K = IS, IE
MN(K) = 0
yes
no
KM = K - 1
I = KM
I < IS
yes
no
WT = WCLT(I) - WC(I)
B
C
D
G

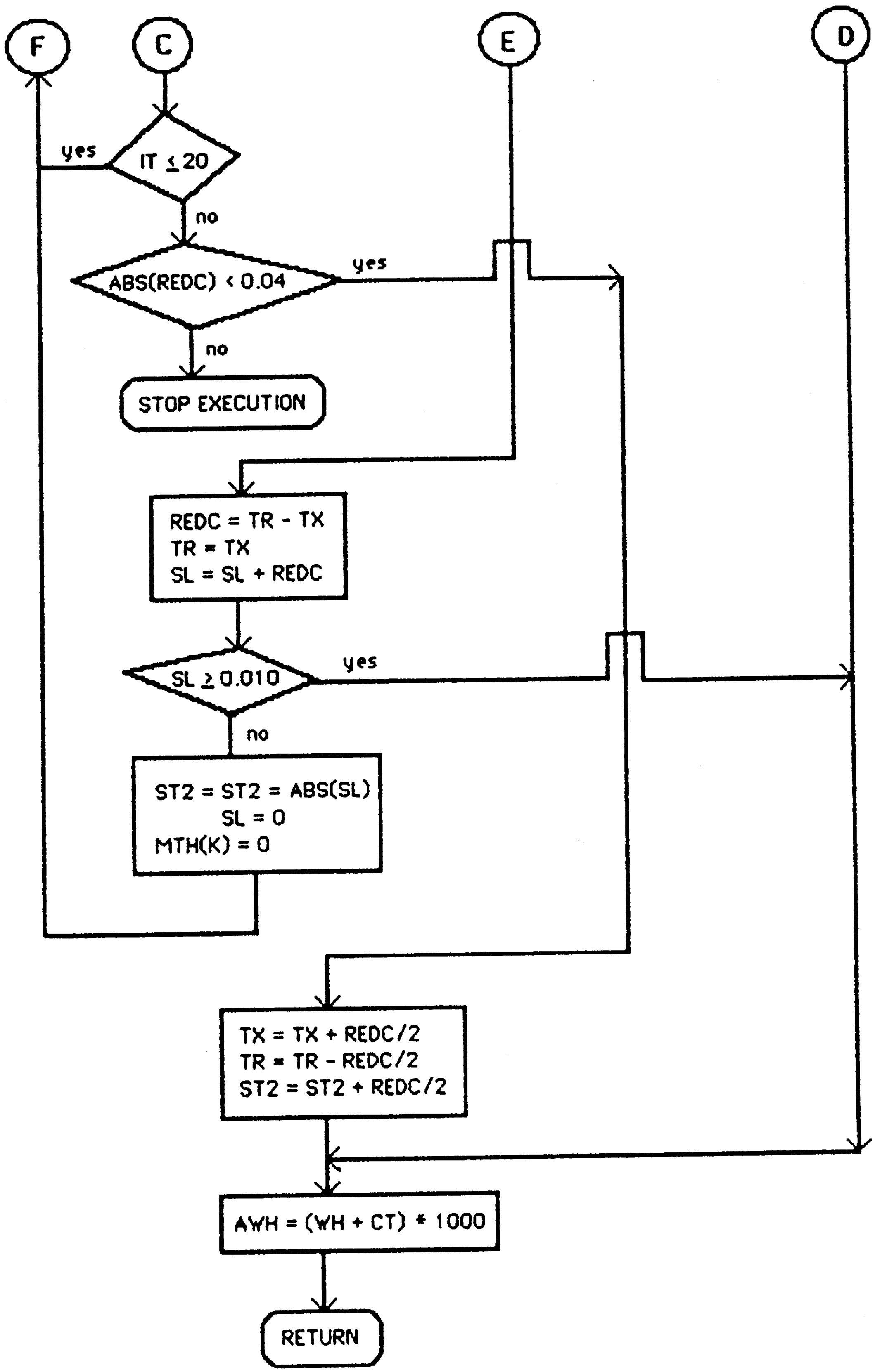

B
ABS(WT) ≥ 0.010
yes
no
WT = 0
SS = S(K) - ABS(WT)
SS < 0.010
WC(I) = WCLT(I)
WT < 0
yes
no
ST(K + 1) - WT
DO 18 J = 1, KM
ST(I + 1) = ST(I + 1) - WT
18
WT = 0
yes
no
S(K) = SS
I = I - 1
WT > 0
WT < 0
yes
no
E
F
D
G
G


E
F
G
WT = 0
yes
no
WT > 0
ST(K + 1) = ST(K + 1) + S(K)
S(K) = 0. -S(K)
WC(I) = WC(I) + S(K)
DO 22 J = I, KM
ST (I + 1) = ST(I + 1) - S(K)
22
S(K) = 0
MN(K) = 0
30
SS = SUM(S, IS, IE)
SS > 0.01
yes
RETURN
no
RETURN M1

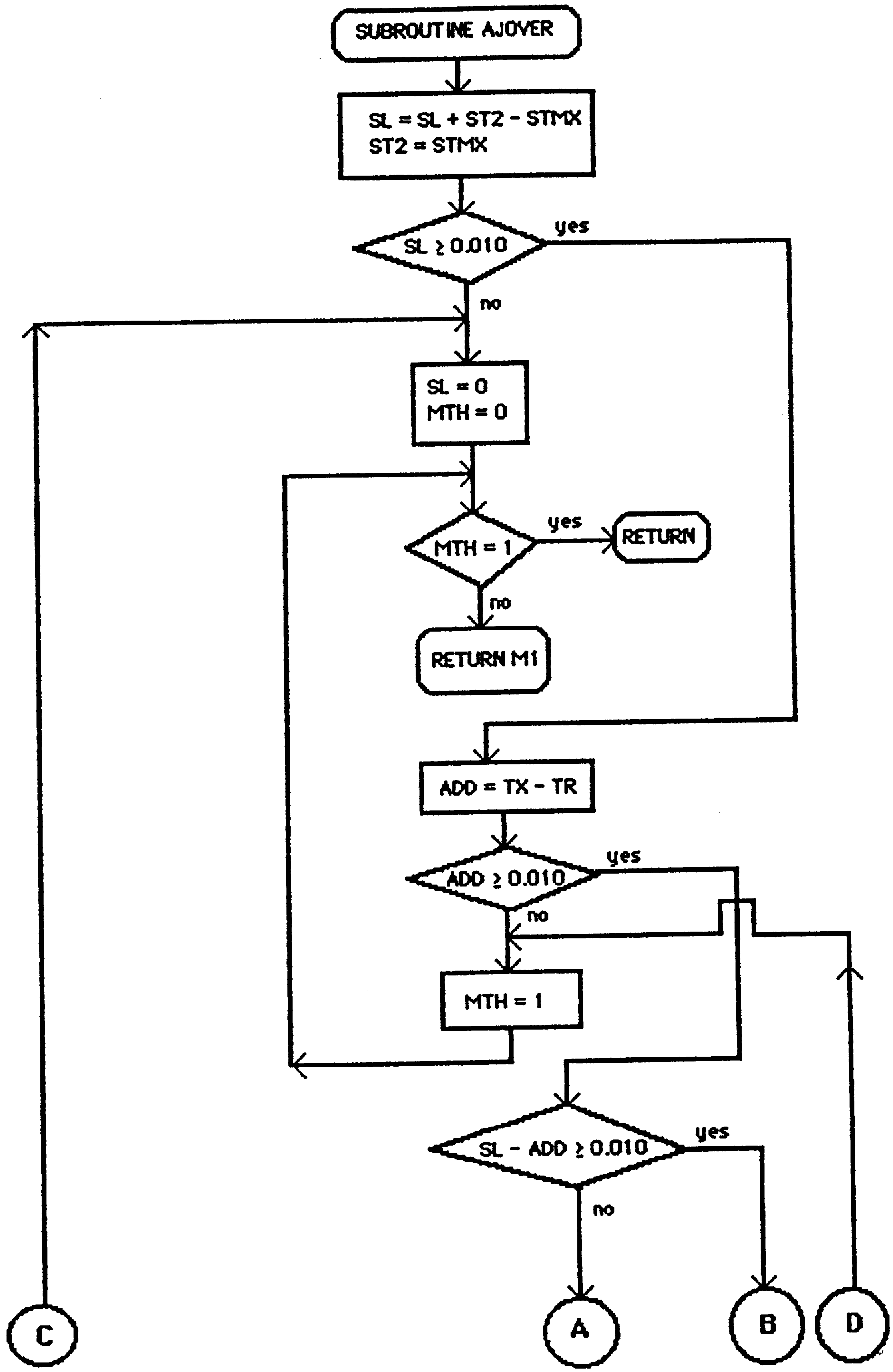
Description: Check the Generated Power with Plant Capacity and Adjust for the Power Generate Water.

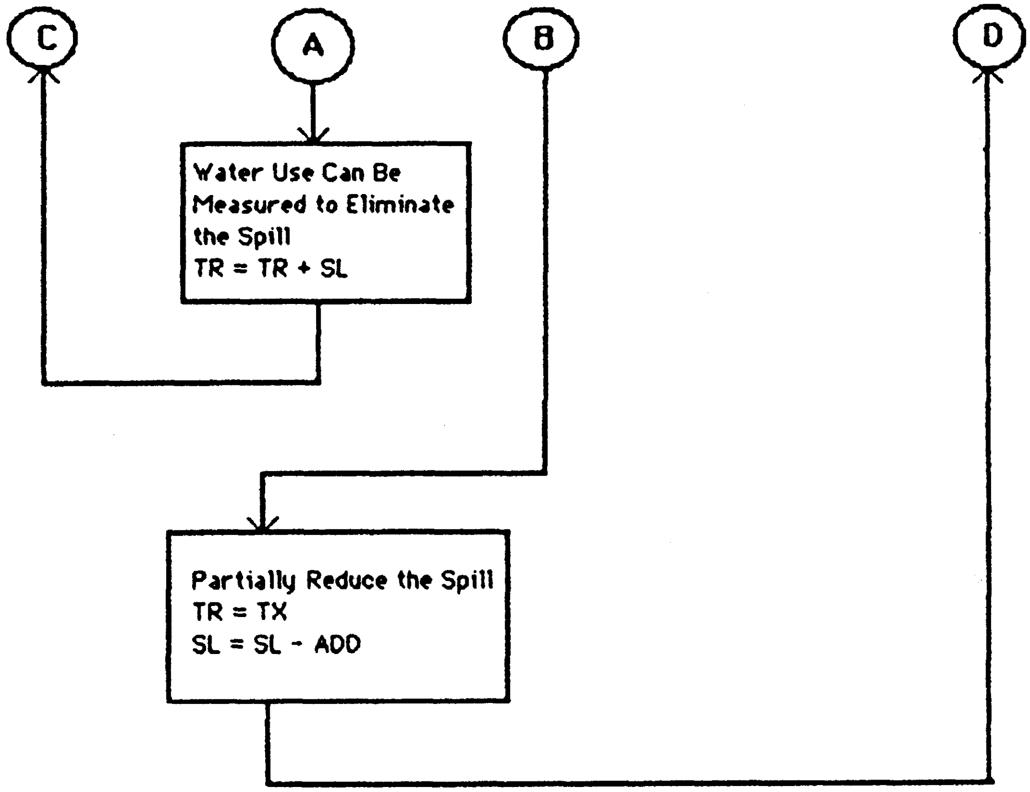



F
A
B
PG =0
TX = 0
AWH =0
RETURN
PG =(WH + CT) * TR
TX = CP/(WH + CT
MTH(K) = 1 and
SL ≥ 0.010
yes
no
IT > 1
yes
no
PG - CP < 0.0001
yes
no
Generated Power Exceeds Plant Capability
Adjust Power Generation Water to Max.
Capacity.
REDC = TR -TX
ABS(REDC ≤ 0.005)
yes
no
TR = TR - REDC/2
ST2 = ST2 + REDC/2
F
C
D
E

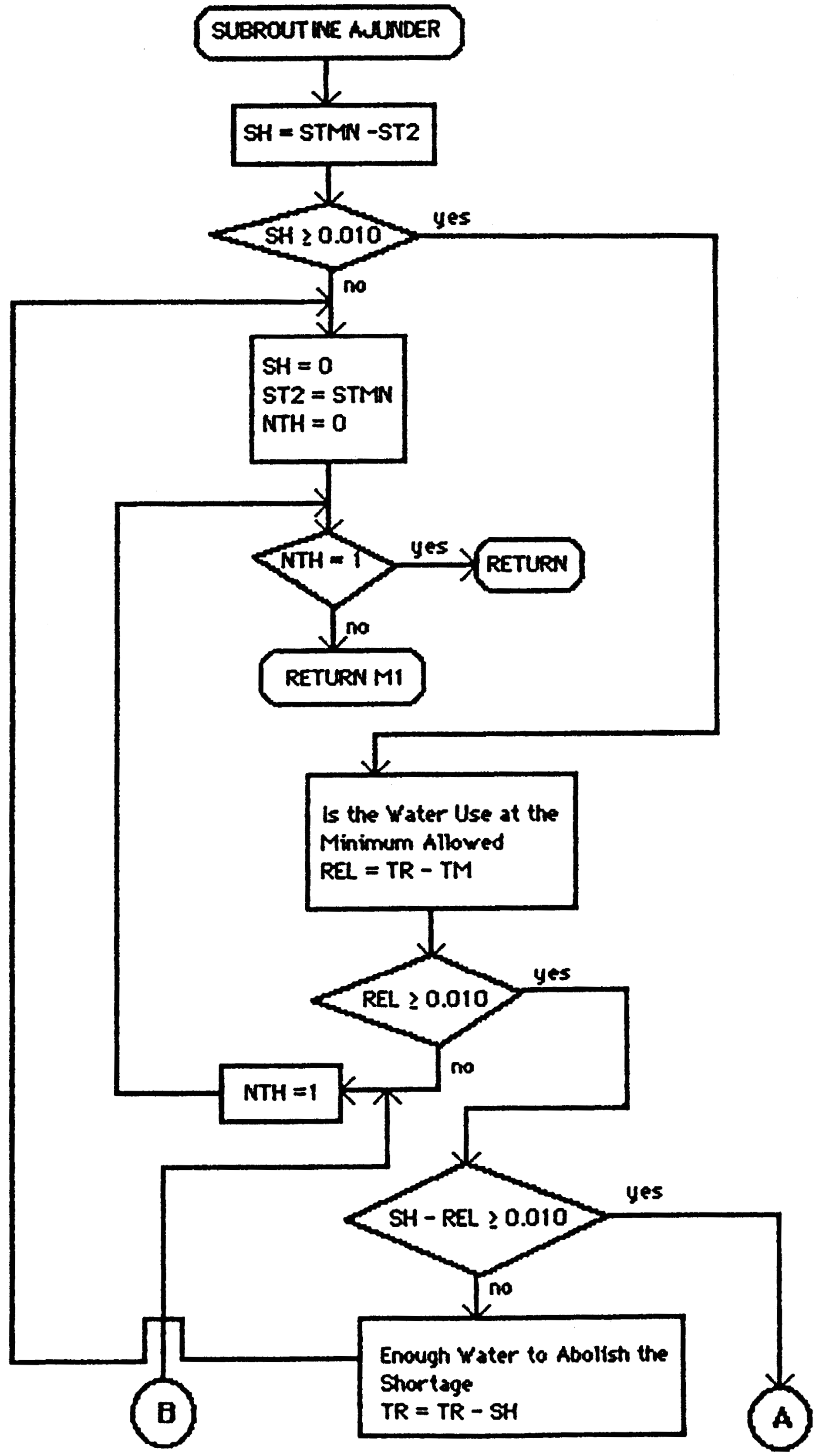

F
C
E
D
IT ≤ 20
yes
no
ABS(REDC) < 0.04
yes
no
STOP EXECUTION
REDC = TR - TX
TR = TX
SL = SL + REDC
SL ≥ 0.010
yes
no
ST2 = ST2 = ABS(SL)
SL = 0
MTH(K) = 0
TX = TX + REDC/2
TR = TR - REDC/2
ST2 = ST2 + REDC/2
AWH = (WH + CT) * 1000
RETURN

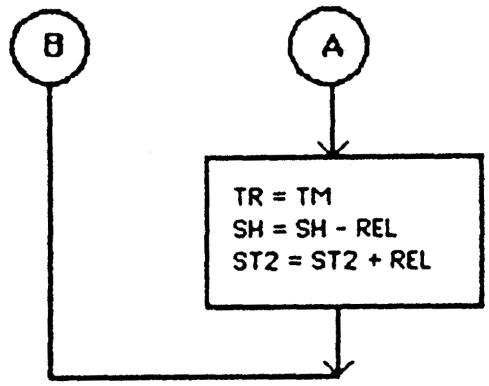
Description: Reservoir Storage Became Greater than Max. Allowable Capacity. This Program Selects One Water Use and Increases the Water Use as High as Permitted to Abolish the Spill. EOM Storage Set to Max. Reservoir Capacity.



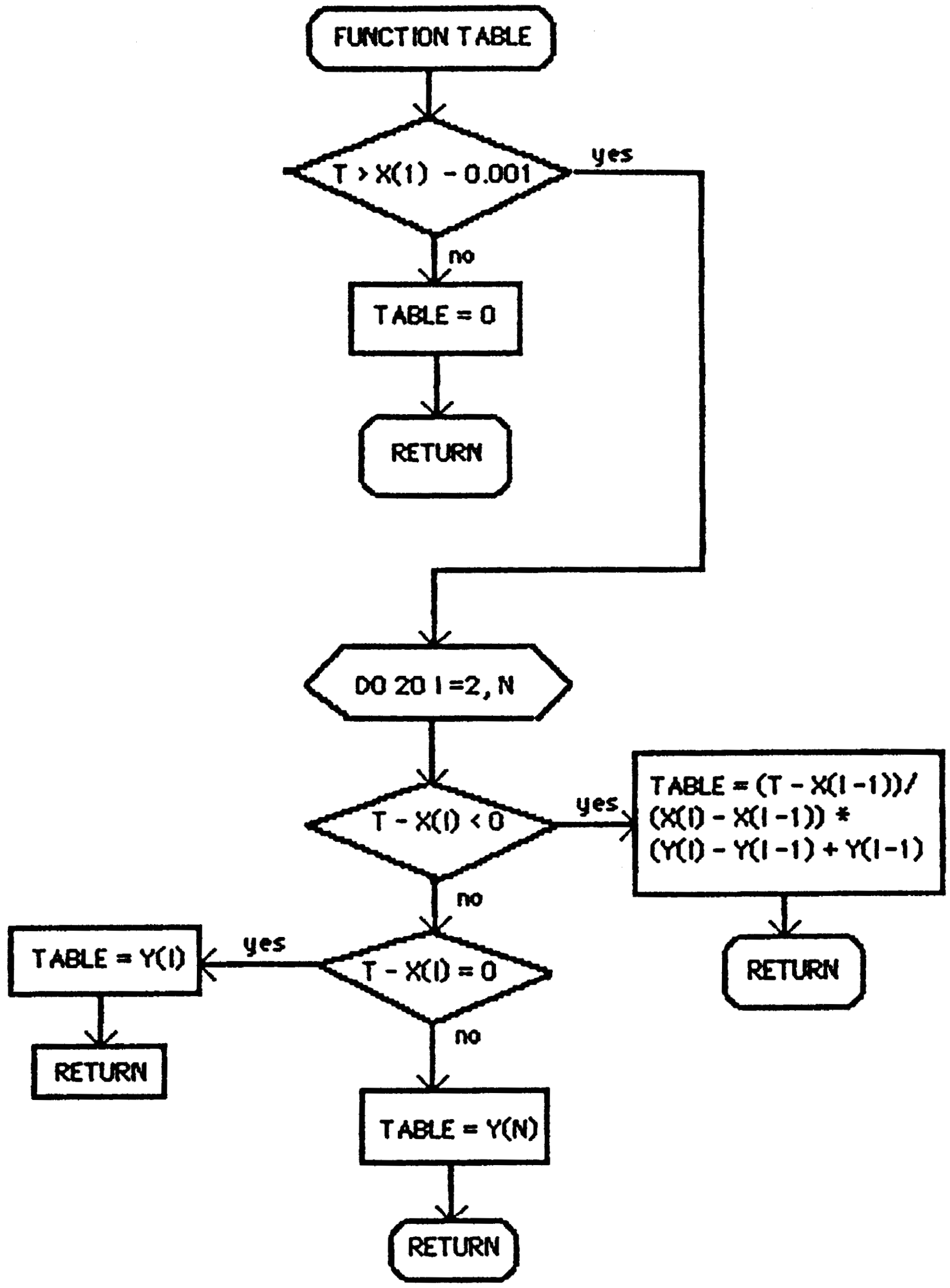

C
A
B
D
Water Use Can Be Measured to Eliminate the Spill
TR = TR + SL
Partially Reduce the Spill
TR = TX
SL = SL - ADD

Description: Reservoir Storage Becomes Lower than Minimum Allowable Capacity. This Program Selects One Water Use and Reduces the Water Use as Low as Permitted to Maintain Reservoir Storage at Lowest Point. EOM Storage Actual Amount.

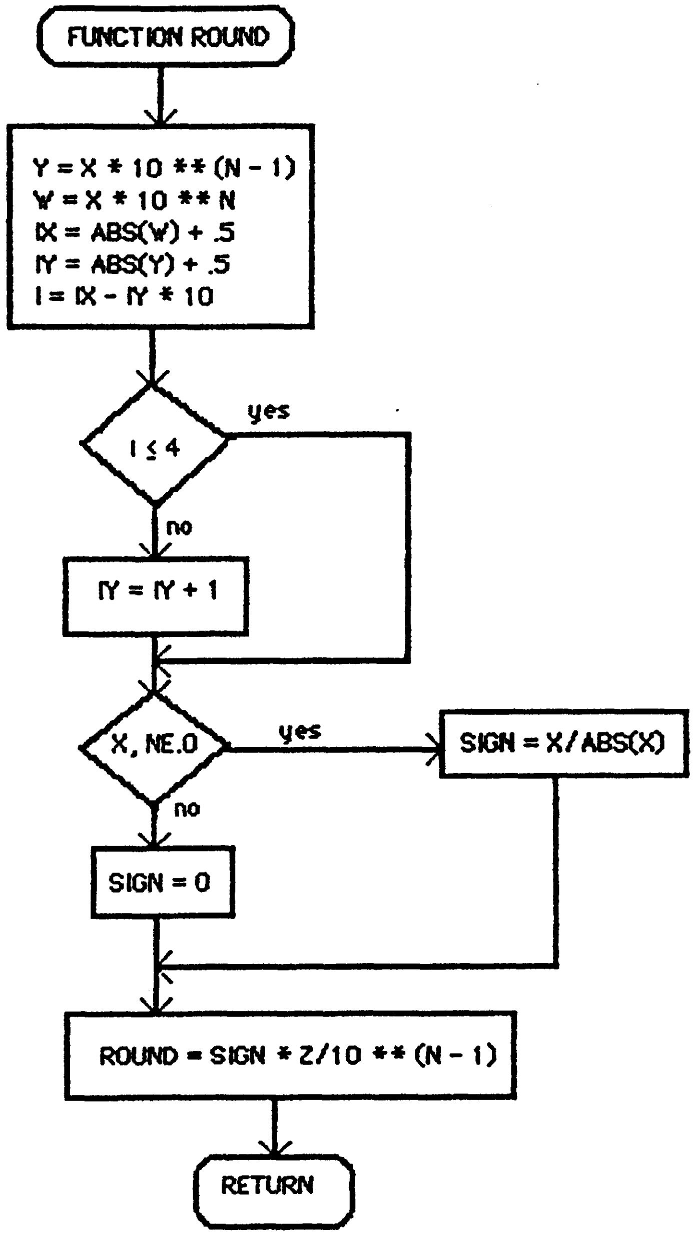



B
A
TR = TM
SH = SH - REL
ST2 = ST2 + REL

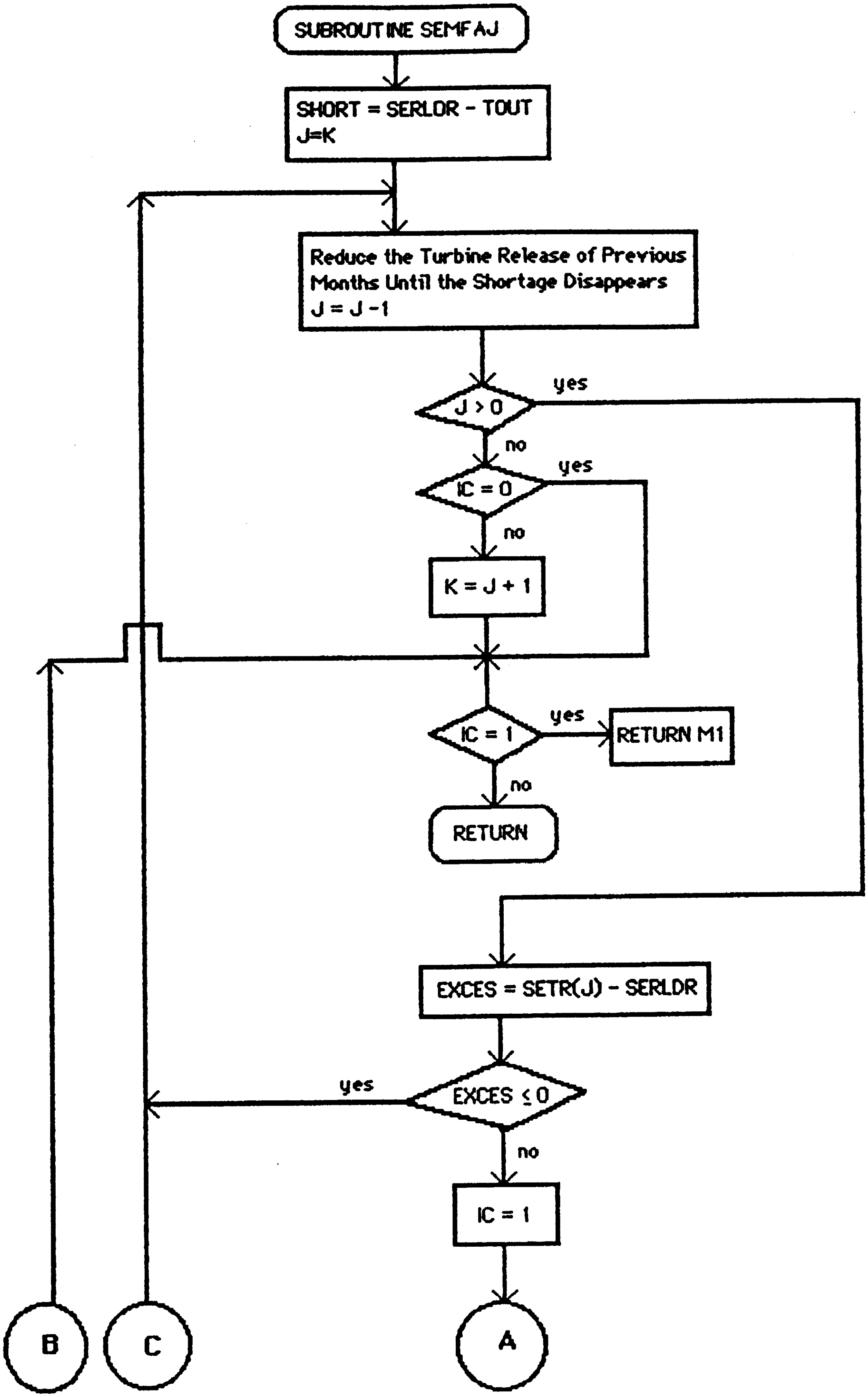
Description: Linear Interpolation of a Table with Data in Ascending Order.
If the Value Located Outside the Range, Boundry Value is Assumed.

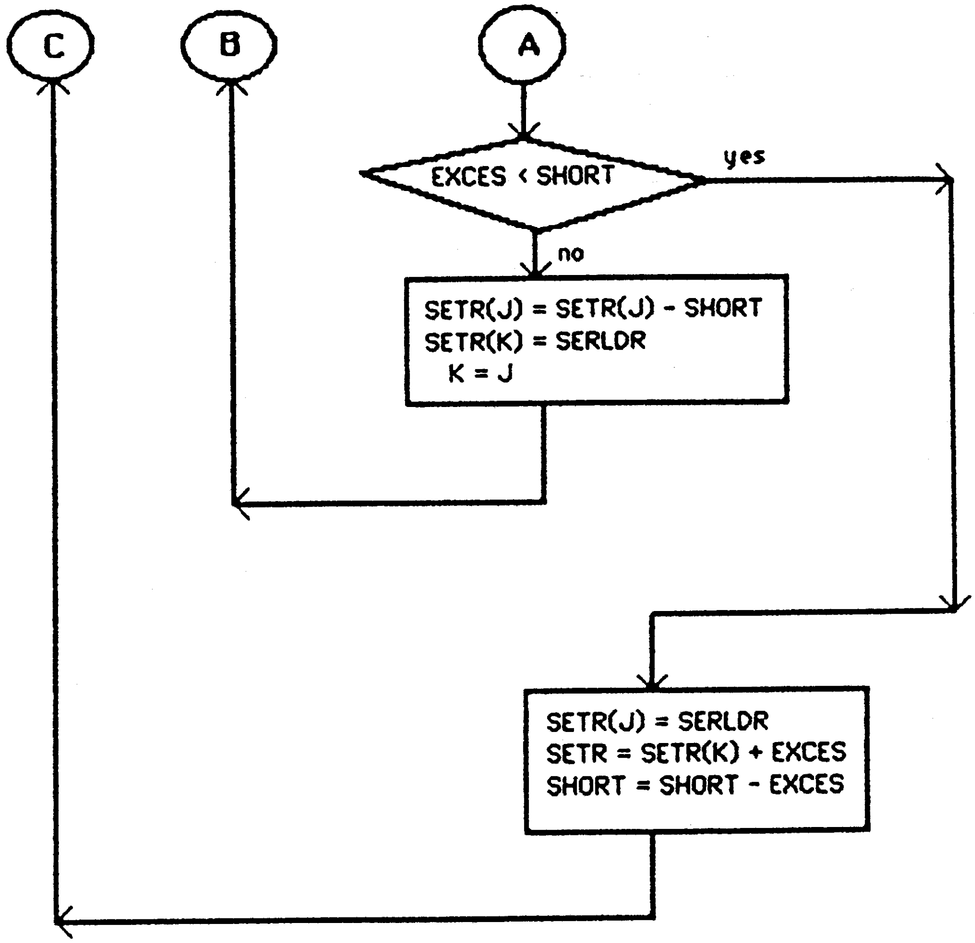


Description: Round Off the Value X at Nth Decimal Place.

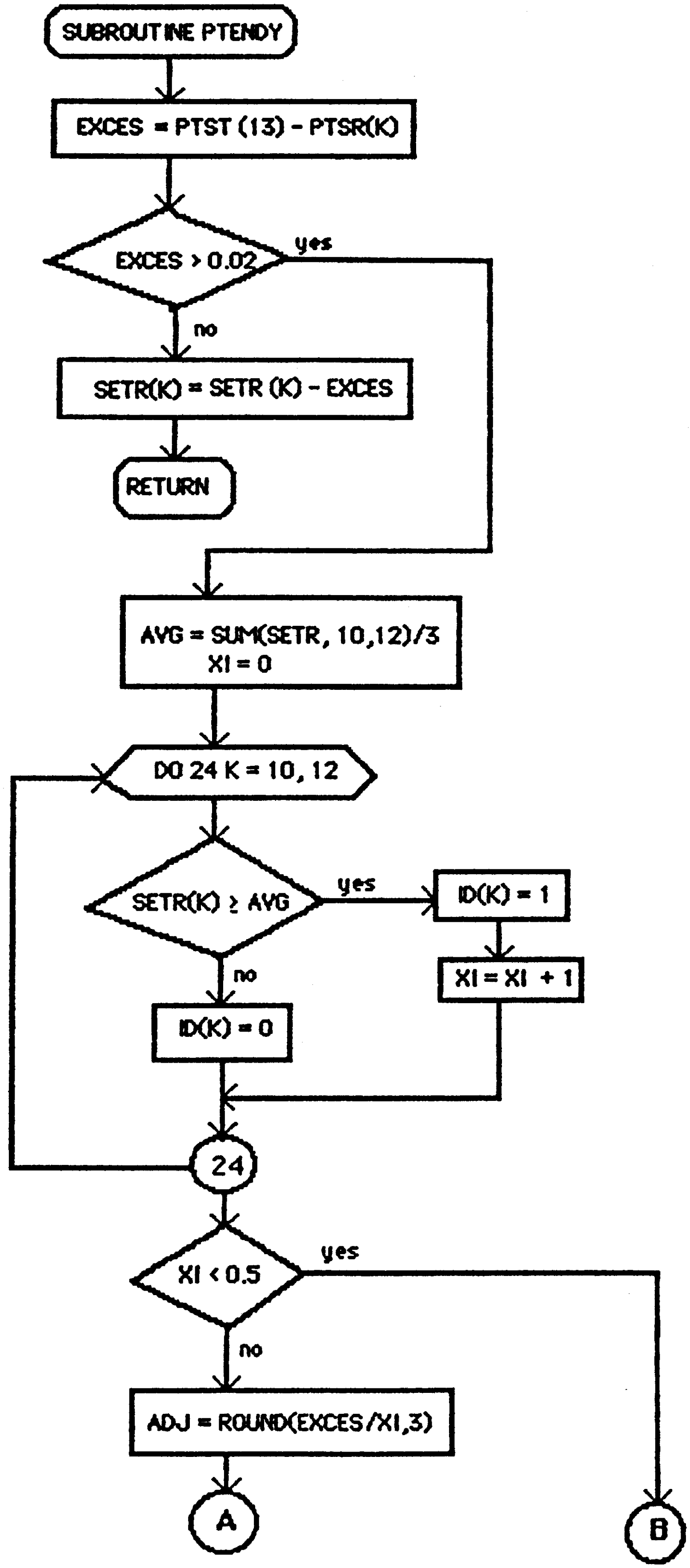


Description: Seminoe Outflow Less than Minimum Required.
Adjust Previous Months to Eliminate the Shortage.

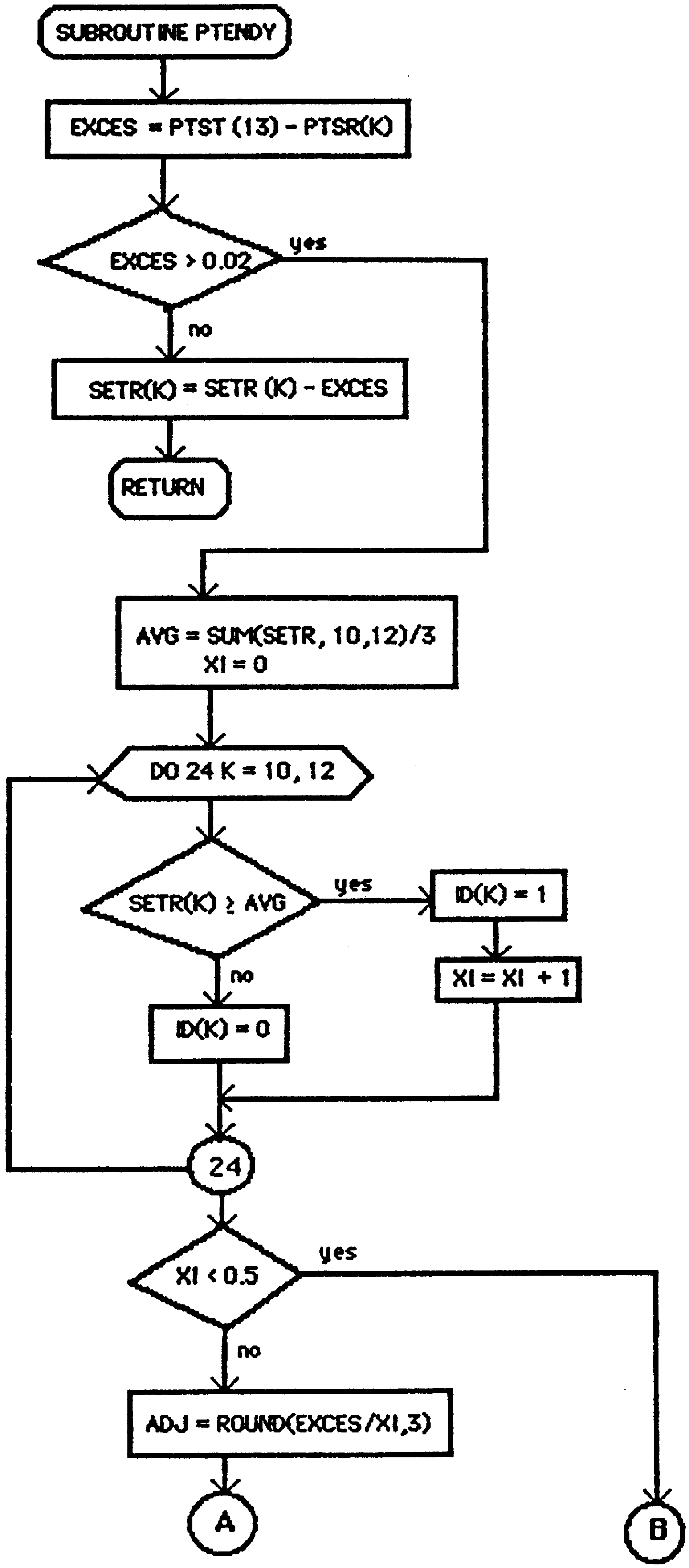


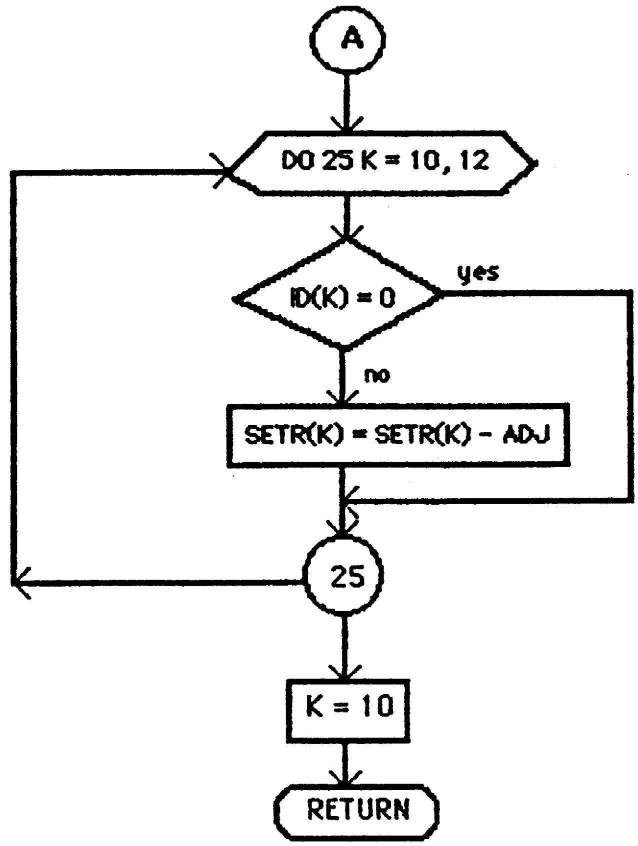

C
B
A
EXCES < SHORT
yes
no
SETR(J) = SETR(J) - SHORT
SETR(K) = SERLDR
K = J
SETR(J) = SERLDR
SETR = SETR(K) + EXCES
SHORT = SHORT - EXCES

Description: Pathfinder End of Year Storage should be kept at 50,000 AF when Seminoe and Pathfinder Combined Storage is Less than 400,000 AF by Adjusting the Last Three Months Outflow from Seminoe.

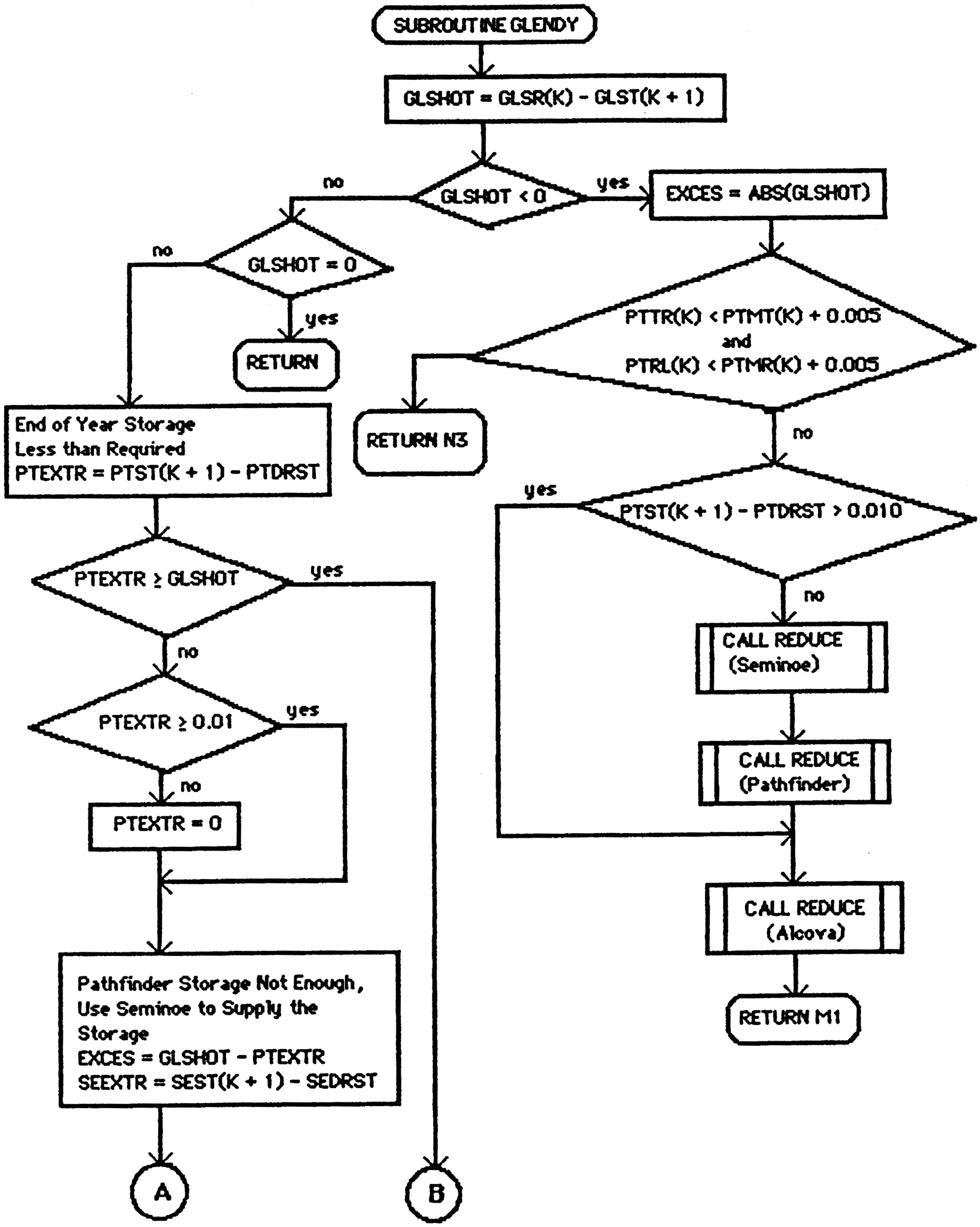


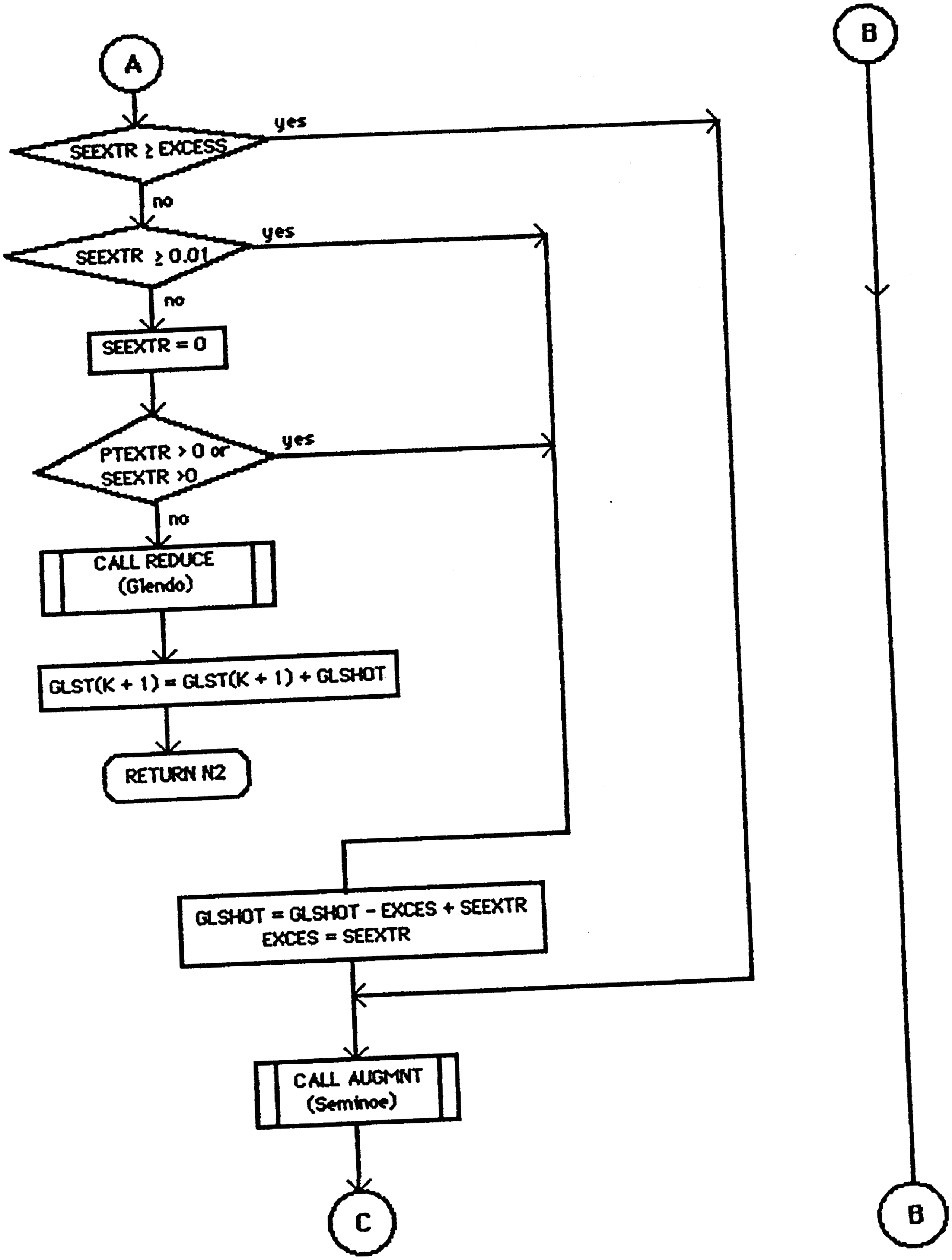
Description: Pathfinder End of Year Storage should be kept at 50,000 AF when Seminoe and Pathfinder Combined Storage is Less than 400,000 AF by Adjusting the Last Three Months Outflow from Seminoe.

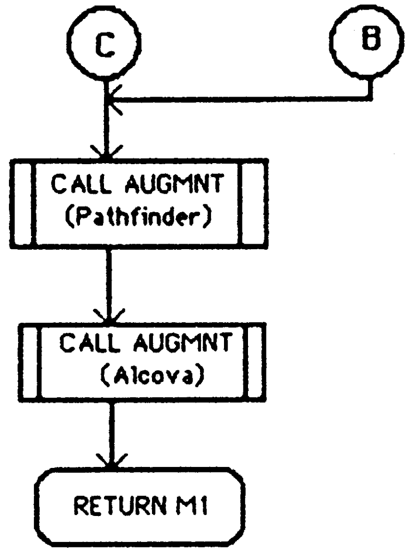


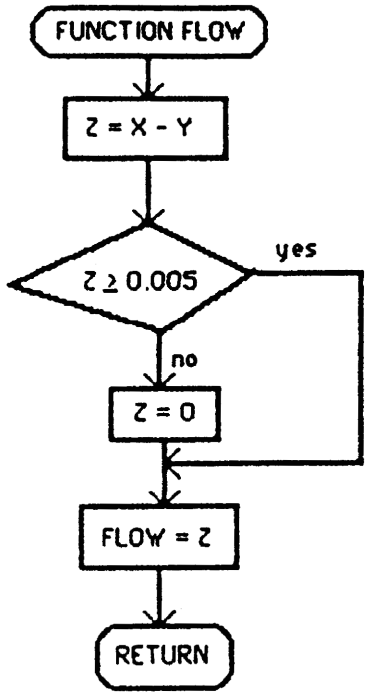

A
DO 25 K = 10, 12
ID(K) = 0
yes
no
SETR(K) = SETR(K) - ADJ
25
K = 10
RETURN

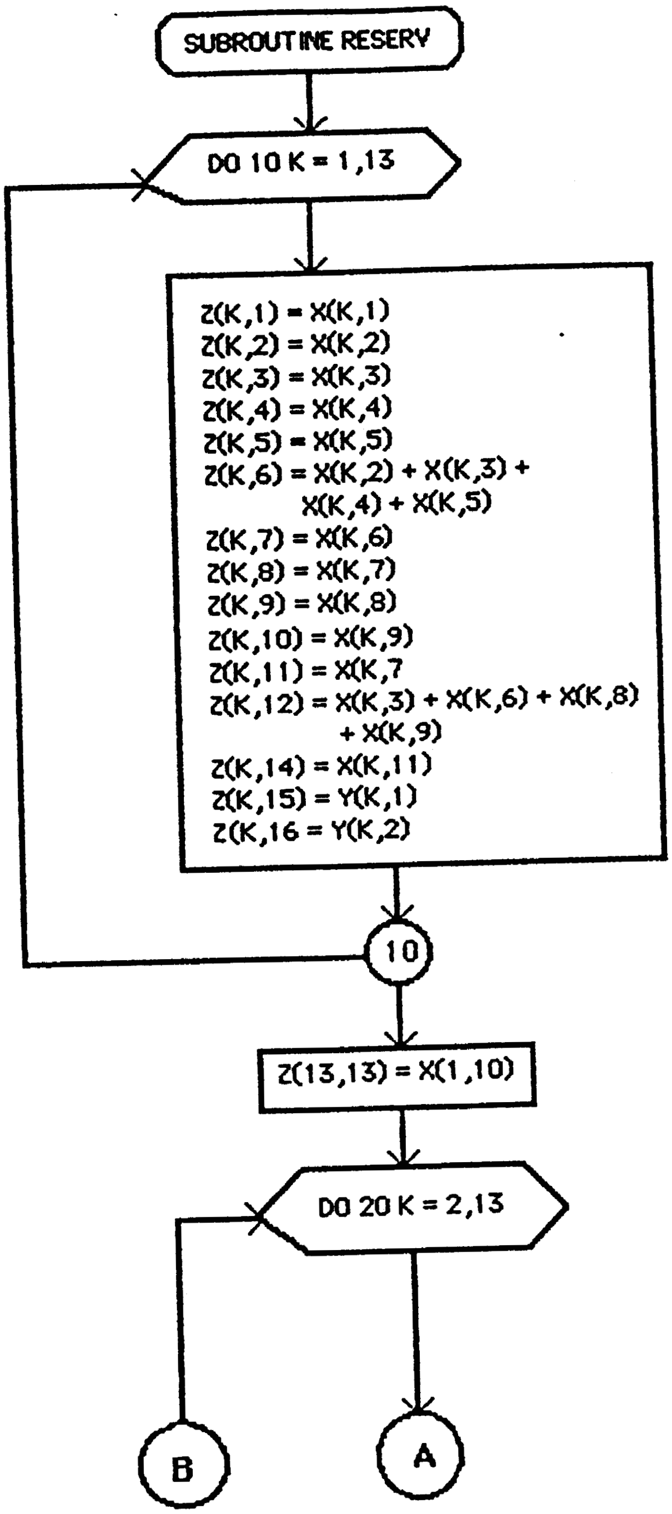
Description: Glendo End of Year Storage Should be Adjusted to a Required Level.

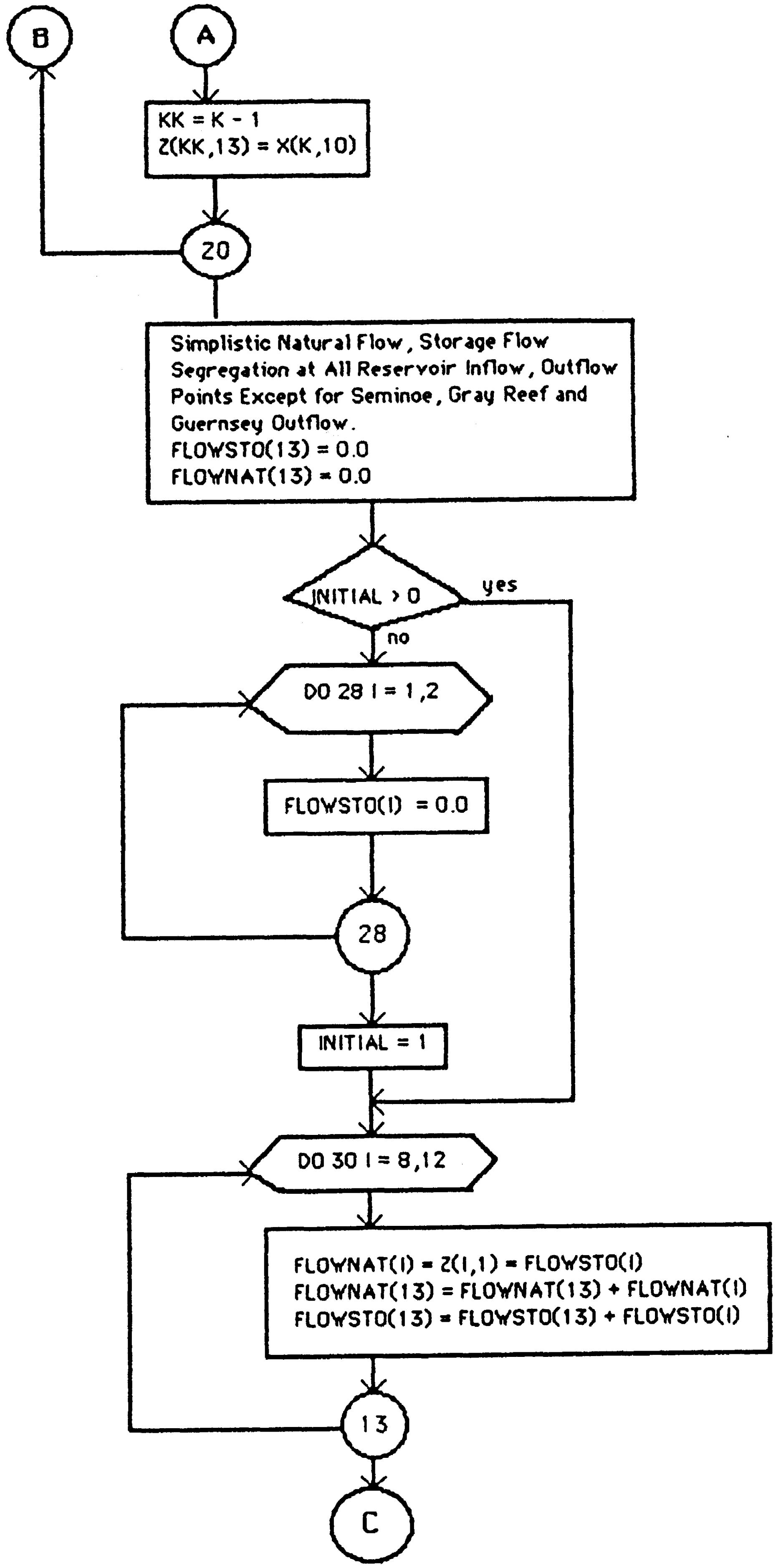


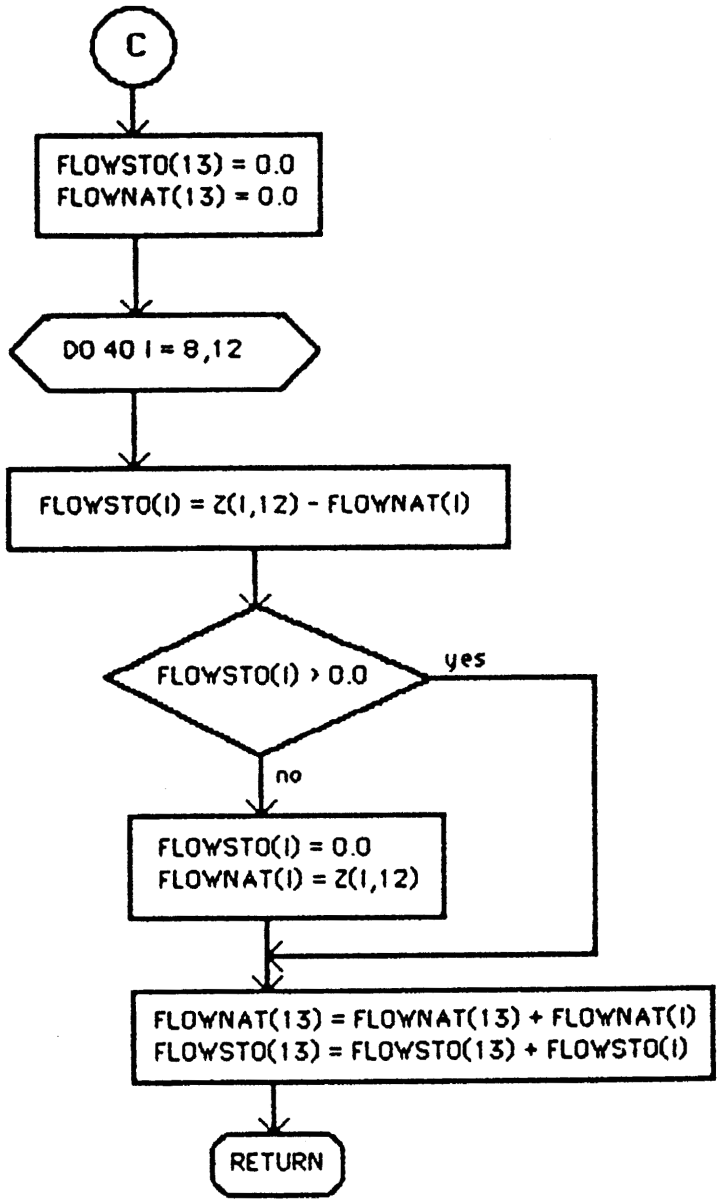

A
SEEXTR ≥ EXCESS
yes
no
SEEXTR ≥ 0.01
yes
no
SEEXTR = 0
PTEXTR > 0 or
SEEXTR >0
yes
no
CALL REDUCE
(Glendo)
GLST(K + 1) = GLST(K + 1) + GLSHOT
RETURN N2
GLSHOT = GLSHOT - EXCES + SEEXTR
EXCES = SEEXTR
CALL AUGMNT
(Seminoe)
C
B
B


C
B
CALL AUGMNT
(Pathfinder)
CALL AUGMNT
(Alcova)
RETURN M1

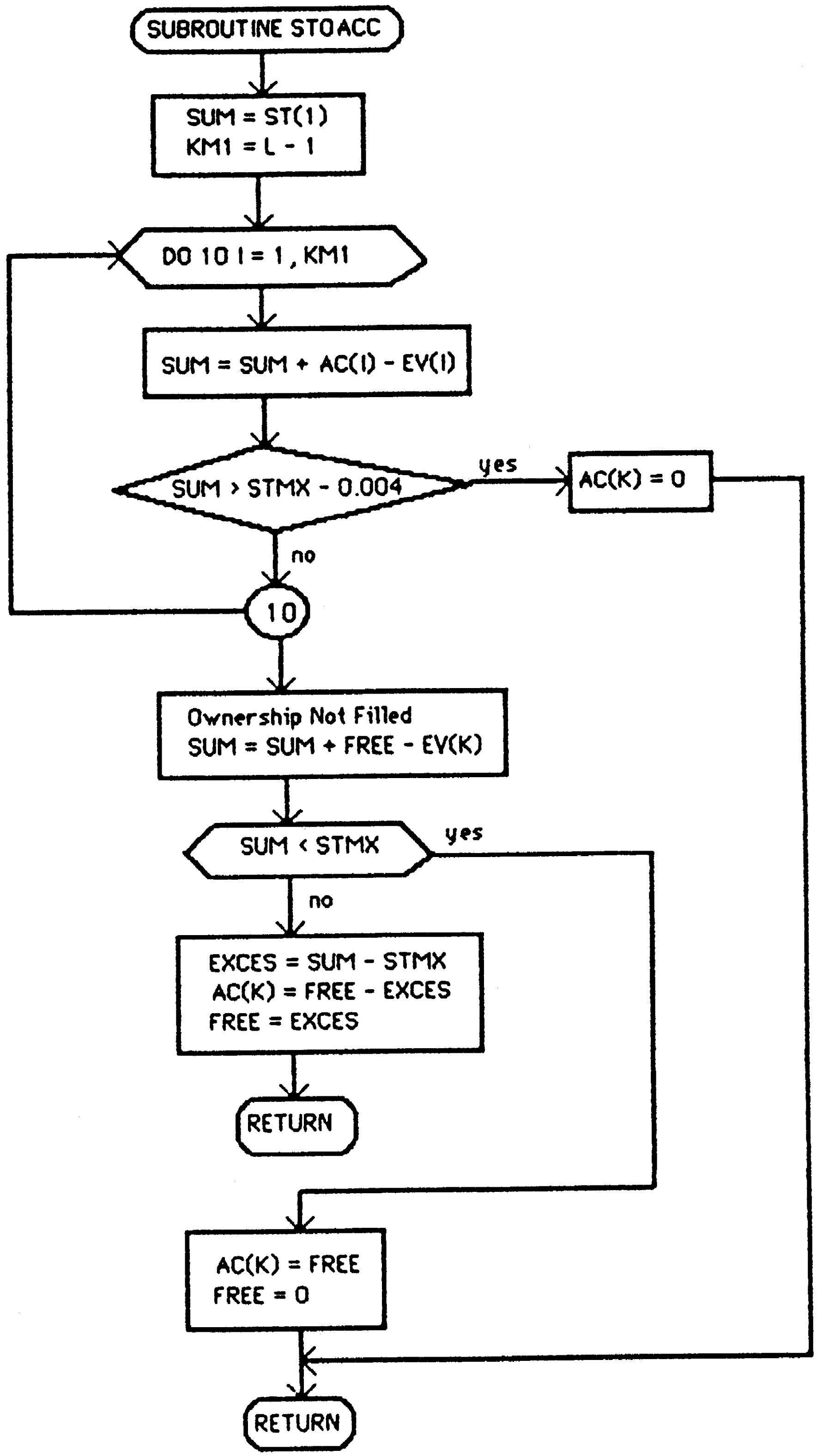

FUNCTION FLOW
Z = X - Y
Z ≥ 0.005
yes
no
Z = 0
FLOW = Z
RETURN


SUBROUTINE RESERV
DO 10 K = 1,13
Z(K,1) = X(K,1)
Z(K,2) = X(K,2)
Z(K,3) = X(K,3)
Z(K,4) = X(K,4)
Z(K,5) = X(K,5)
Z(K,6) = X(K,2) + X(K,3) +
X(K,4) + X(K,5)
Z(K,7) = X(K,6)
Z(K,8) = X(K,7)
Z(K,9) = X(K,8)
Z(K,10) = X(K,9)
Z(K,11) = X(K,7
Z(K,12) = X(K,3) + X(K,6) + X(K,8)
+ X(K,9)
Z(K,14) = X(K,11)
Z(K,15) = Y(K,1)
Z(K,16 = Y(K,2)
10
Z(13,13) = X(1,10)
DO 20 K = 2,13
B
A


B
A
KK = K - 1
Z(KK,13) = X(K,10)
20
Simplistic Natural Flow, Storage Flow Segregation at All Reservoir Inflow, Outflow Points Except for Seminoe, Gray Reef and Guernsey Outflow.
FLOWSTO(13) = 0.0
FLOWNAT(13) = 0.0
INITIAL > 0
yes
no
DO 28 I = 1,2
FLOWSTO(I) = 0.0
28
INITIAL = 1
DO 30 I = 8,12
FLOWNAT(I) = Z(I,1) = FLOWSTO(I)
FLOWNAT(13) = FLOWNAT(13) + FLOWNAT(I)
FLOWSTO(13) = FLOWSTO(13) + FLOWSTO(I)
13
C


C
FLOWSTO(13) = 0.0
FLOWNAT(13) = 0.0
DO 40 I = 8,12
FLOWSTO(I) = Z(I,12) - FLOWNAT(I)
FLOWSTO(I) > 0.0
yes
no
FLOWSTO(I) = 0.0
FLOWNAT(I) = Z(I,12)
FLOWNAT(13) = FLOWNAT(13) + FLOWNAT(I)
FLOWSTO(13) = FLOWSTO(13) + FLOWSTO(I)
RETURN

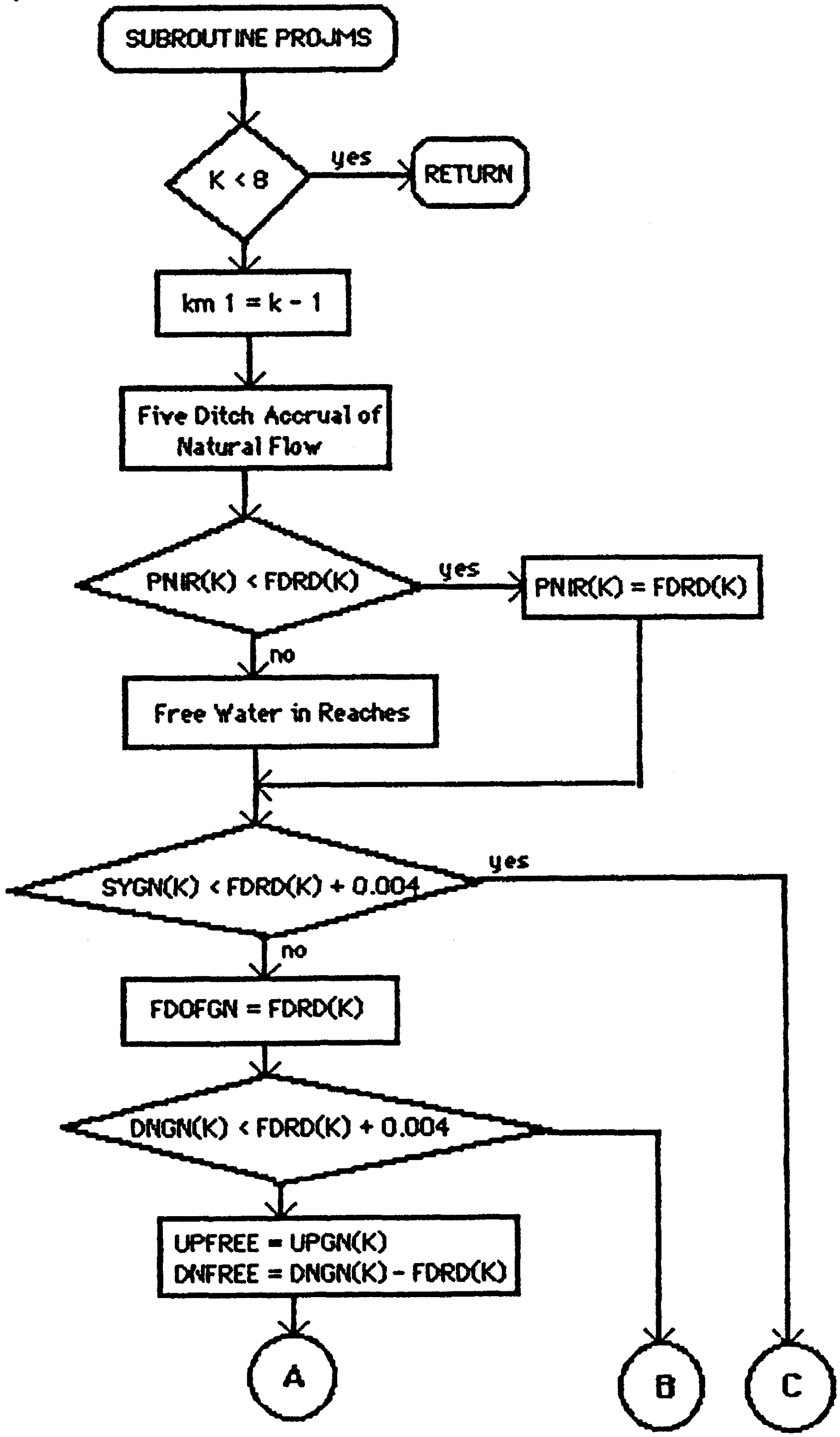
Description: Ownership Gain for Storage Up to STMX

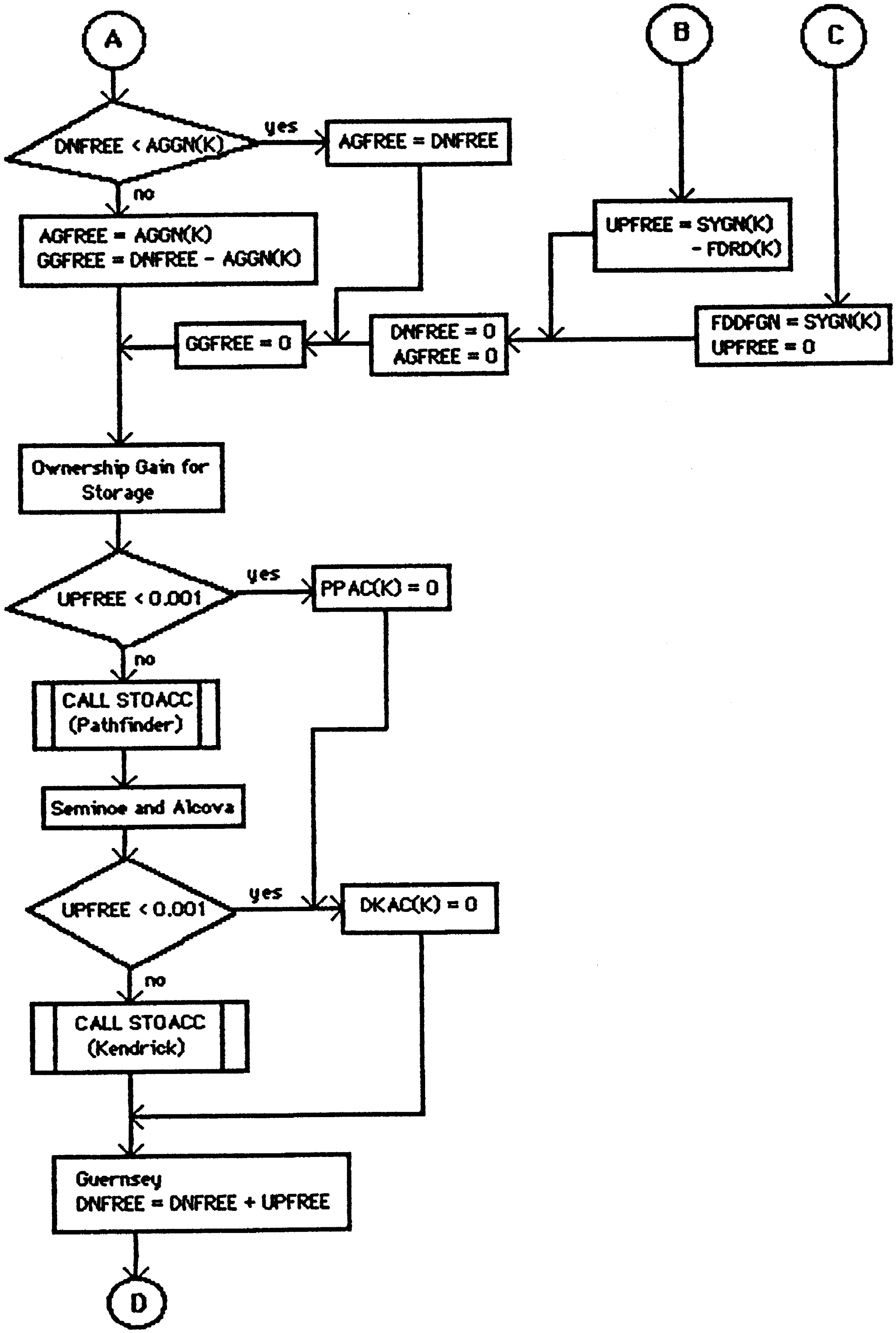


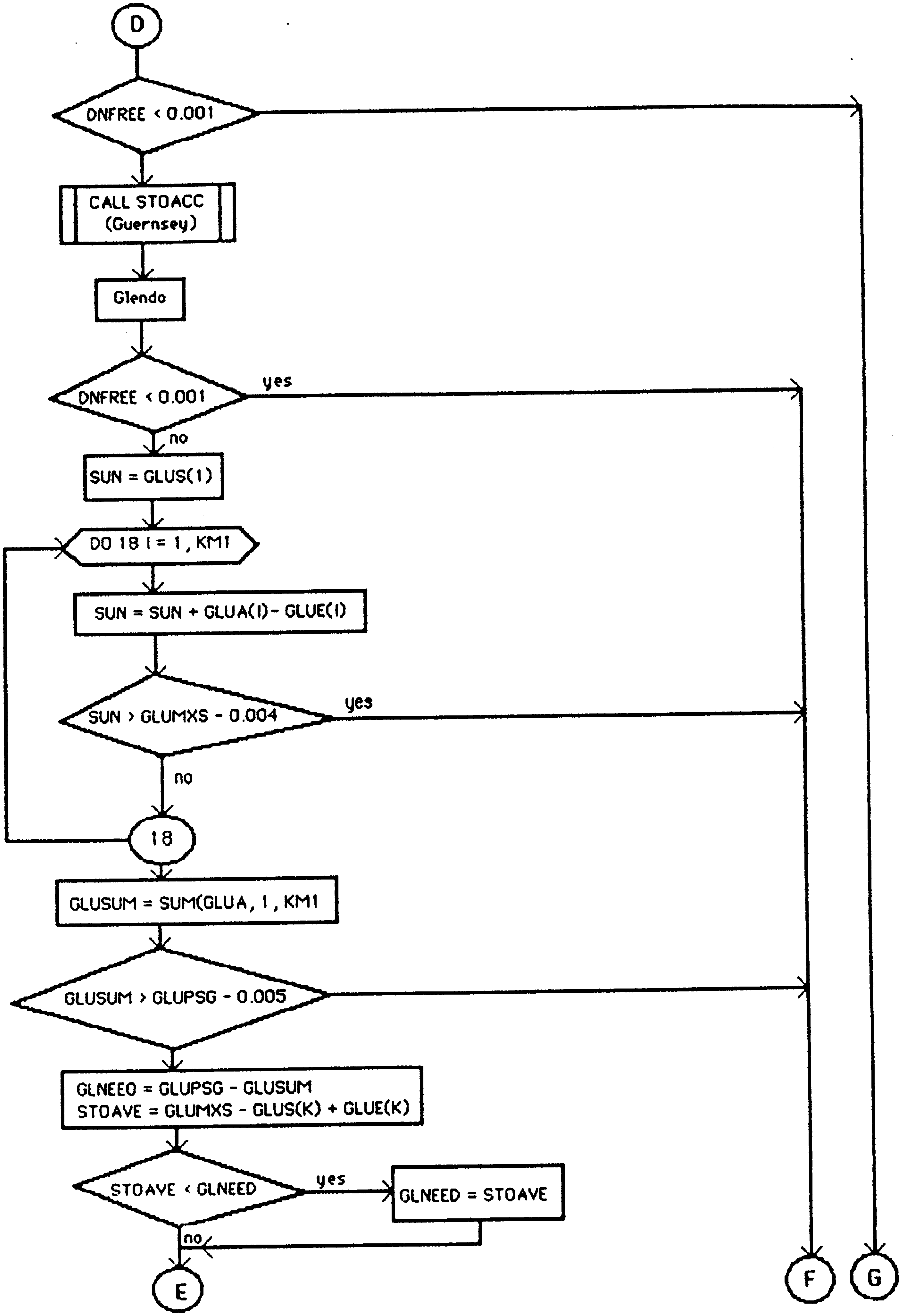
Description: Ownership Distribution

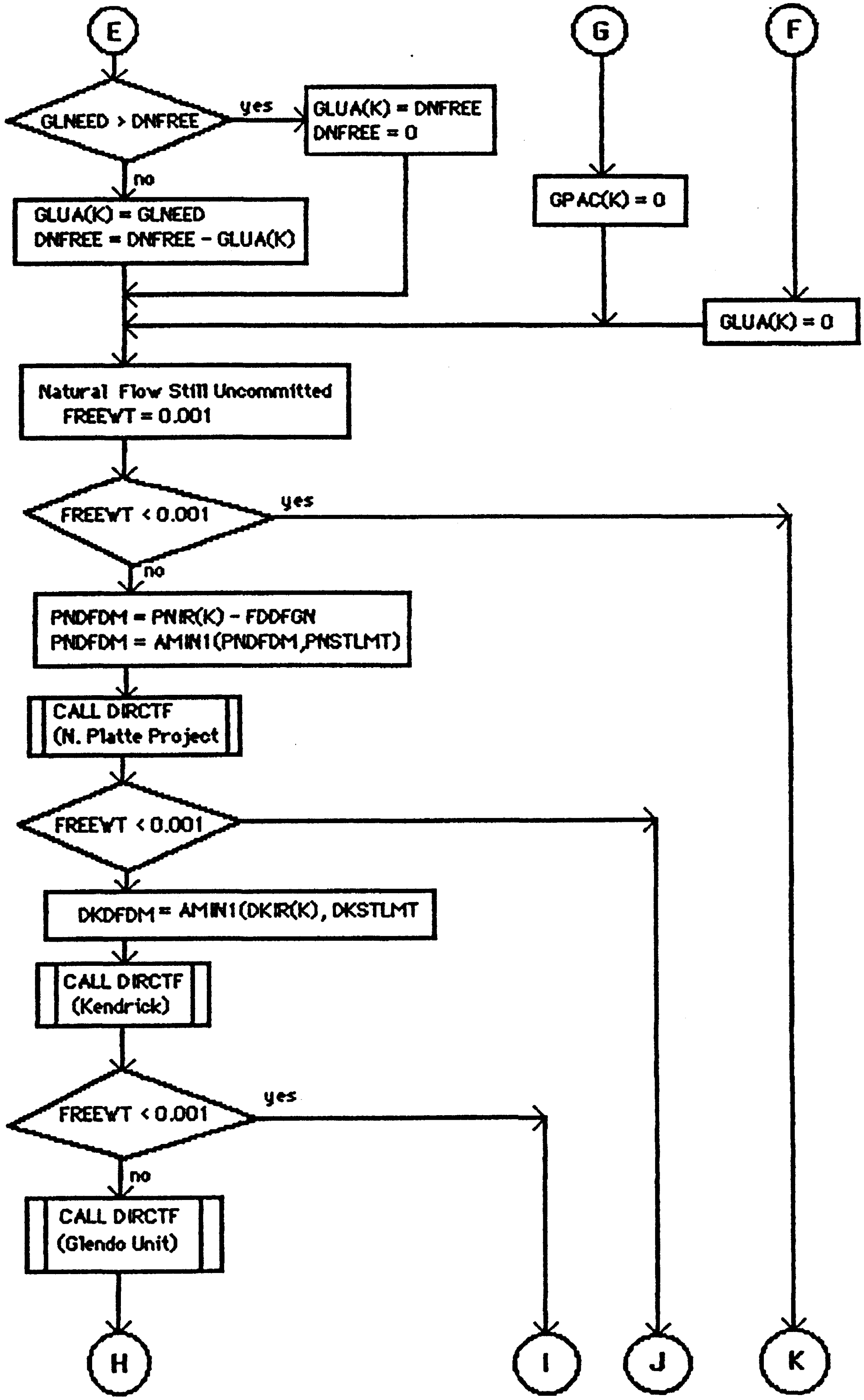
1. Five Ditch
2. Pathfinder Ownership in Storage
3. Guernsey Ownership in Storage
4. Kendrick Ownership in Storage
5. Glendo Unit Ownership in Storage
6. N. Platte Direct Flow Right
7. Kendrick Direct Flow Right
8. Glendo Unit Direct Flow Right
9. River Water

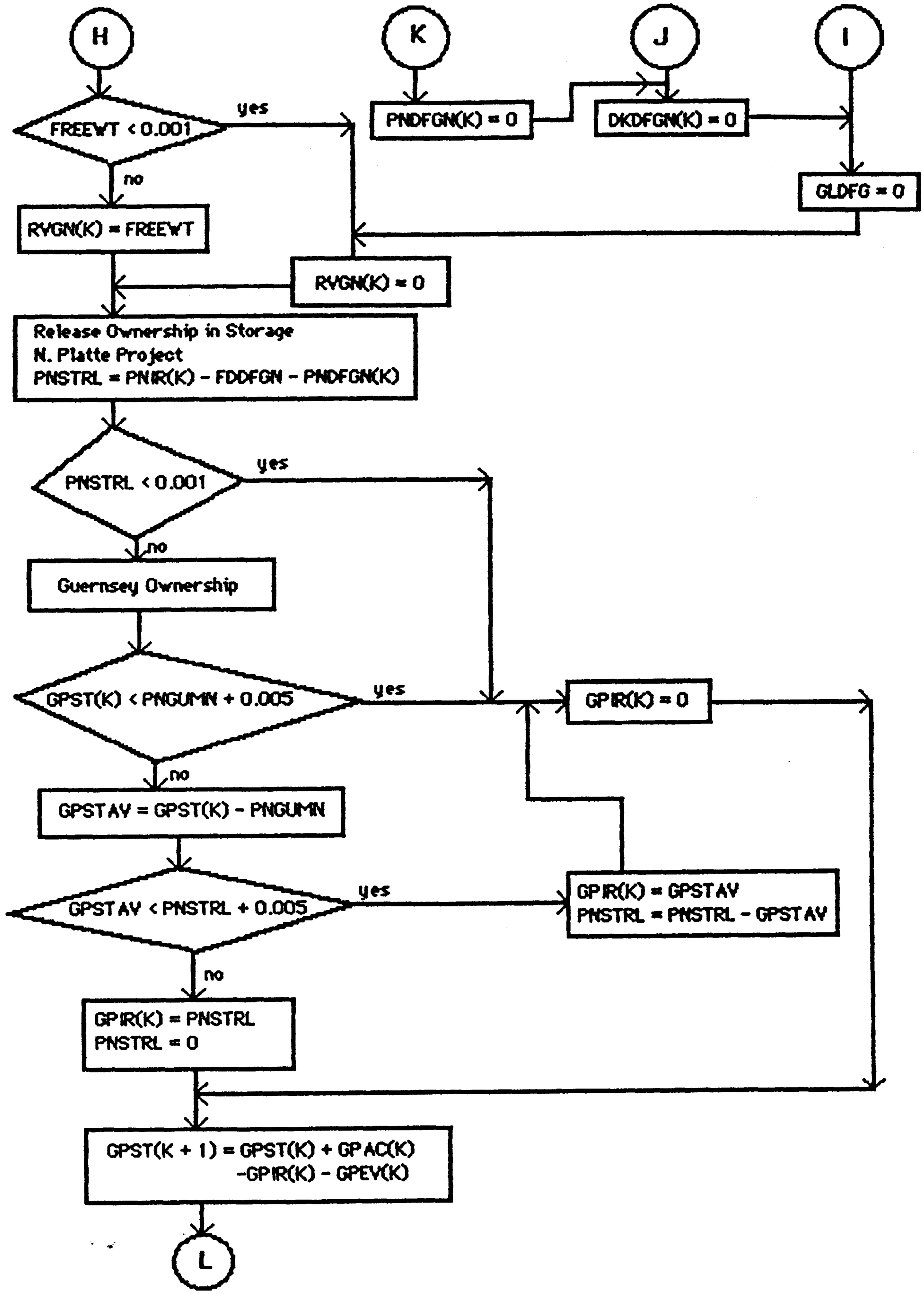
Evaporation Assumed as been Computed

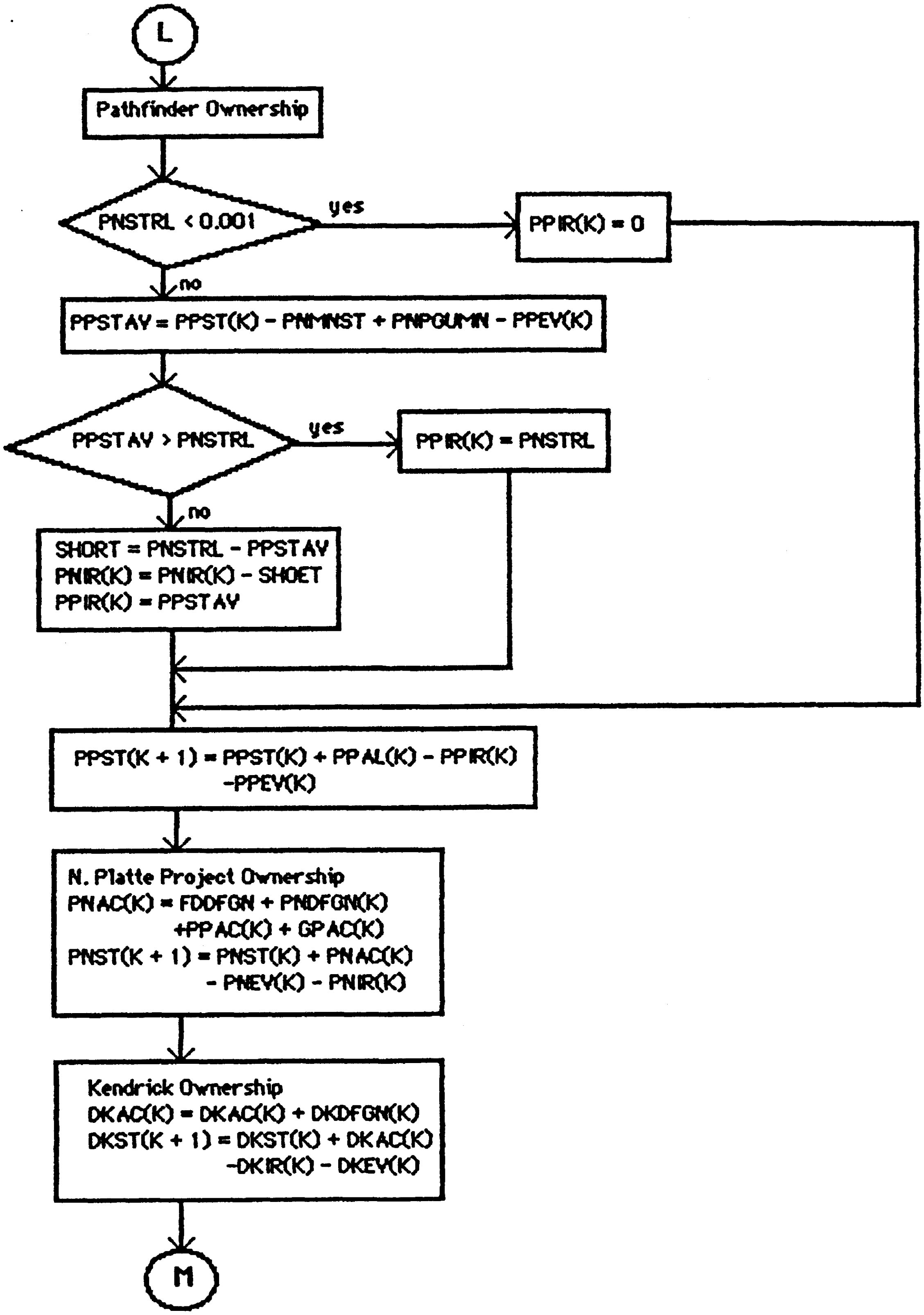


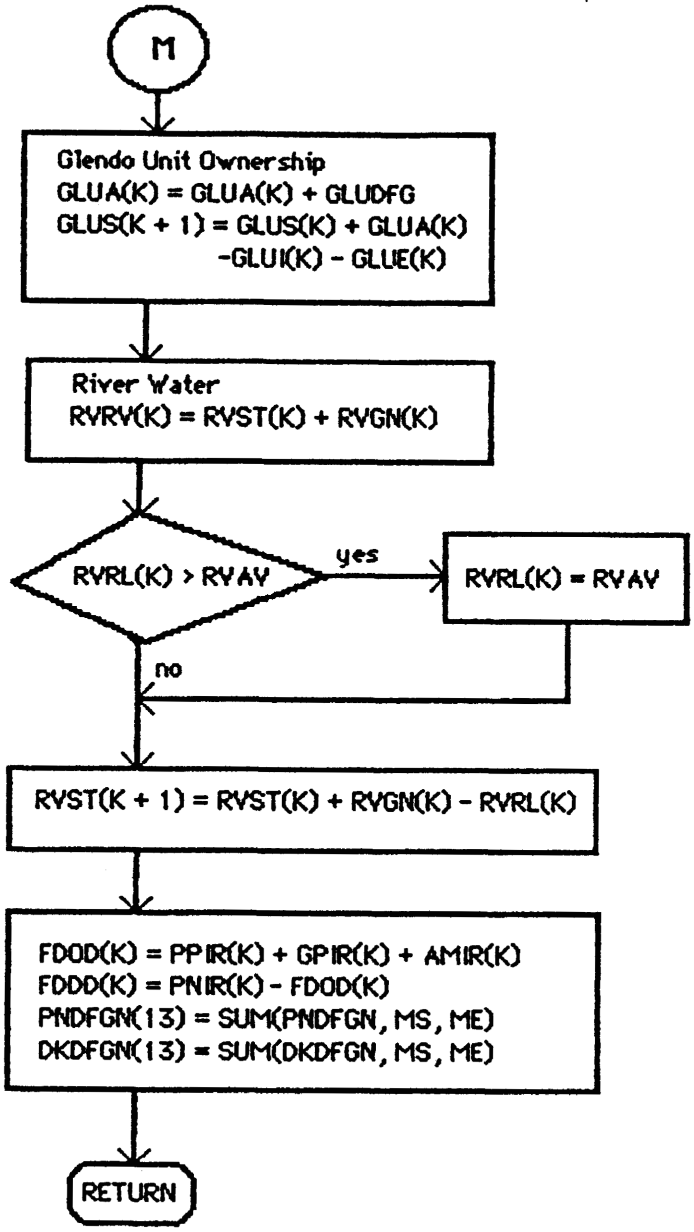

A
B
C
DNFREE < AGGN(K)
yes
no
AGFREE = DNFREE
AGFREE = AGGN(K)
GGFREE = DNFREE - AGGN(K)
UPFREE = SYGN(K)
- FDRD(K)
GGFREE = 0
DNFREE = 0
AGFREE = 0
FDDFGN = SYGN(K)
UPFREE = 0
Ownership Gain for
Storage
UPFREE < 0.001
yes
no
PPAC(K) = 0
CALL STOACC
(Pathfinder)
Seminoe and Alcova
UPFREE < 0.001
yes
no
DKAC(K) = 0
CALL STOACC
(Kendrick)
Guernsey
DNFREE = DNFREE + UPFREE
D

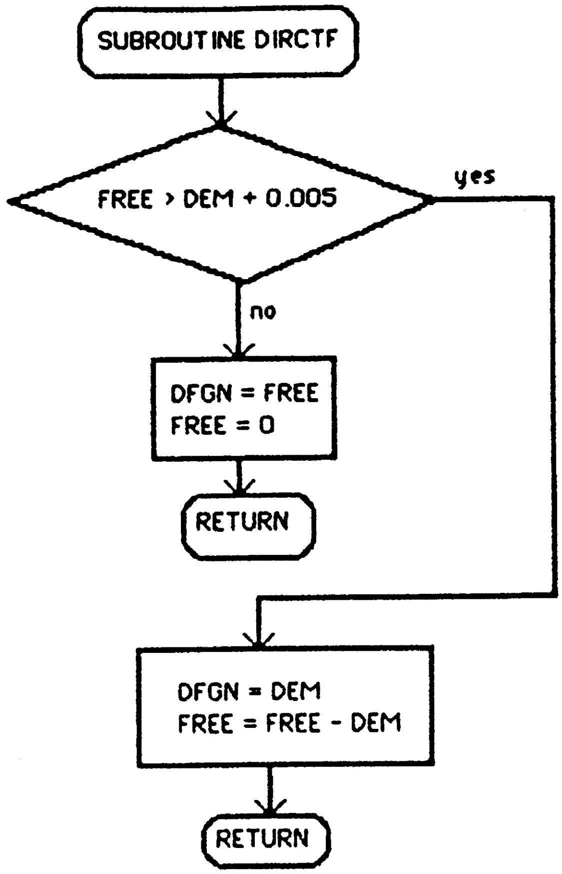

D
DNFREE < 0.001
CALL STOACC
(Guernsey)
Glendo
DNFREE < 0.001
yes
no
SUN = GLUS(1)
DO 18 I = 1, KM1
SUN = SUN + GLUA(I) - GLUE(I)
SUN > GLUMXS - 0.004
yes
no
18
GLUSUM = SUM(GLUA, 1, KM1
GLUSUM > GLUPSG - 0.005
GLNEEO = GLUPSG - GLUSUM
STOAVE = GLUMXS - GLUS(K) + GLUE(K)
STOAVE < GLNEED
yes
GLNEED = STOAVE
no
E
F
G


E
G
F
GLNEED > DNFREE
yes
GLUA(K) = DNFREE
DNFREE = 0
no
GLUA(K) = GLNEED
DNFREE = DNFREE - GLUA(K)
GPAC(K) = 0
GLUA(K) = 0
Natural Flow Still Uncommitted
FREEWT = 0.001
FREEWT < 0.001
yes
no
PNDFDM = PNIR(K) - FDDFGN
PNDFDM = AMIN1(PNDFDM,PNSTLMT)
CALL DIRCTF
(N. Platte Project
FREEWT < 0.001
DKDFDM = AMIN1(DKIR(K), DKSTLMT
CALL DIRCTF
(Kendrick)
FREEWT < 0.001
yes
no
CALL DIRCTF
(Glendo Unit)
H
I
J
K

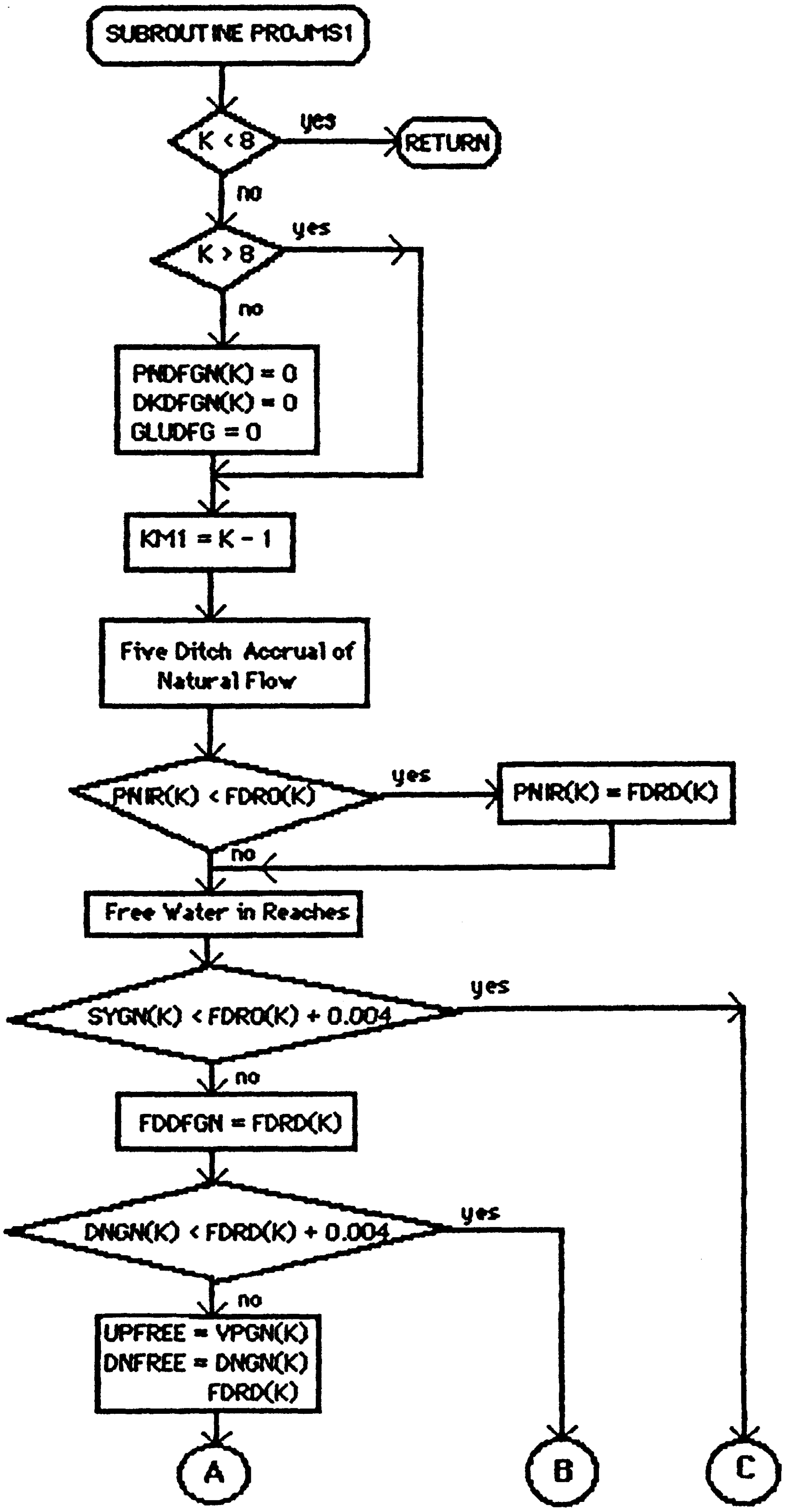

H
K
J
I
FREEWT < 0.001
yes
no
PNDFGN(K) = 0
DKDFGN(K) = 0
GLDFG = 0
RVGN(K) = FREEWT
RVGN(K) = 0
Release Ownership in Storage
N. Platte Project
PNSTRL = PNIR(K) - FDDFGN - PNDFGN(K)
PNSTRL < 0.001
yes
no
Guernsey Ownership
GPST(K) < PNGUMN + 0.005
yes
GPIR(K) = 0
no
GPSTAV = GPST(K) - PNGUMN
GPSTAV < PNSTRL + 0.005
yes
GPIR(K) = GPSTAV
PNSTRL = PNSTRL - GPSTAV
no
GPIR(K) = PNSTRL
PNSTRL = 0
GPST(K + 1) = GPST(K) + GPAC(K)
-GPIR(K) - GPEV(K)
L

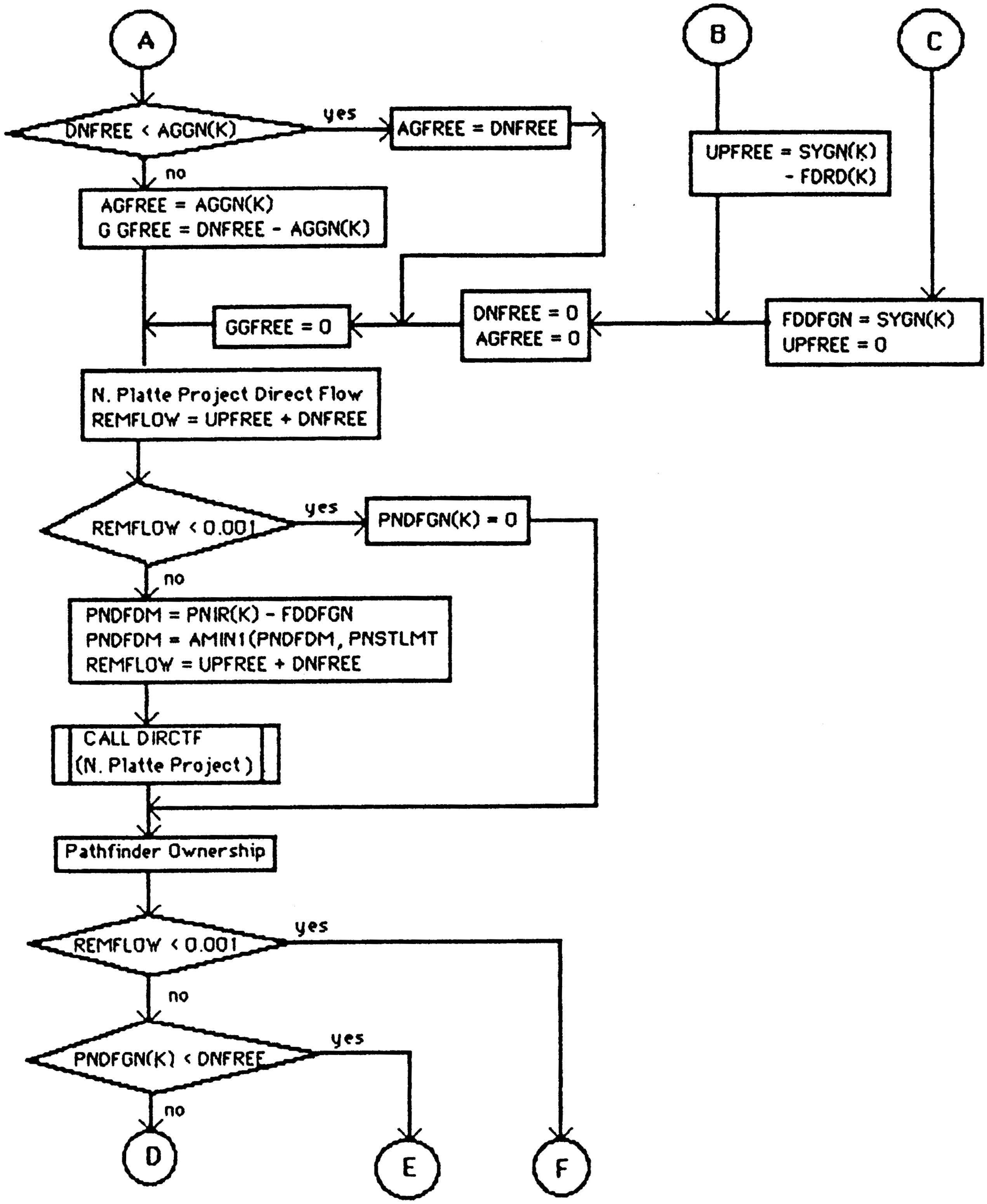

L
Pathfinder Ownership
PNSTRL < 0.001
yes
PPIR(K) = 0
no
PPSTAV = PPST(K) - PNMNST + PNPGUMN - PPEV(K)
PPSTAV > PNSTRL
yes
PPIR(K) = PNSTRL
no
SHORT = PNSTRL - PPSTAV
PNIR(K) = PNIR(K) - SHOET
PPIR(K) = PPSTAV
PPST(K + 1) = PPST(K) + PPAL(K) - PPIR(K) -PPEV(K)
N. Platte Project Ownership
PNAC(K) = FDDFGN + PNDFGN(K) +PPAC(K) + GPAC(K)
PNST(K + 1) = PNST(K) + PNAC(K) - PNEV(K) - PNIR(K)
Kendrick Ownership
DKAC(K) = DKAC(K) + DKDFGN(K)
DKST(K + 1) = DKST(K) + DKAC(K) -DKIR(K) - DKEV(K)
M

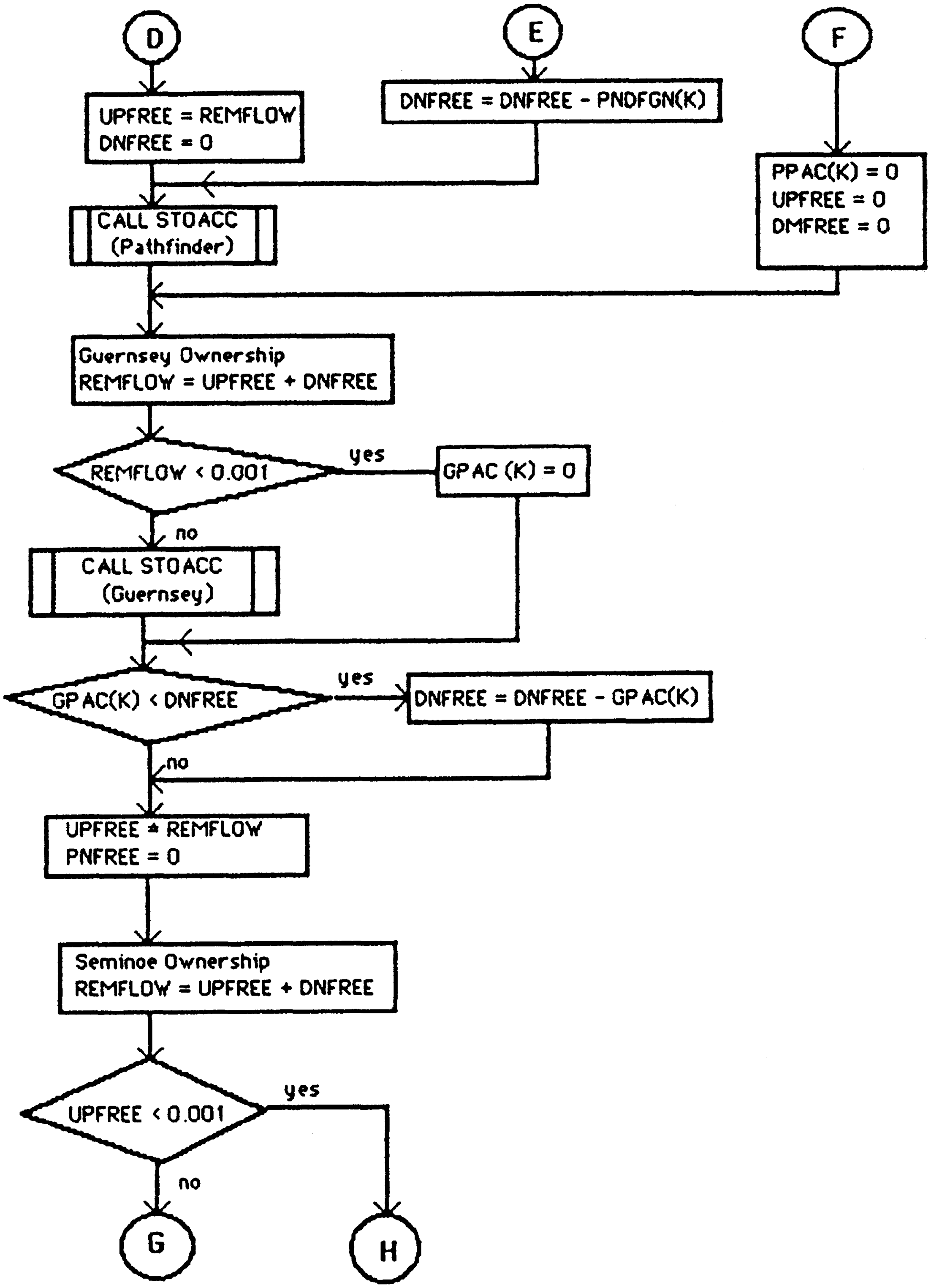

M
Glendo Unit Ownership
GLUA(K) = GLUA(K) + GLUDFG
GLUS(K + 1) = GLUS(K) + GLUA(K)
-GLUI(K) - GLUE(K)
River Water
RVRV(K) = RVST(K) + RVGN(K)
RVRL(K) > RVAV
yes
RVRL(K) = RVAV
no
RVST(K + 1) = RVST(K) + RVGN(K) - RVRL(K)
FDOD(K) = PPIR(K) + GPIR(K) + AMIR(K)
FDDD(K) = PNIR(K) - FDOD(K)
PNDFGN(13) = SUM(PNDFGN, MS, ME)
DKDFGN(13) = SUM(DKDFGN, MS, ME)
RETURN

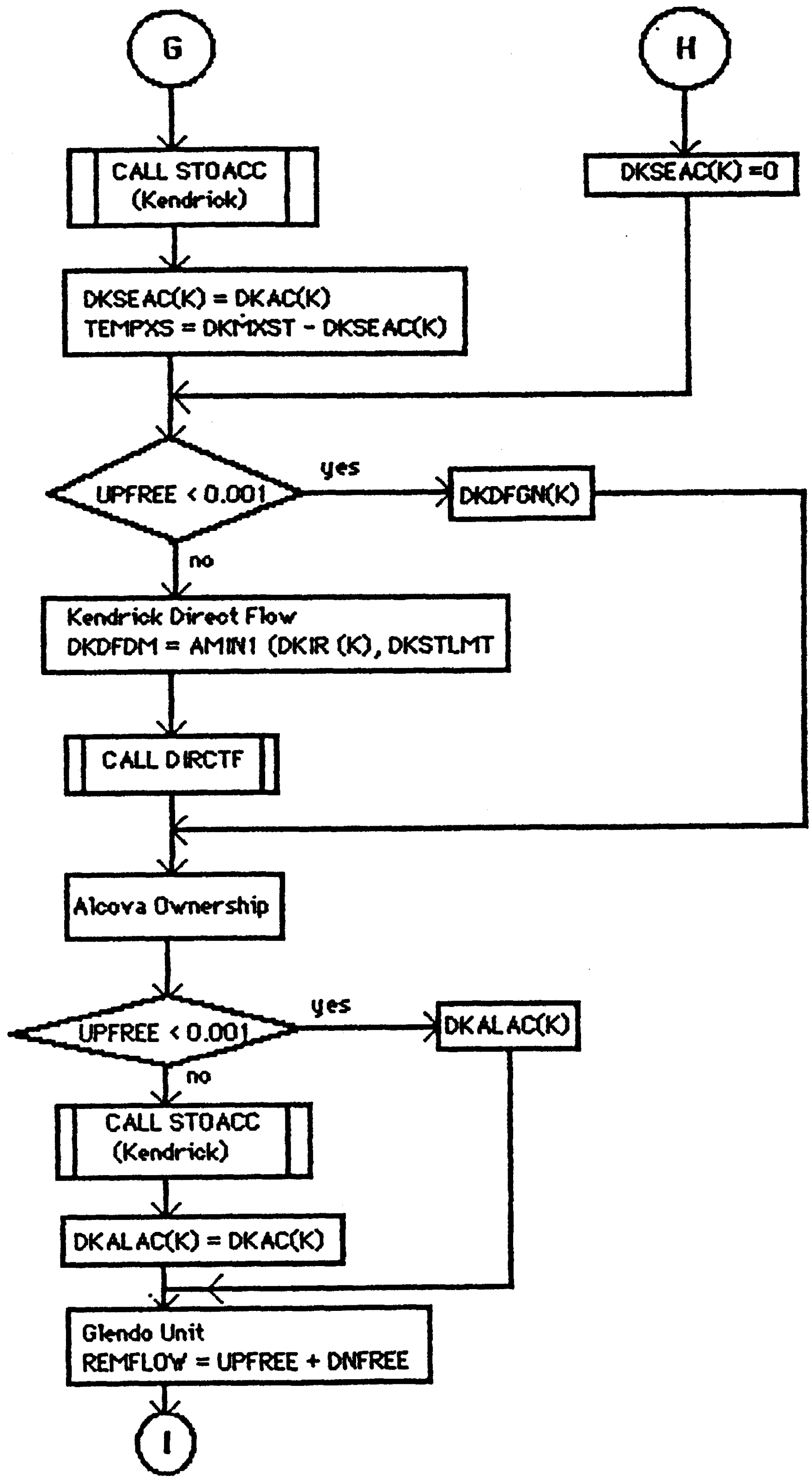

SUBROUTINE DIRCTF
FREE > DEM + 0.005
yes
no
DFGN = FREE
FREE = 0
RETURN
DFGN = DEM
FREE = FREE - DEM
RETURN

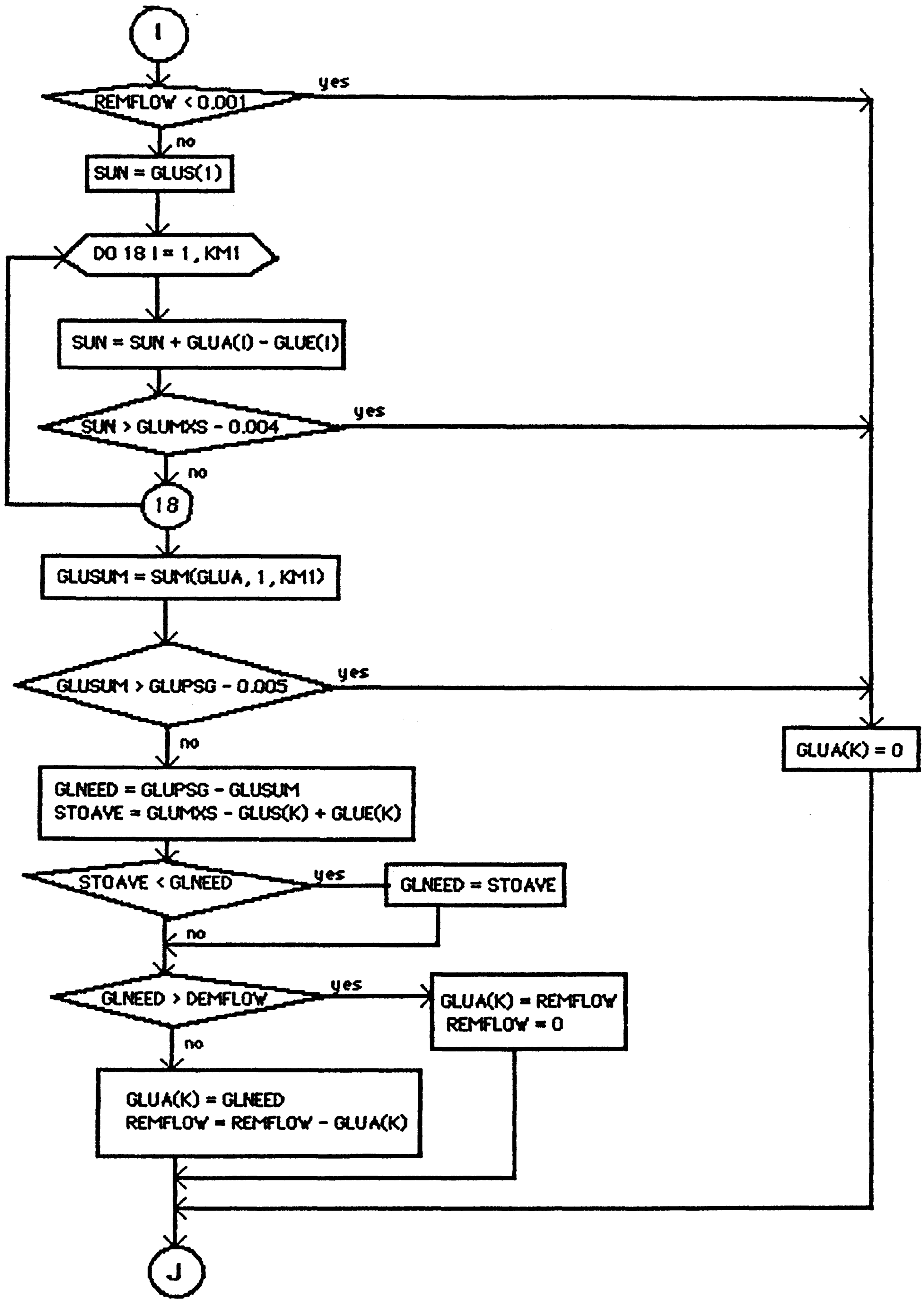
Description: Ownership Redistribution for May - Sept. Contains Some Redundant Code Due to Attempted Separtation of Kendrick Project into Seminoe, Alcova, and Direct Flow and Subsequent Recombination into One Priorty. Priority is (1) Five Ditches, (2) N. Platte Project Direct Flow up to Statutory Limit, (3) Pathfinder Ownership in Storage (4) Guernsey Ownership in Storage (5) Kendrick Project (6) Glendo Unit Ownership in Storage (7) River Water.

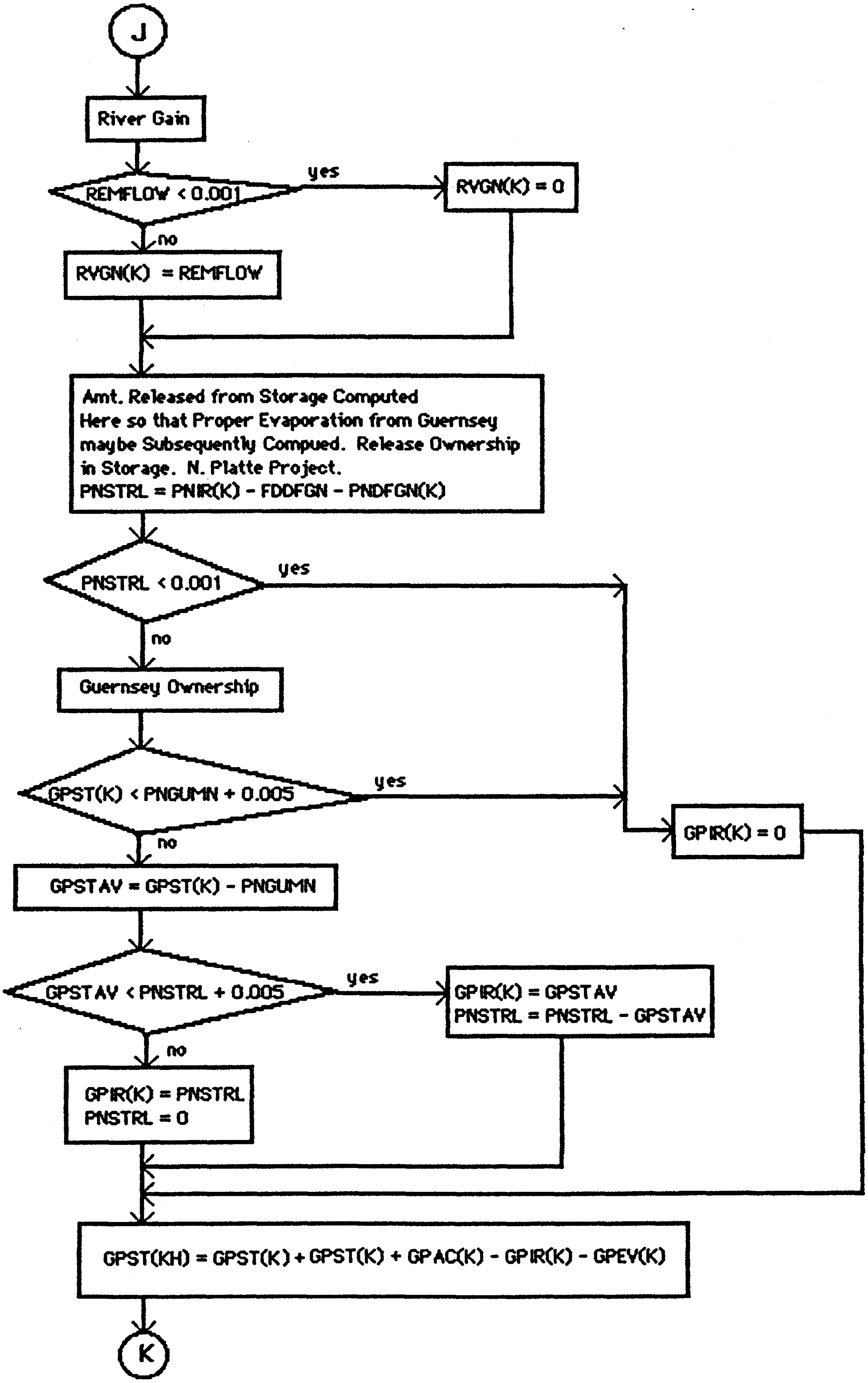


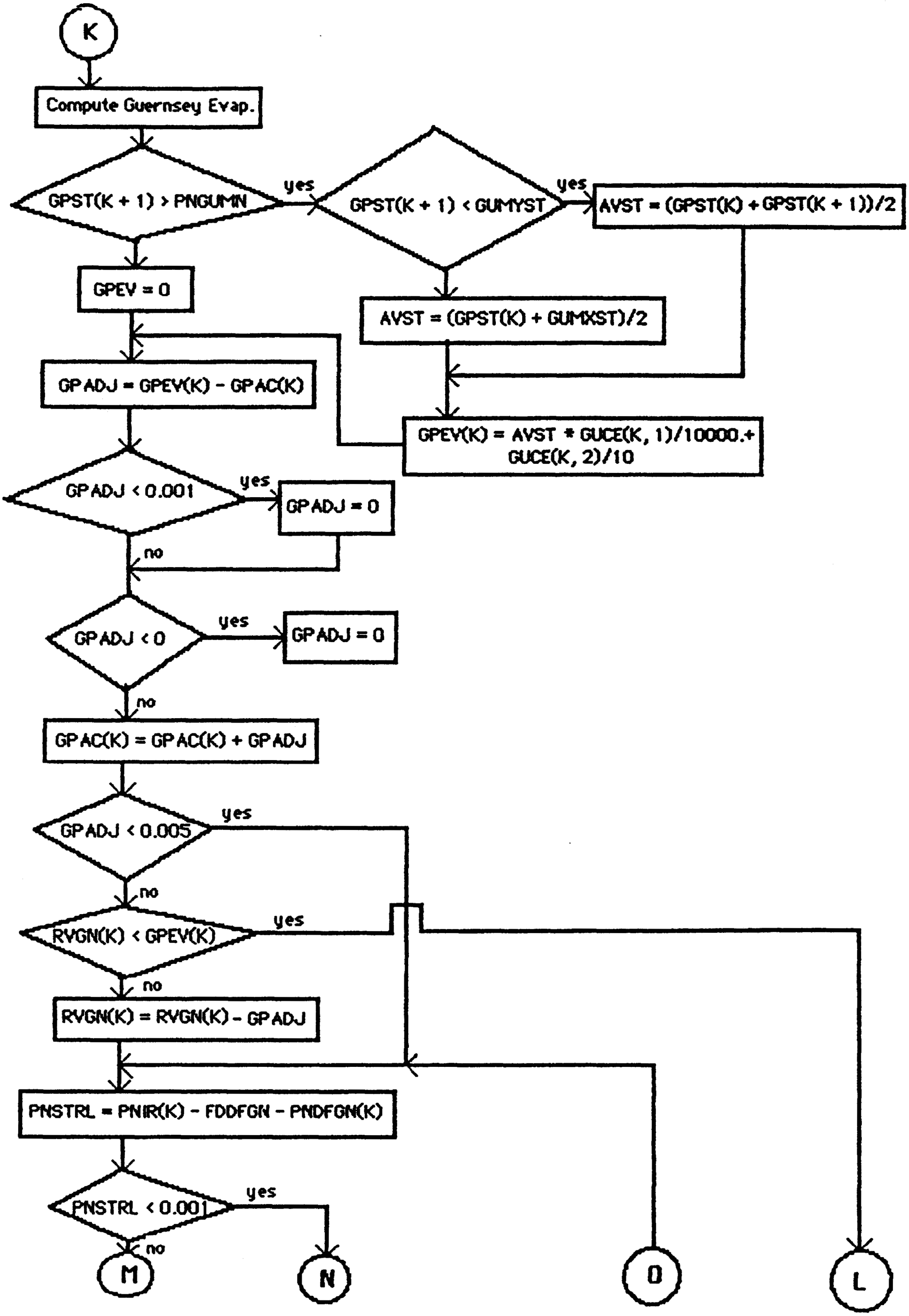

A
B
C
DNFREE < AGGN(K)
yes
no
AGFREE = DNFREE
UPFREE = SYGN(K) - FDRD(K)
AGFREE = AGGN(K)
G GFREE = DNFREE - AGGN(K)
GGFREE = 0
DNFREE = 0
AGFREE = 0
FDDFGN = SYGN(K)
UPFREE = 0
N. Platte Project Direct Flow
REMFLOW = UPFREE + DNFREE
REMFLOW < 0.001
PNDFGN(K) = 0
PNDFDM = PNIR(K) - FDDFGN
PNDFDM = AMIN1(PNDFDM, PNSTLMT
REMFLOW = UPFREE + DNFREE
CALL DIRCTF
(N. Platte Project)
Pathfinder Ownership
REMFLOW < 0.001
PNDFGN(K) < DNFREE
D
E
F

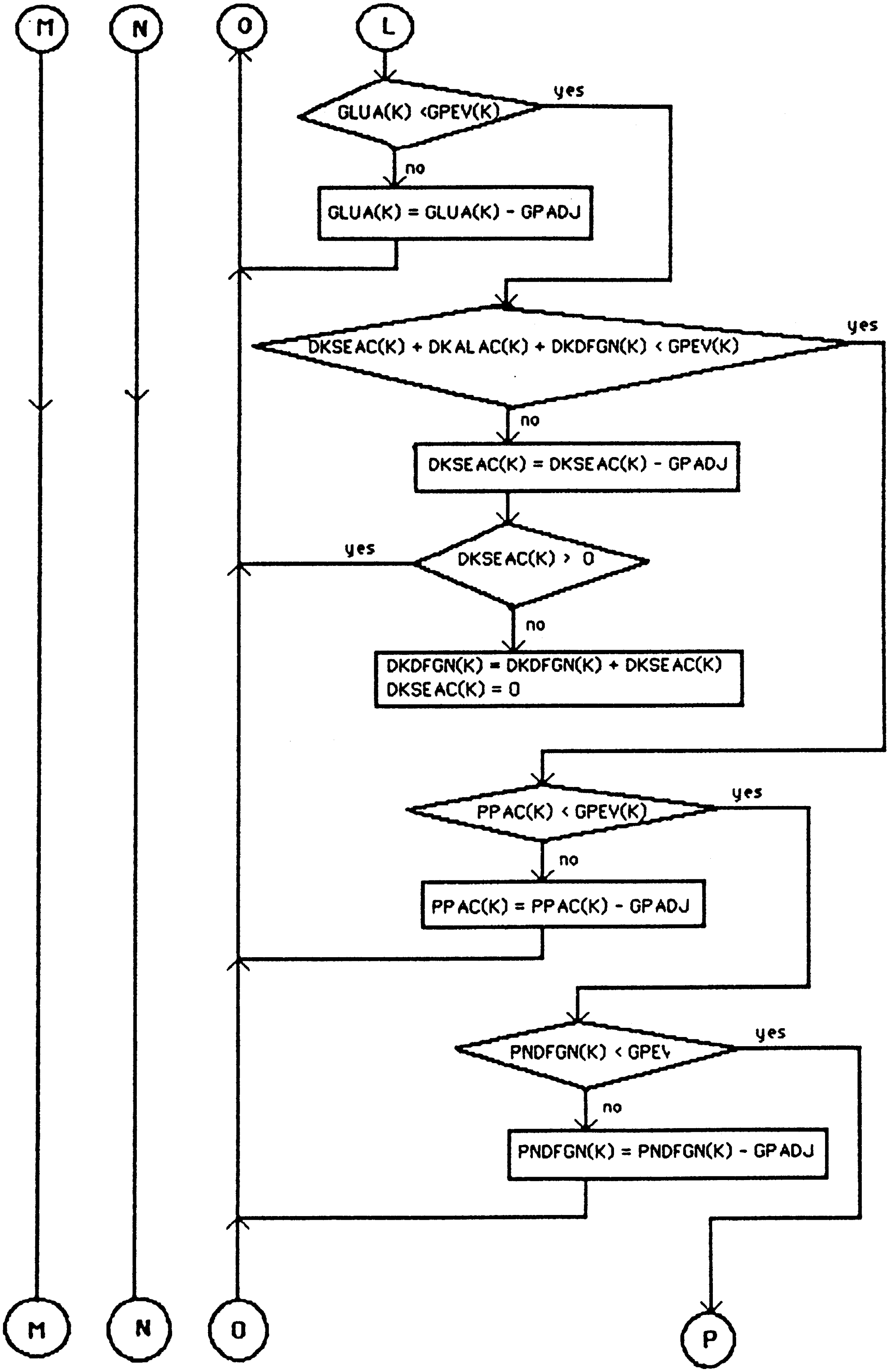

D
E
F
UPFREE = REMFLOW
DNFREE = 0
DNFREE = DNFREE - PNDFGN(K)
PPAC(K) = 0
UPFREE = 0
DMFREE = 0
CALL STOACC
(Pathfinder)
Guernsey Ownership
REMFLOW = UPFREE + DNFREE
REMFLOW < 0.001
yes
GPAC (K) = 0
no
CALL STOACC
(Guernsey)
GPAC(K) < DNFREE
yes
DNFREE = DNFREE - GPAC(K)
no
UPFREE = REMFLOW
PNFREE = 0
Seminoe Ownership
REMFLOW = UPFREE + DNFREE
UPFREE < 0.001
yes
no
G
H

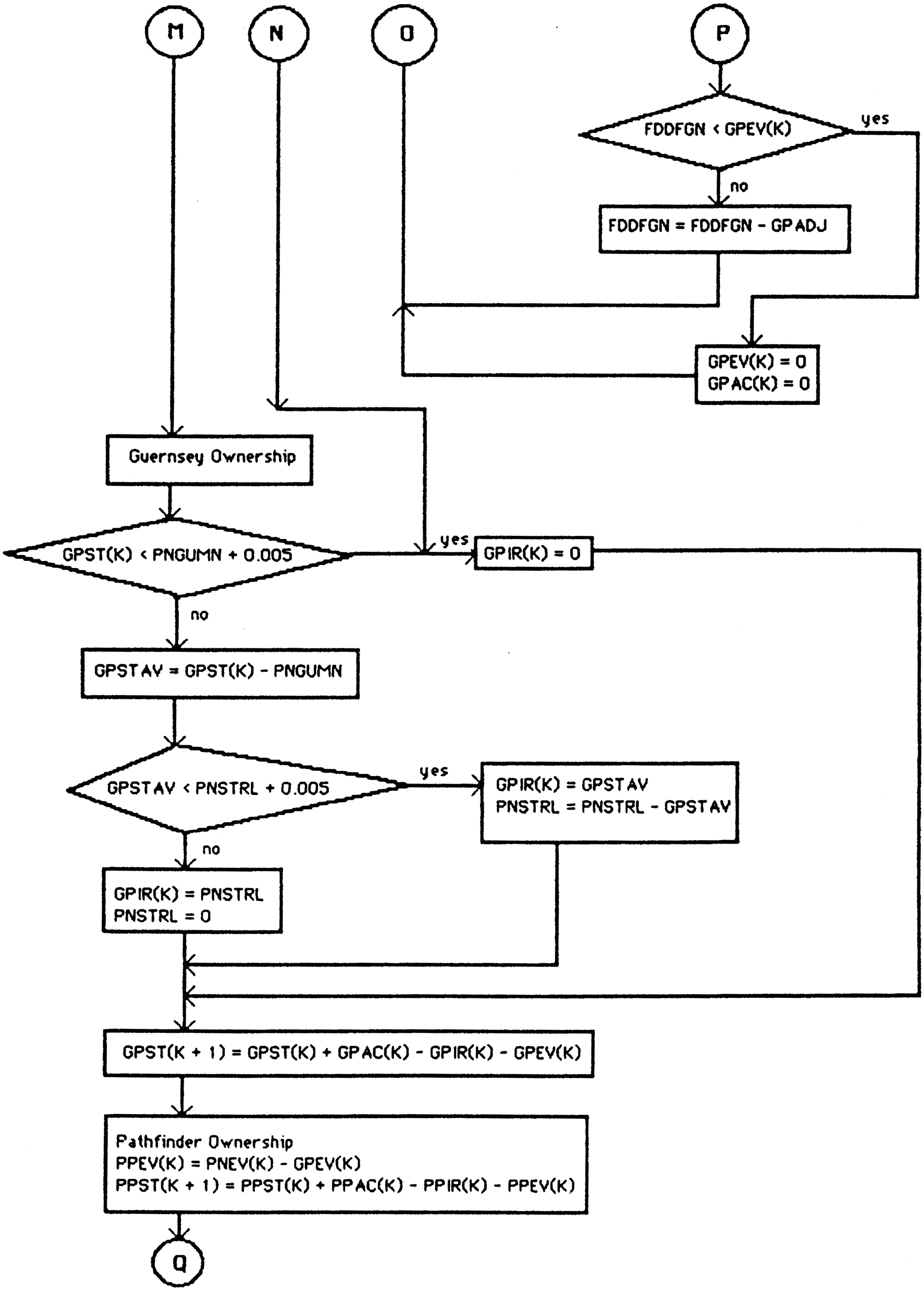

G
H
CALL STOACC (Kendrick)
DKSEAC(K) =0
DKSEAC(K) = DKAC(K)
TEMPXS = DKMXST - DKSEAC(K)
UPFREE < 0.001
yes
DKDFGN(K)
no
Kendrick Direct Flow
DKDFDM = AMIN1 (DKIR (K), DKSTLMT
CALL DIRCTF
Alcova Ownership
UPFREE < 0.001
yes
DKALAC(K)
no
CALL STOACC (Kendrick)
DKALAC(K) = DKAC(K)
Glendo Unit
REMFLOW = UPFREE + DNFREE
I

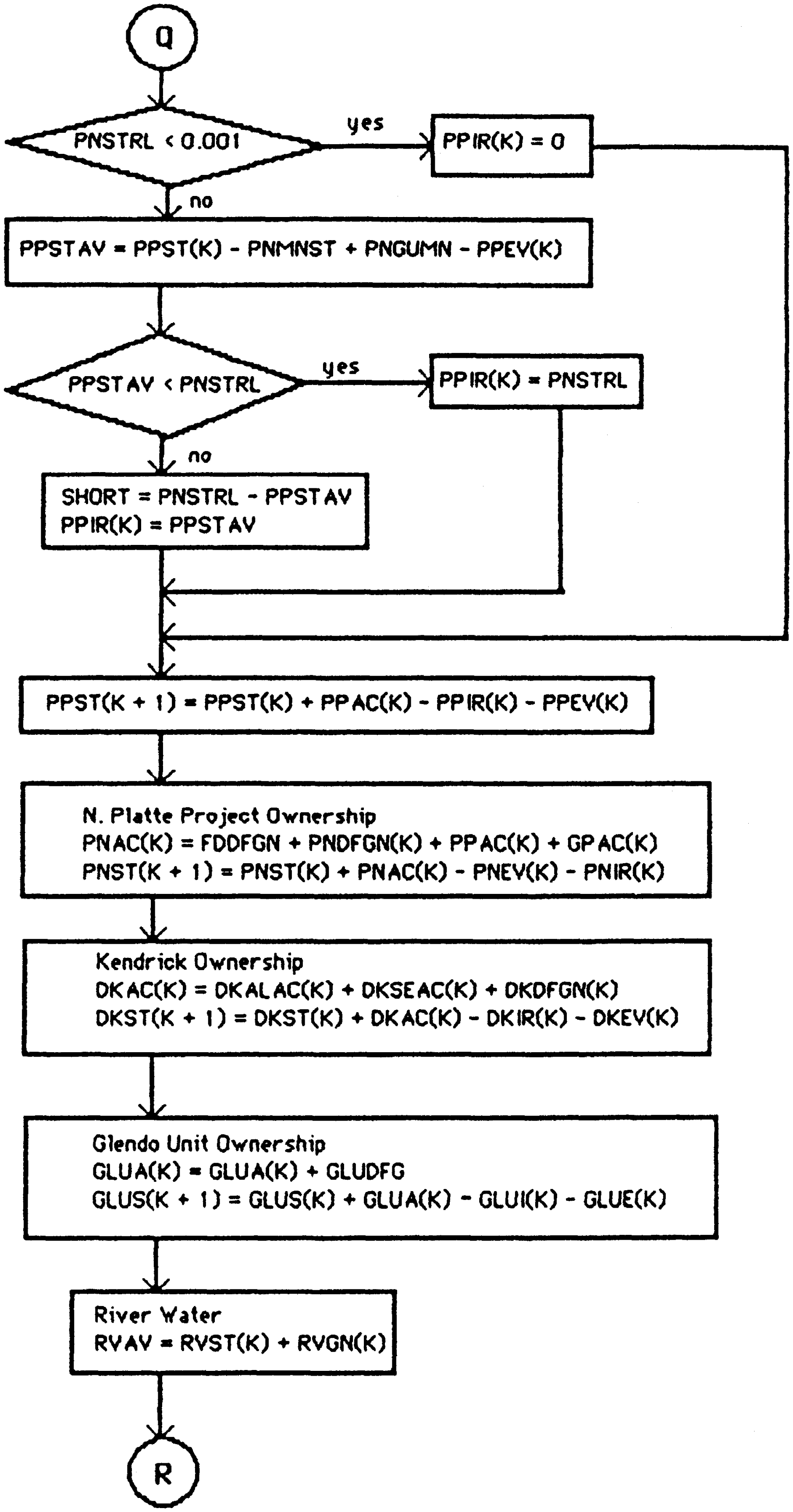

I
REMFLOW < 0.001
yes
no
SUN = GLUS(1)
DO 18 I = 1, KM1
SUN = SUN + GLUA(I) - GLUE(I)
SUN > GLUMXS - 0.004
yes
no
18
GLUSUM = SUM(GLUA, 1, KM1)
GLUSUM > GLUPSG - 0.005
yes
no
GLUA(K) = 0
GLNEED = GLUPSG - GLUSUM
STOAVE = GLUMXS - GLUS(K) + GLUE(K)
STOAVE < GLNEED
yes
GLNEED = STOAVE
no
GLNEED > DEMFLOW
yes
GLUA(K) = REMFLOW
REMFLOW = 0
no
GLUA(K) = GLNEED
REMFLOW = REMFLOW - GLUA(K)
J

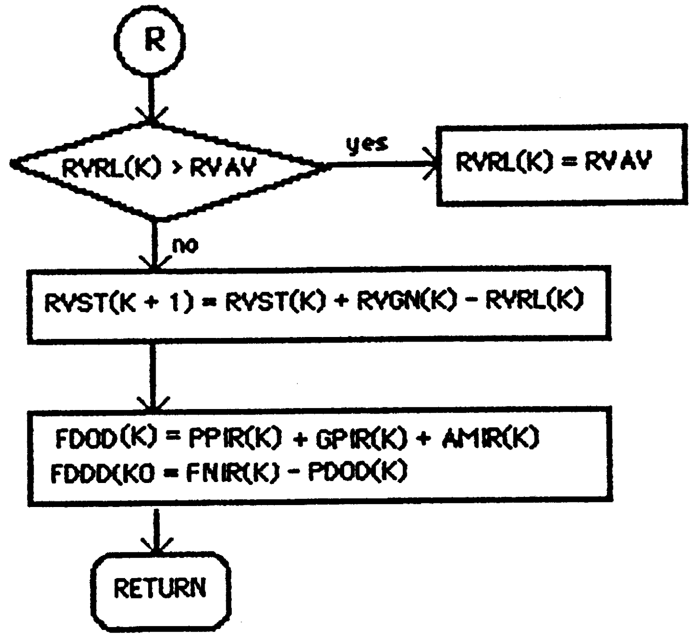

J
River Gain
REMFLOW < 0.001
yes
RVGN(K) = 0
no
RVGN(K) = REMFLOW
Amt. Released from Storage Computed
Here so that Proper Evaporation from Guernsey
maybe Subsequently Compued. Release Ownership
in Storage. N. Platte Project.
PNSTRL = PNIR(K) - FDDFGN - PNDFGN(K)
PNSTRL < 0.001
yes
no
Guernsey Ownership
GPST(K) < PNGUMN + 0.005
yes
GPIR(K) = 0
no
GPSTAV = GPST(K) - PNGUMN
GPSTAV < PNSTRL + 0.005
yes
GPIR(K) = GPSTAV
PNSTRL = PNSTRL - GPSTAV
no
GPIR(K) = PNSTRL
PNSTRL = 0
GPST(KH) = GPST(K) + GPST(K) + GPAC(K) - GPIR(K) - GPEV(K)
K


K
Compute Guernsey Evap.
GPST(K + 1) > PNGUMN
yes
GPST(K + 1) < GUMYST
yes
AVST = (GPST(K) + GPST(K + 1))/2
GPEV = 0
AVST = (GPST(K) + GUMXST)/2
GPADJ = GPEV(K) - GPAC(K)
GPEV(K) = AVST * GUCE(K, 1)/10000.+ GUCE(K, 2)/10
GPADJ < 0.001
yes
GPADJ = 0
no
GPADJ < 0
yes
GPADJ = 0
no
GPAC(K) = GPAC(K) + GPADJ
GPADJ < 0.005
yes
no
RVGN(K) < GPEV(K)
yes
no
RVGN(K) = RVGN(K) - GPADJ
PNSTRL = PNIR(K) - FDDFGN - PNDFGN(K)
PNSTRL < 0.001
yes
no
M
N
O
L

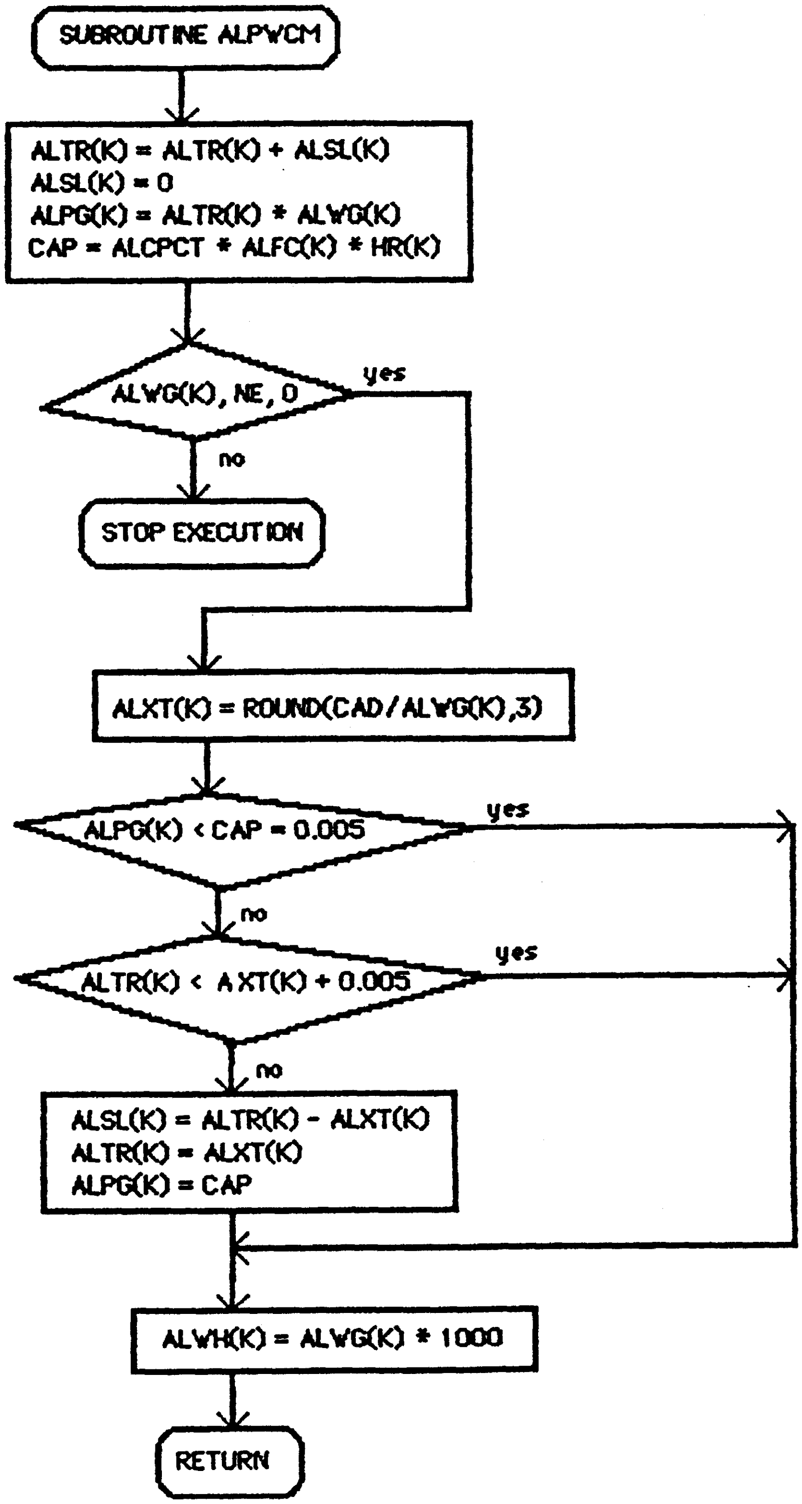

M
N
O
L
GLUA(K) <GPEV(K)
yes
no
GLUA(K) = GLUA(K) - GPADJ
DKSEAC(K) + DKALAC(K) + DKDFGN(K) < GPEV(K)
yes
no
DKSEAC(K) = DKSEAC(K) - GPADJ
DKSEAC(K) > 0
yes
no
DKDFGN(K) = DKDFGN(K) + DKSEAC(K)
DKSEAC(K) = 0
PPAC(K) < GPEV(K)
yes
no
PPAC(K) = PPAC(K) - GPADJ
PNDFGN(K) < GPEV
yes
no
PNDFGN(K) = PNDFGN(K) - GPADJ
M
N
O
P


M
N
O
P
FDDFGN < GPEV(K)
yes
no
FDDFGN = FDDFGN - GPADJ
GPEV(K) = 0
GPAC(K) = 0
Guernsey Ownership
GPST(K) < PNGUMN + 0.005
yes
GPIR(K) = 0
no
GPSTAV = GPST(K) - PNGUMN
GPSTAV < PNSTRL + 0.005
yes
GPIR(K) = GPSTAV
PNSTRL = PNSTRL - GPSTAV
no
GPIR(K) = PNSTRL
PNSTRL = 0
GPST(K + 1) = GPST(K) + GPAC(K) - GPIR(K) - GPEV(K)
Pathfinder Ownership
PPEV(K) = PNEV(K) - GPEV(K)
PPST(K + 1) = PPST(K) + PPAC(K) - PPIR(K) - PPEV(K)
Q

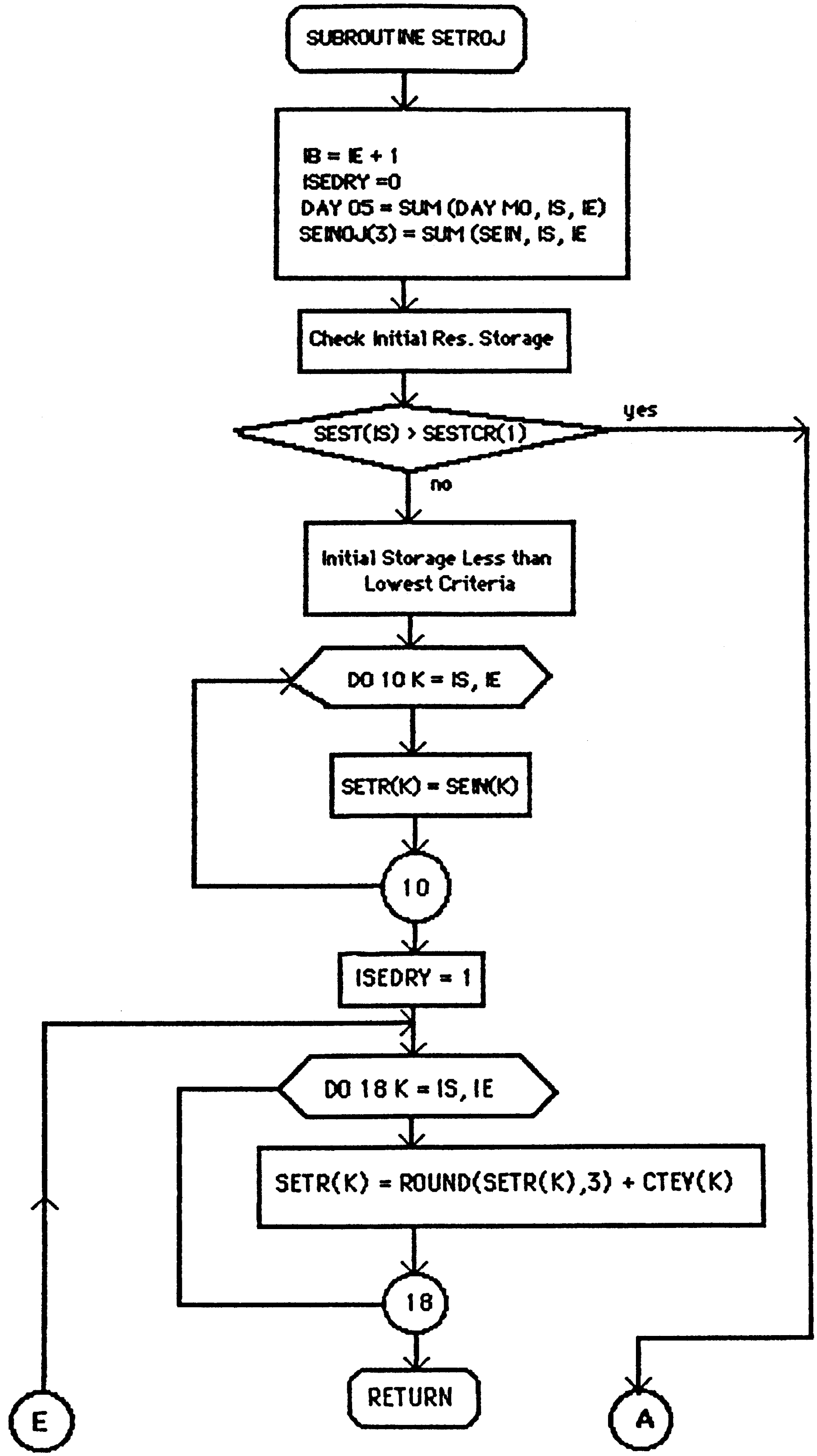

Q
PNSTRL < 0.001
yes
PPIR(K) = 0
no
PPSTAV = PPST(K) - PNMNST + PNGUMN - PPEV(K)
PPSTAV < PNSTRL
yes
PPIR(K) = PNSTRL
no
SHORT = PNSTRL - PPSTAV
PPIR(K) = PPSTAV
PPST(K + 1) = PPST(K) + PPAC(K) - PPIR(K) - PPEV(K)
N. Platte Project Ownership
PNAC(K) = FDDFGN + PNDFGN(K) + PPAC(K) + GPAC(K)
PNST(K + 1) = PNST(K) + PNAC(K) - PNEV(K) - PNIR(K)
Kendrick Ownership
DKAC(K) = DKALAC(K) + DKSEAC(K) + DKDFGN(K)
DKST(K + 1) = DKST(K) + DKAC(K) - DKIR(K) - DKEV(K)
Glendo Unit Ownership
GLUA(K) = GLUA(K) + GLUDFG
GLUS(K + 1) = GLUS(K) + GLUA(K) - GLUI(K) - GLUE(K)
River Water
RVAV = RVST(K) + RVGN(K)
R

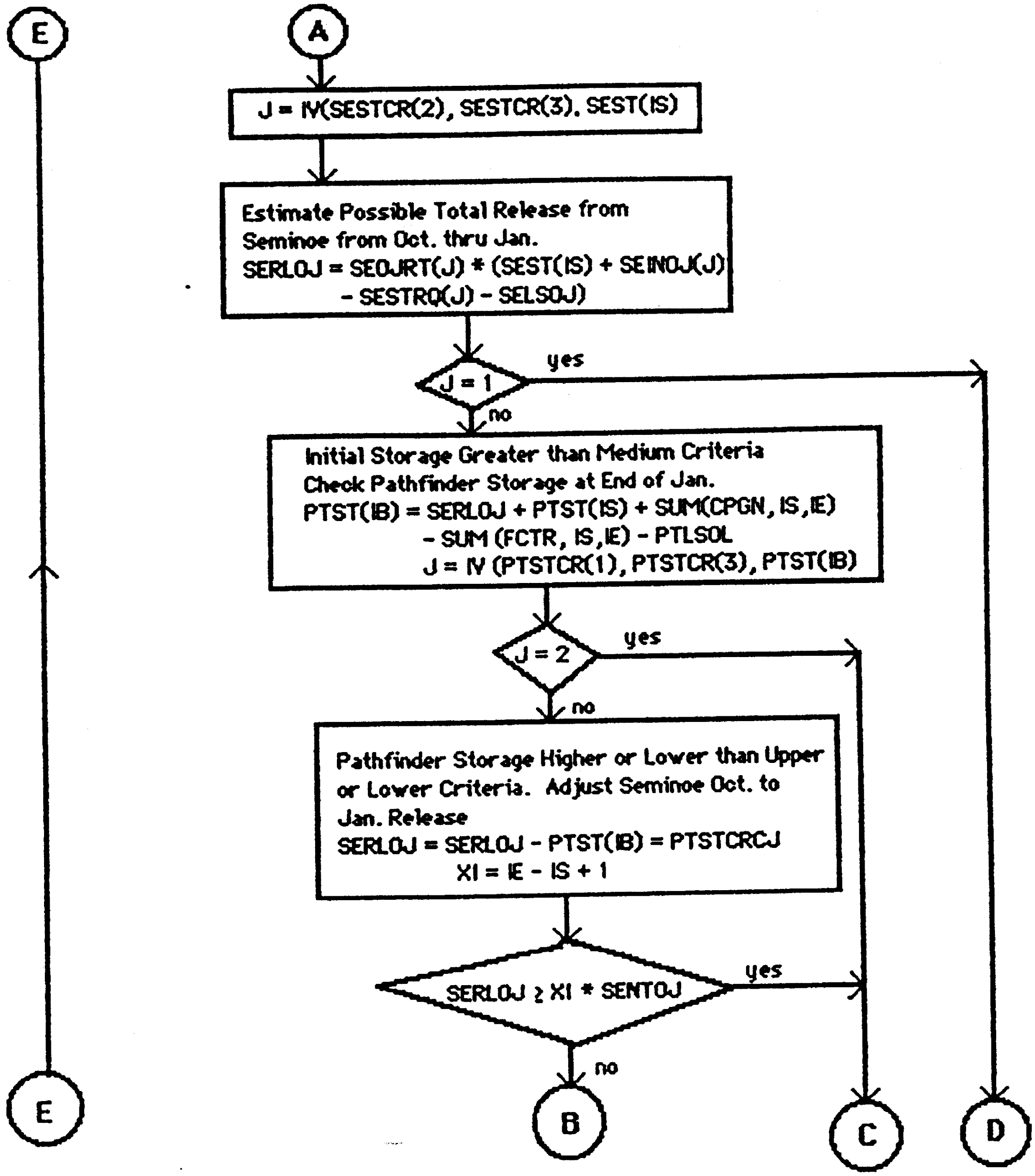

R
RVRL(K) > RVAV
yes
RVRL(K) = RVAV
no
RVST(K + 1) = RVST(K) + RVGN(K) - RVRL(K)
FDOD(K) = PPIR(K) + GPIR(K) + AMIR(K)
FDDD(KO = FNIR(K) - PDOD(K)
RETURN

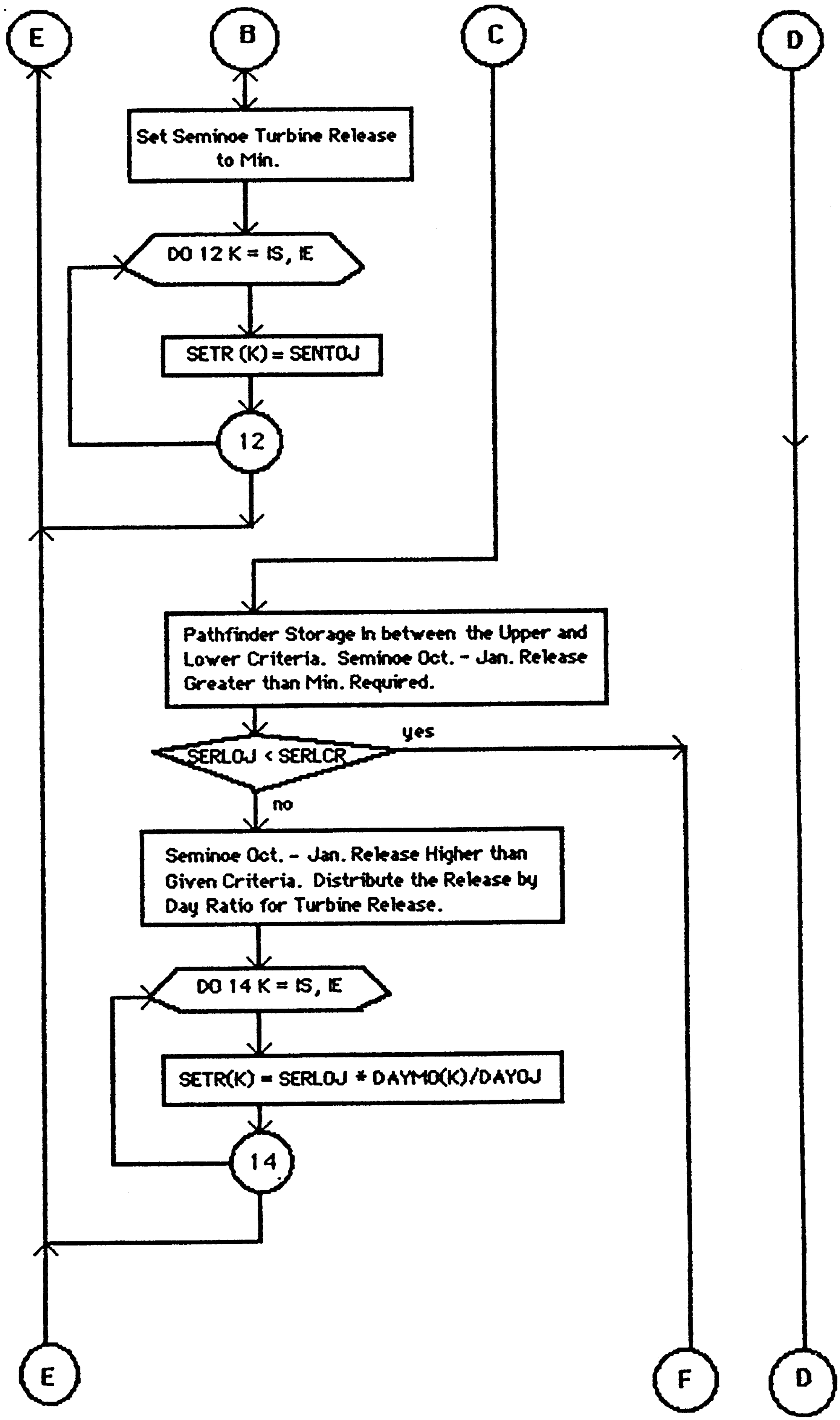
Descrition: Compute Alcova Power Generation and Assign Exess Water to Spill.

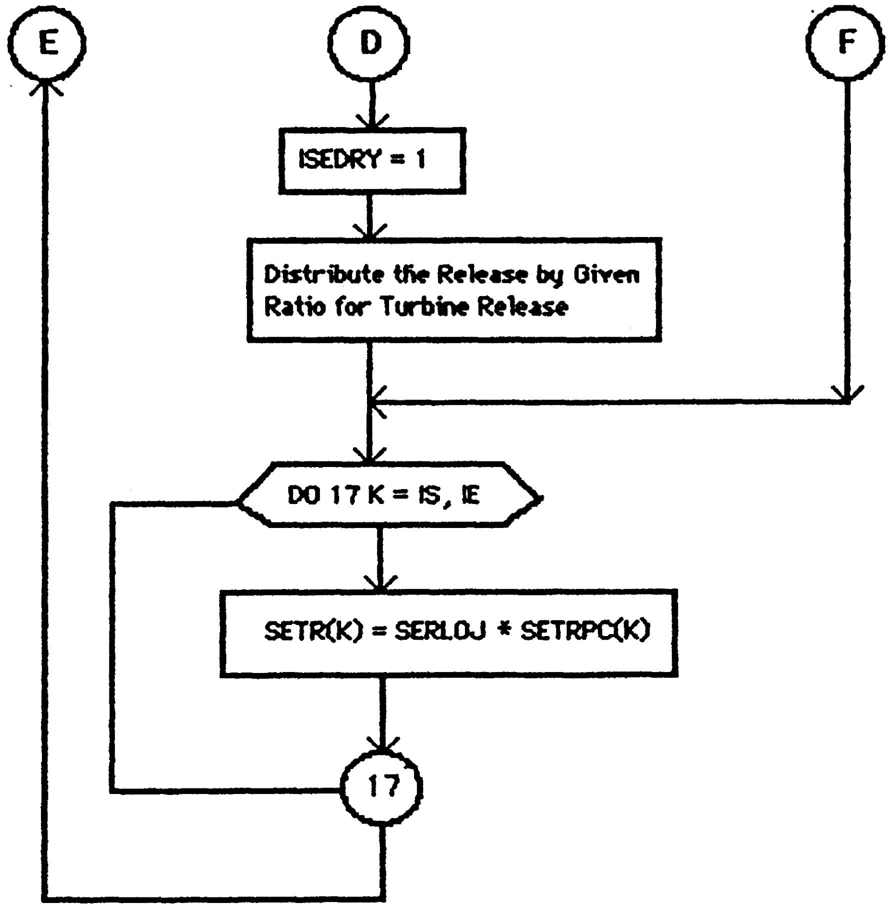


Description: Primary Estimation of Turbine Release for Seminoe in Oct. thru Jan. According to Seminoe Storage at the End of Jan.



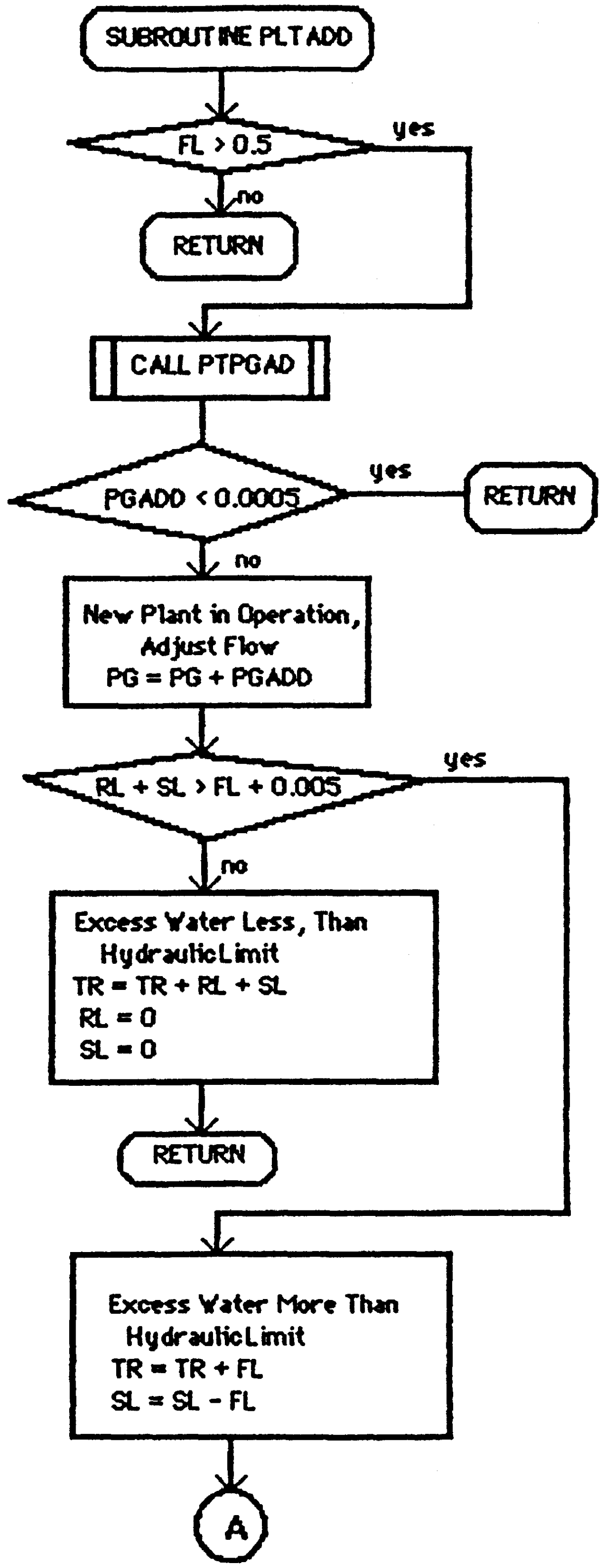

E
A
J = IV(SESTCR(2), SESTCR(3), SEST(IS)
Estimate Possible Total Release from
Seminoe from Oct. thru Jan.
SERLOJ = SEOJRT(J) * (SEST(IS) + SEINOJ(J)
- SESTRQ(J) - SELSOJ)
yes
J = 1
no
Initial Storage Greater than Medium Criteria
Check Pathfinder Storage at End of Jan.
PTST(IB) = SERLOJ + PTST(IS) + SUM(CPGN, IS, IE)
- SUM (FCTR, IS, IE) - PTLSOL
J = IV (PTSTCR(1), PTSTCR(3), PTST(IB)
yes
J = 2
no
Pathfinder Storage Higher or Lower than Upper
or Lower Criteria. Adjust Seminoe Oct. to
Jan. Release
SERLOJ = SERLOJ - PTST(IB) = PTSTCRCJ
XI = IE - IS + 1
yes
SERLOJ ≥ XI * SENTOJ
no
E
B
C
D

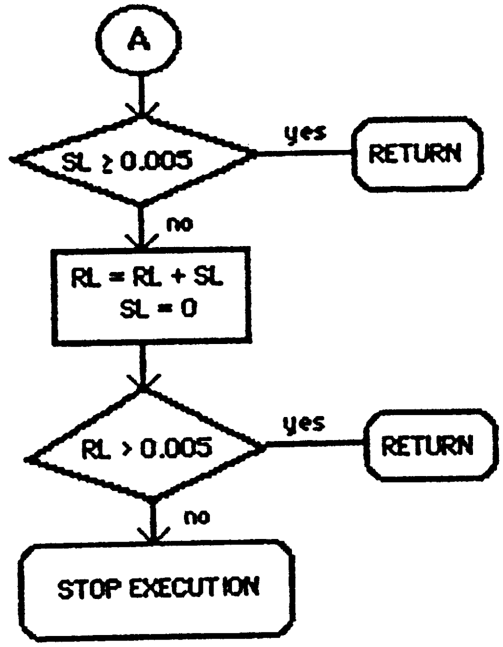

E
B
C
D
Set Seminoe Turbine Release to Min.
DO 12 K = IS, IE
SETR (K) = SENTOJ
12
Pathfinder Storage in between the Upper and Lower Criteria. Seminoe Oct. - Jan. Release Greater than Min. Required.
SERLOJ < SERLCR
yes
no
Seminoe Oct. - Jan. Release Higher than Given Criteria. Distribute the Release by Day Ratio for Turbine Release.
DO 14 K = IS, IE
SETR(K) = SERLOJ * DAYMO(K)/DAYOJ
14
E
F
D



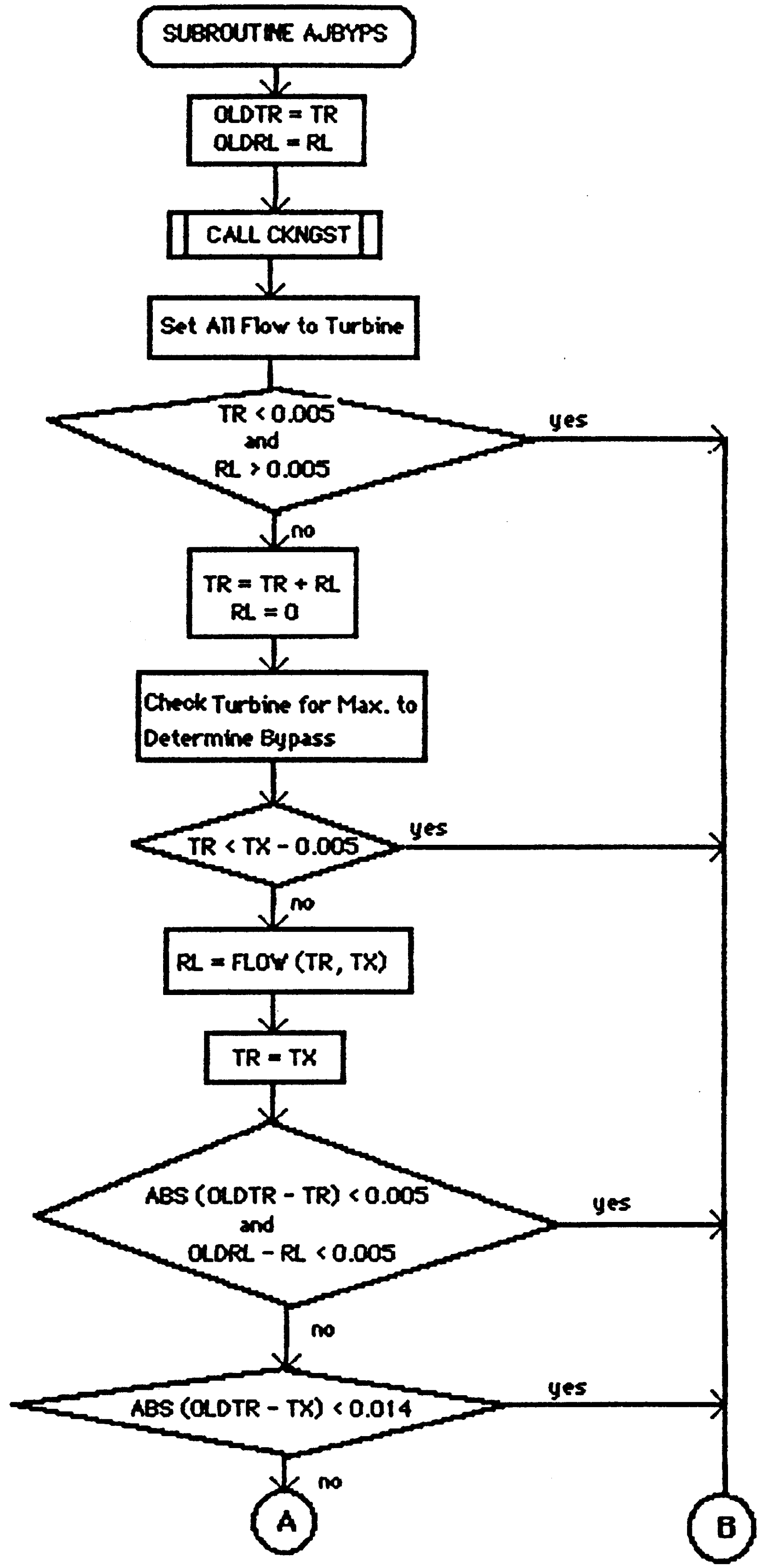
E
D
F
ISEDRY = 1
Distribute the Release by Given Ratio for Turbine Release
DO 17 K = IS, IE
SETR(K) = SERLOJ * SETRPC(K)
17

Description: New Power Plant Added Below Glendo and Guernsey Dam Assumed when Bypass and Spill Water are Used for the New Plant. Max. Hydraulic Capacity of the Plant is Minimum Flow of Glendo or Guernsey Whichever is Available.



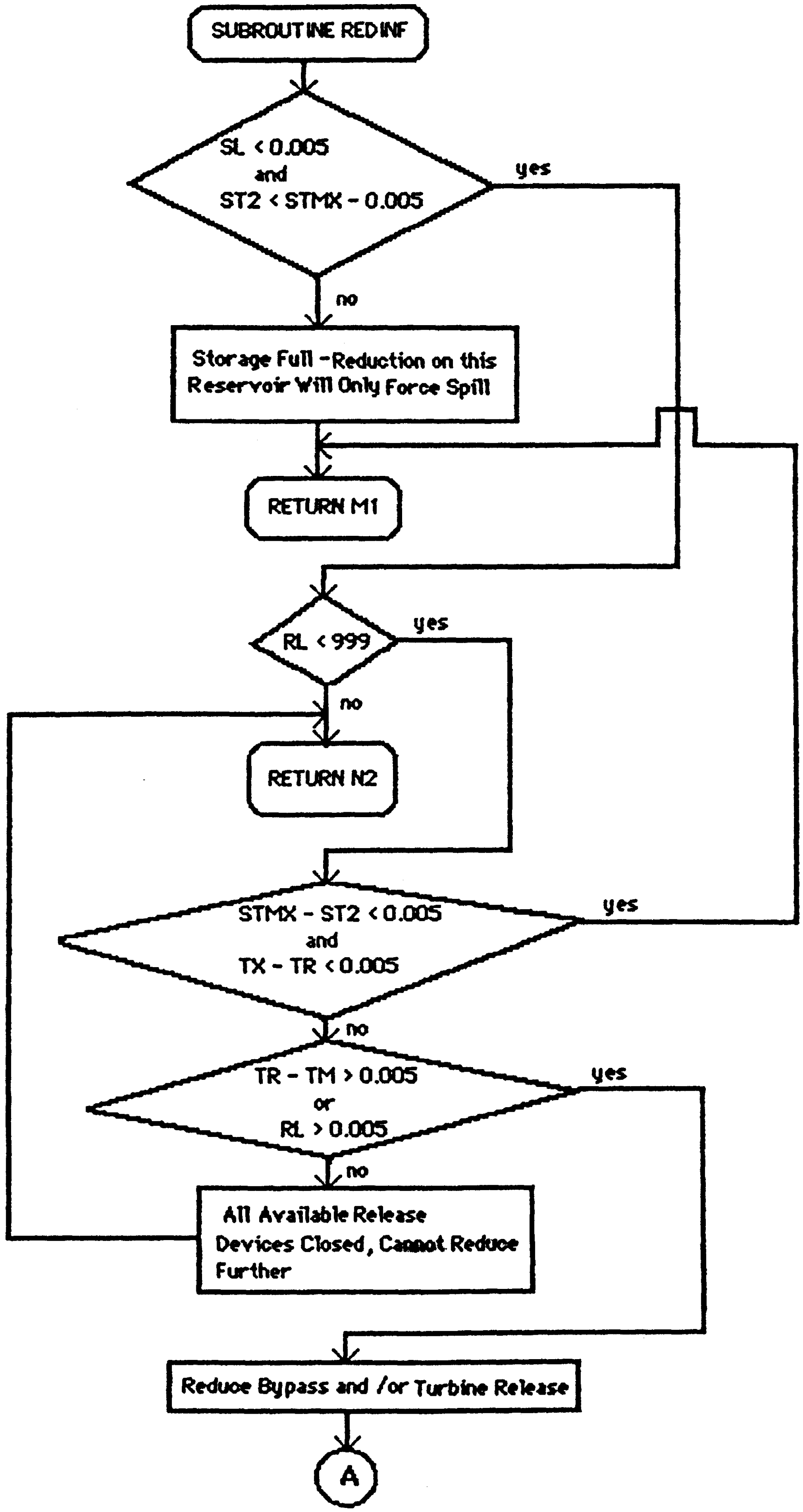

A
SL ≥ 0.005
yes
RETURN
no
RL = RL + SL
SL = 0
RL > 0.005
yes
RETURN
no
STOP EXECUTION

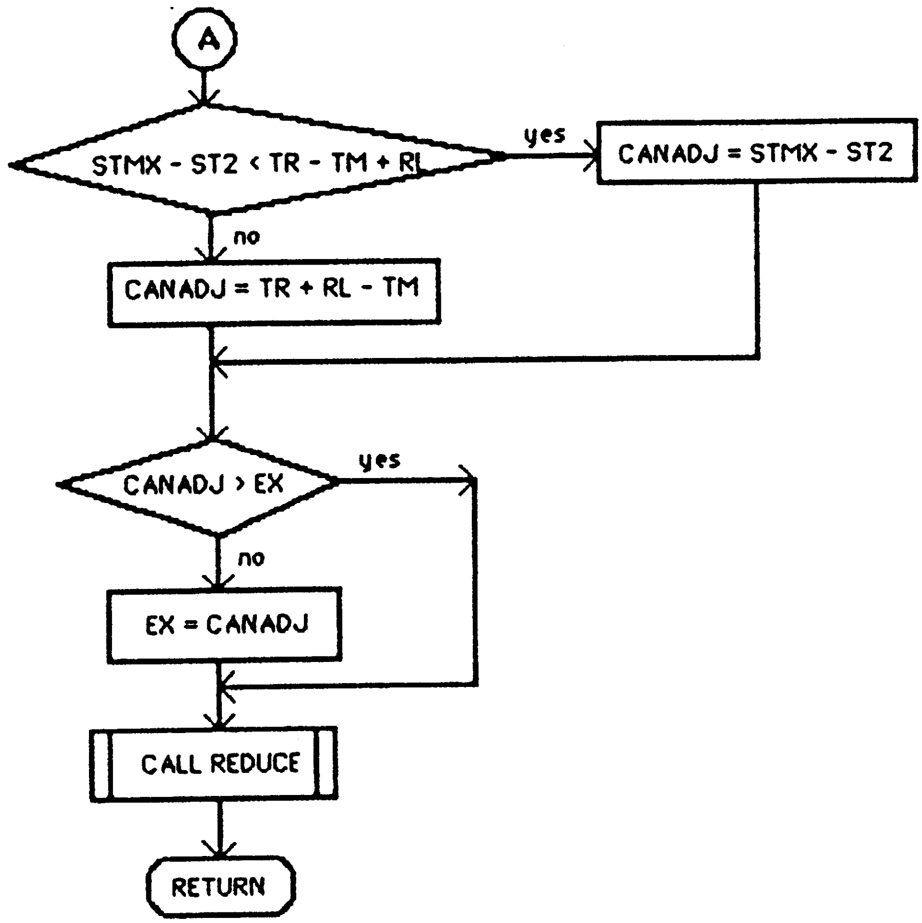
Description: Ensure Water Goes Through Turbine Up to Capacity Before Bypass Release.



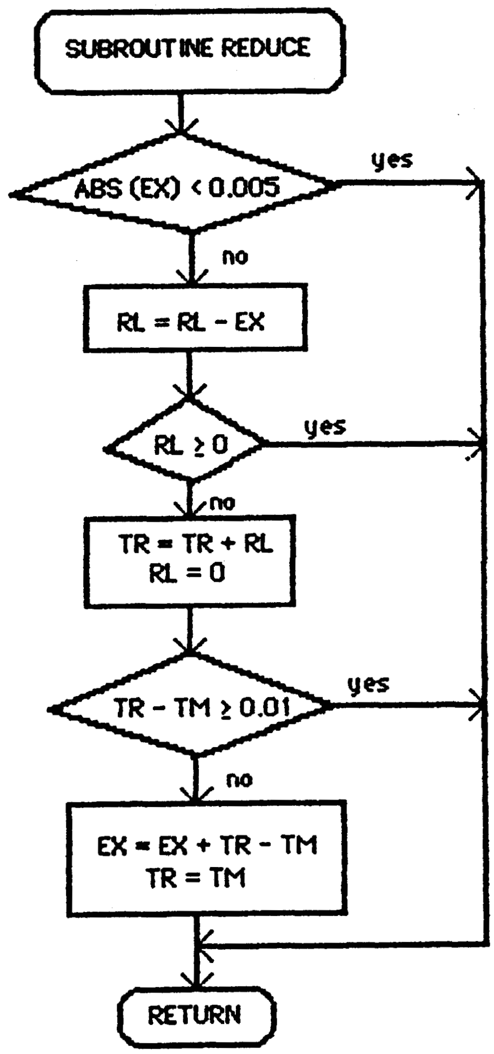

A
RETURN M1
B
RETURN

Description: Reduce the Outflow of Upstream Reservoir to Maintain the Storage of Computing Reservoir at a Desired Level.

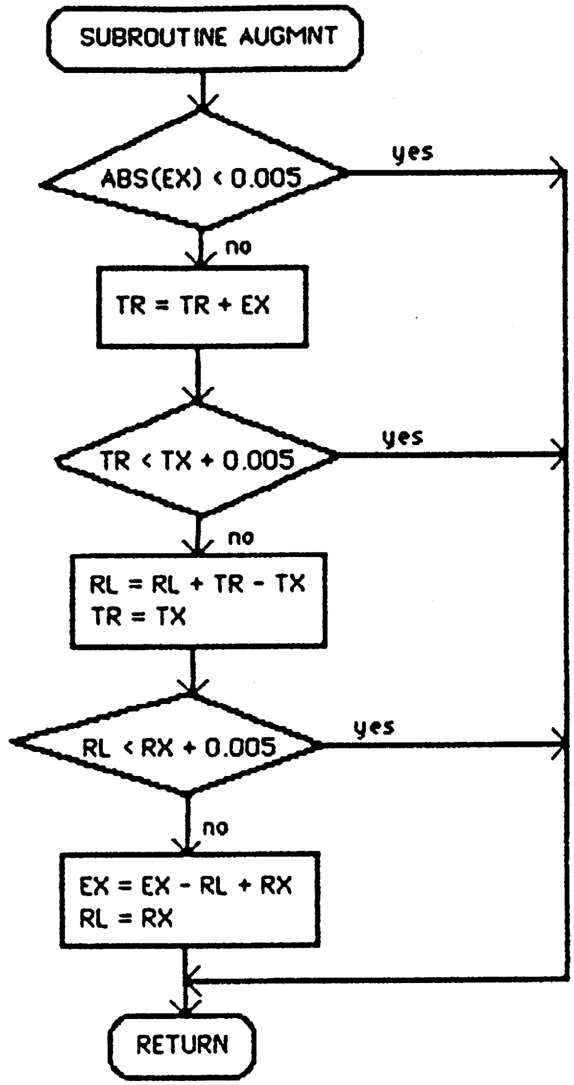



A
STMX - ST2 < TR - TM + RL
yes
CANADJ = STMX - ST2
no
CANADJ = TR + RL - TM
CANADJ > EX
yes
no
EX = CANADJ
CALL REDUCE
RETURN

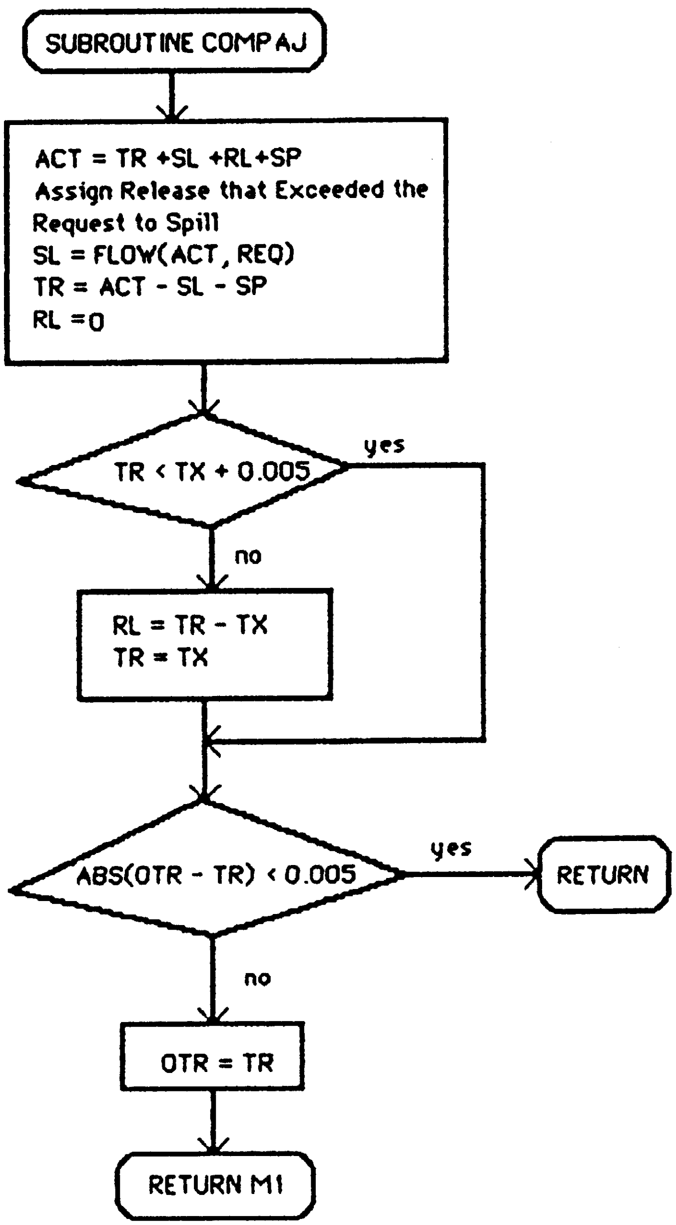
Description: Reduce the Amount of Excess From Bypass (RL) and Turbine Release (TR).



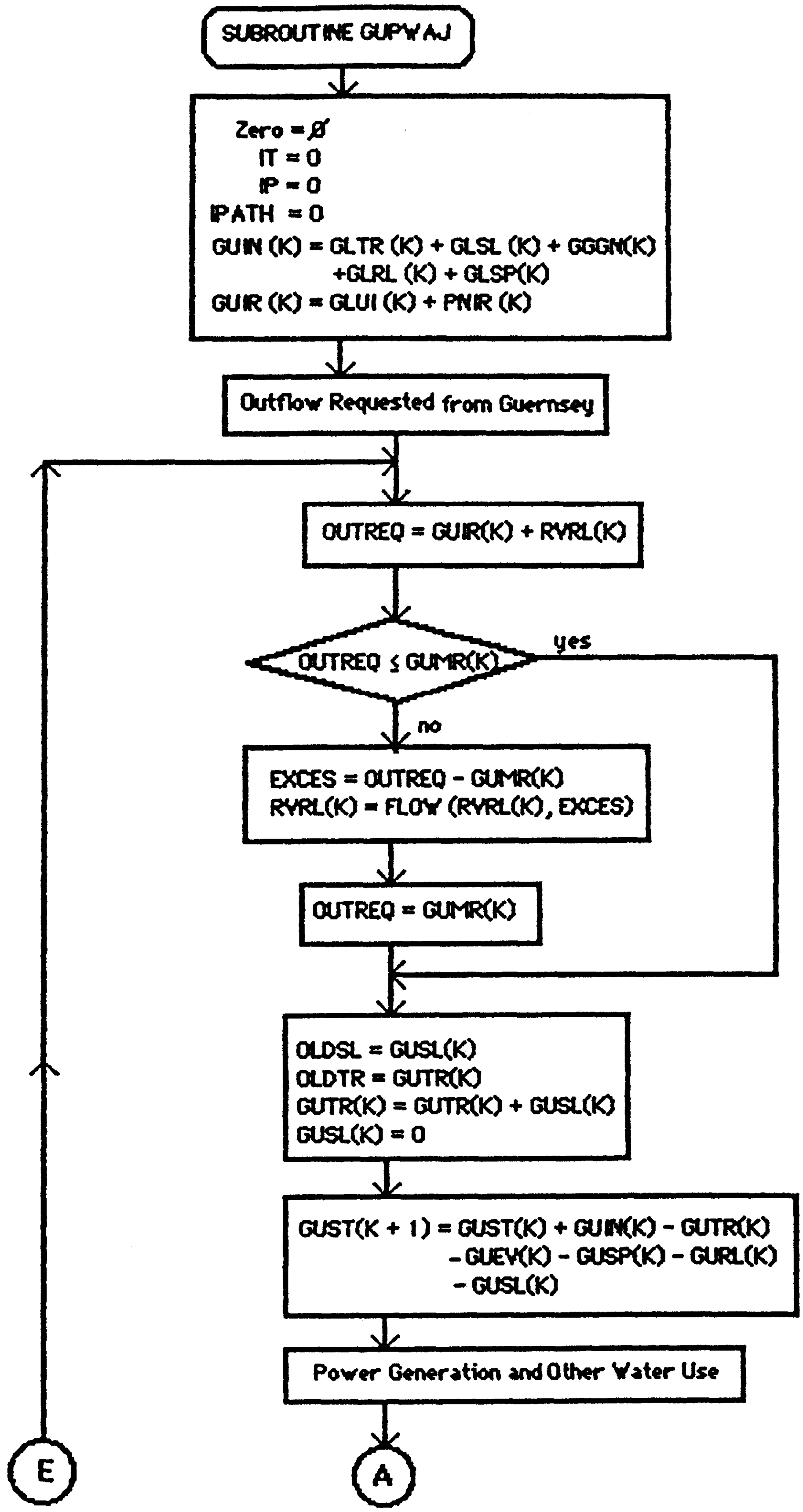
Description: Increase the Amount of Excess in Turbine (TR) and Bypass (RL)

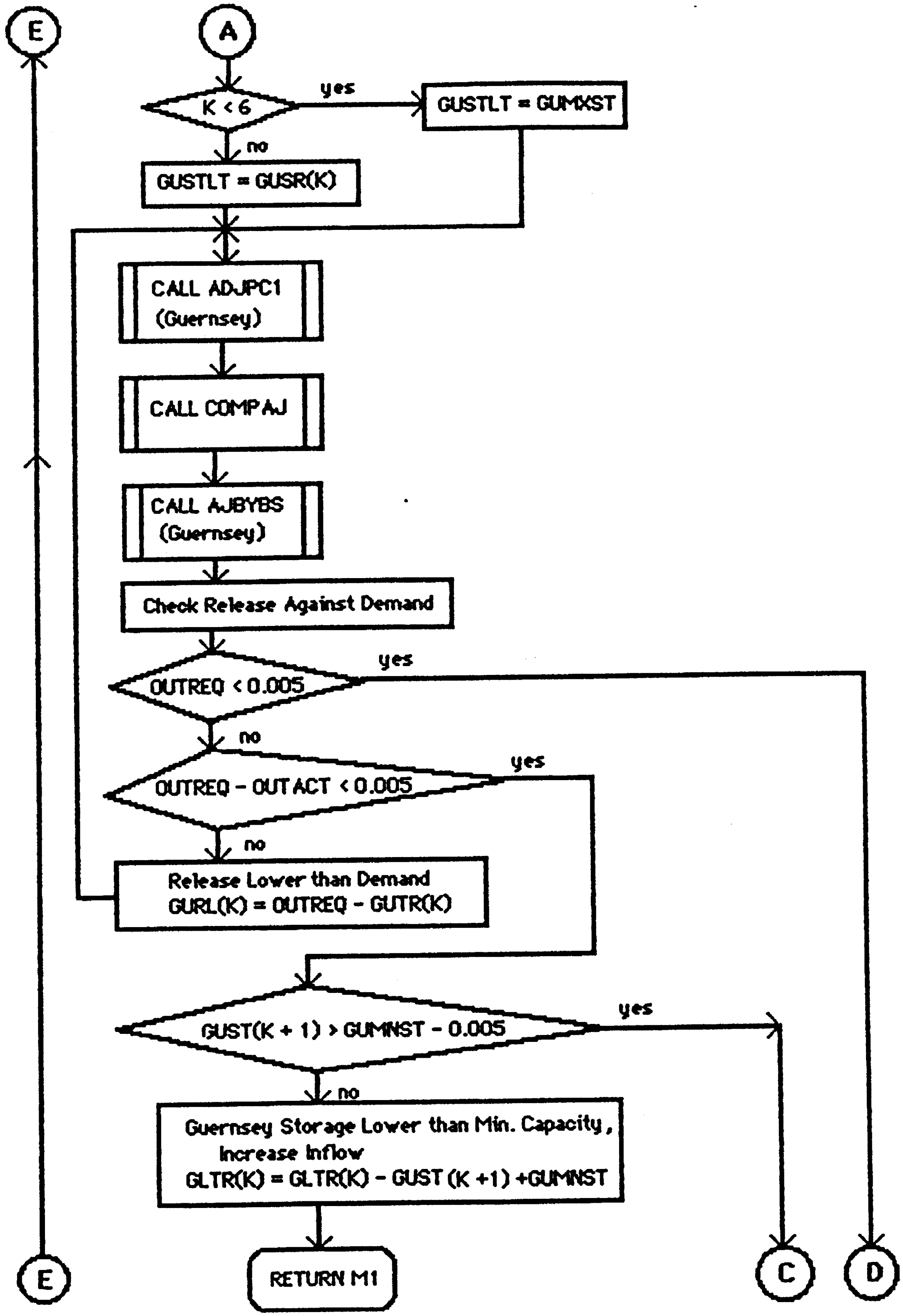


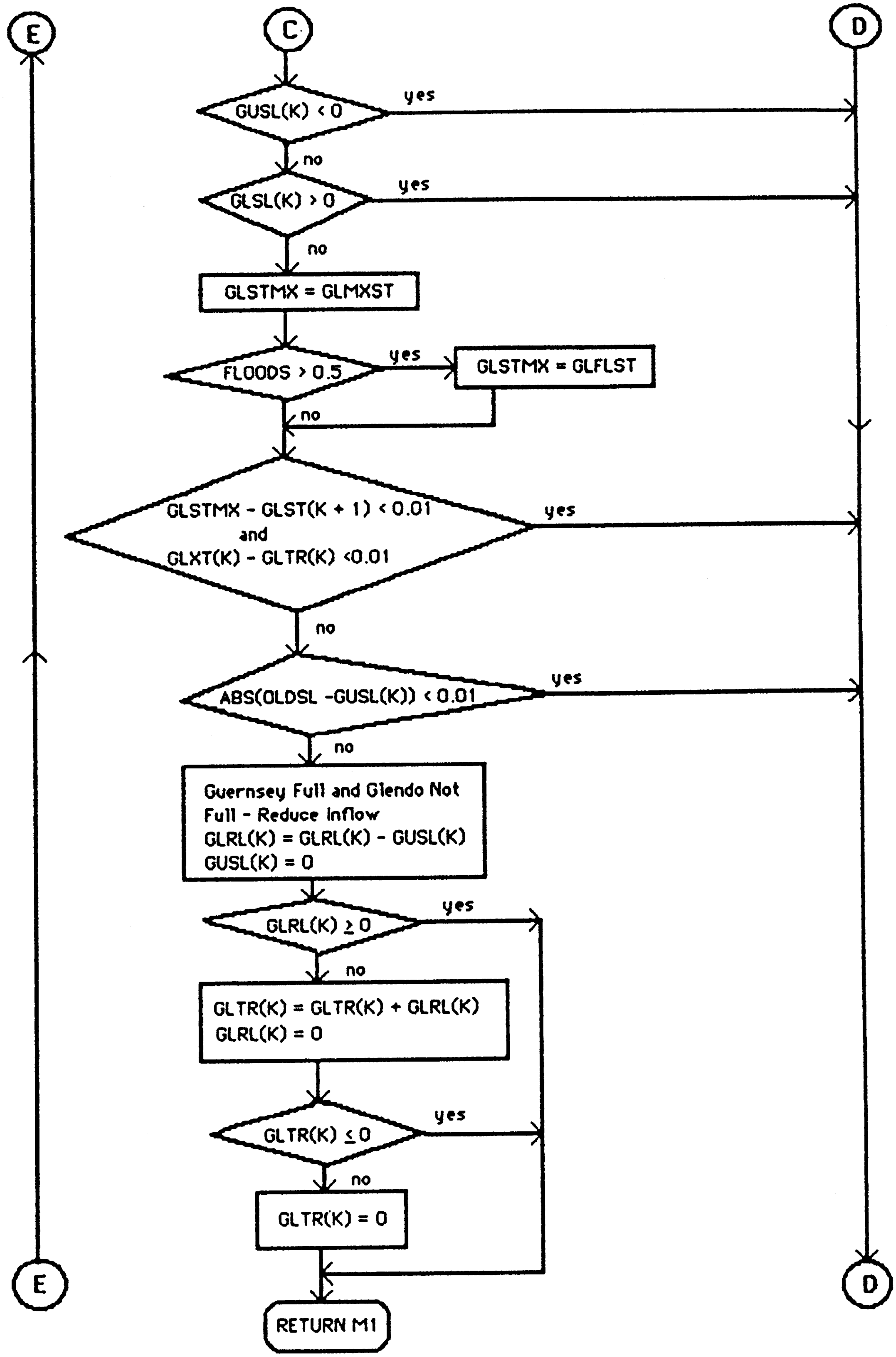
Description: Assign Release Water to Proper Component.

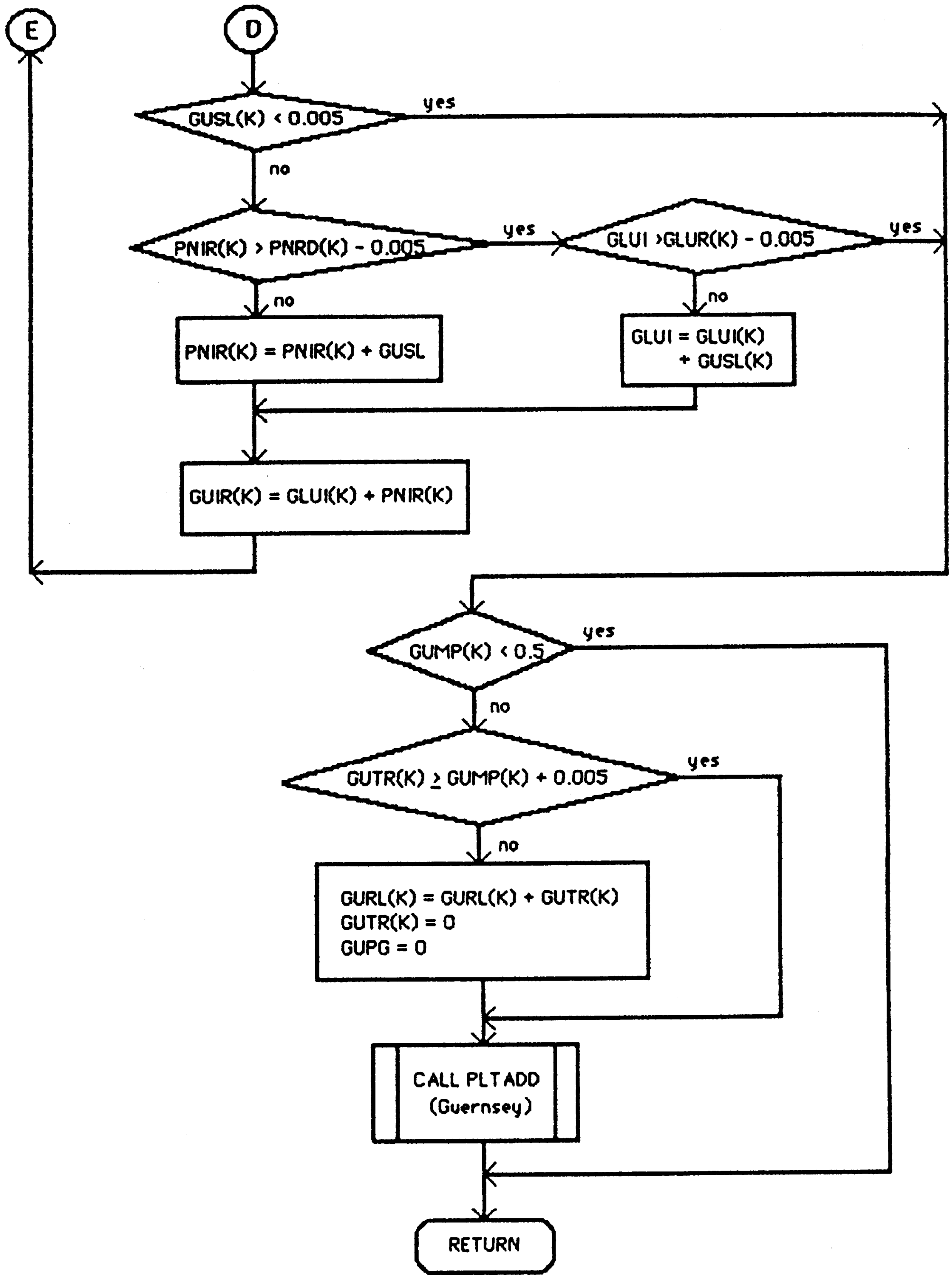


Descprition: Computation of Inflow, Storage, Water Use and Power Generation in Guernsey and Adjustment of Glendo Turbine Release.

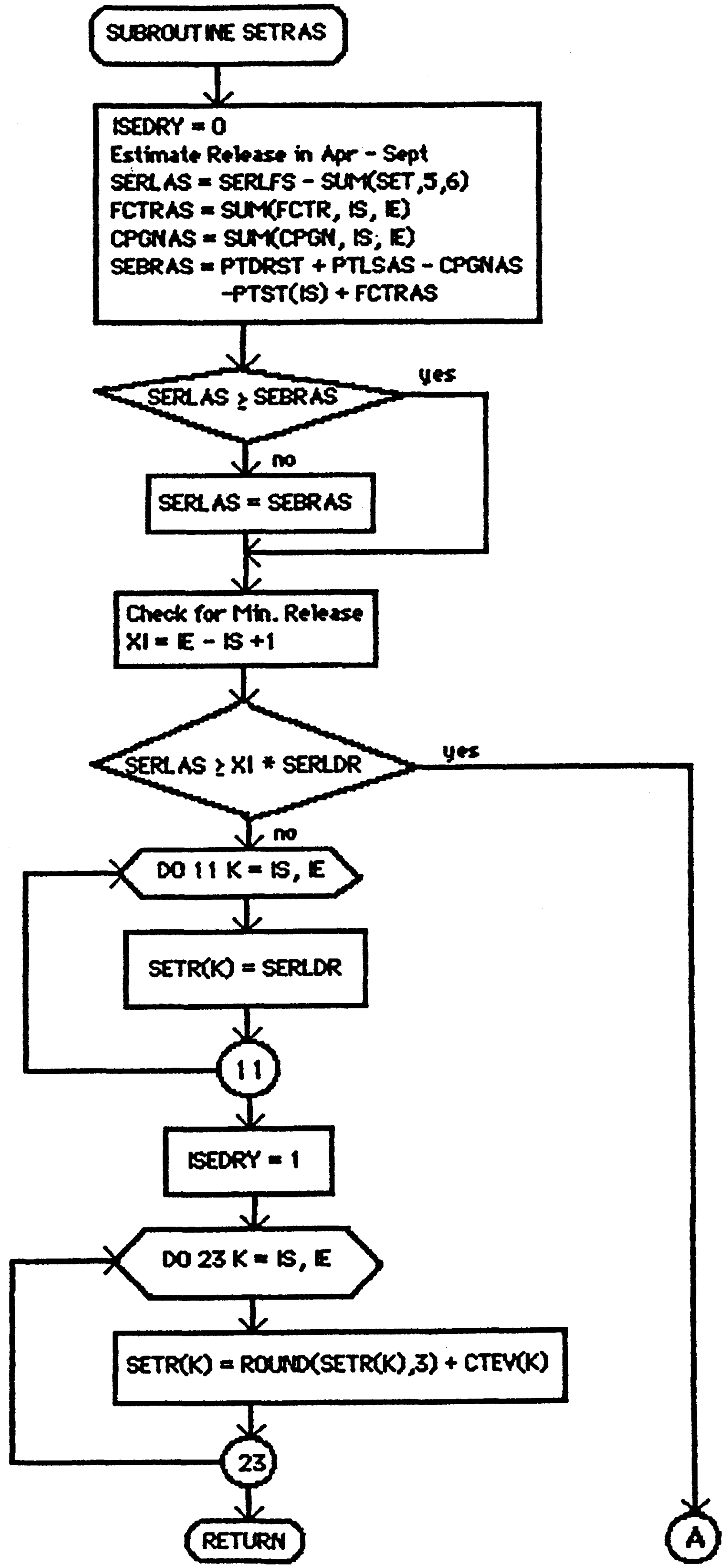


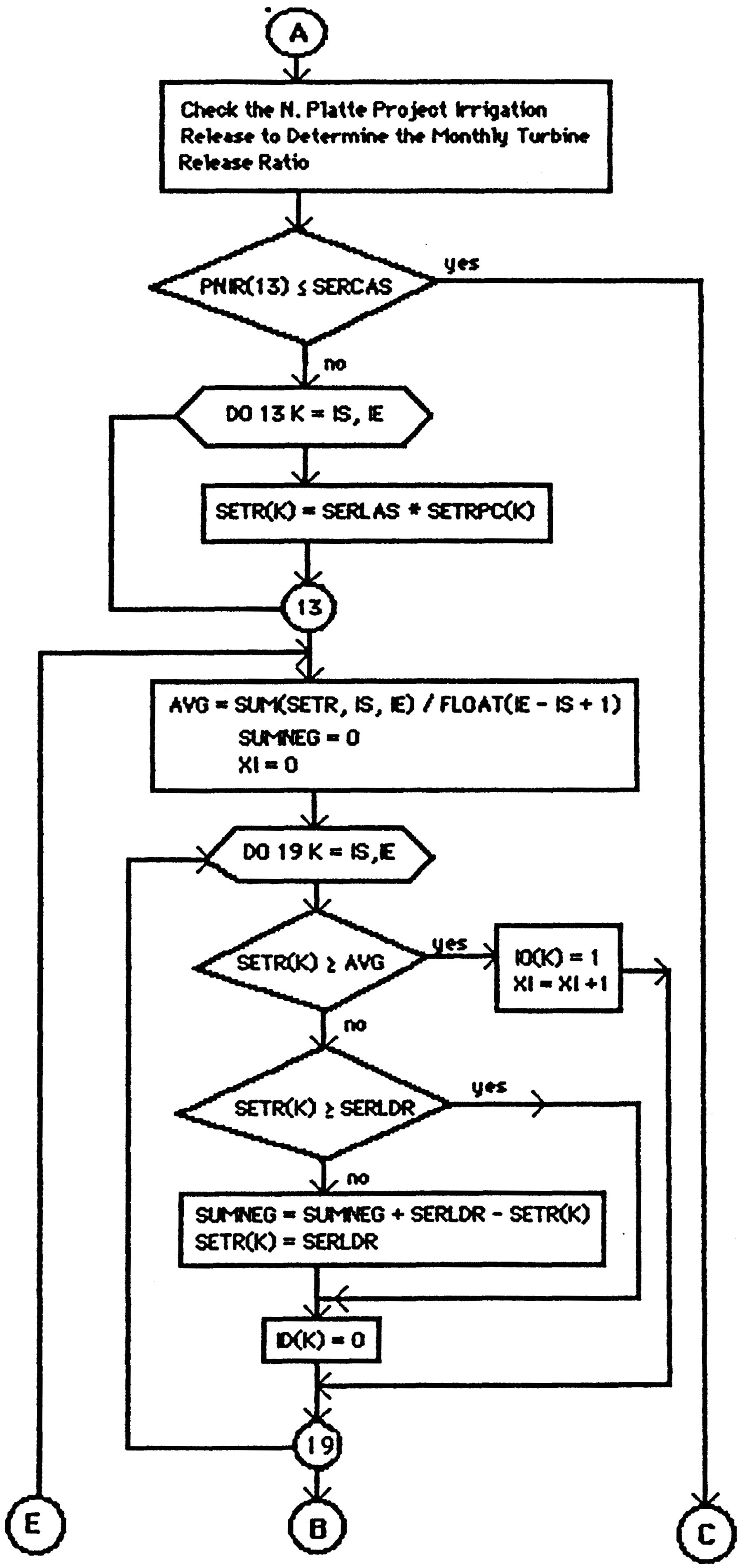

E
A
K < 6
yes
GUSTLT = GUMXST
no
GUSTLT = GUSR(K)
CALL ADJPC1 (Guernsey)
CALL COMPAJ
CALL AJBYBS (Guernsey)
Check Release Against Demand
OUTREQ < 0.005
yes
no
OUTREQ - OUTACT < 0.005
yes
no
Release Lower than Demand
GURL(K) = OUTREQ - GUTR(K)
GUST(K + 1) > GUMNST - 0.005
yes
no
Guernsey Storage Lower than Min. Capacity, Increase Inflow
GLTR(K) = GLTR(K) - GUST (K +1) +GUMNST
E
RETURN M1
C
D

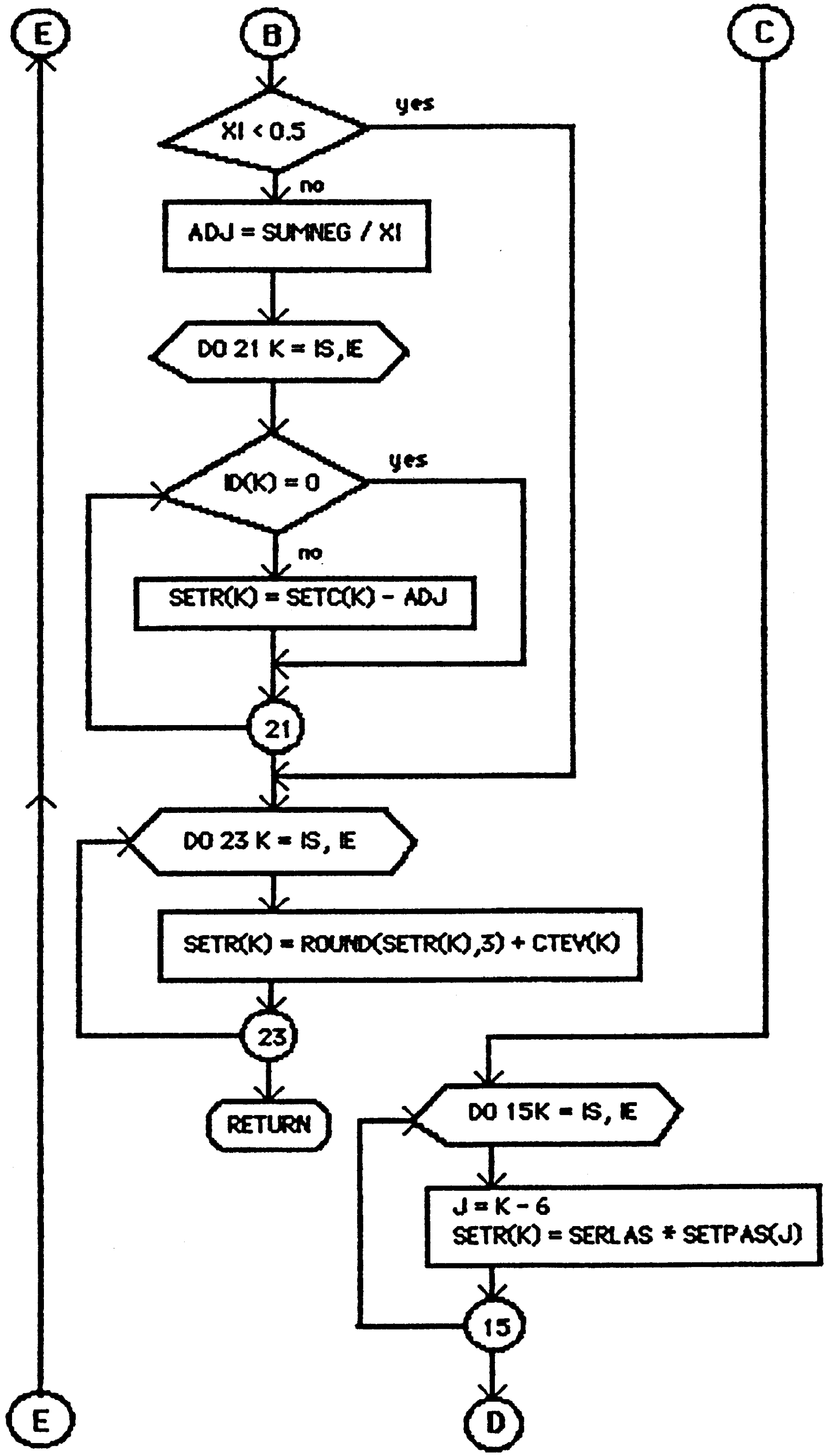

E
C
D
GUSL(K) < 0
yes
no
GLSL(K) > 0
yes
no
GLSTMX = GLMXST
FLOODS > 0.5
yes
GLSTMX = GLFLST
no
GLSTMX - GLST(K + 1) < 0.01
and
GLXT(K) - GLTR(K) <0.01
yes
no
ABS(OLDSL -GUSL(K)) < 0.01
yes
no
Guernsey Full and Glendo Not
Full - Reduce Inflow
GLRL(K) = GLRL(K) - GUSL(K)
GUSL(K) = 0
GLRL(K) ≥ 0
yes
no
GLTR(K) = GLTR(K) + GLRL(K)
GLRL(K) = 0
GLTR(K) ≤ 0
yes
no
GLTR(K) = 0
E
D
RETURN M1

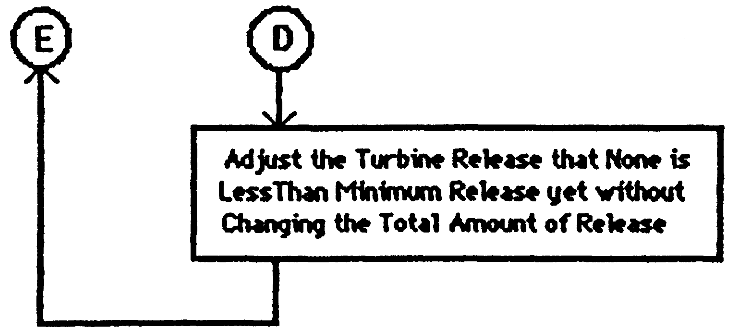

E
D
GUSL(K) < 0.005
yes
no
PNIR(K) > PNRD(K) - 0.005
yes
GLUI >GLUR(K) - 0.005
yes
no
no
PNIR(K) = PNIR(K) + GUSL
GLUI = GLUI(K)
+ GUSL(K)
GUIR(K) = GLUI(K) + PNIR(K)
GUMP(K) < 0.5
yes
no
GUTR(K) ≥ GUMP(K) + 0.005
yes
no
GURL(K) = GURL(K) + GUTR(K)
GUTR(K) = 0
GUPG = 0
CALL PLTADD
(Guernsey)
RETURN

Description: Primary Estimation of Turbine Release for Seminoe in Apr to Sept According to Estimated Available to be Released in this Period.

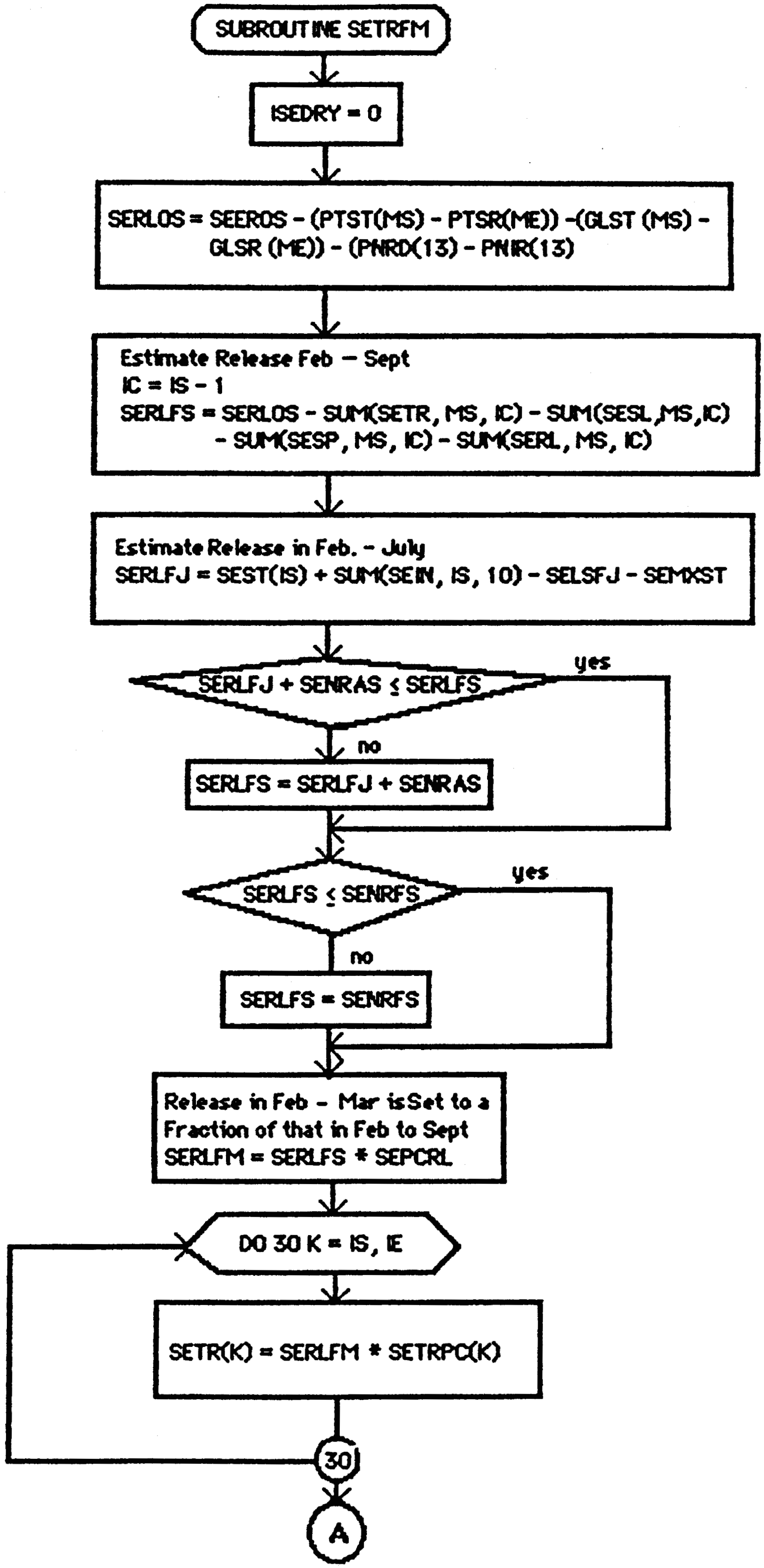


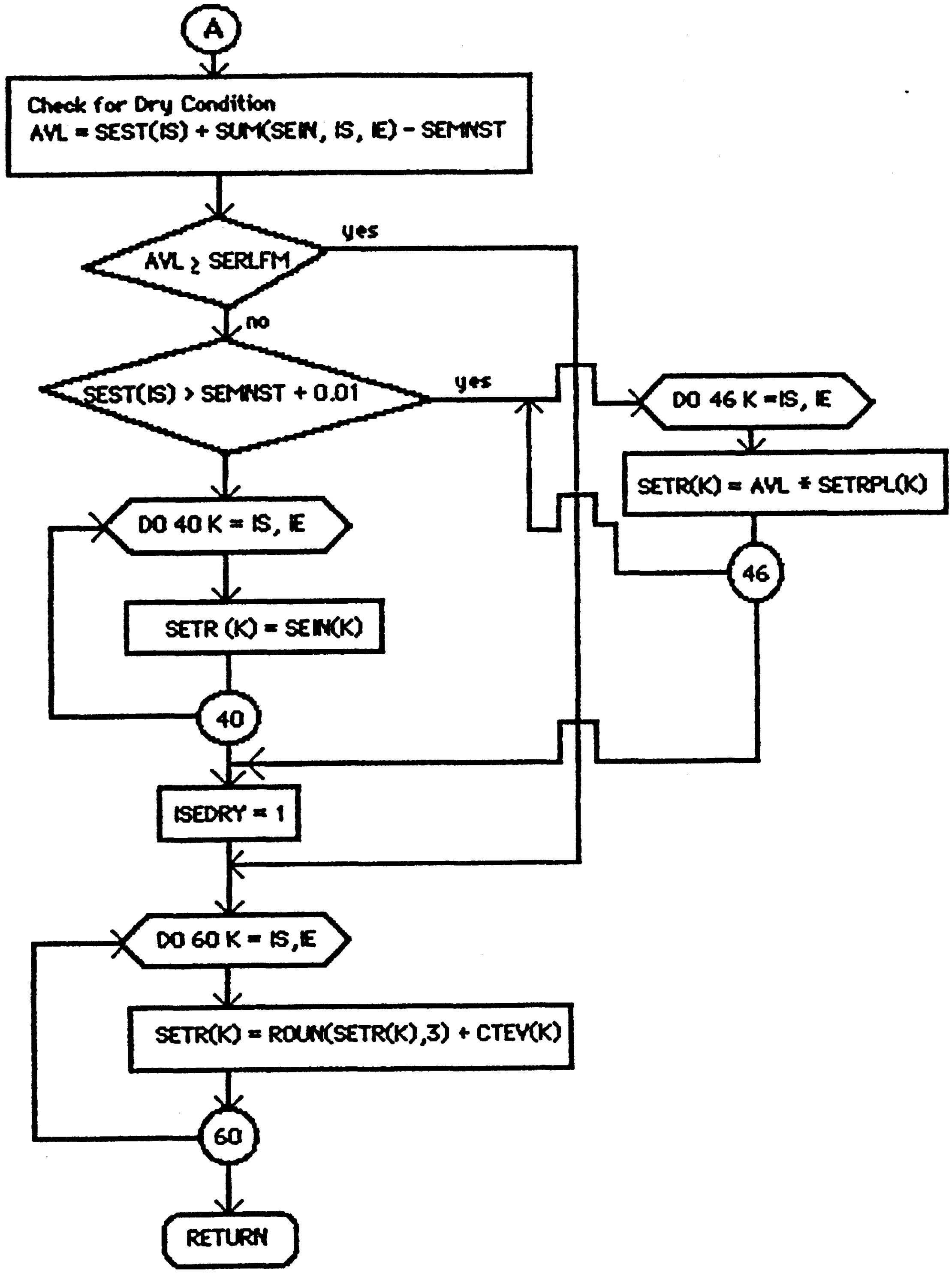

A
Check the N. Platte Project Irrigation Release to Determine the Monthly Turbine Release Ratio
PNIR(13) ≤ SERCAS
yes
no
DO 13 K = IS, IE
SETR(K) = SERLAS * SETRPC(K)
13
AVG = SUM(SETR, IS, IE) / FLOAT(IE - IS + 1)
SUMNEG = 0
XI = 0
DO 19 K = IS,IE
SETR(K) ≥ AVG
yes
ID(K) = 1
XI = XI + 1
no
SETR(K) ≥ SERLDR
yes
no
SUMNEG = SUMNEG + SERLDR - SETR(K)
SETR(K) = SERLDR
ID(K) = 0
19
E
B
C


E
B
C
XI < 0.5
yes
no
ADJ = SUMNEG / XI
DO 21 K = IS,IE
ID(K) = 0
yes
no
SETR(K) = SETC(K) - ADJ
21
DO 23 K = IS, IE
SETR(K) = ROUND(SETR(K),3) + CTEV(K)
23
RETURN
DO 15K = IS, IE
J = K - 6
SETR(K) = SERLAS * SETPAS(J)
15
E
D

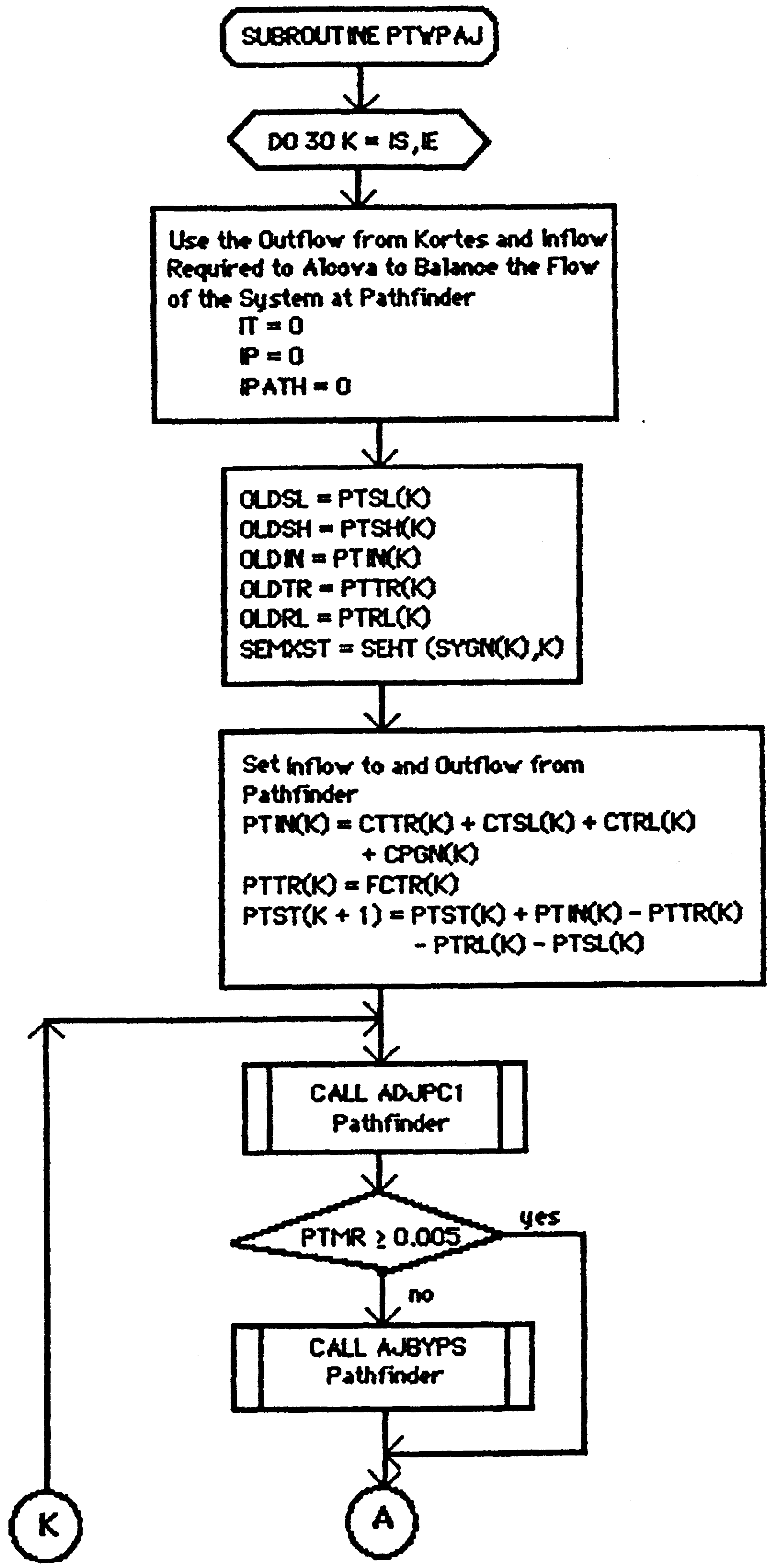

E
D
Adjust the Turbine Release that None is LessThan Minimum Release yet without Changing the Total Amount of Release

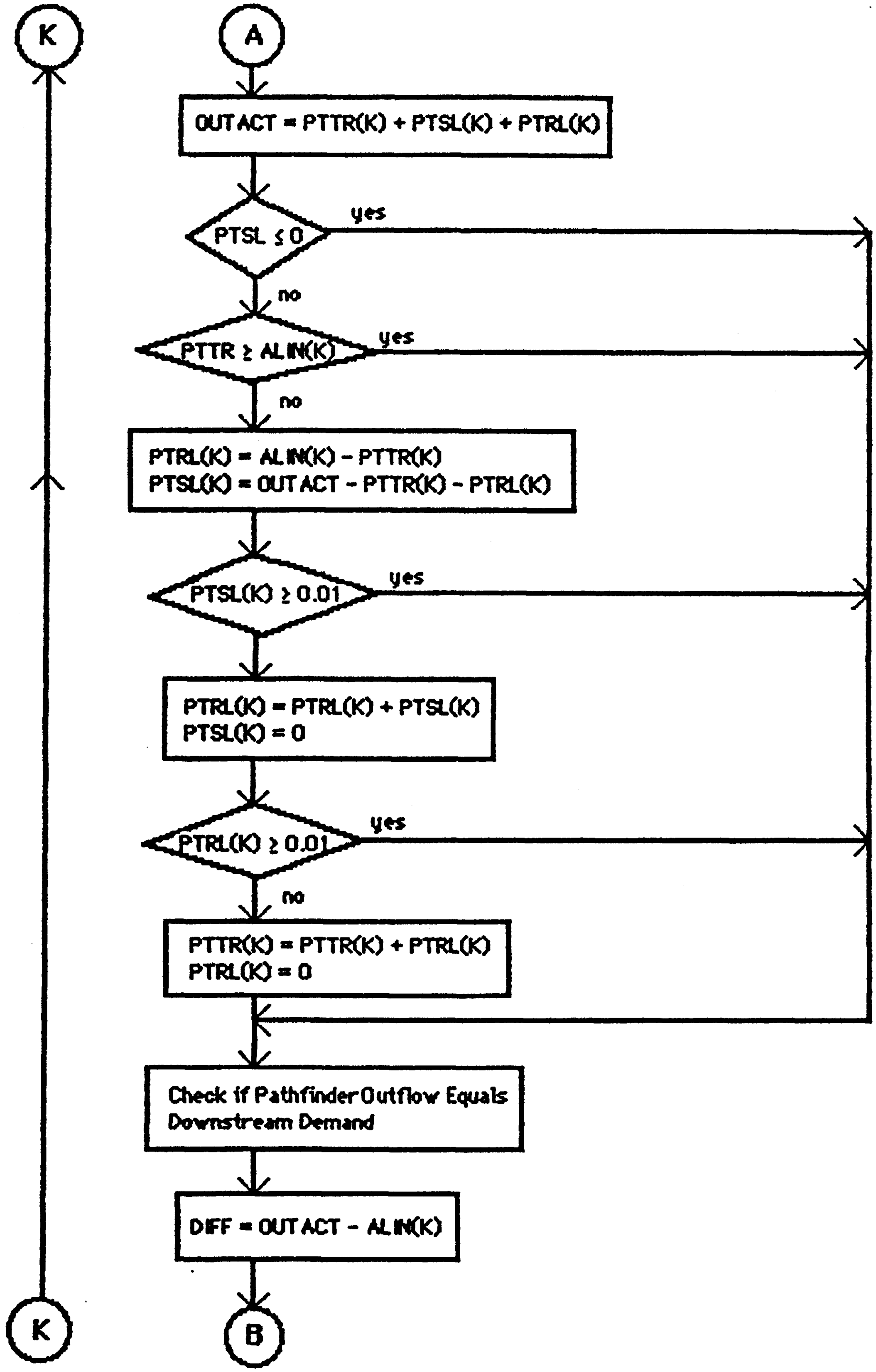
Description: Primary Estimation of Turbine Release for Seminoe in Feb. and Mar. According to Estimated Available Water to be Released in this Period.

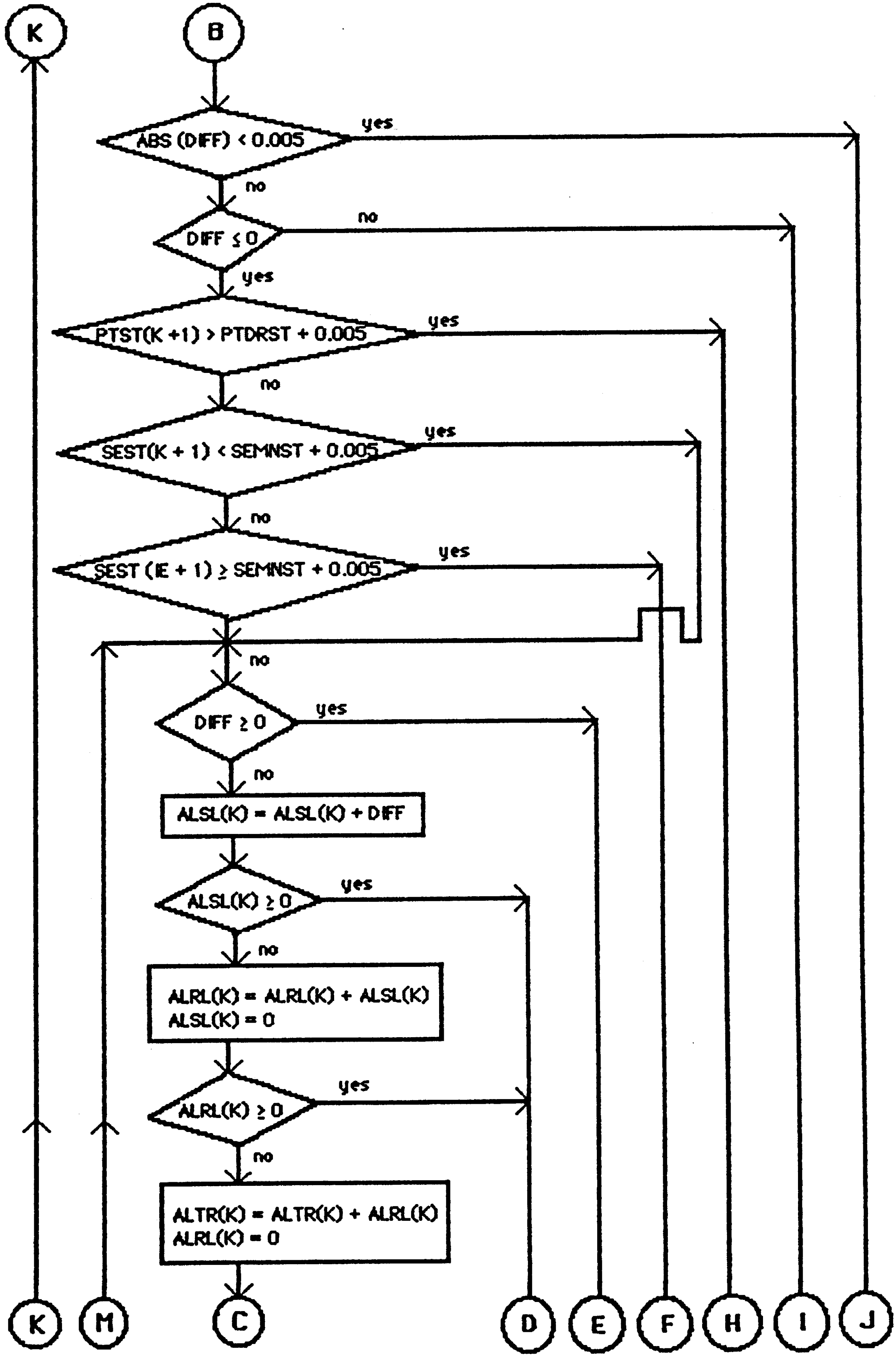


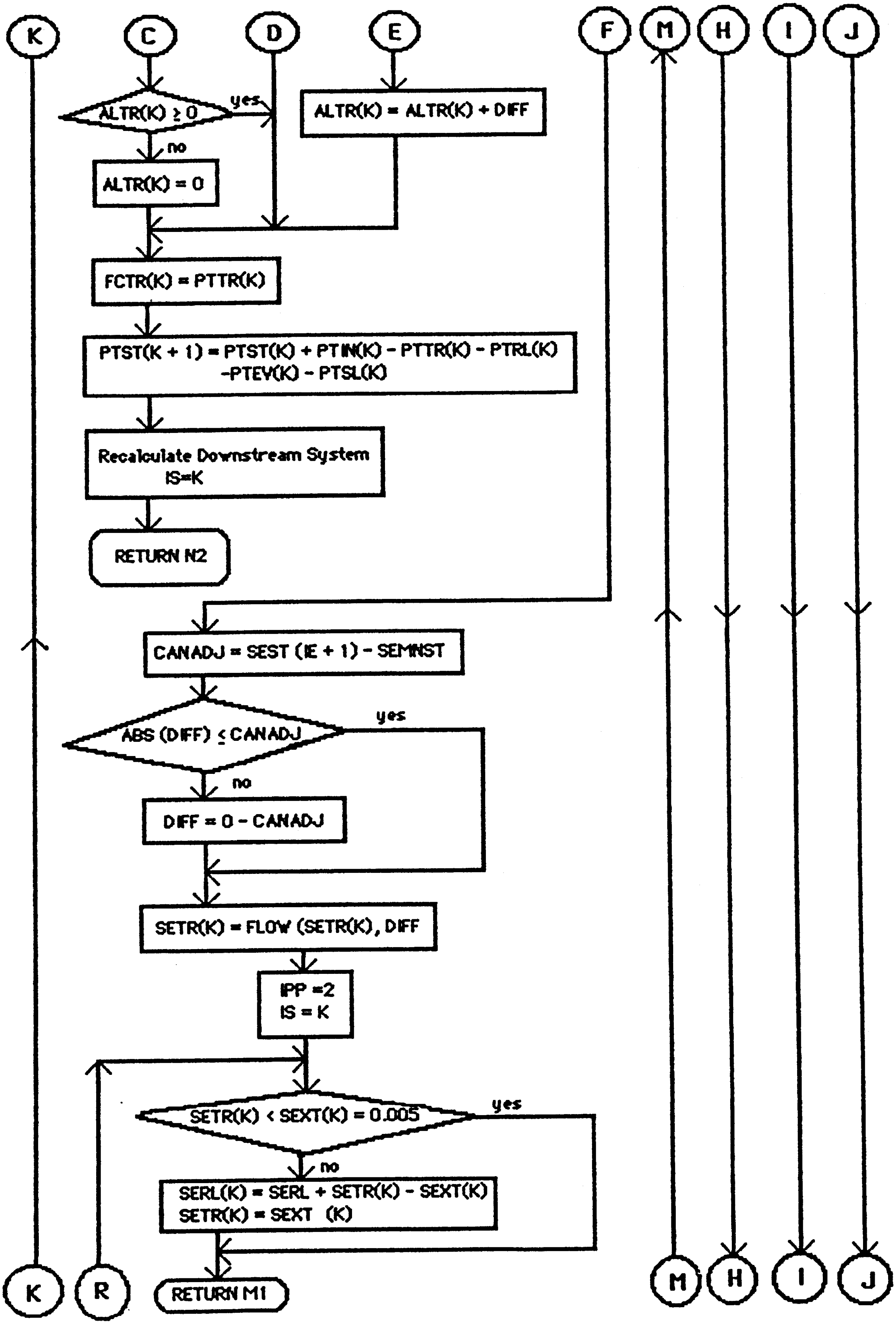

A
Check for Dry Condition
AVL = SEST(IS) + SUM(SEIN, IS, IE) - SEMNST
AVL ≥ SERLFM
yes
no
SEST(IS) > SEMNST + 0.01
yes
DO 46 K = IS, IE
SETR(K) = AVL * SETRPL(K)
46
DO 40 K = IS, IE
SETR (K) = SEIN(K)
40
ISEDRY = 1
DO 60 K = IS,IE
SETR(K) = ROUN(SETR(K),3) + CTEV(K)
60
RETURN

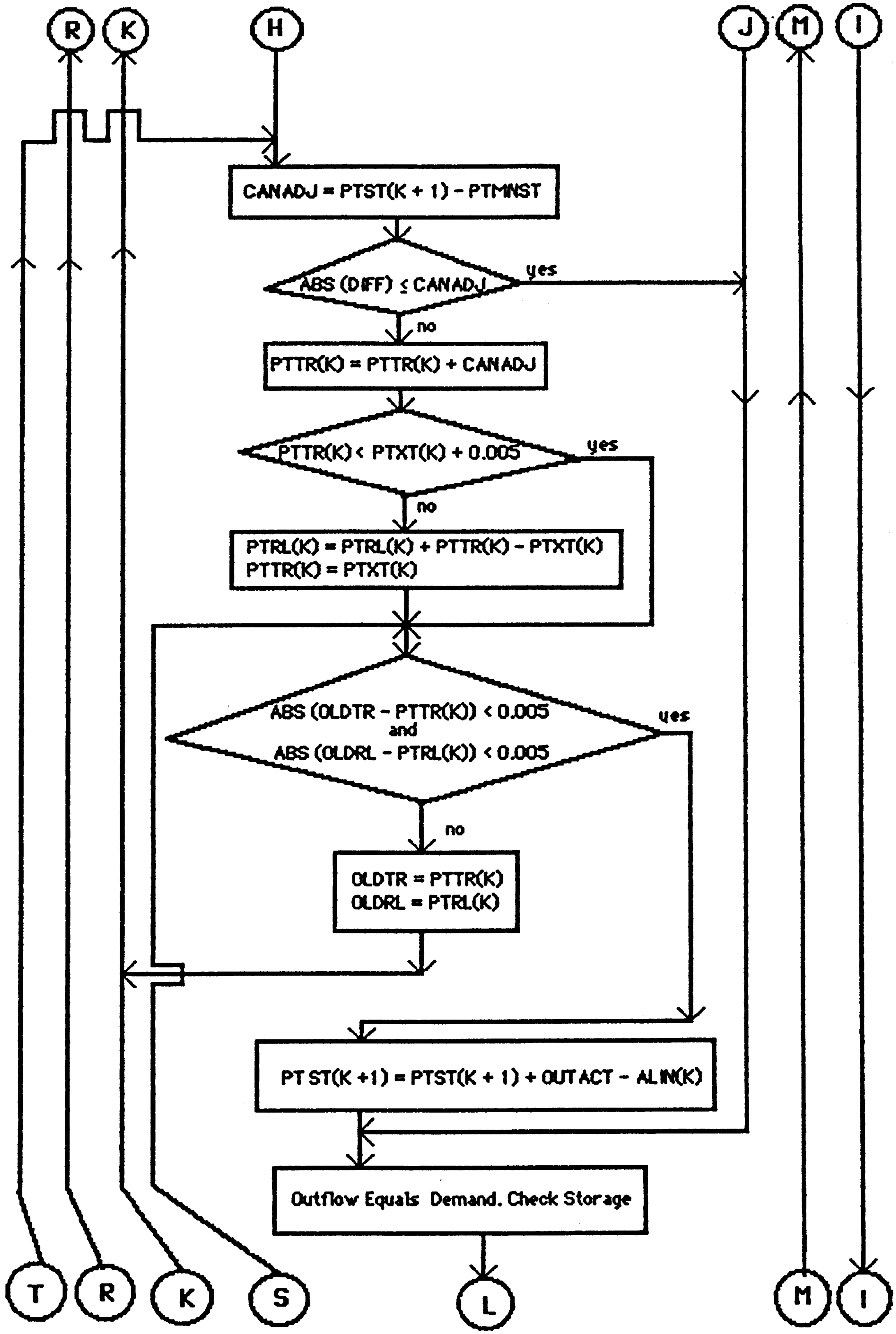
Description: Compute and Adjust Water Use and Power Generation in Pathfinder, then Adjust the Turbine Release of Seminoe, Fremont Canyon, and Alcova According to Storage in Pathfinder and Seminoe.

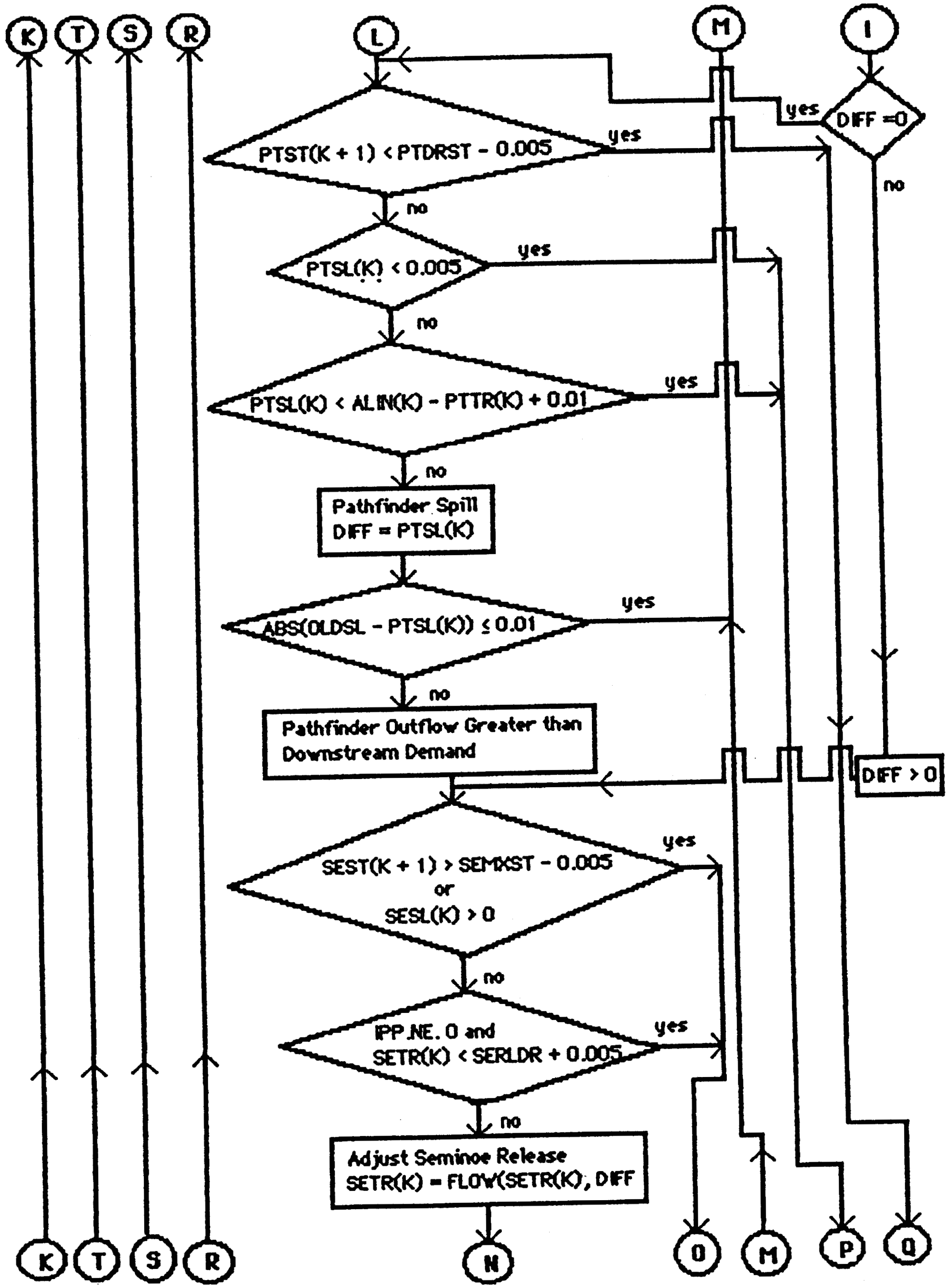


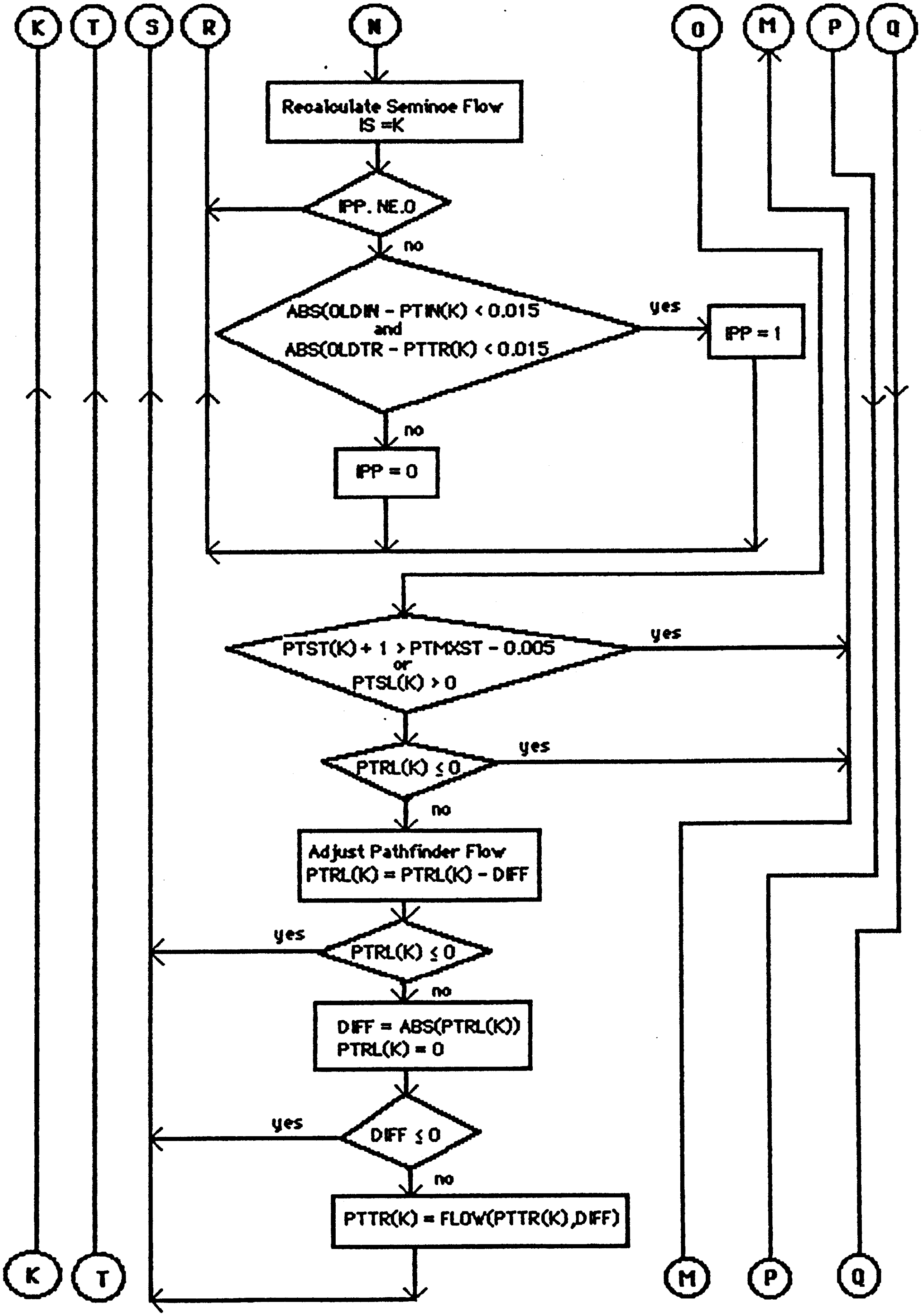

K
A
OUTACT = PTTR(K) + PTSL(K) + PTRL(K)
PTSL ≤ 0
yes
no
PTTR ≥ ALIN(K)
yes
no
PTRL(K) = ALIN(K) - PTTR(K)
PTSL(K) = OUTACT - PTTR(K) - PTRL(K)
PTSL(K) ≥ 0.01
yes
PTRL(K) = PTRL(K) + PTSL(K)
PTSL(K) = 0
PTRL(K) ≥ 0.01
yes
no
PTTR(K) = PTTR(K) + PTRL(K)
PTRL(K) = 0
Check if Pathfinder Outflow Equals
Downstream Demand
DIFF = OUTACT - ALIN(K)
K
B

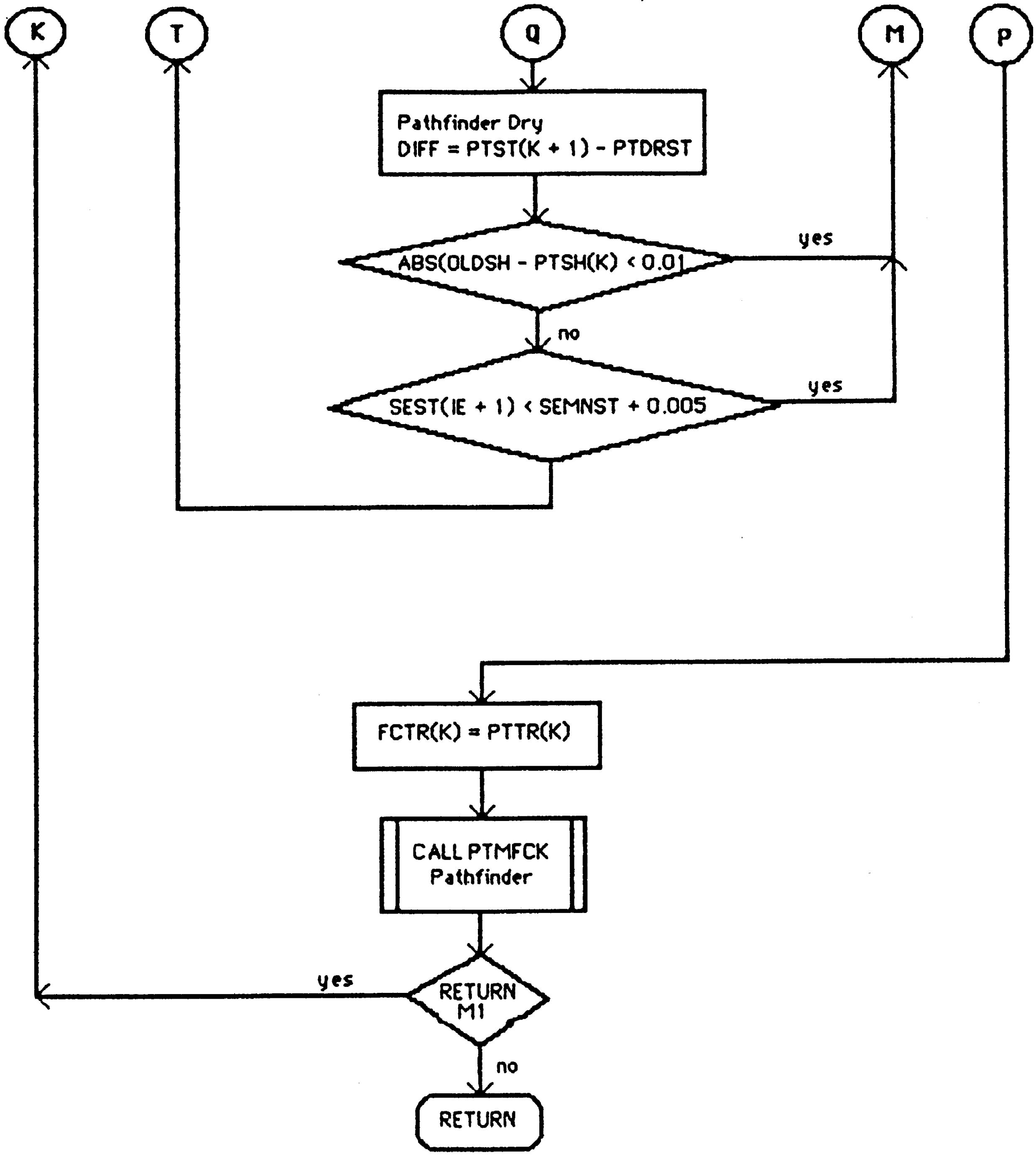

K
B
ABS (DIFF) < 0.005
yes
no
DIFF ≤ 0
no
yes
PTST(K +1) > PTDRST + 0.005
yes
no
SEST(K + 1) < SEMNST + 0.005
yes
no
SEST (IE + 1) ≥ SEMNST + 0.005
yes
no
DIFF ≥ 0
yes
no
ALSL(K) = ALSL(K) + DIFF
ALSL(K) ≥ 0
yes
no
ALRL(K) = ALRL(K) + ALSL(K)
ALSL(K) = 0
ALRL(K) ≥ 0
yes
no
ALTR(K) = ALTR(K) + ALRL(K)
ALRL(K) = 0
K
M
C
D
E
F
H
I
J


K
C
D
E
F
M
H
I
J
ALTR(K) ≥ 0
yes
no
ALTR(K) = ALTR(K) + DIFF
ALTR(K) = 0
FCTR(K) = PTTR(K)
PTST(K + 1) = PTST(K) + PTIN(K) - PTTR(K) - PTRL(K)
-PTEV(K) - PTSL(K)
Recalculate Downstream System
IS=K
RETURN N2
CANADJ = SEST (IE + 1) - SEMNST
ABS (DIFF) ≤ CANADJ
yes
no
DIFF = 0 - CANADJ
SETR(K) = FLOW (SETR(K), DIFF
IPP =2
IS = K
SETR(K) < SEXT(K) = 0.005
yes
no
SERL(K) = SERL + SETR(K) - SEXT(K)
SETR(K) = SEXT (K)
K
R
RETURN M1
M
H
I
J

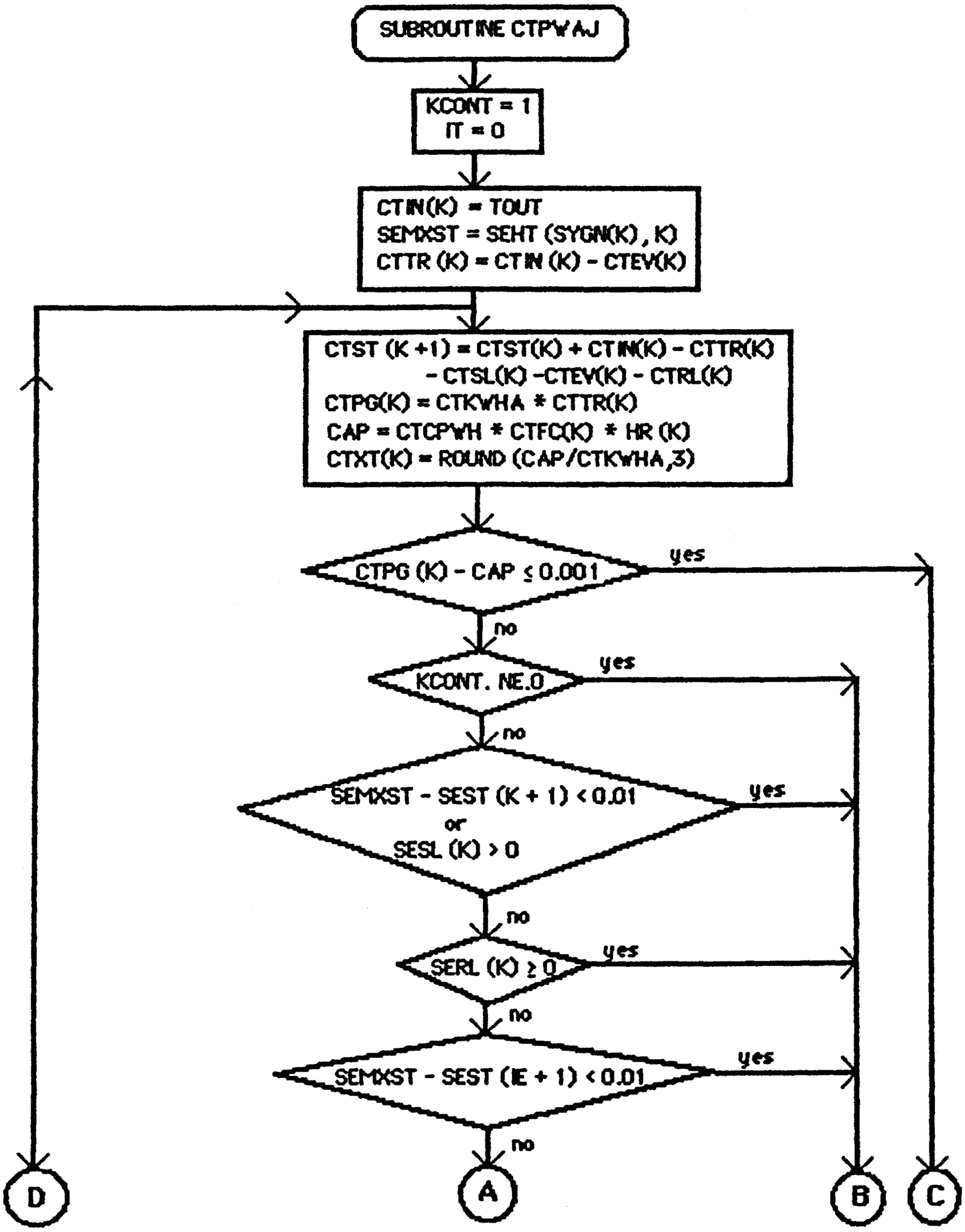

R
K
H
J
M
I
CANADJ = PTST(K + 1) - PTMNST
ABS (DIFF) ≤ CANADJ
yes
no
PTTR(K) = PTTR(K) + CANADJ
PTTR(K) < PTXT(K) + 0.005
yes
no
PTRL(K) = PTRL(K) + PTTR(K) - PTXT(K)
PTTR(K) = PTXT(K)
ABS (OLDTR - PTTR(K)) < 0.005
and
ABS (OLDRL - PTRL(K)) < 0.005
yes
no
OLDTR = PTTR(K)
OLDRL = PTRL(K)
PT ST(K +1) = PTST(K + 1) + OUTACT - ALIN(K)
Outflow Equals Demand. Check Storage
T
R
K
S
L
M
I

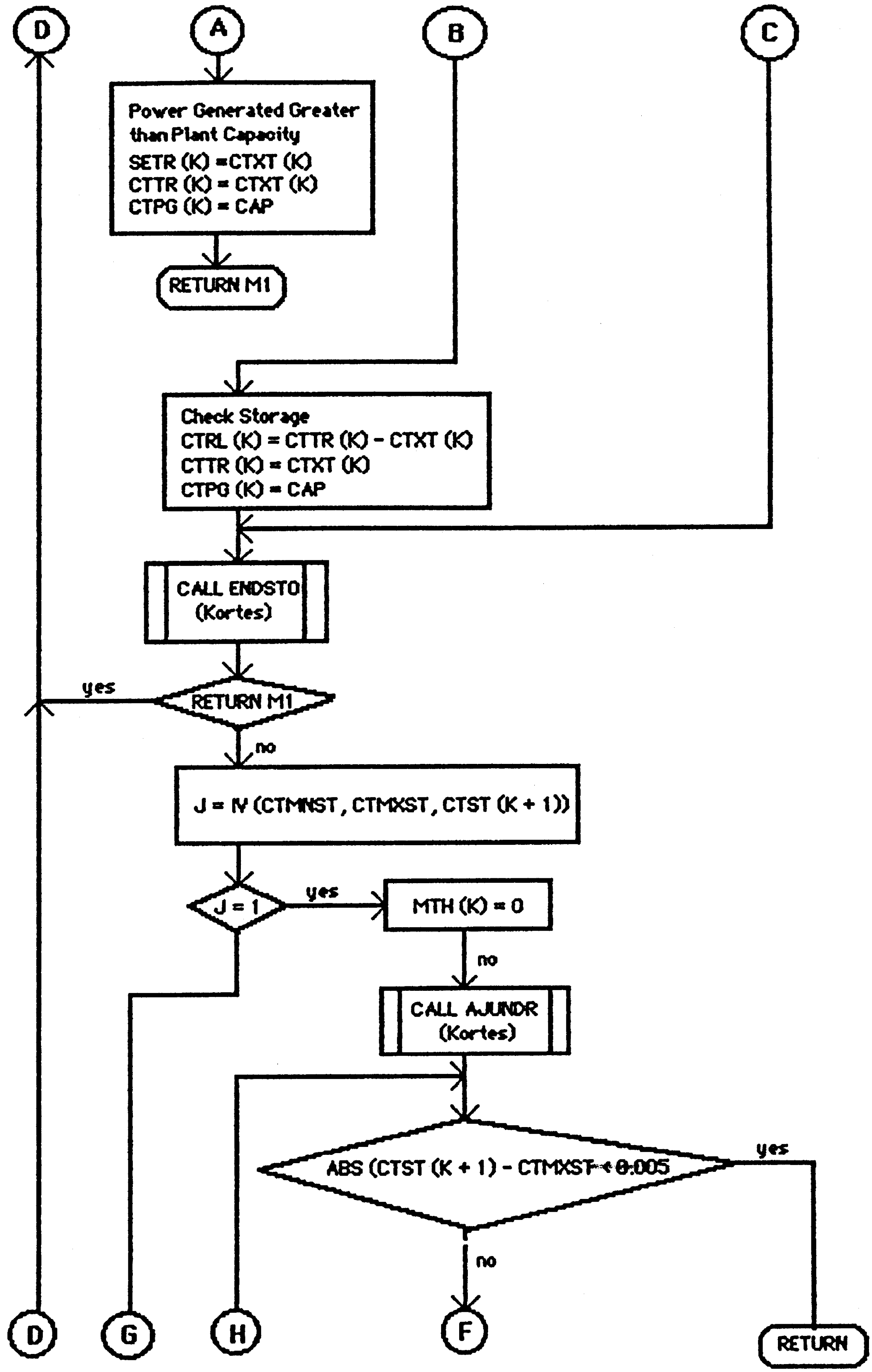

K
T
S
R
L
M
I
PTST(K + 1) < PTDRST - 0.005
yes
DIFF =0
yes
no
no
PTSL(K) < 0.005
yes
no
PTSL(K) < ALIN(K) - PTTR(K) + 0.01
yes
no
Pathfinder Spill
DIFF = PTSL(K)
ABS(OLDSL - PTSL(K)) ≤ 0.01
yes
no
Pathfinder Outflow Greater than
Downstream Demand
DIFF > 0
SEST(K + 1) > SEMXST - 0.005
or
SESL(K) > 0
yes
no
IPP.NE. 0 and
SETR(K) < SERLDR + 0.005
yes
no
Adjust Seminoe Release
SETR(K) = FLOW(SETR(K), DIFF
K
T
S
R
N
O
M
P
Q

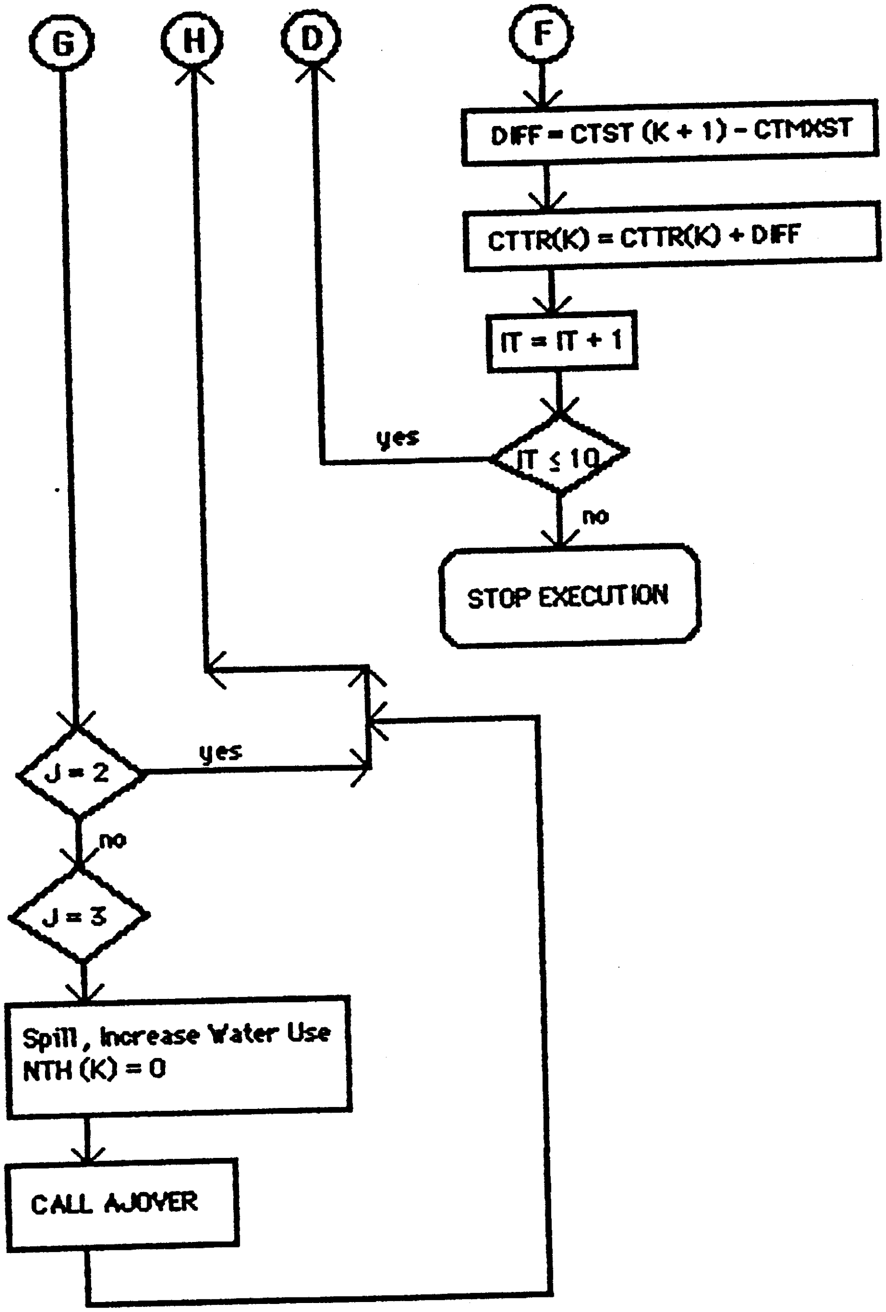

K
T
S
R
N
O
M
P
Q
Recalculate Seminoe Flow
IS =K
IPP. NE.0
no
ABS(OLDIN - PTIN(K) < 0.015
and
ABS(OLDTR - PTTR(K) < 0.015
yes
IPP = 1
no
IPP = 0
PTST(K) + 1 > PTMXST - 0.005
or
PTSL(K) > 0
yes
PTRL(K) ≤ 0
yes
no
Adjust Pathfinder Flow
PTRL(K) = PTRL(K) - DIFF
yes
PTRL(K) ≤ 0
no
DIFF = ABS(PTRL(K))
PTRL(K) = 0
yes
DIFF ≤ 0
no
PTTR(K) = FLOW(PTTR(K),DIFF)
K
T
M
P
Q


K
T
Q
M
P
Pathfinder Dry
DIFF = PTST(K + 1) - PTDRST
ABS(OLDSH - PTSH(K) < 0.01
yes
no
SEST(IE + 1) < SEMNST + 0.005
yes
FCTR(K) = PTTR(K)
CALL PTMFCK
Pathfinder
yes
RETURN
M1
no
RETURN

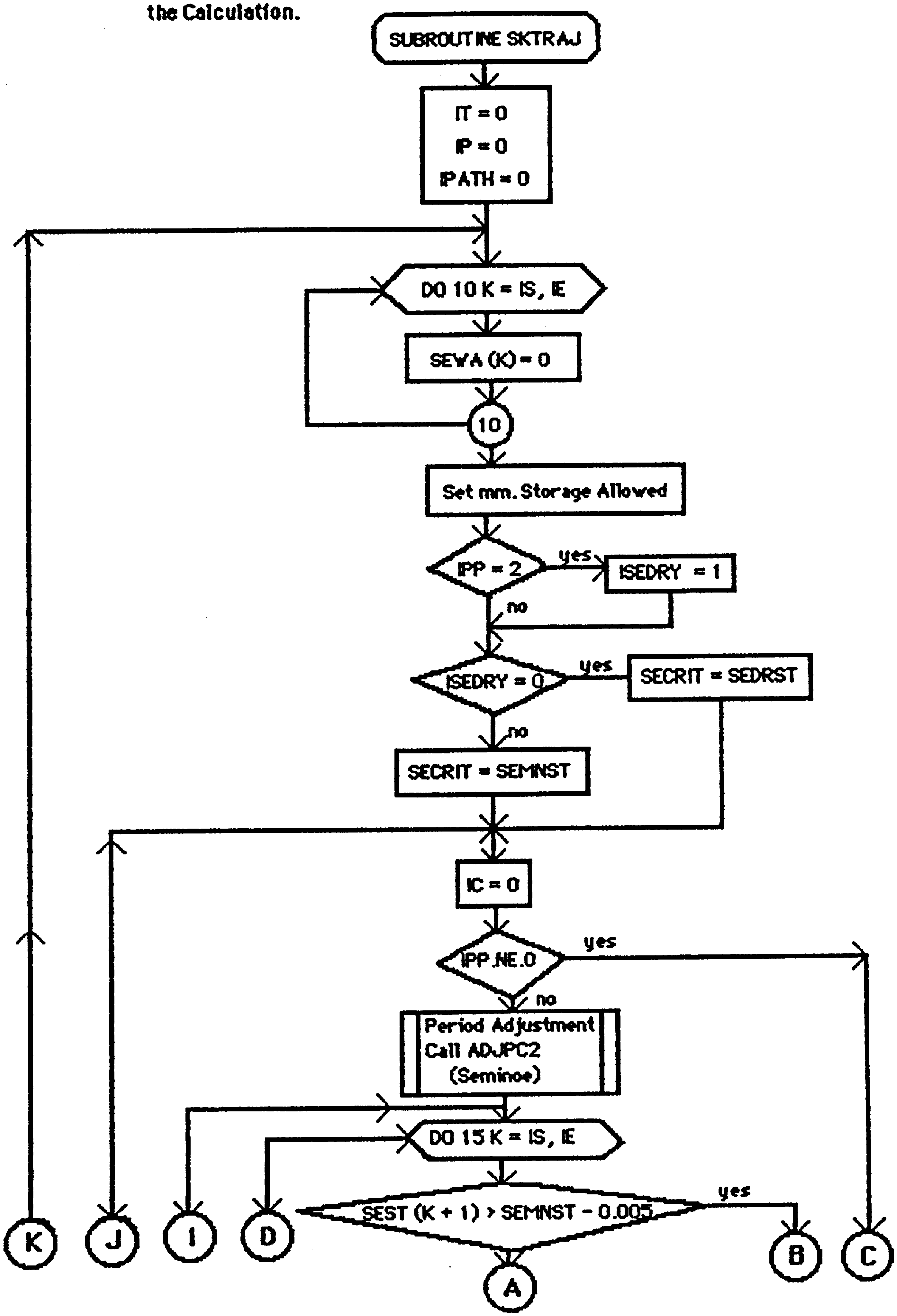
Description: Kortes Power and Water Components Computation. At the Beginning Seminoe Turbine Release is Set as that of Kortes. Later it is Checked with Kortes Plant Capacity and the Excess Water is Set as Spill.

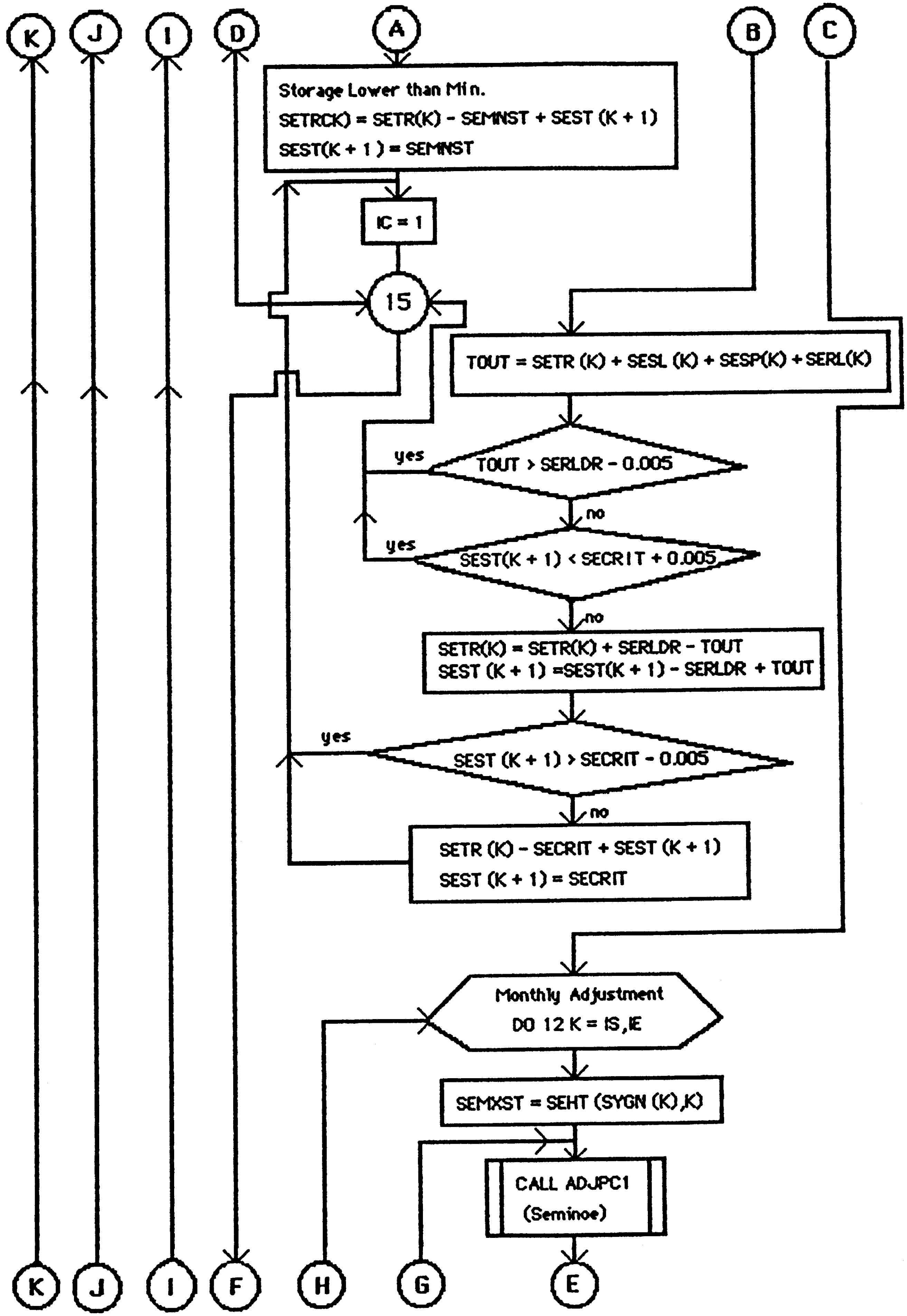



D
A
B
C
Power Generated Greater than Plant Capacity
SETR (K) = CTXT (K)
CTTR (K) = CTXT (K)
CTPG (K) = CAP
RETURN M1
Check Storage
CTRL (K) = CTTR (K) - CTXT (K)
CTTR (K) = CTXT (K)
CTPG (K) = CAP
CALL ENDSTO (Kortes)
yes
RETURN M1
no
J = IV (CTMNST, CTMXST, CTST (K + 1))
J = 1
yes
MTH (K) = 0
no
CALL AJUNDR (Kortes)
ABS (CTST (K + 1) - CTMXST < 0.005
yes
no
D
G
H
F
RETURN

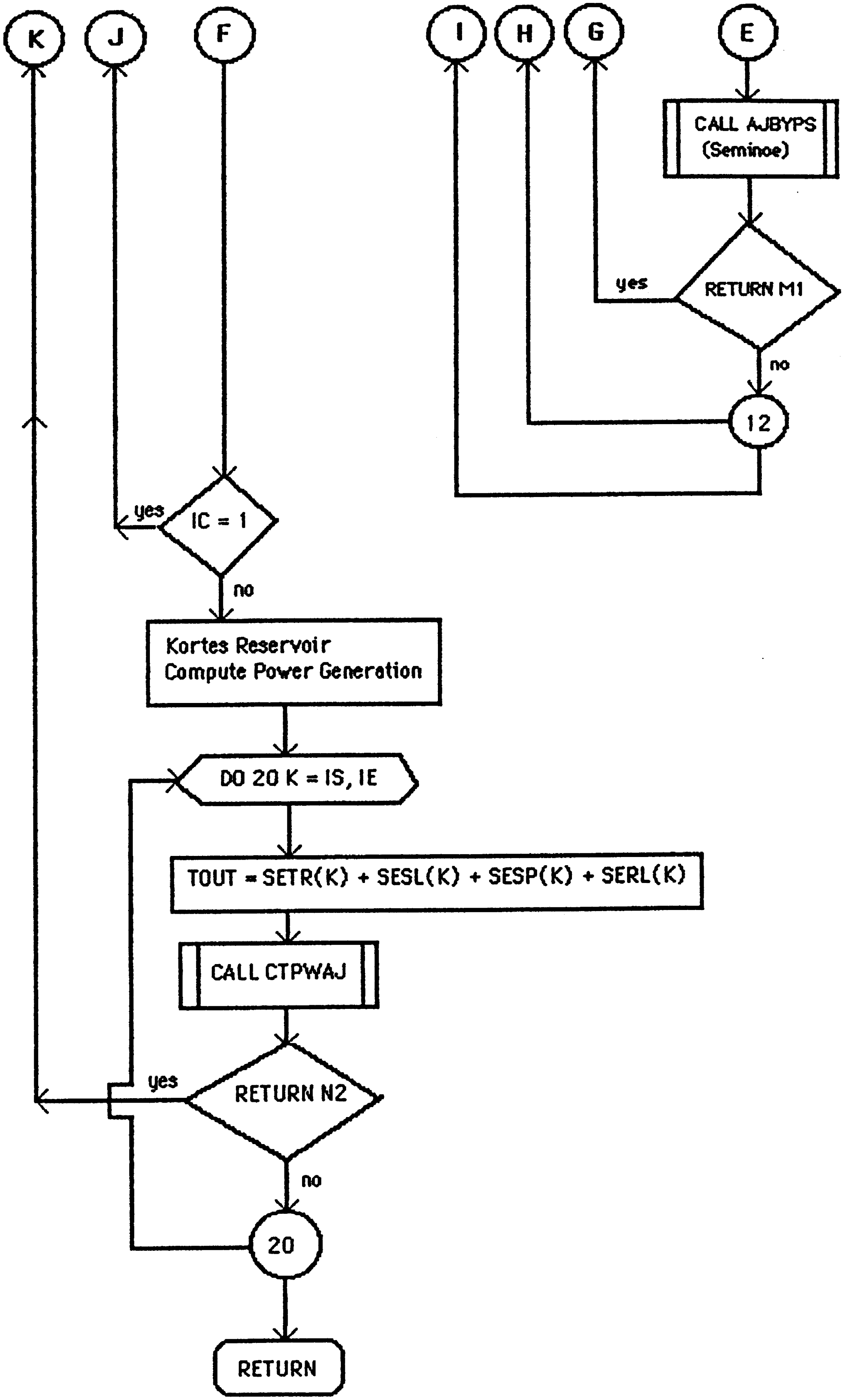

G
H
D
F
DIFF = CTST (K + 1) - CTMXST
CTTR(K) = CTTR(K) + DIFF
IT = IT + 1
IT ≤ 10
yes
no
STOP EXECUTION
J = 2
yes
no
J = 3
Spill, Increase Water Use
NTH (K) = 0
CALL AJOVER

Description: Seminoe and Kortes Combine Operation for a given Period. First Compute and Adjust Water Use and Power Generation in a Period for Seminoe. Then Assume the Turbine Release from Kortes is Equal to that of Seminoe to Compute and Adjust Water Use and Power Generation in Kortes. If the Kortes Turbine Release Value Changed, Reset Seminoe Turbine Release and Repeat the Calculation.

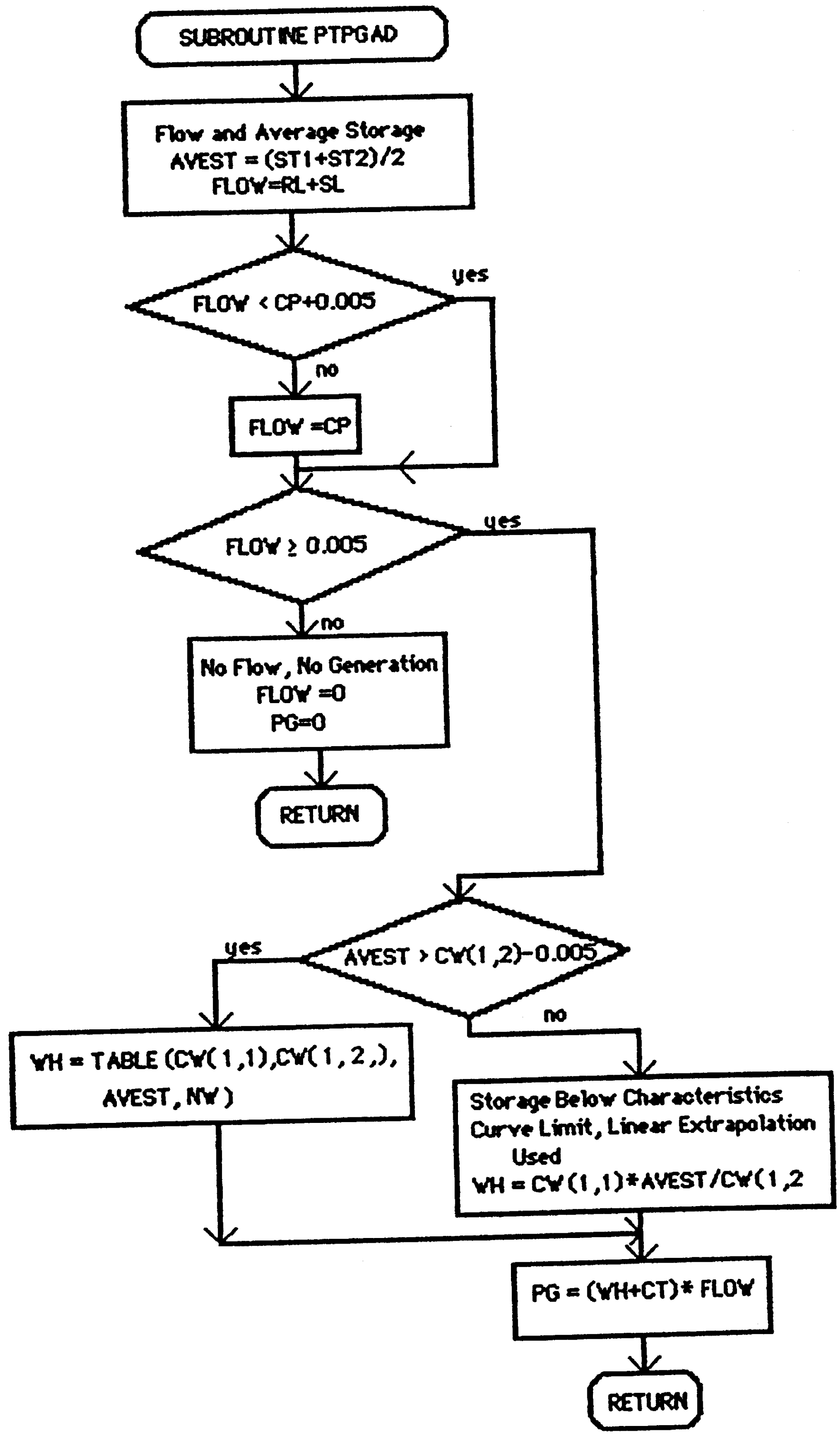


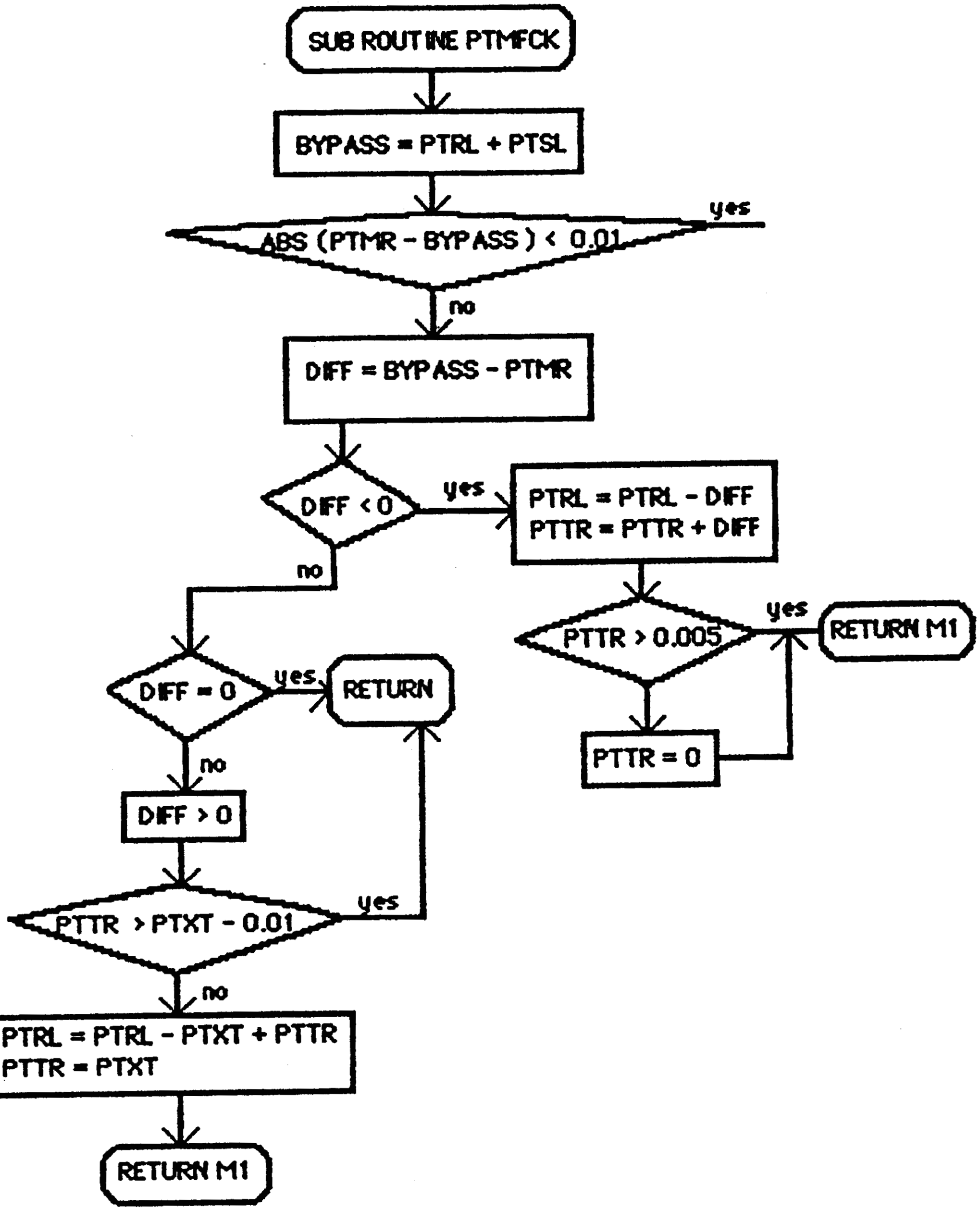


K
J
I
D
A
B
C
Storage Lower than Min.
SETRCK) = SETR(K) - SEMNST + SEST (K + 1)
SEST(K + 1) = SEMNST
IC = 1
15
TOUT = SETR (K) + SESL (K) + SESP(K) + SERL(K)
yes
TOUT > SERLDR - 0.005
no
yes
SEST(K + 1) < SECRIT + 0.005
no
SETR(K) = SETR(K) + SERLDR - TOUT
SEST (K + 1) =SEST(K + 1) - SERLDR + TOUT
yes
SEST (K + 1) > SECRIT - 0.005
no
SETR (K) - SECRIT + SEST (K + 1)
SEST (K + 1) = SECRIT
Monthly Adjustment
DO 12 K = IS,IE
SEMXST = SEHT (SYGN (K),K)
CALL ADJPC1
(Seminoe)
K
J
I
F
H
G
E

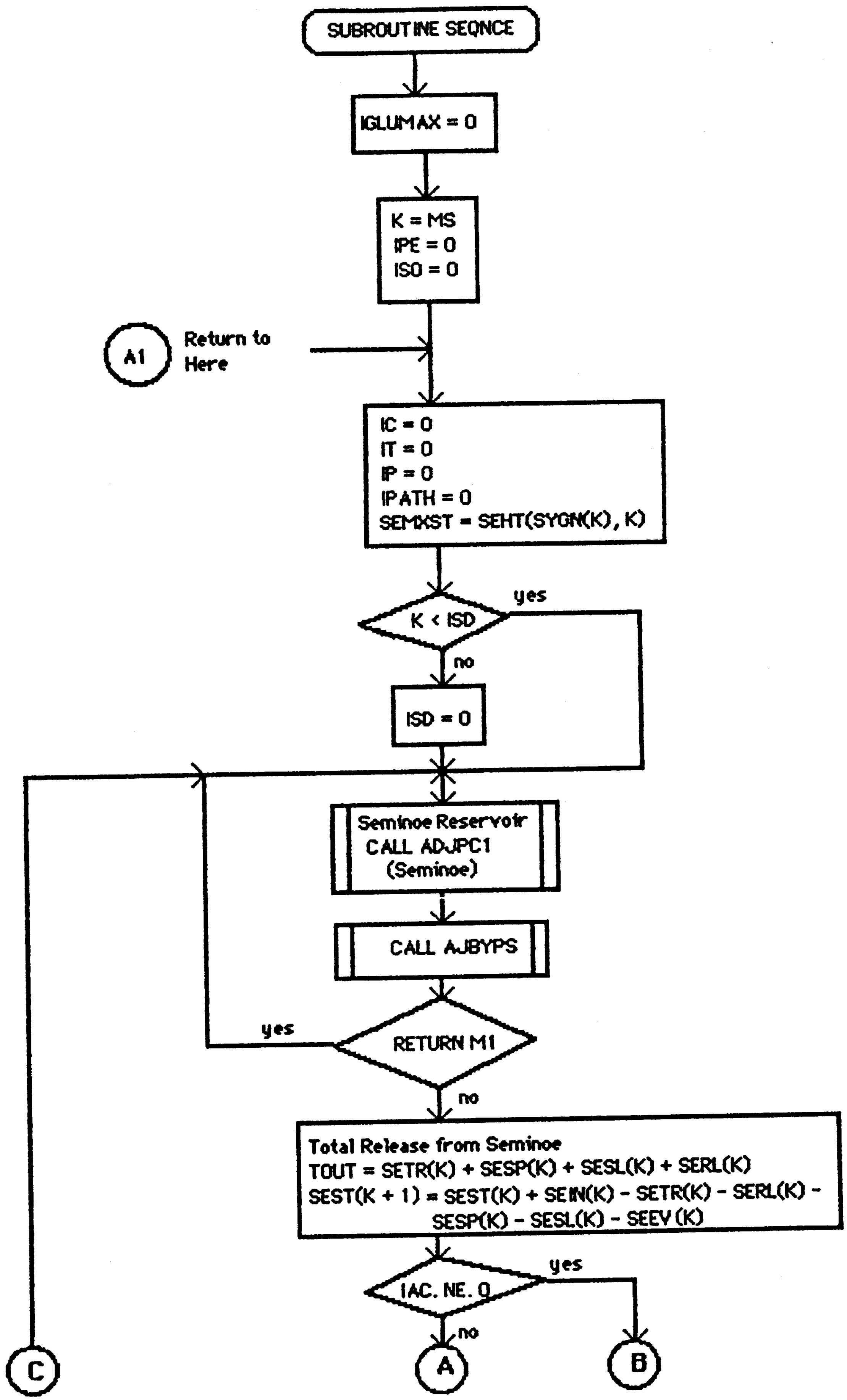

K
J
F
I
H
G
E
CALL AJBYPS
(Seminoe)
RETURN M1
yes
no
12
IC = 1
yes
no
Kortes Reservoir
Compute Power Generation
DO 20 K = IS, IE
TOUT = SETR(K) + SESL(K) + SESP(K) + SERL(K)
CALL CTPWAJ
RETURN N2
yes
no
20
RETURN

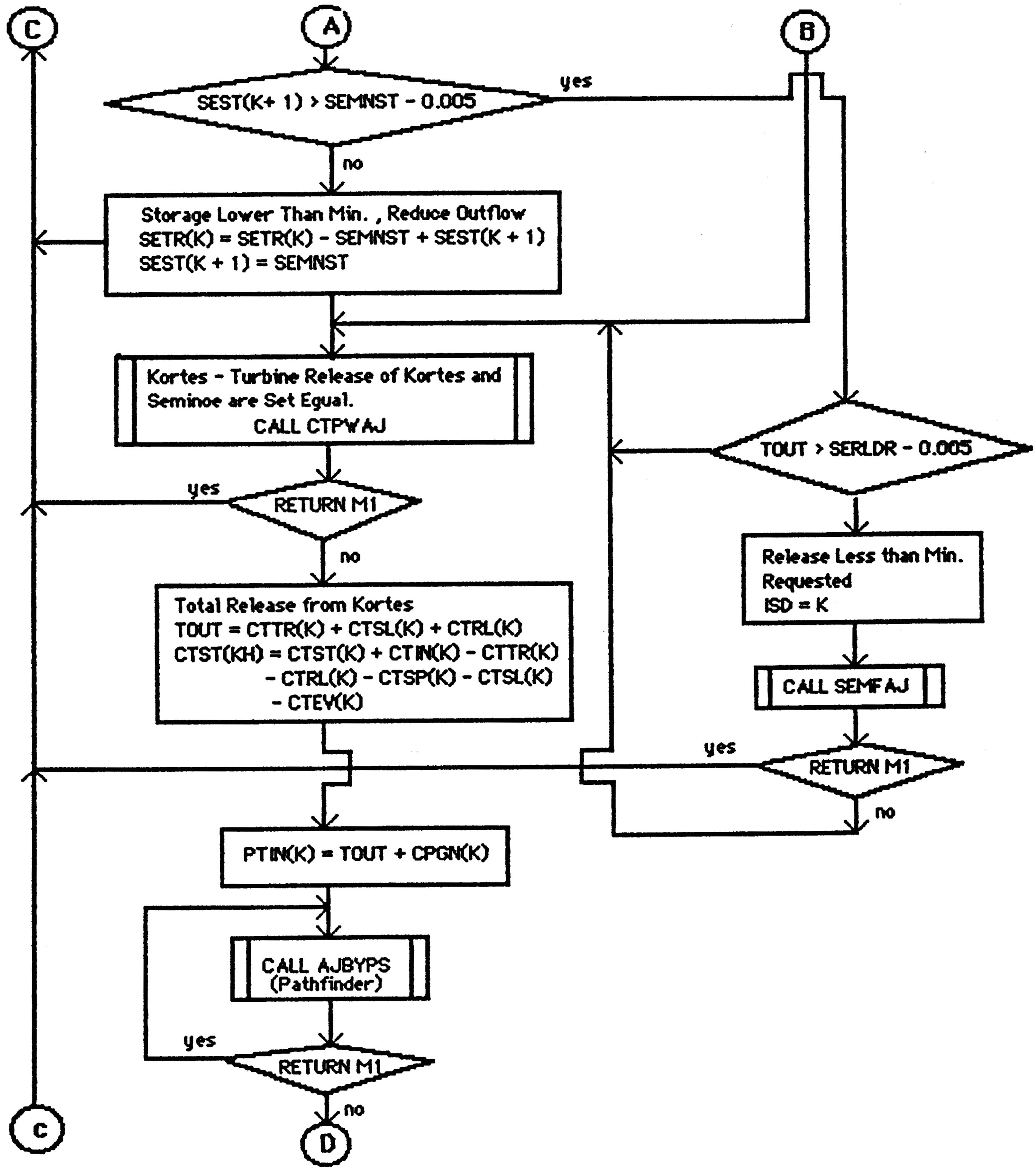
Description: New Power Plant Added Below Pathfinder Dam
Assumed all Bypass and Spill Water Delivered to the Plant. No Plant Max. Hydraulic Capacity Imposed. Fremont Canyon Power Characteristics Used.

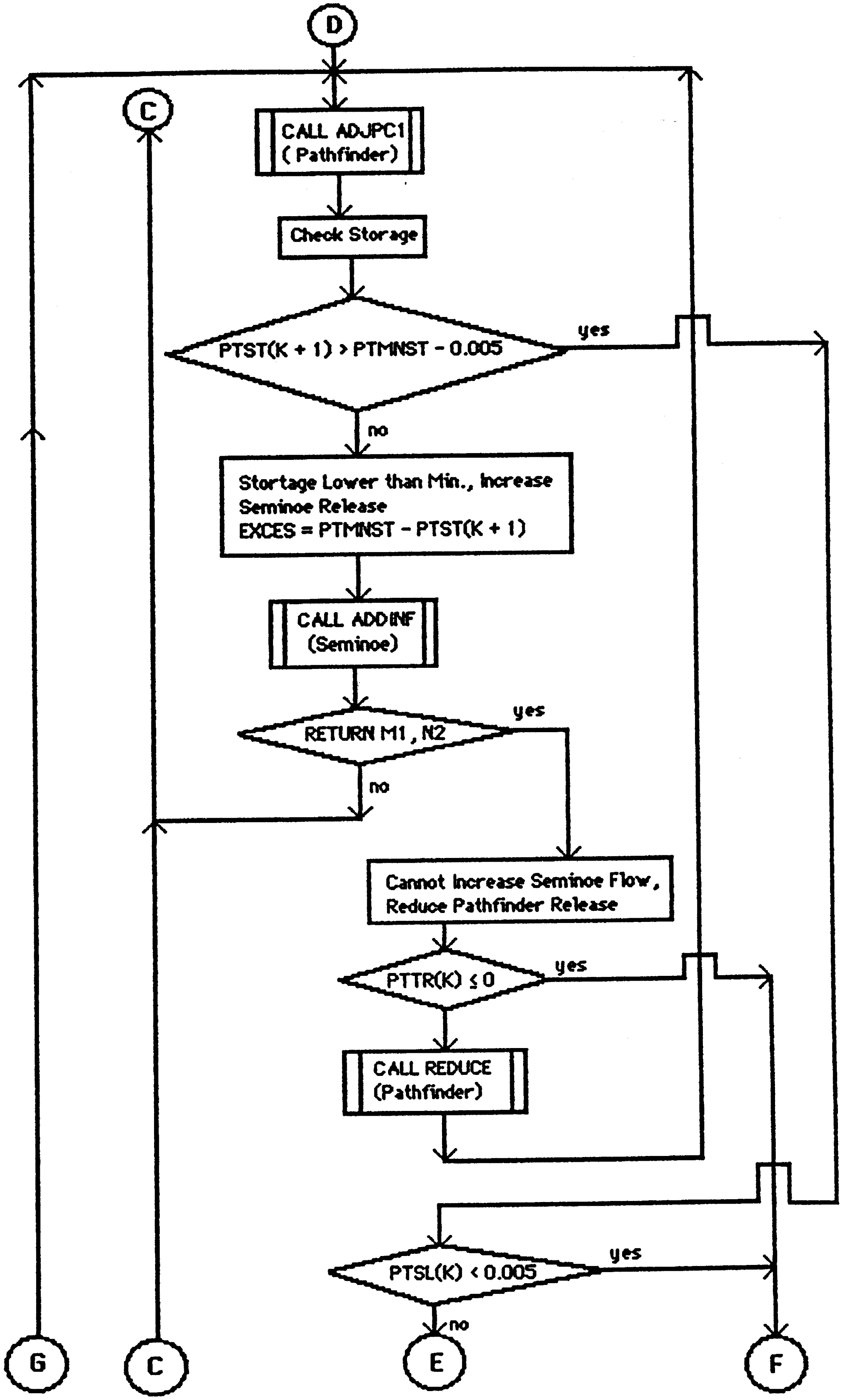



SUB ROUTINE PTMFCK
BYPASS = PTRL + PTSL
ABS (PTMR - BYPASS) < 0.01
yes
no
DIFF = BYPASS - PTMR
DIFF < 0
yes
PTRL = PTRL - DIFF
PTTR = PTTR + DIFF
no
PTTR > 0.005
yes
RETURN M1
DIFF = 0
yes
RETURN
PTTR = 0
no
DIFF > 0
PTTR > PTXT - 0.01
yes
no
PTRL = PTRL - PTXT + PTTR
PTTR = PTXT
RETURN M1

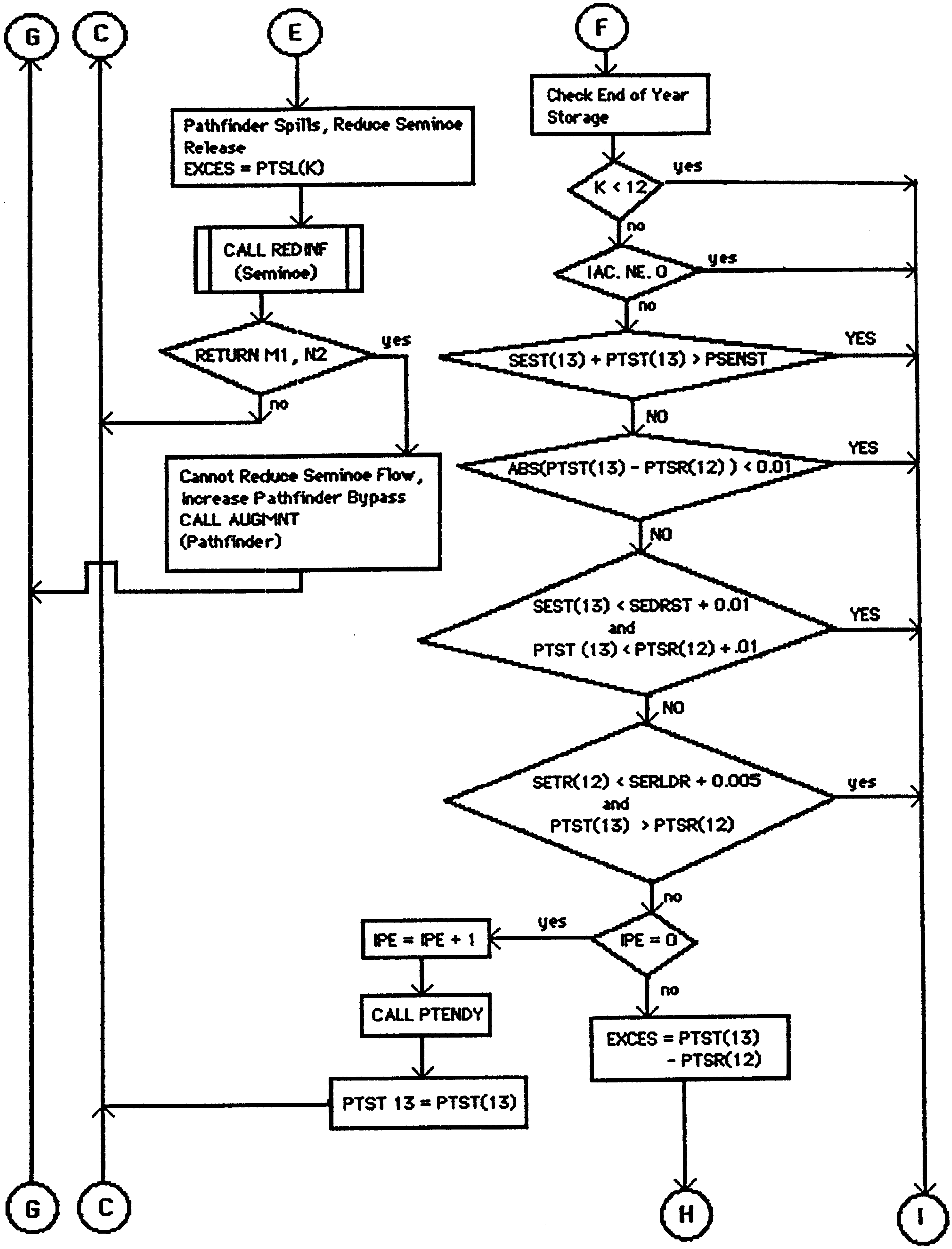
Description : Sequence Operation of the Entire Basin.



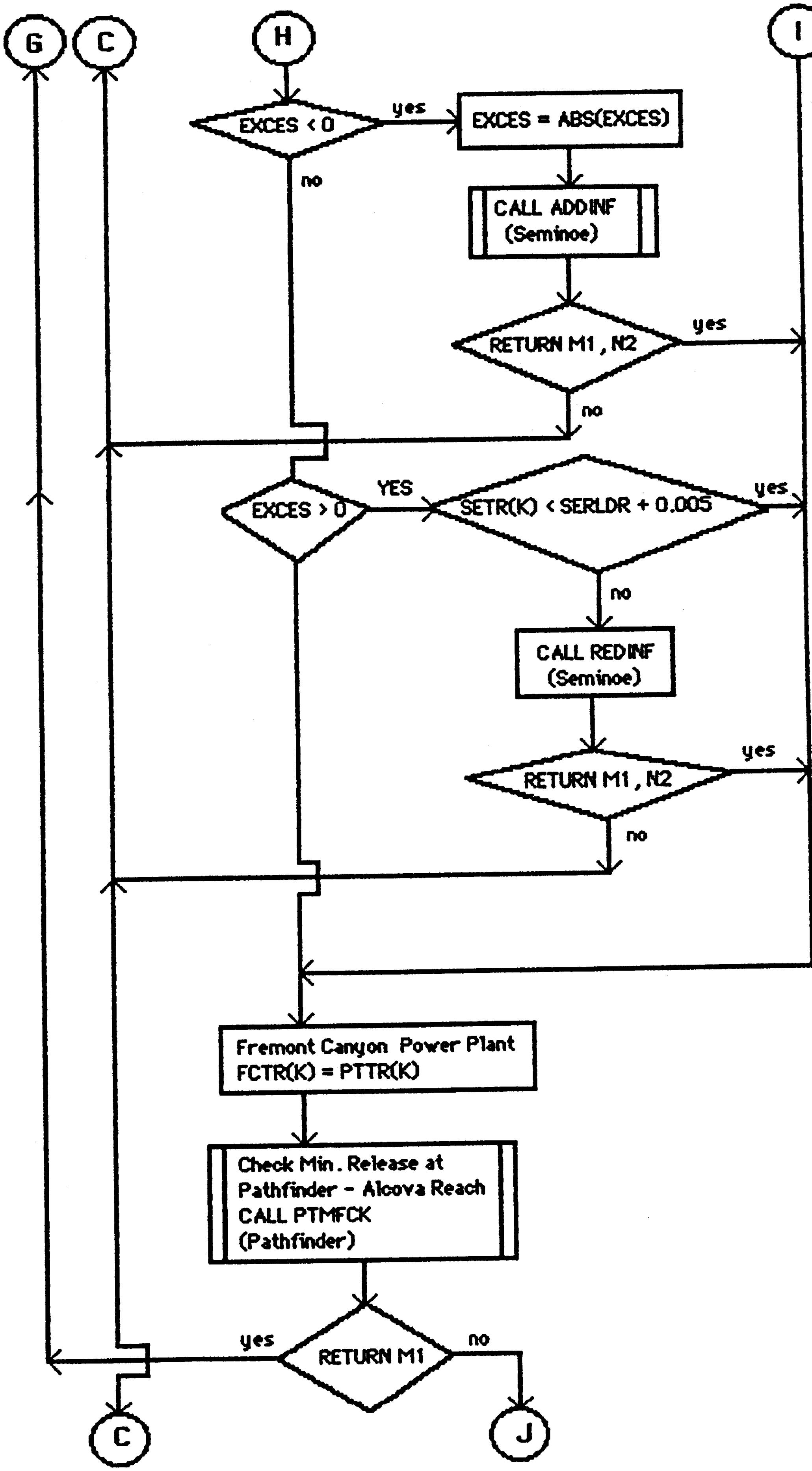

C
A
B
SEST(K+ 1) > SEMNST - 0.005
yes
no
Storage Lower Than Min. , Reduce Outflow
SETR(K) = SETR(K) - SEMNST + SEST(K + 1)
SEST(K + 1) = SEMNST
Kortes - Turbine Release of Kortes and
Seminoe are Set Egual.
CALL CTPWAJ
yes
RETURN M1
no
Total Release from Kortes
TOUT = CTTR(K) + CTSL(K) + CTRL(K)
CTST(KH) = CTST(K) + CTIN(K) - CTTR(K)
- CTRL(K) - CTSP(K) - CTSL(K)
- CTEV(K)
TOUT > SERLDR - 0.005
Release Less than Min.
Requested
ISD = K
CALL SEMFAJ
yes
RETURN M1
no
PTIN(K) = TOUT + CPGN(K)
CALL AJBYPS
(Pathfinder)
yes
RETURN M1
no
C
D

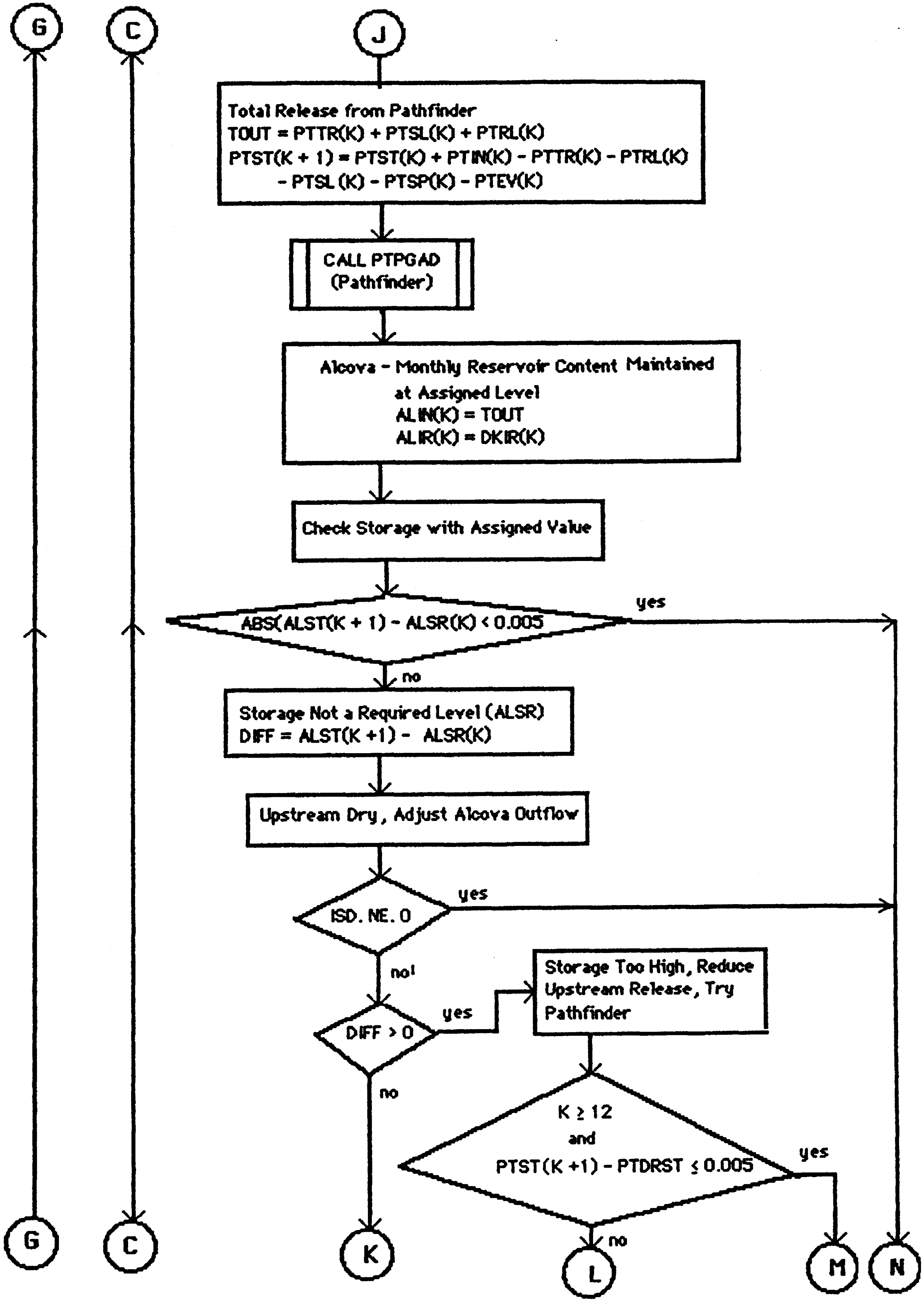


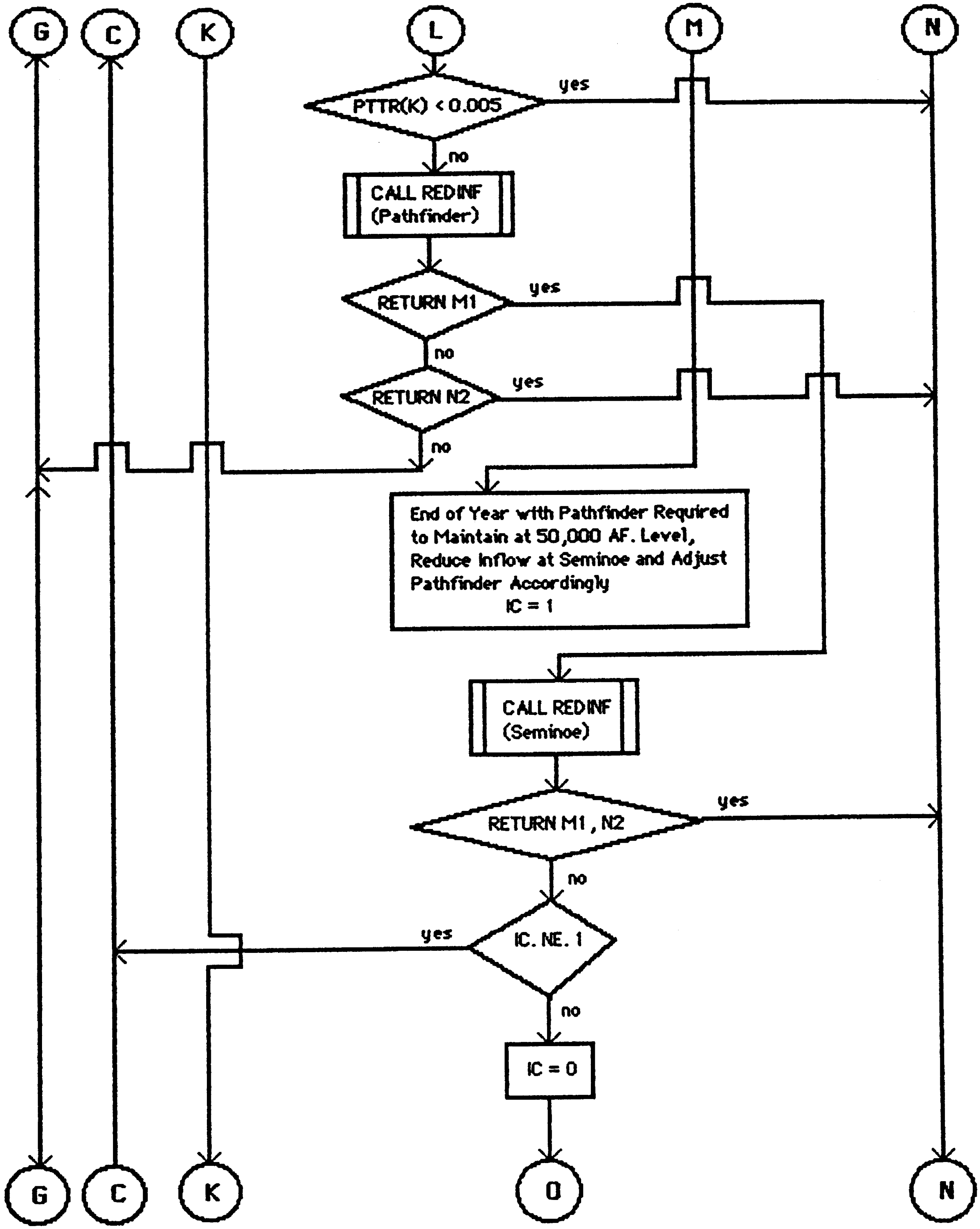
D
C
CALL ADJPC1
(Pathfinder)
Check Storage
PTST(K + 1) > PTMNST - 0.005
yes
no
Stortage Lower than Min., Increase
Seminoe Release
EXCES = PTMNST - PTST(K + 1)
CALL ADDINF
(Seminoe)
RETURN M1, N2
yes
no
Cannot Increase Seminoe Flow,
Reduce Pathfinder Release
PTTR(K) ≤ 0
yes
CALL REDUCE
(Pathfinder)
PTSL(K) < 0.005
yes
no
G
C
E
F

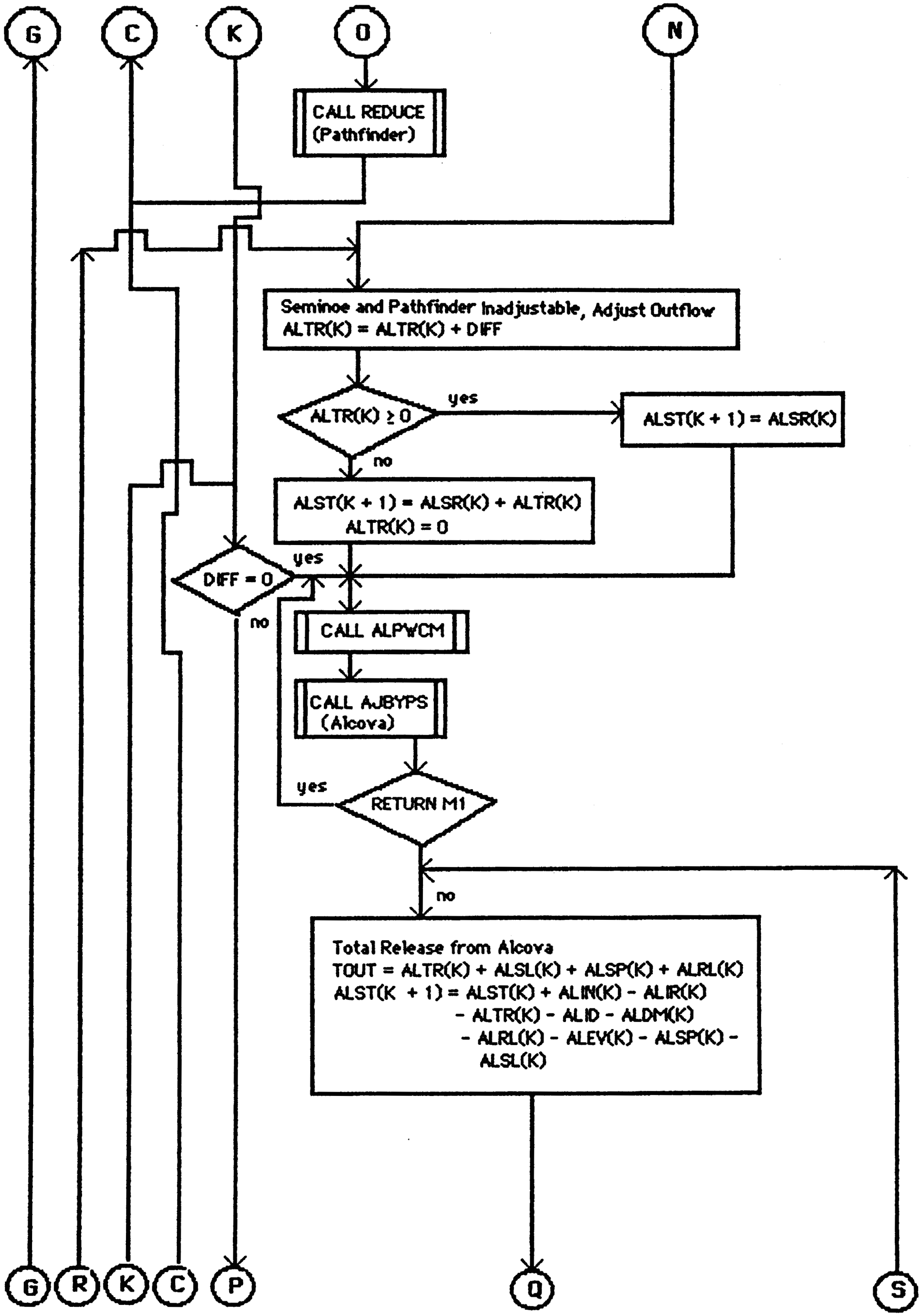


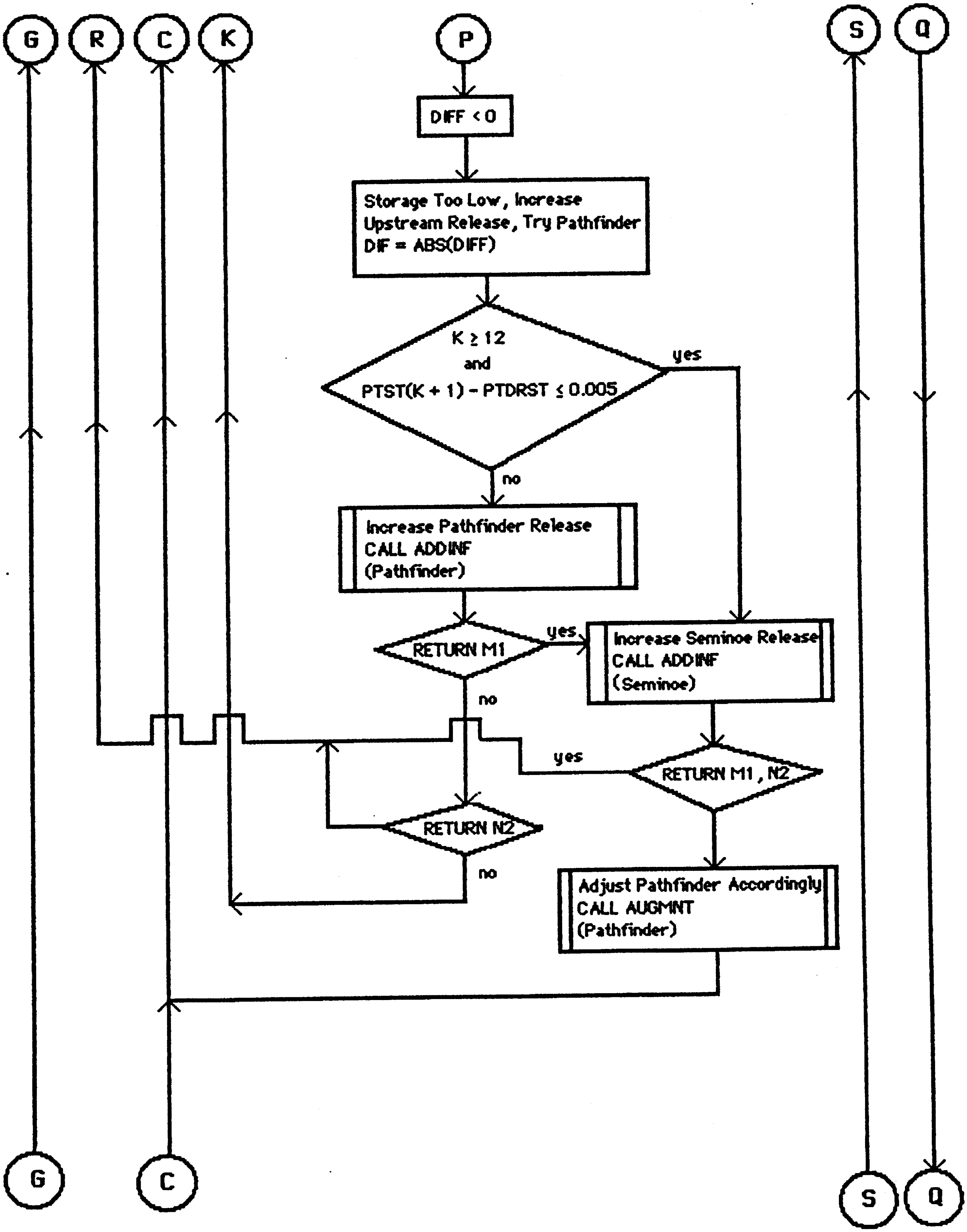
G
C
E
F
Check End of Year Storage
Pathfinder Spills, Reduce Seminoe Release
EXCES = PTSL(K)
K < 12
yes
no
CALL REDINF (Seminoe)
IAC. NE. 0
yes
no
RETURN M1, N2
yes
no
SEST(13) + PTST(13) > PSENST
YES
NO
Cannot Reduce Seminoe Flow, Increase Pathfinder Bypass
CALL AUGMNT (Pathfinder)
ABS(PTST(13) - PTSR(12)) < 0.01
YES
NO
SEST(13) < SEDRST + 0.01
and
PTST (13) < PTSR(12) + .01
YES
NO
SETR(12) < SERLDR + 0.005
and
PTST(13) > PTSR(12)
yes
no
IPE = IPE + 1
yes
IPE = 0
no
CALL PTENDY
EXCES = PTST(13) - PTSR(12)
PTST 13 = PTST(13)
G
C
H
I

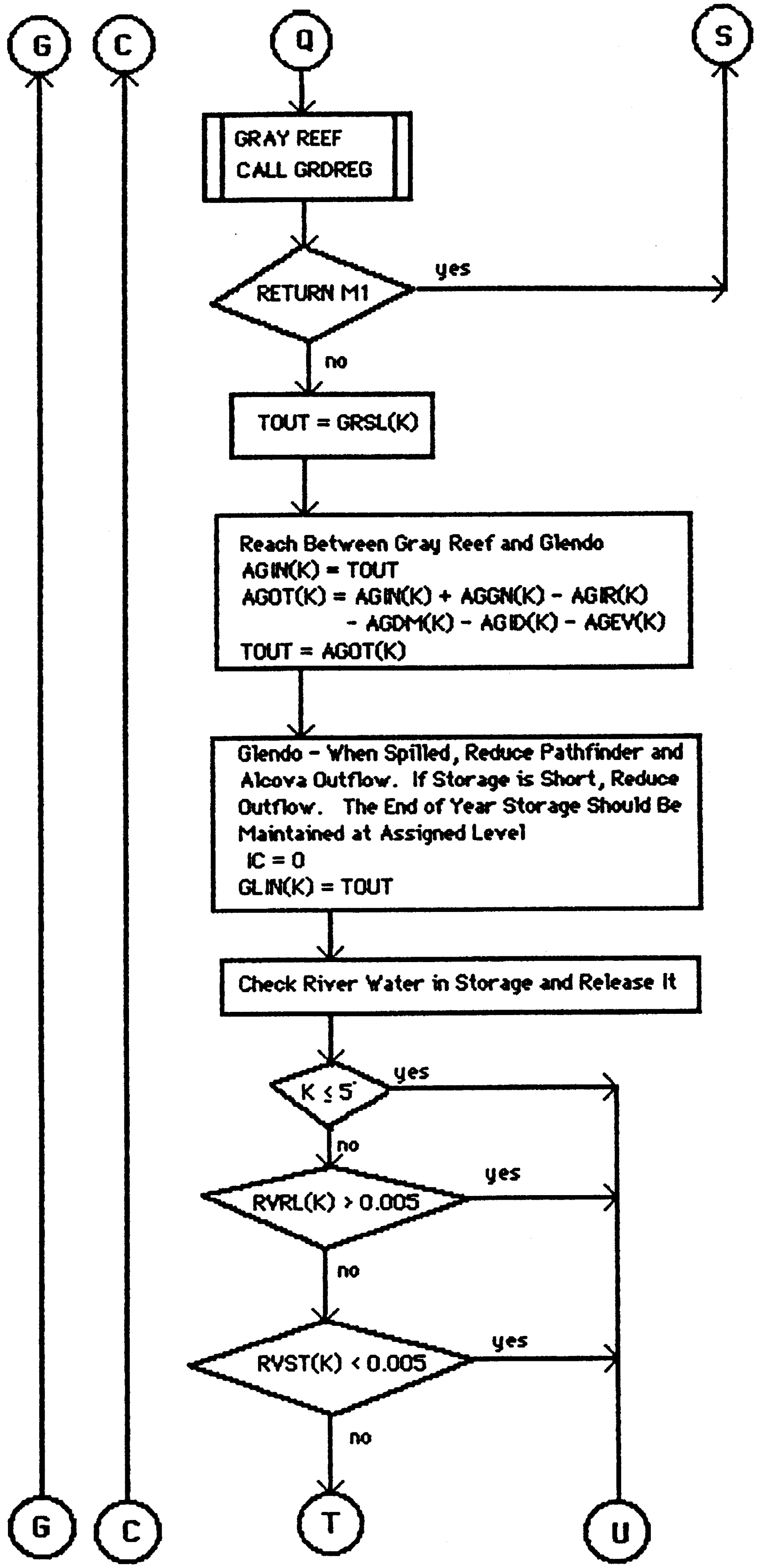

G
C
H
I
EXCES < 0
yes
EXCES = ABS(EXCES)
no
CALL ADDINF (Seminoe)
RETURN M1, N2
yes
no
EXCES > 0
YES
SETR(K) < SERLDR + 0.005
yes
no
CALL REDINF (Seminoe)
RETURN M1, N2
yes
no
Fremont Canyon Power Plant FCTR(K) = PTTR(K)
Check Min. Release at Pathfinder - Alcova Reach CALL PTMFCK (Pathfinder)
RETURN M1
yes
no
C
J

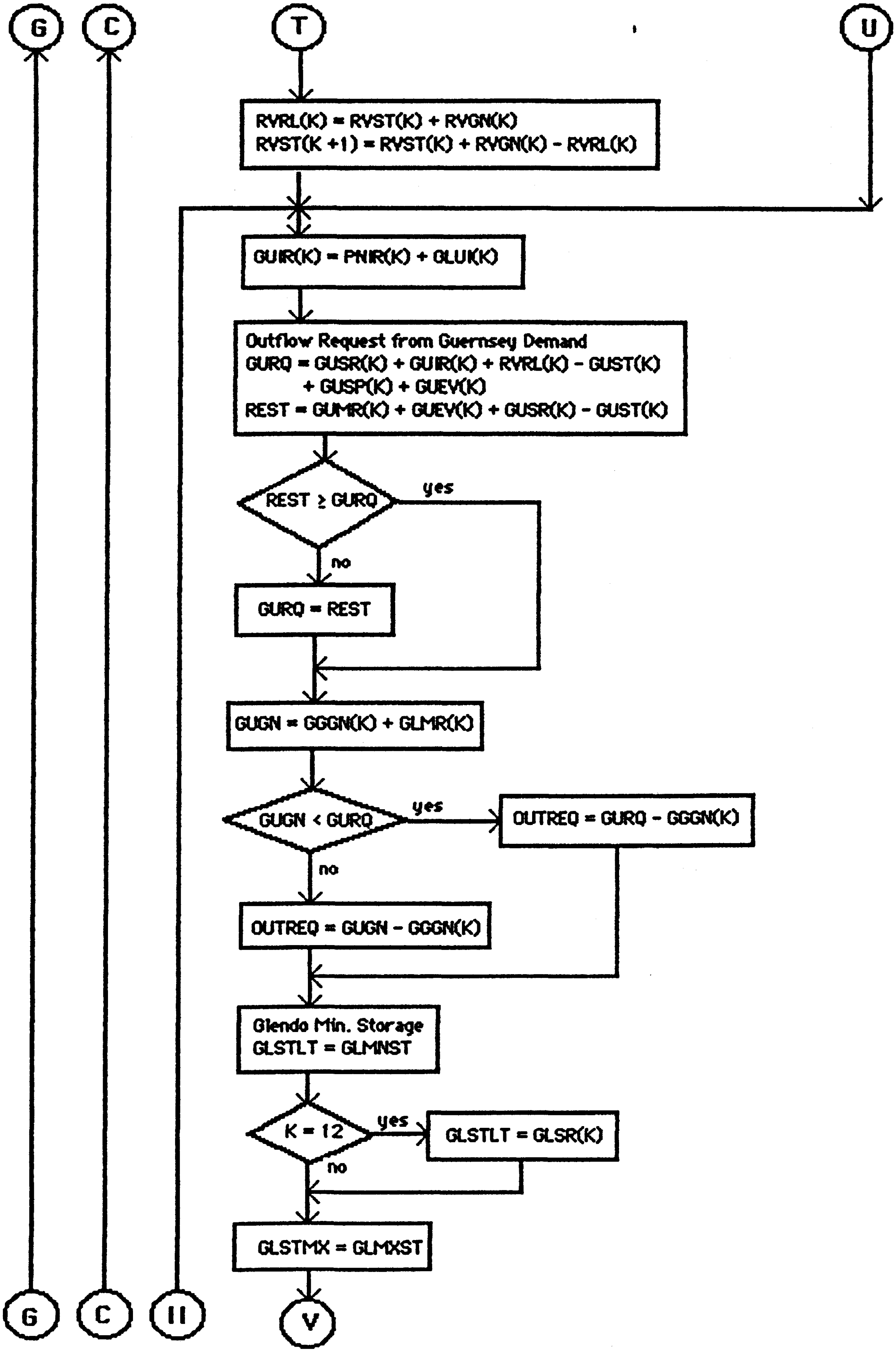

G
C
J
Total Release from Pathfinder
TOUT = PTTR(K) + PTSL(K) + PTRL(K)
PTST(K + 1) = PTST(K) + PTIN(K) - PTTR(K) - PTRL(K)
- PTSL (K) - PTSP(K) - PTEV(K)
CALL PTPGAD
(Pathfinder)
Alcova - Monthly Reservoir Content Maintained
at Assigned Level
ALIN(K) = TOUT
ALIR(K) = DKIR(K)
Check Storage with Assigned Value
ABS(ALST(K + 1) - ALSR(K) < 0.005
yes
no
Storage Not a Required Level (ALSR)
DIFF = ALST(K +1) - ALSR(K)
Upstream Dry, Adjust Alcova Outflow
ISD. NE. 0
yes
no!
DIFF > 0
yes
Storage Too High, Reduce
Upstream Release, Try
Pathfinder
no
K ≥ 12
and
PTST(K +1) - PTDRST ≤ 0.005
yes
no
G
C
K
L
M
N

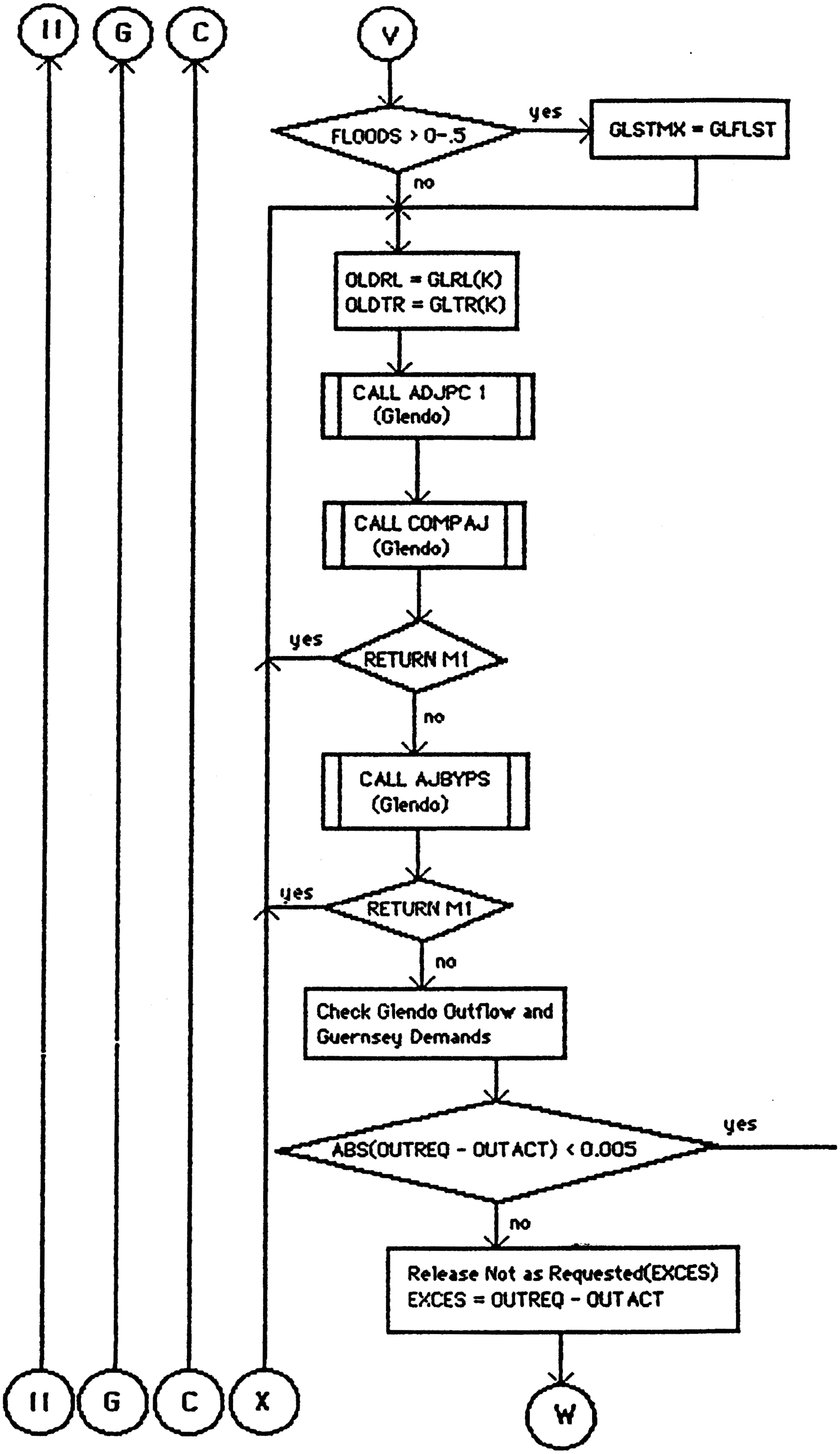

G
C
K
L
M
N
PTTR(K) < 0.005
yes
no
CALL REDINF (Pathfinder)
RETURN M1
yes
no
RETURN N2
yes
no
End of Year with Pathfinder Required to Maintain at 50,000 AF. Level, Reduce Inflow at Seminoe and Adjust Pathfinder Accordingly
IC = 1
CALL REDINF (Seminoe)
RETURN M1, N2
yes
no
IC. NE. 1
yes
no
IC = 0
G
C
K
O
N


G
C
K
O
N
CALL REDUCE
(Pathfinder)
Seminoe and Pathfinder Inadjustable, Adjust Outflow
ALTR(K) = ALTR(K) + DIFF
ALTR(K) ≥ 0
yes
ALST(K + 1) = ALSR(K)
no
ALST(K + 1) = ALSR(K) + ALTR(K)
ALTR(K) = 0
DIFF = 0
yes
no
CALL ALPWCM
CALL AJBYPS
(Alcova)
RETURN M1
yes
no
Total Release from Alcova
TOUT = ALTR(K) + ALSL(K) + ALSP(K) + ALRL(K)
ALST(K + 1) = ALST(K) + ALIN(K) - ALIR(K)
- ALTR(K) - ALID - ALDM(K)
- ALRL(K) - ALEV(K) - ALSP(K) -
ALSL(K)
G
R
K
C
P
Q
S

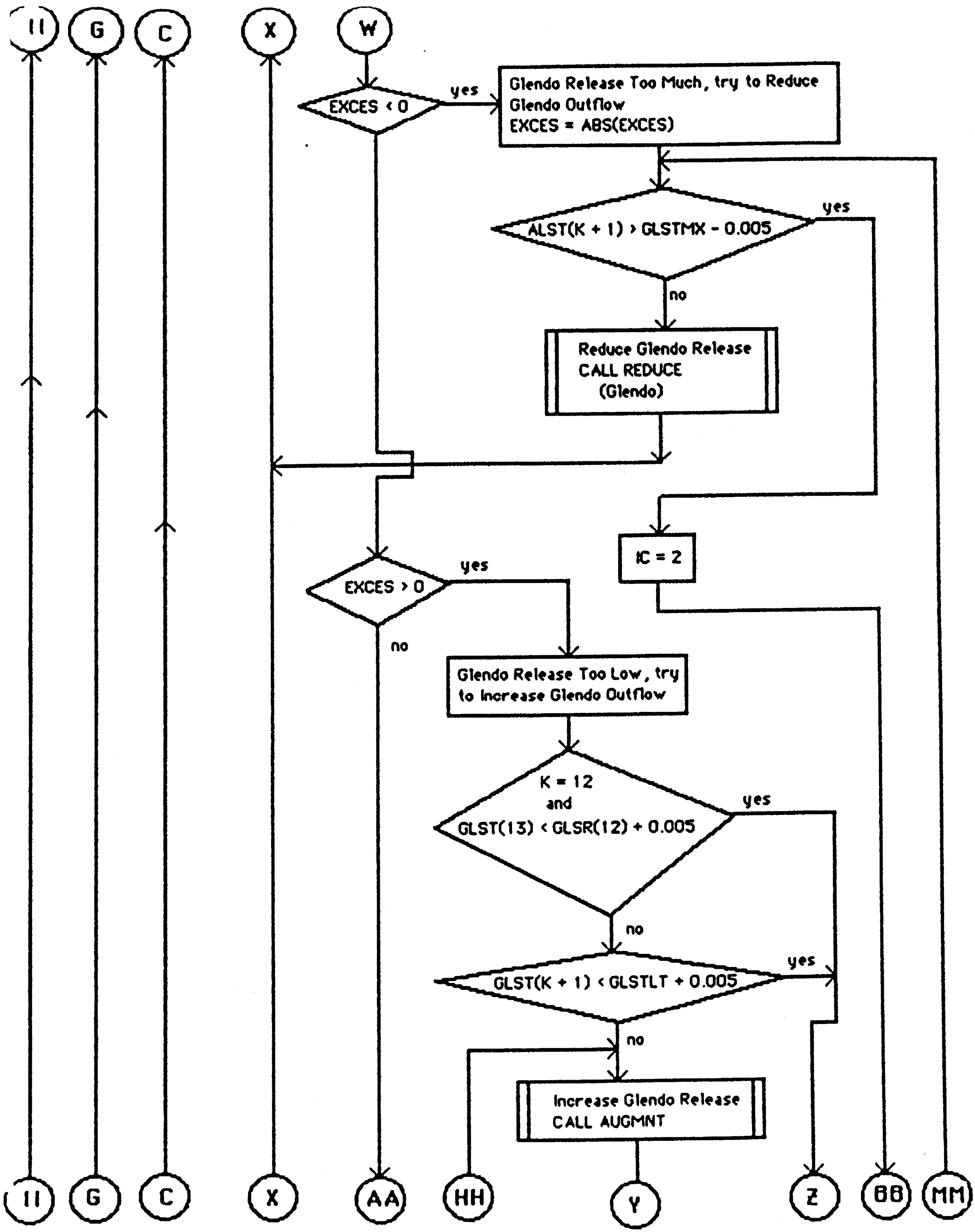

G
R
C
K
P
S
Q
DIFF < 0
Storage Too Low, Increase Upstream Release, Try Pathfinder DIF = ABS(DIFF)
K ≥ 12 and PTST(K + 1) – PTDRST ≤ 0.005
yes
no
Increase Pathfinder Release CALL ADDINF (Pathfinder)
RETURN M1
yes
no
Increase Seminoe Release CALL ADDINF (Seminoe)
yes
RETURN M1, N2
RETURN N2
no
Adjust Pathfinder Accordingly CALL AUGMNT (Pathfinder)
G
C
S
Q

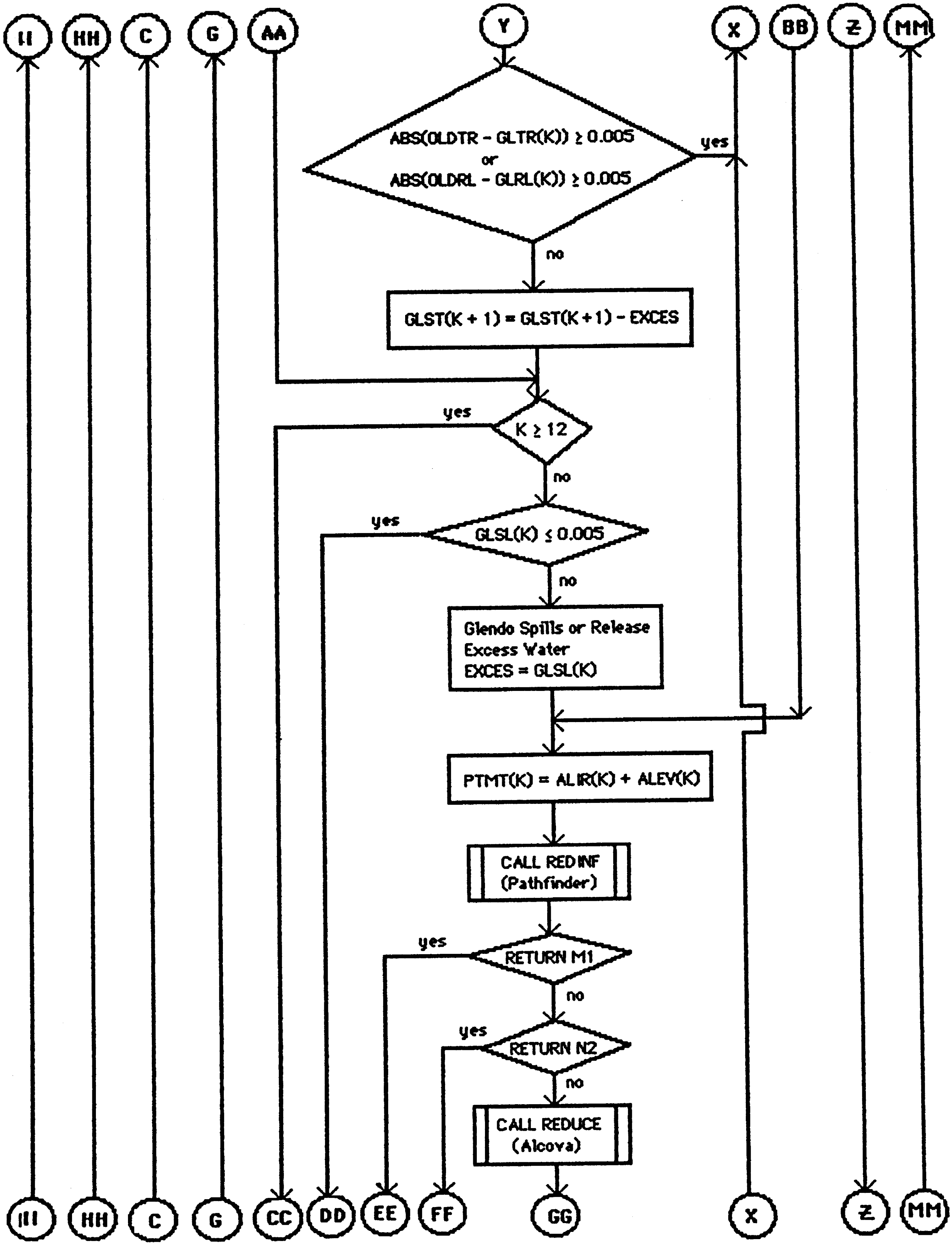

G
C
Q
S
GRAY REEF
CALL GRDREG
RETURN M1
yes
no
TOUT = GRSL(K)
Reach Between Gray Reef and Glendo
AGIN(K) = TOUT
AGOT(K) = AGIN(K) + AGGN(K) - AGIR(K)
- AGDM(K) - AGID(K) - AGEV(K)
TOUT = AGOT(K)
Glendo - When Spilled, Reduce Pathfinder and Alcova Outflow. If Storage is Short, Reduce Outflow. The End of Year Storage Should Be Maintained at Assigned Level
IC = 0
GLIN(K) = TOUT
Check River Water in Storage and Release It
K ≤ 5
yes
no
RVRL(K) > 0.005
yes
no
RVST(K) < 0.005
yes
no
G
C
T
U

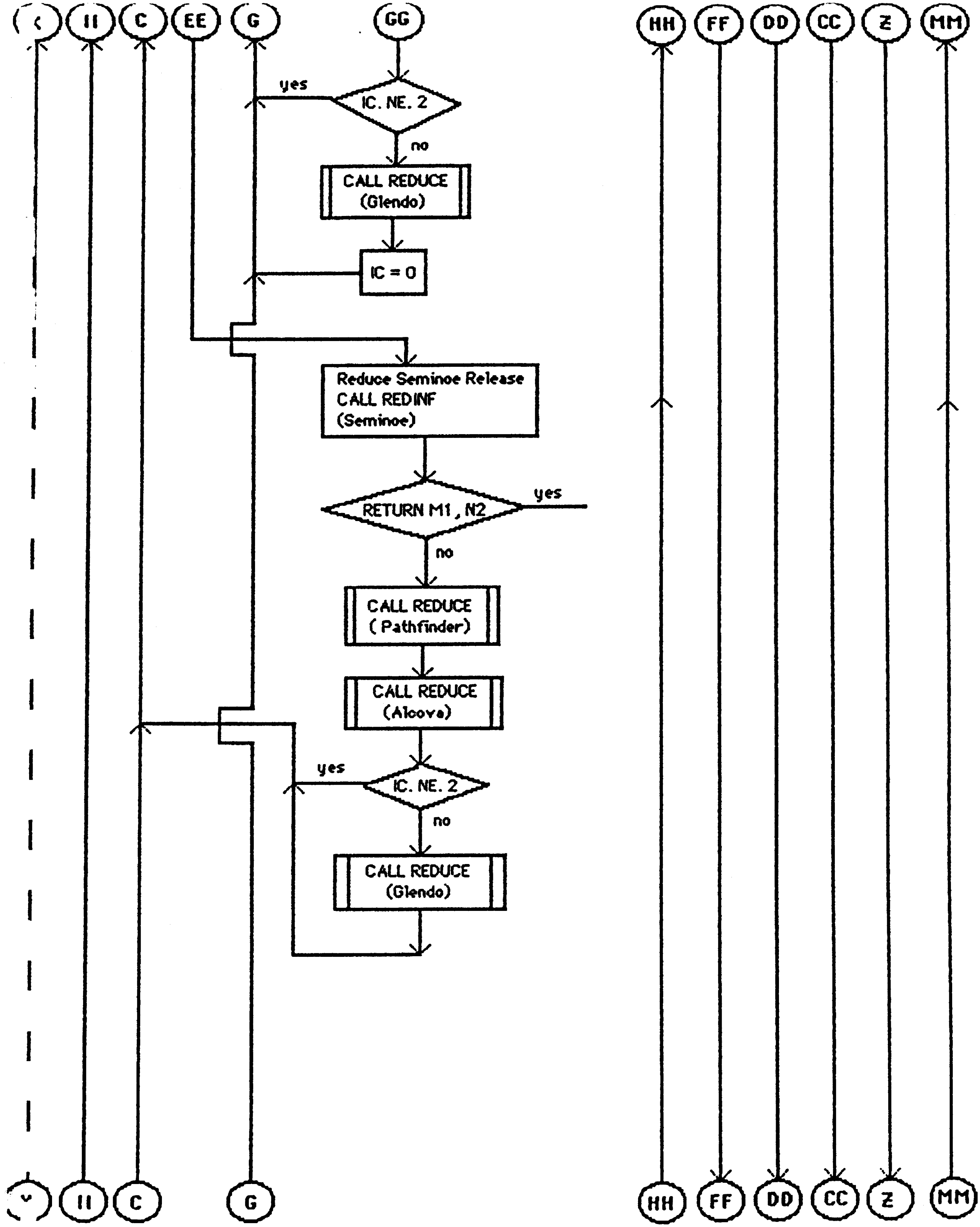

G
C
T
U
RVRL(K) = RVST(K) + RVGN(K)
RVST(K +1) = RVST(K) + RVGN(K) - RVRL(K)
GUIR(K) = PNIR(K) + GLUK(K)
Outflow Request from Guernsey Demand
GURQ = GUSR(K) + GUIR(K) + RVRL(K) - GUST(K) + GUSP(K) + GUEV(K)
REST = GUMR(K) + GUEV(K) + GUSR(K) - GUST(K)
REST ≥ GURQ
yes
no
GURQ = REST
GUGN = GGGN(K) + GLMR(K)
GUGN < GURQ
yes
OUTREQ = GURQ - GGGN(K)
no
OUTREQ = GUGN - GGGN(K)
Glendo Min. Storage
GLSTLT = GLMNST
K = 12
yes
GLSTLT = GLSR(K)
no
GLSTMX = GLMXST
G
C
II
V

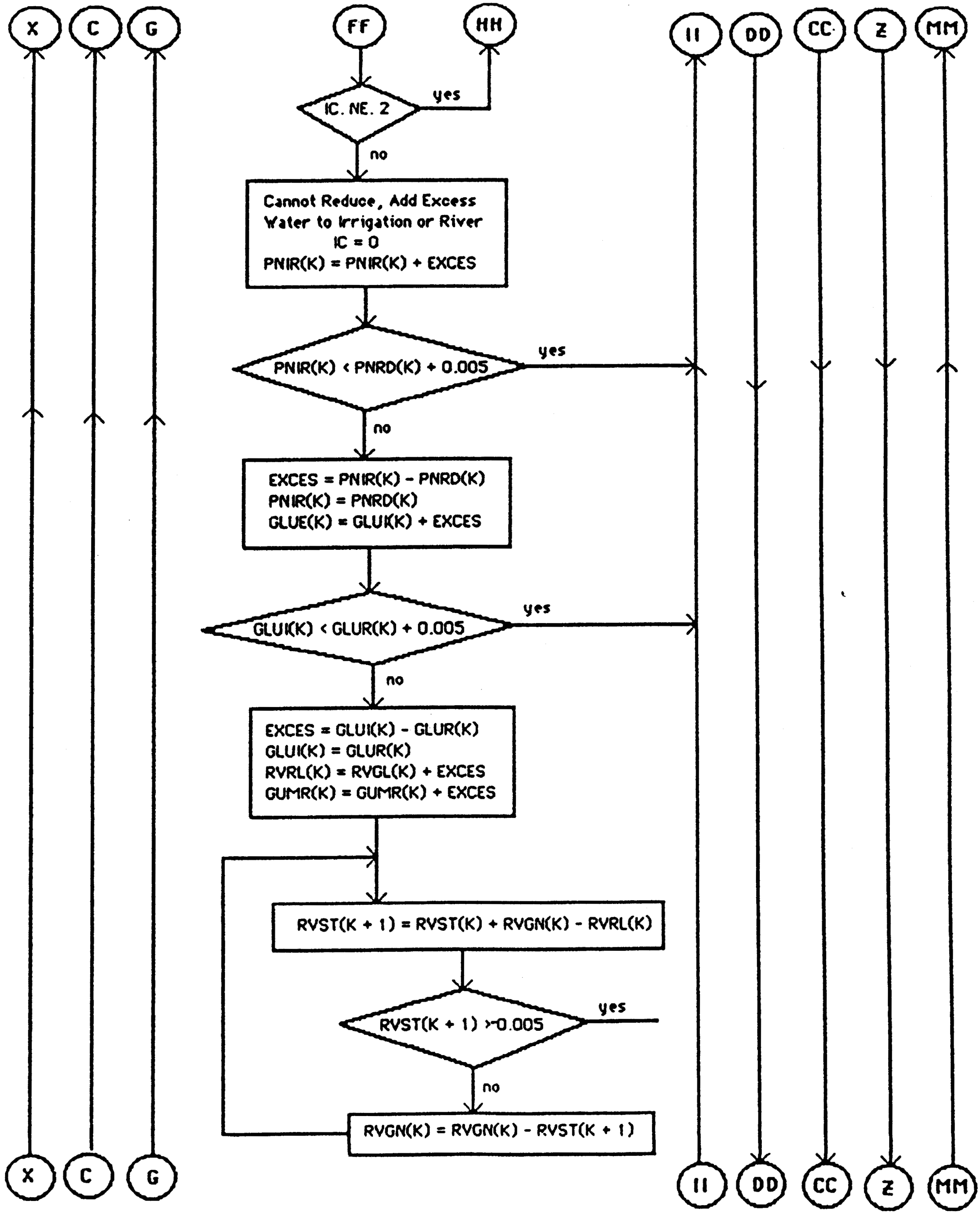


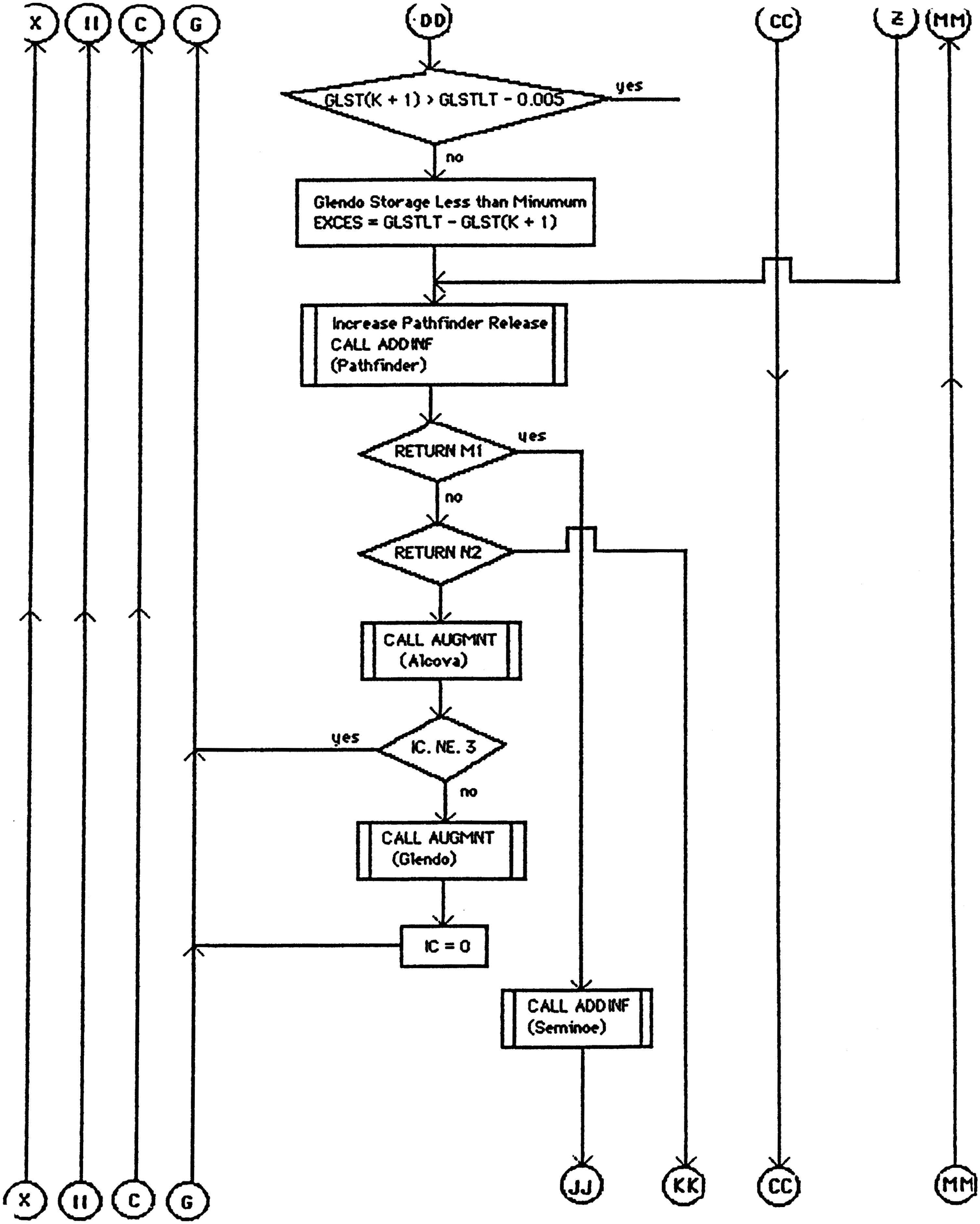
II
G
C
V
FLOODS > 0-.5
yes
GLSTMX = GLFLST
no
OLDRL = GLRL(K)
OLDTR = GLTR(K)
CALL ADJPC 1
(Glendo)
CALL COMPAJ
(Glendo)
yes
RETURN M1
no
CALL AJBYPS
(Glendo)
yes
RETURN M1
no
Check Glendo Outflow and
Guernsey Demands
ABS(OUTREQ - OUTACT) < 0.005
yes
no
Release Not as Requested(EXCES)
EXCES = OUTREQ - OUTACT
II
G
C
X
W

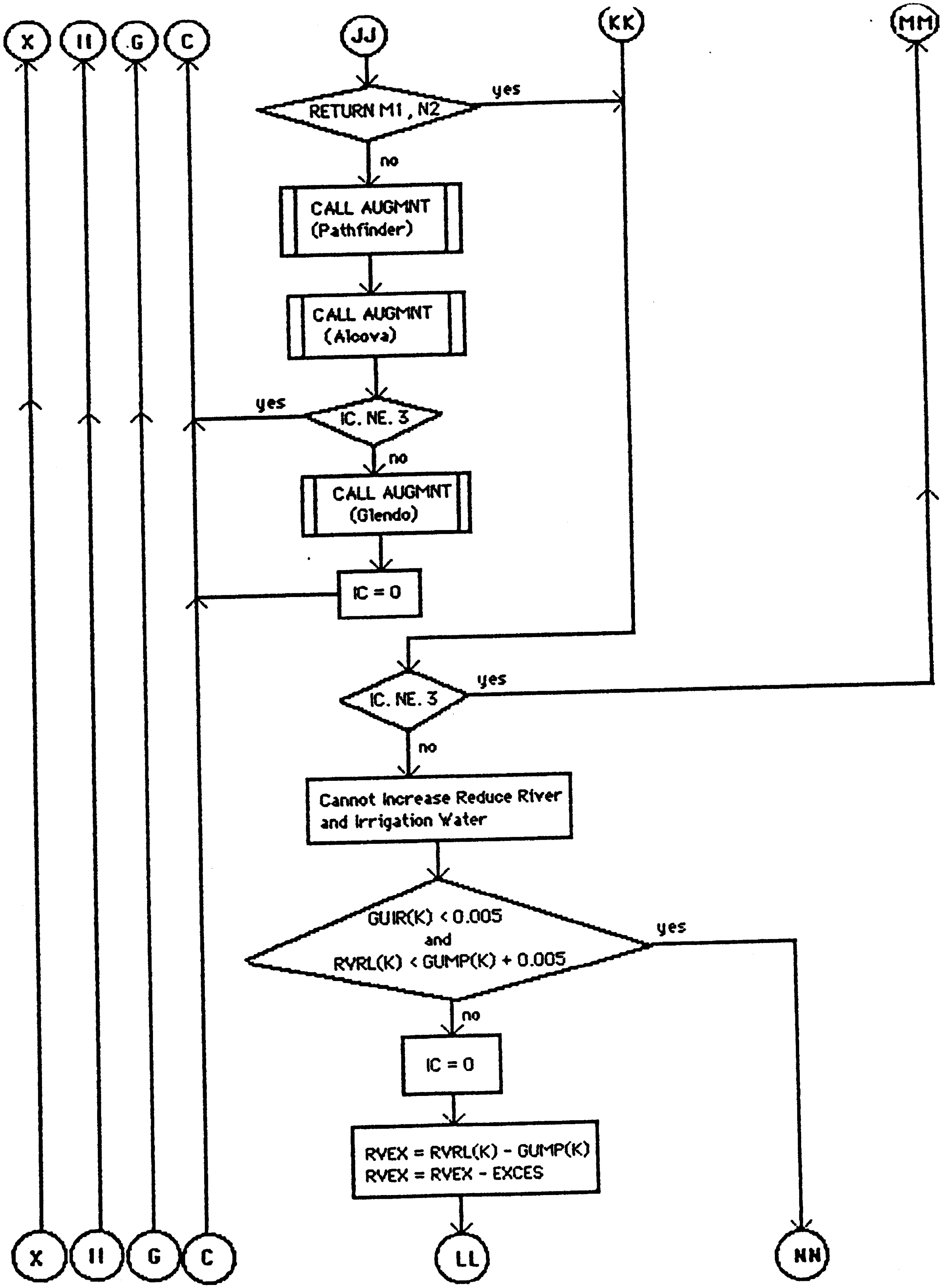

II
G
C
X
W
EXCES < 0
yes
Glendo Release Too Much, try to Reduce Glendo Outflow
EXCES = ABS(EXCES)
yes
ALST(K + 1) > GLSTMX - 0.005
no
Reduce Glendo Release
CALL REDUCE
(Glendo)
IC = 2
yes
EXCES > 0
no
Glendo Release Too Low, try to Increase Glendo Outflow
K = 12
and
GLST(13) < GLSR(12) + 0.005
yes
no
yes
GLST(K + 1) < GLSTLT + 0.005
no
Increase Glendo Release
CALL AUGMNT
II
G
C
X
AA
HH
Y
Z
BB
MM

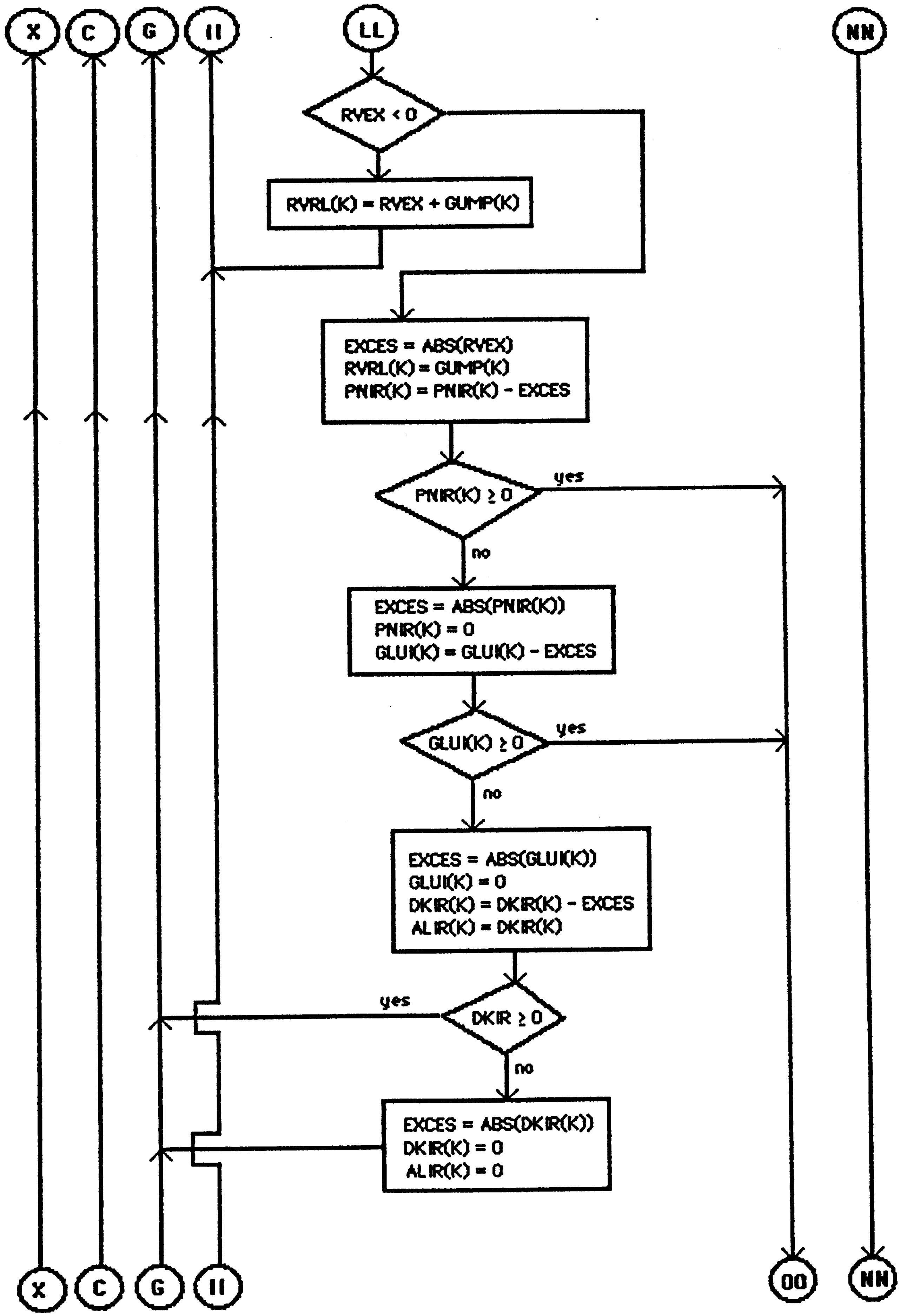

II
HH
C
G
AA
Y
X
BB
Z
MM
ABS(OLDTR - GLTR(K)) ≥ 0.005
or
ABS(OLDRL - GLRL(K)) ≥ 0.005
yes
no
GLST(K + 1) = GLST(K + 1) - EXCES
yes
K ≥ 12
no
yes
GLSL(K) ≤ 0.005
no
Glendo Spills or Release
Excess Water
EXCES = GLSL(K)
PTMT(K) = ALIR(K) + ALEV(K)
CALL REDINF
(Pathfinder)
yes
RETURN M1
no
yes
RETURN N2
no
CALL REDUCE
(Alcova)
III
HH
C
G
CC
DD
EE
FF
GG
X
Z
MM


GG
IC. NE. 2
yes
no
CALL REDUCE (Glendo)
IC = 0
EE
G
C
II
HH
FF
DD
CC
Z
MM
Reduce Seminoe Release CALL REDINF (Seminoe)
RETURN M1, N2
yes
no
CALL REDUCE (Pathfinder)
CALL REDUCE (Alcova)
IC. NE. 2
yes
no
CALL REDUCE (Glendo)

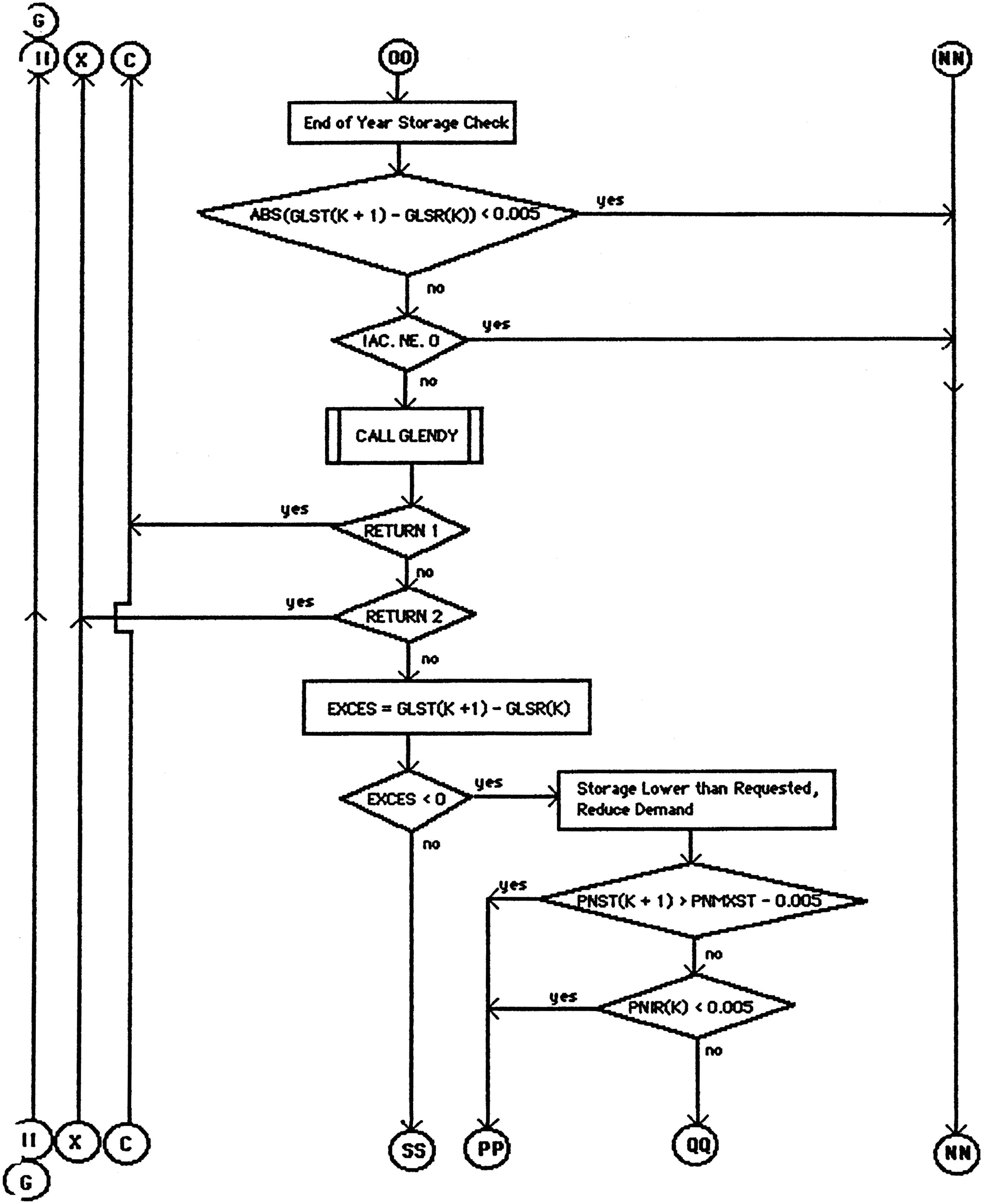

X
C
G
FF
HH
II
DD
CC
Z
MM
IC. NE. 2
yes
no
Cannot Reduce, Add Excess Water to Irrigation or River
IC = 0
PNIR(K) = PNIR(K) + EXCES
PNIR(K) < PNRD(K) + 0.005
yes
no
EXCES = PNIR(K) - PNRD(K)
PNIR(K) = PNRD(K)
GLUE(K) = GLUI(K) + EXCES
GLUI(K) < GLUR(K) + 0.005
yes
no
EXCES = GLUI(K) - GLUR(K)
GLUI(K) = GLUR(K)
RVRL(K) = RVGL(K) + EXCES
GUMR(K) = GUMR(K) + EXCES
RVST(K + 1) = RVST(K) + RVGN(K) - RVRL(K)
RVST(K + 1) >-0.005
yes
no
RVGN(K) = RVGN(K) - RVST(K + 1)
X
C
G
II
DD
CC
Z
MM

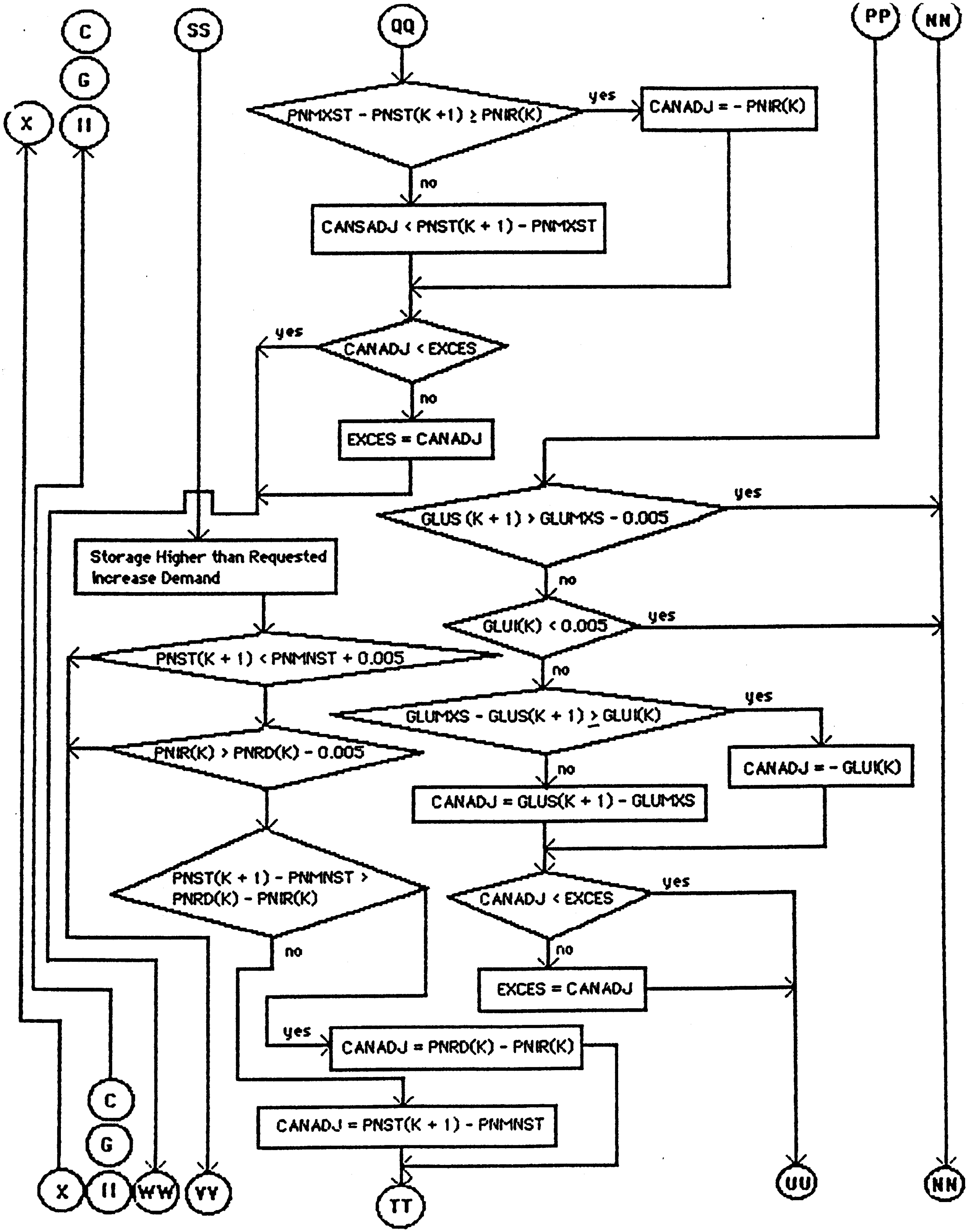

X
II
C
G
DD
CC
Z
MM
GLST(K + 1) > GLSTLT - 0.005
yes
no
Glendo Storage Less than Minumum
EXCES = GLSTLT - GLST(K + 1)
Increase Pathfinder Release
CALL ADDINF
(Pathfinder)
RETURN M1
yes
no
RETURN N2
CALL AUGMNT
(Alcova)
IC. NE. 3
yes
no
CALL AUGMNT
(Glendo)
IC = 0
CALL ADDINF
(Seminoe)
X
II
C
G
JJ
KK
CC
MM

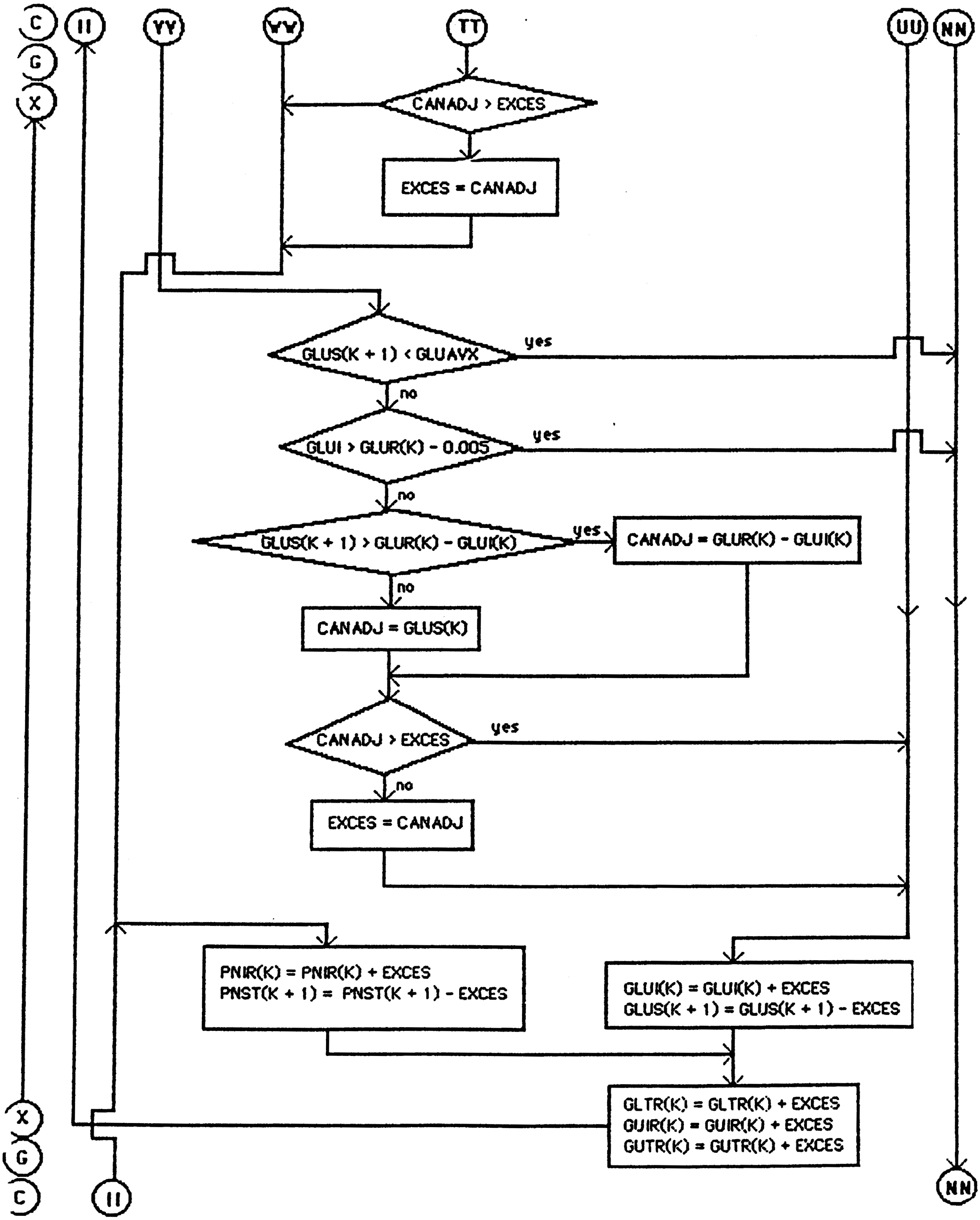

X
II
G
C
JJ
KK
MM
RETURN M1, N2
yes
no
CALL AUGMNT
(Pathfinder)
CALL AUGMNT
(Alcova)
IC. NE. 3
yes
no
CALL AUGMNT
(Glendo)
IC = 0
IC. NE. 3
yes
no
Cannot Increase Reduce River and Irrigation Water
GUIR(K) < 0.005
and
RVRL(K) < GUMP(K) + 0.005
yes
no
IC = 0
RVEX = RVRL(K) - GUMP(K)
RVEX = RVEX - EXCES
X
II
G
C
LL
NN

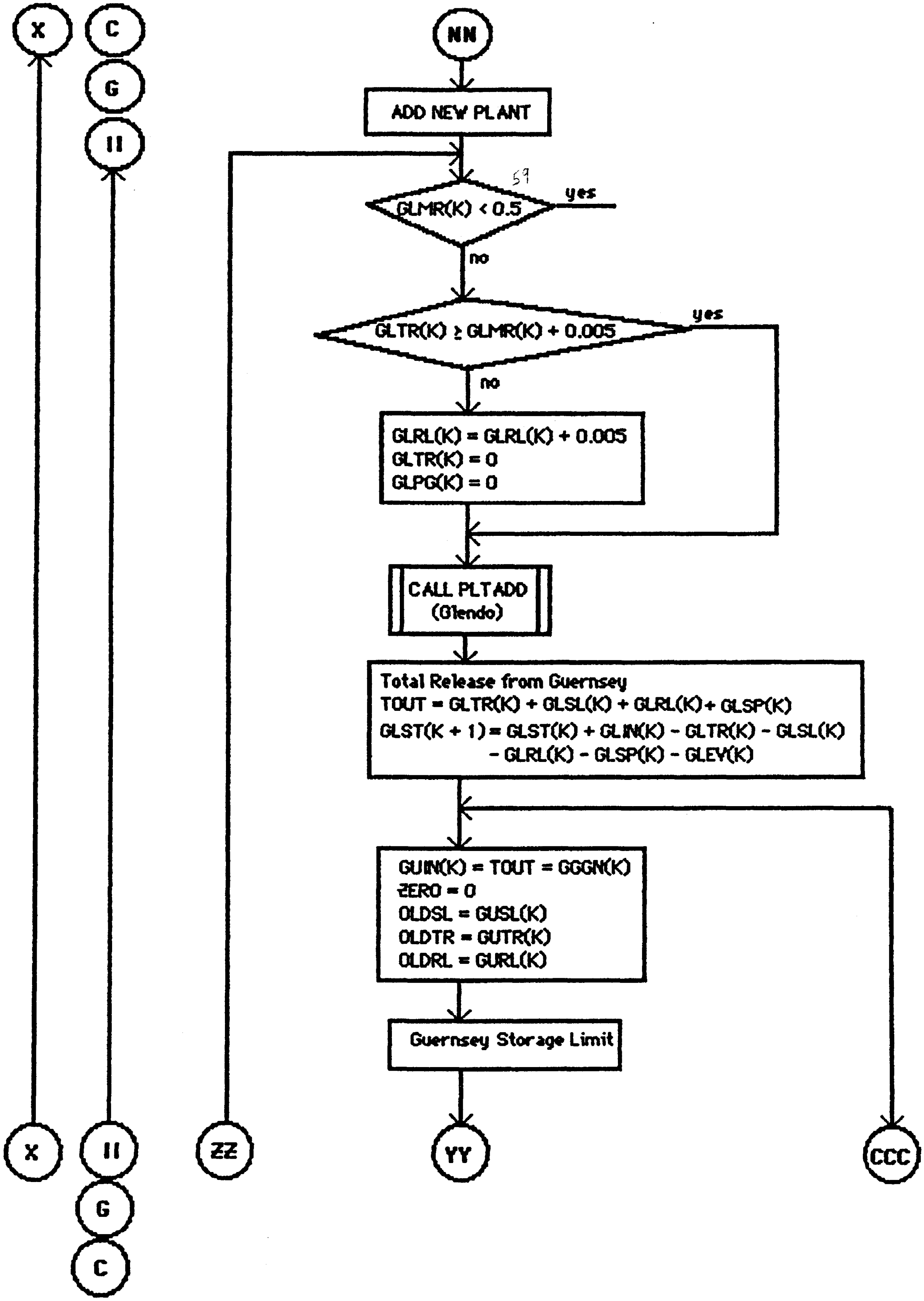


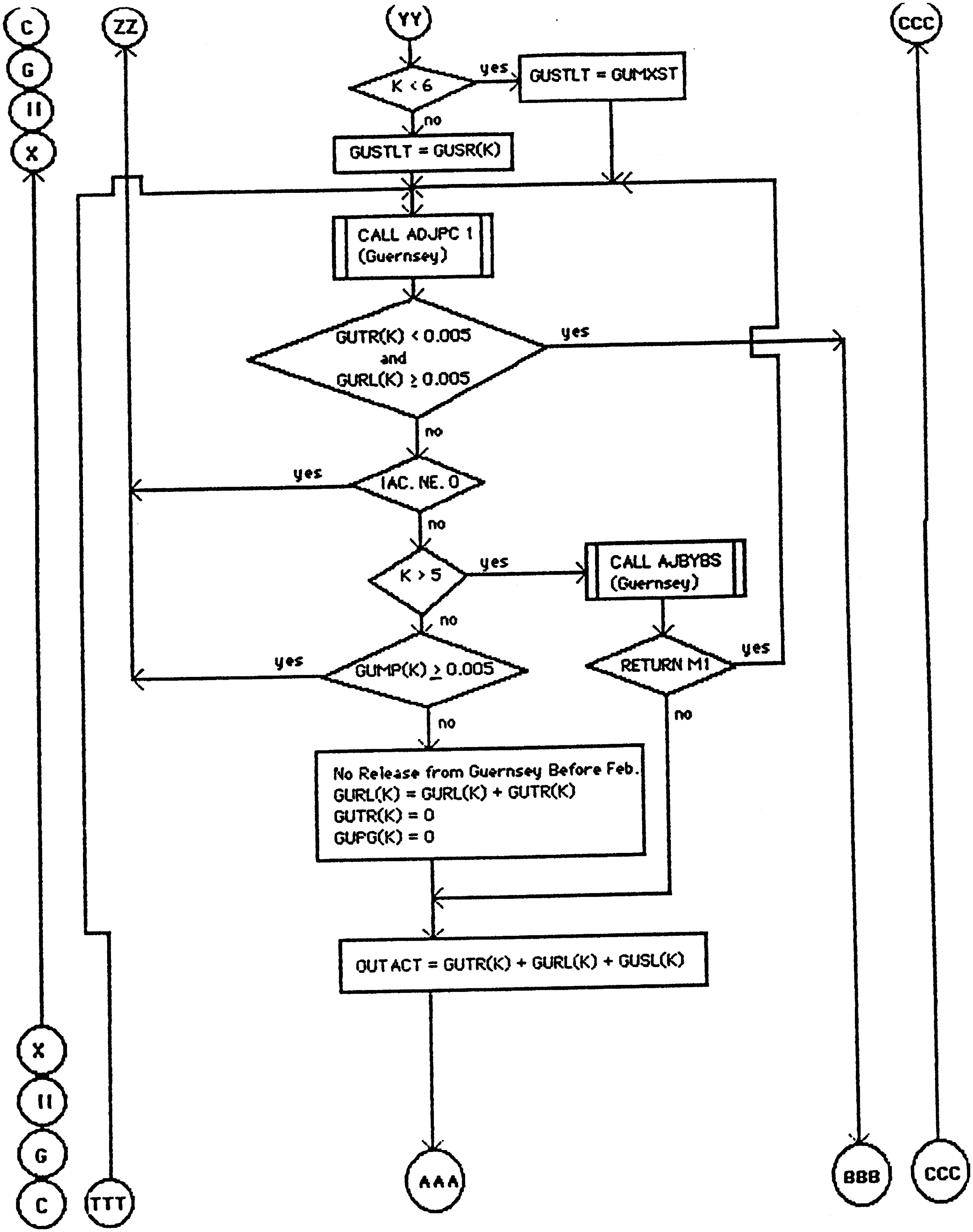
X
C
G
II
LL
NN
RVEX < 0
RVRL(K) = RVEX + GUMP(K)
EXCES = ABS(RVEX)
RVRL(K) = GUMP(K)
PNIR(K) = PNIR(K) - EXCES
PNIR(K) ≥ 0
yes
no
EXCES = ABS(PNIR(K))
PNIR(K) = 0
GLUI(K) = GLUI(K) - EXCES
GLUI(K) ≥ 0
yes
no
EXCES = ABS(GLUI(K))
GLUI(K) = 0
DKIR(K) = DKIR(K) - EXCES
ALIR(K) = DKIR(K)
DKIR ≥ 0
yes
no
EXCES = ABS(DKIR(K))
DKIR(K) = 0
ALIR(K) = 0
X
C
G
II
OO
NN

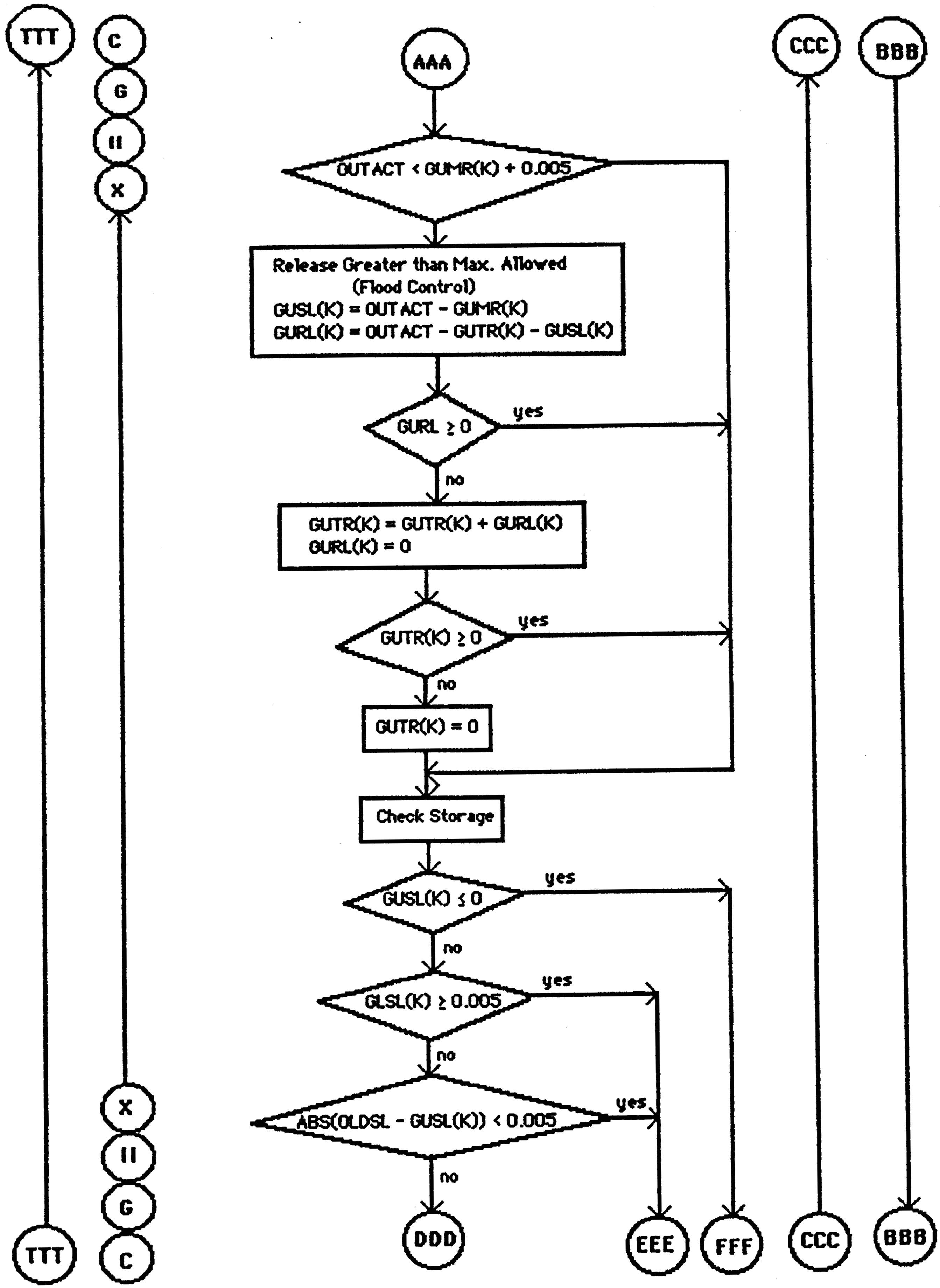

G
II
X
C
OO
NN
End of Year Storage Check
ABS(GLST(K + 1) - GLSR(K)) < 0.005
yes
no
IAC. NE. 0
yes
no
CALL GLENDY
yes
RETURN 1
no
yes
RETURN 2
no
EXCES = GLST(K +1) - GLSR(K)
EXCES < 0
yes
no
Storage Lower than Requested, Reduce Demand
yes
PNST(K + 1) > PNMXST - 0.005
no
yes
PNIR(K) < 0.005
no
II
X
C
G
SS
PP
QQ
NN

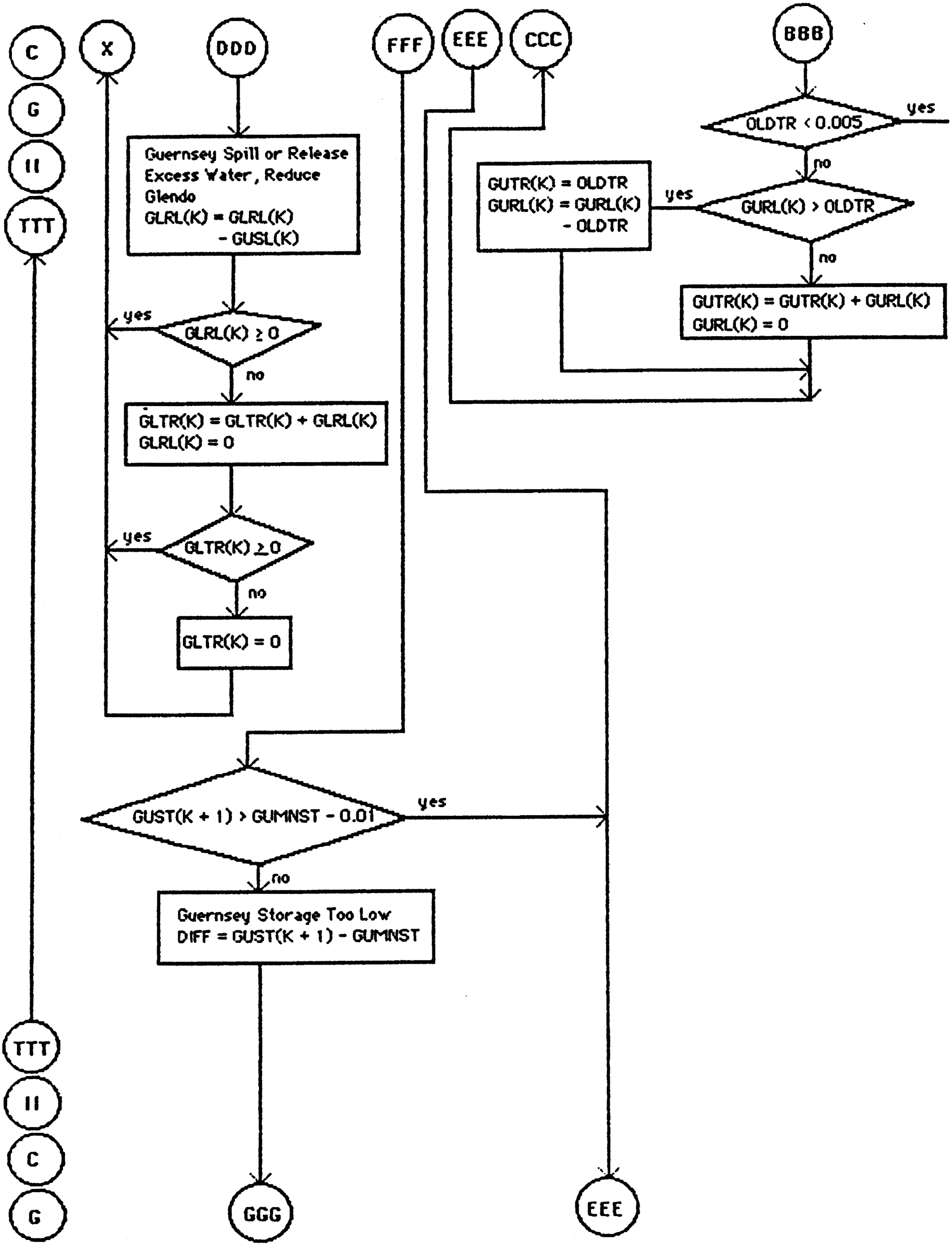

C
G
II
X
SS
QQ
PP
NN
PNMXST - PNST(K +1) ≥ PNIR(K)
yes
CANADJ = - PNIR(K)
no
CANSADJ < PNST(K + 1) - PNMXST
yes
CANADJ < EXCES
no
EXCES = CANADJ
GLUS (K + 1) > GLUMXS - 0.005
yes
no
Storage Higher than Requested
Increase Demand
GLUI(K) < 0.005
yes
no
PNST(K + 1) < PNMNST + 0.005
GLUMXS - GLUS(K + 1) ≥ GLUI(K)
yes
PNIR(K) > PNRD(K) - 0.005
no
CANADJ = - GLUI(K)
CANADJ = GLUS(K + 1) - GLUMXS
PNST(K + 1) - PNMNST >
PNRD(K) - PNIR(K)
CANADJ < EXCES
yes
no
no
EXCES = CANADJ
yes
CANADJ = PNRD(K) - PNIR(K)
C
G
CANADJ = PNST(K + 1) - PNMNST
X
II
WW
YY
TT
UU
NN

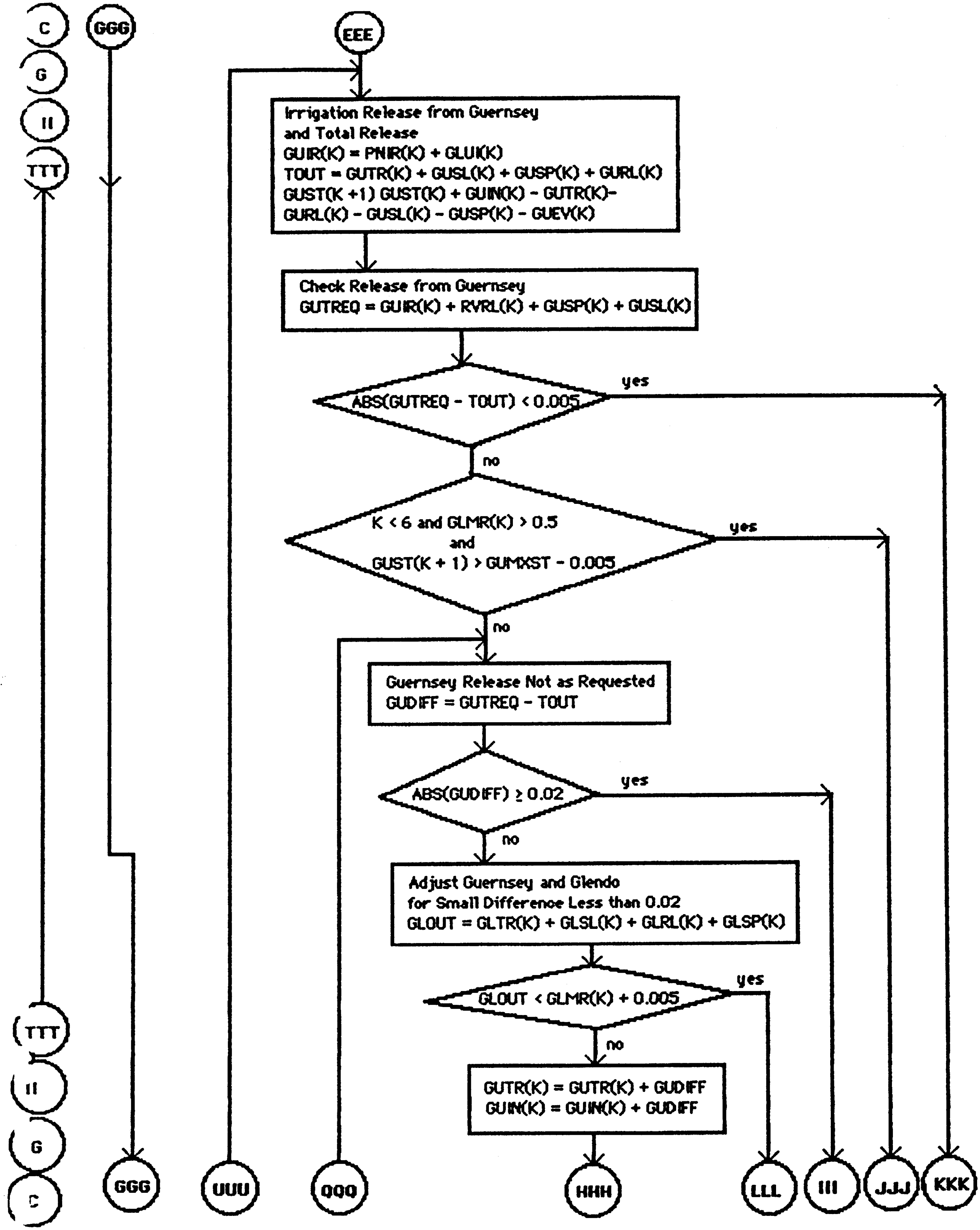

C
G
X
II
YY
WW
TT
UU
NN
CANADJ > EXCES
EXCES = CANADJ
GLUS(K + 1) < GLUAVX
yes
no
GLUI > GLUR(K) - 0.005
yes
no
GLUS(K + 1) > GLUR(K) - GLUI(K)
yes
CANADJ = GLUR(K) - GLUI(K)
no
CANADJ = GLUS(K)
CANADJ > EXCES
yes
no
EXCES = CANADJ
PNIR(K) = PNIR(K) + EXCES
PNST(K + 1) = PNST(K + 1) - EXCES
GLUI(K) = GLUI(K) + EXCES
GLUS(K + 1) = GLUS(K + 1) - EXCES
GLTR(K) = GLTR(K) + EXCES
GUIR(K) = GUIR(K) + EXCES
GUTR(K) = GUTR(K) + EXCES
X
G
C
II
NN


X
C
G
II
NN
ADD NEW PLANT
GLMR(K) < 0.5
yes
no
GLTR(K) ≥ GLMR(K) + 0.005
yes
no
GLRL(K) = GLRL(K) + 0.005
GLTR(K) = 0
GLPG(K) = 0
CALL PLTADD
(Glendo)
Total Release from Guernsey
TOUT = GLTR(K) + GLSL(K) + GLRL(K) + GLSP(K)
GLST(K + 1) = GLST(K) + GLIN(K) - GLTR(K) - GLSL(K) - GLRL(K) - GLSP(K) - GLEV(K)
GUIN(K) = TOUT = GGGN(K)
ZERO = 0
OLDSL = GUSL(K)
OLDTR = GUTR(K)
OLDRL = GURL(K)
Guernsey Storage Limit
X
II
G
C
ZZ
YY
CCC

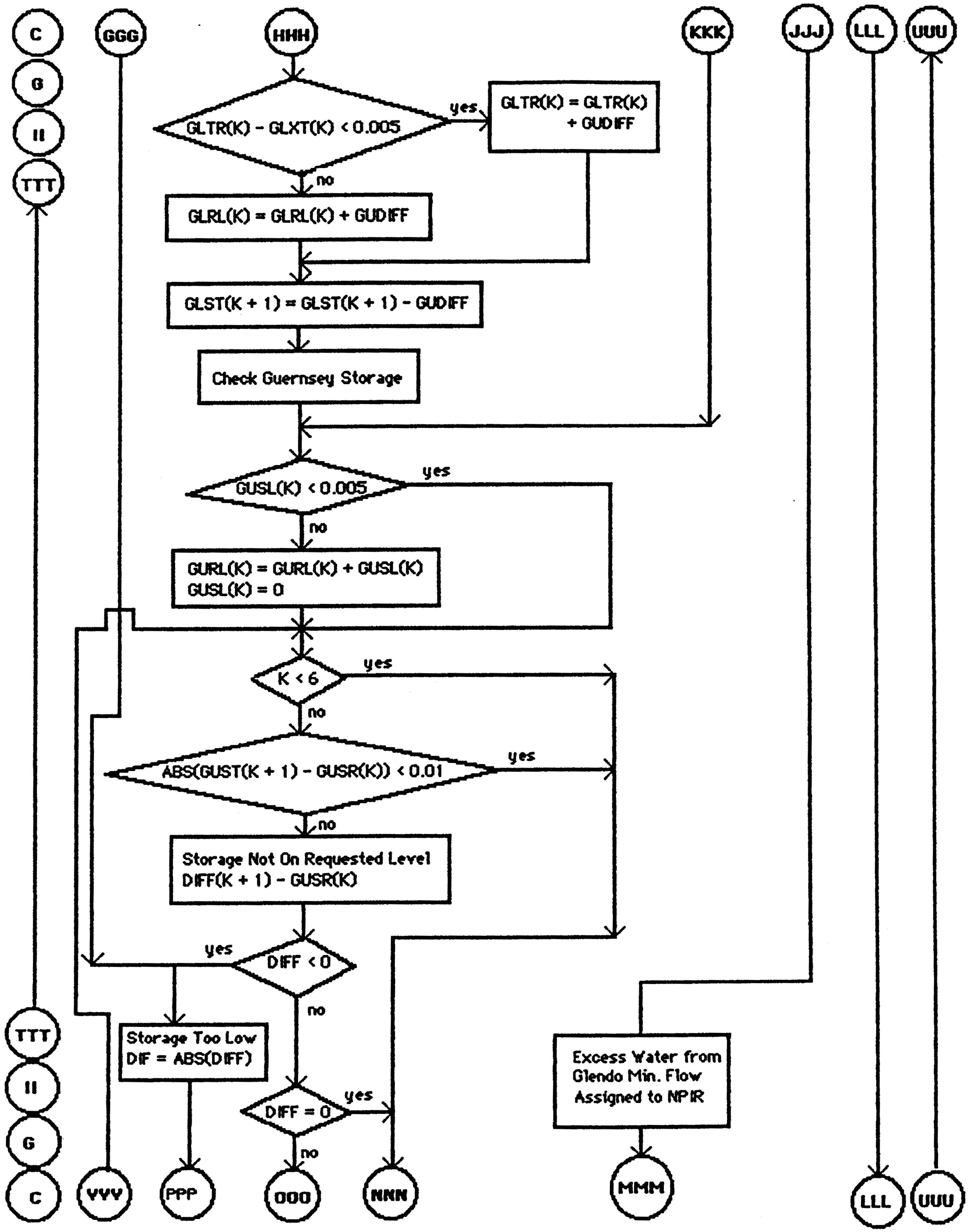

C
G
II
X
ZZ
YY
CCC
K < 6
yes
no
GUSTLT = GUMXST
GUSTLT = GUSR(K)
CALL ADJPC 1
(Guernsey)
GUTR(K) < 0.005
and
GURL(K) ≥ 0.005
yes
no
IAC. NE. 0
yes
no
K > 5
yes
no
CALL AJBYBS
(Guernsey)
GUMP(K) ≥ 0.005
yes
no
RETURN M1
yes
no
No Release from Guernsey Before Feb.
GURL(K) = GURL(K) + GUTR(K)
GUTR(K) = 0
GUPG(K) = 0
OUT ACT = GUTR(K) + GURL(K) + GUSL(K)
X
II
G
C
TTT
AAA
BBB
CCC

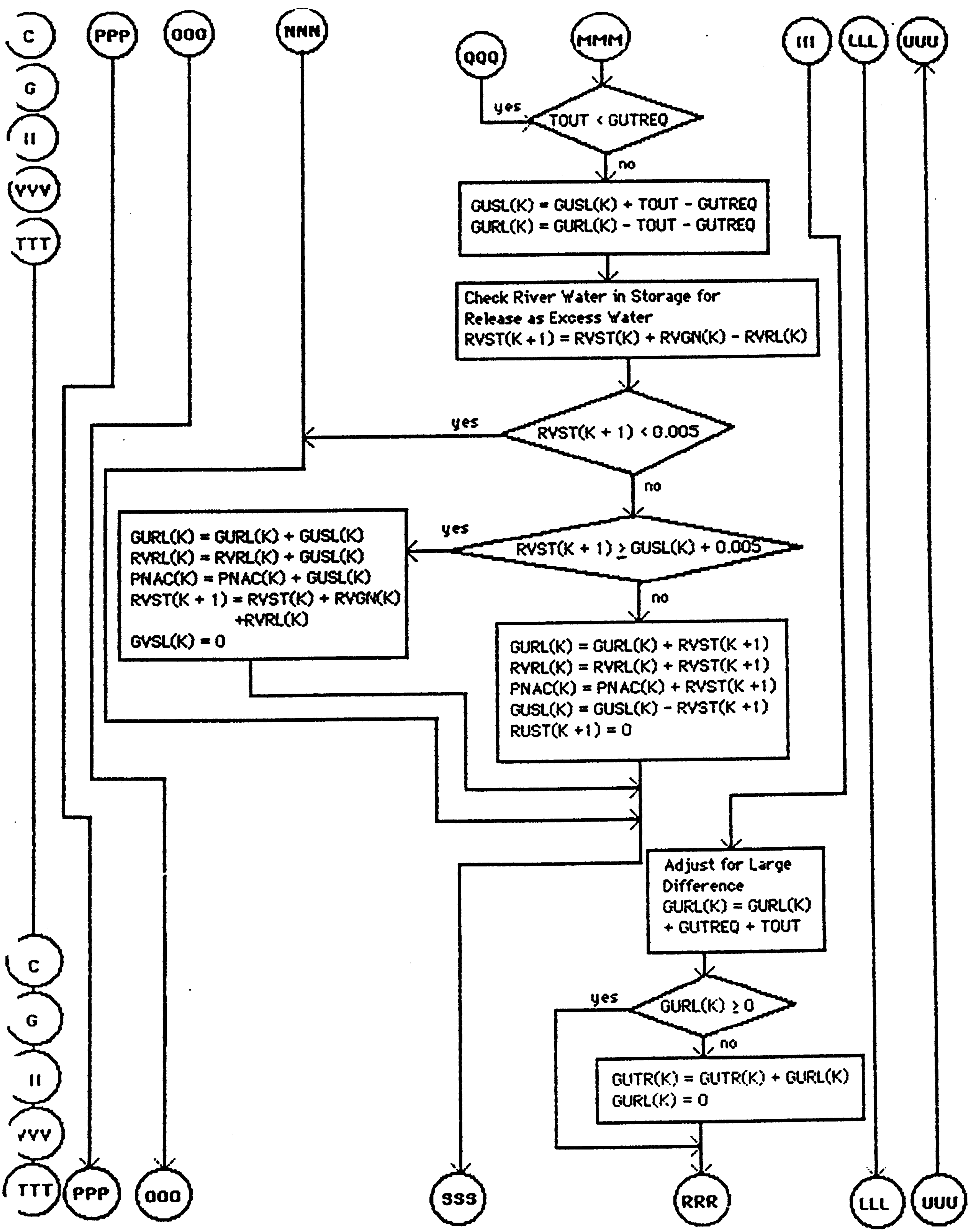

TTT
C
G
II
X
AAA
CCC
BBB
OUTACT < GUMR(K) + 0.005
Release Greater than Max. Allowed
(Flood Control)
GUSL(K) = OUTACT - GUMR(K)
GURL(K) = OUTACT - GUTR(K) - GUSL(K)
GURL ≥ 0
yes
no
GUTR(K) = GUTR(K) + GURL(K)
GURL(K) = 0
GUTR(K) ≥ 0
yes
no
GUTR(K) = 0
Check Storage
GUSL(K) ≤ 0
yes
no
GLSL(K) ≥ 0.005
yes
no
ABS(OLDSL - GUSL(K)) < 0.005
yes
no
X
II
G
C
TTT
DDD
EEE
FFF
CCC
BBB

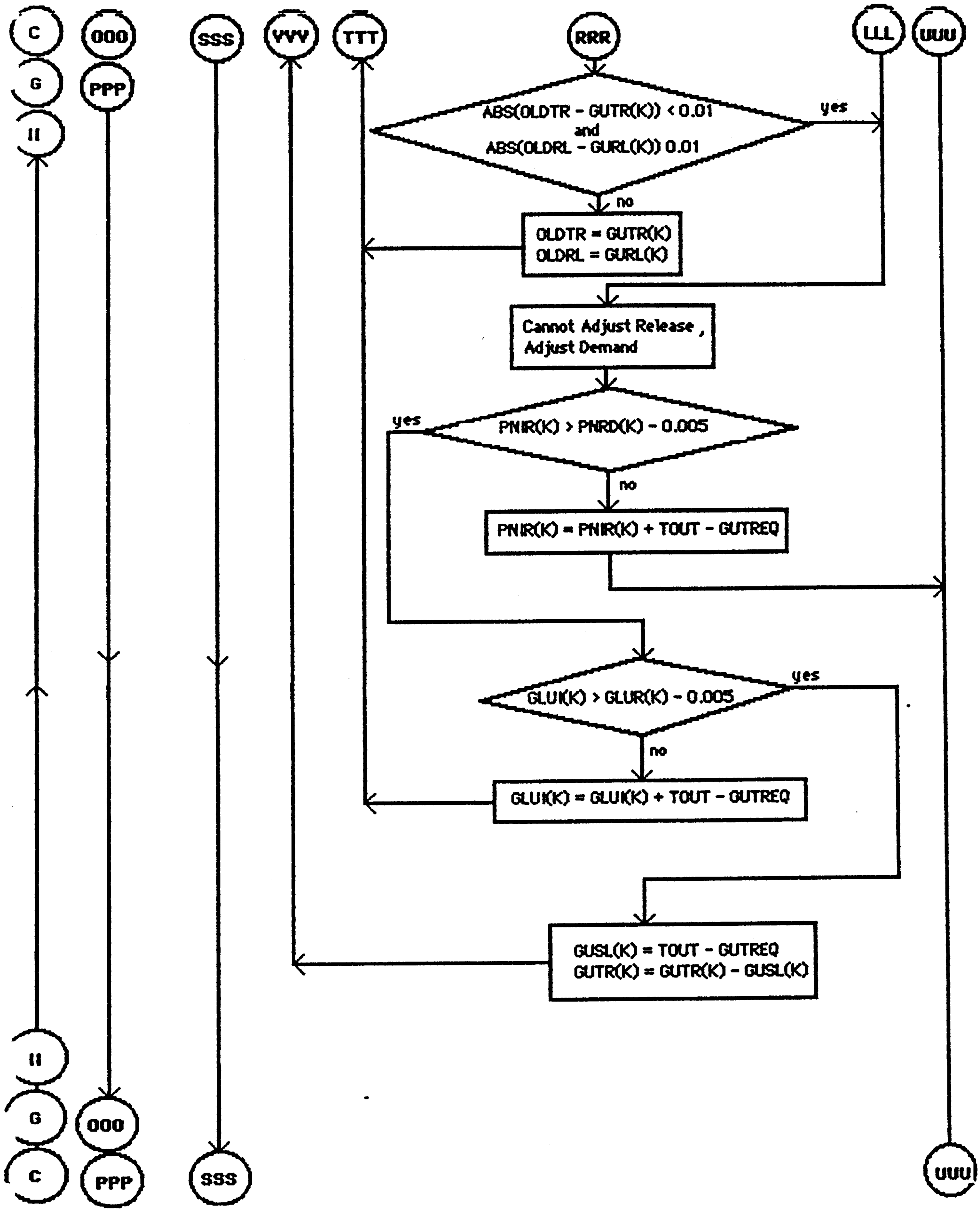

C
G
II
TTT
X
DDD
FFF
EEE
CCC
BBB
Guernsey Spill or Release Excess Water, Reduce Glendo
GLRL(K) = GLRL(K) - GUSL(K)
yes
GLRL(K) ≥ 0
no
GLTR(K) = GLTR(K) + GLRL(K)
GLRL(K) = 0
yes
GLTR(K) ≥ 0
no
GLTR(K) = 0
OLDTR < 0.005
yes
no
GUTR(K) = OLDTR
GURL(K) = GURL(K) - OLDTR
yes
GURL(K) > OLDTR
no
GUTR(K) = GUTR(K) + GURL(K)
GURL(K) = 0
GUST(K + 1) > GUMNST - 0.01
yes
no
Guernsey Storage Too Low
DIFF = GUST(K + 1) - GUMNST
TTT
II
C
G
GGG
EEE

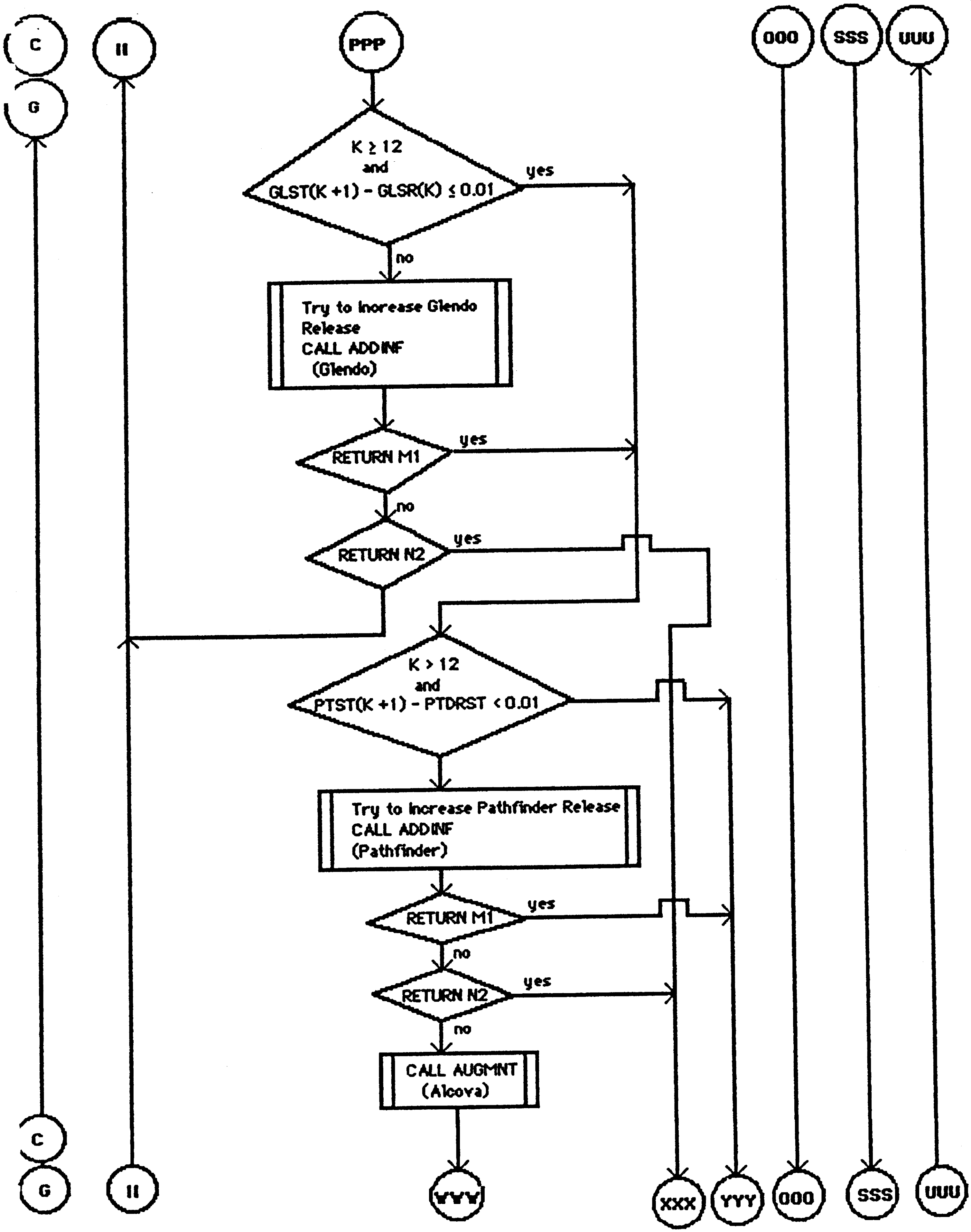


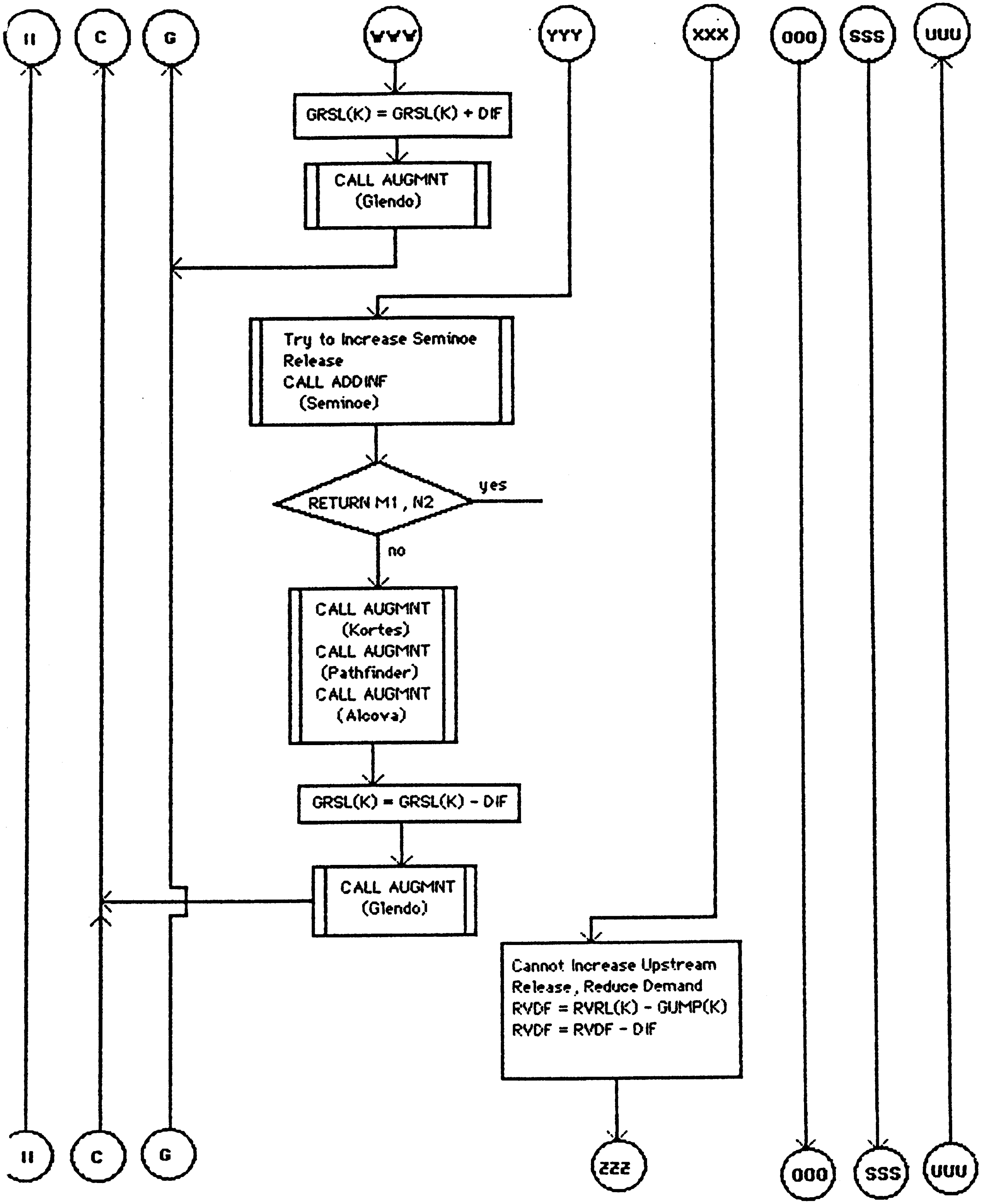
C
G
II
TTT
GGG
EEE
Irrigation Release from Guernsey
and Total Release
GUIR(K) = PNIR(K) + GLUI(K)
TOUT = GUTR(K) + GUSL(K) + GUSP(K) + GURL(K)
GUST(K +1) GUST(K) + GUIN(K) - GUTR(K)-
GURL(K) - GUSL(K) - GUSP(K) - GUEV(K)
Check Release from Guernsey
GUTREQ = GUIR(K) + RVRL(K) + GUSP(K) + GUSL(K)
ABS(GUTREQ - TOUT) < 0.005
yes
no
K < 6 and GLMR(K) > 0.5
and
GUST(K + 1) > GUMXST - 0.005
yes
no
Guernsey Release Not as Requested
GUDIFF = GUTREQ - TOUT
ABS(GUDIFF) ≥ 0.02
yes
no
Adjust Guernsey and Glendo
for Small Difference Less than 0.02
GLOUT = GLTR(K) + GLSL(K) + GLRL(K) + GLSP(K)
GLOUT < GLMR(K) + 0.005
yes
no
GUTR(K) = GUTR(K) + GUDIFF
GUIN(K) = GUIN(K) + GUDIFF
TTT
II
G
C
GGG
UUU
QQQ
HHH
LLL
III
JJJ
KKK

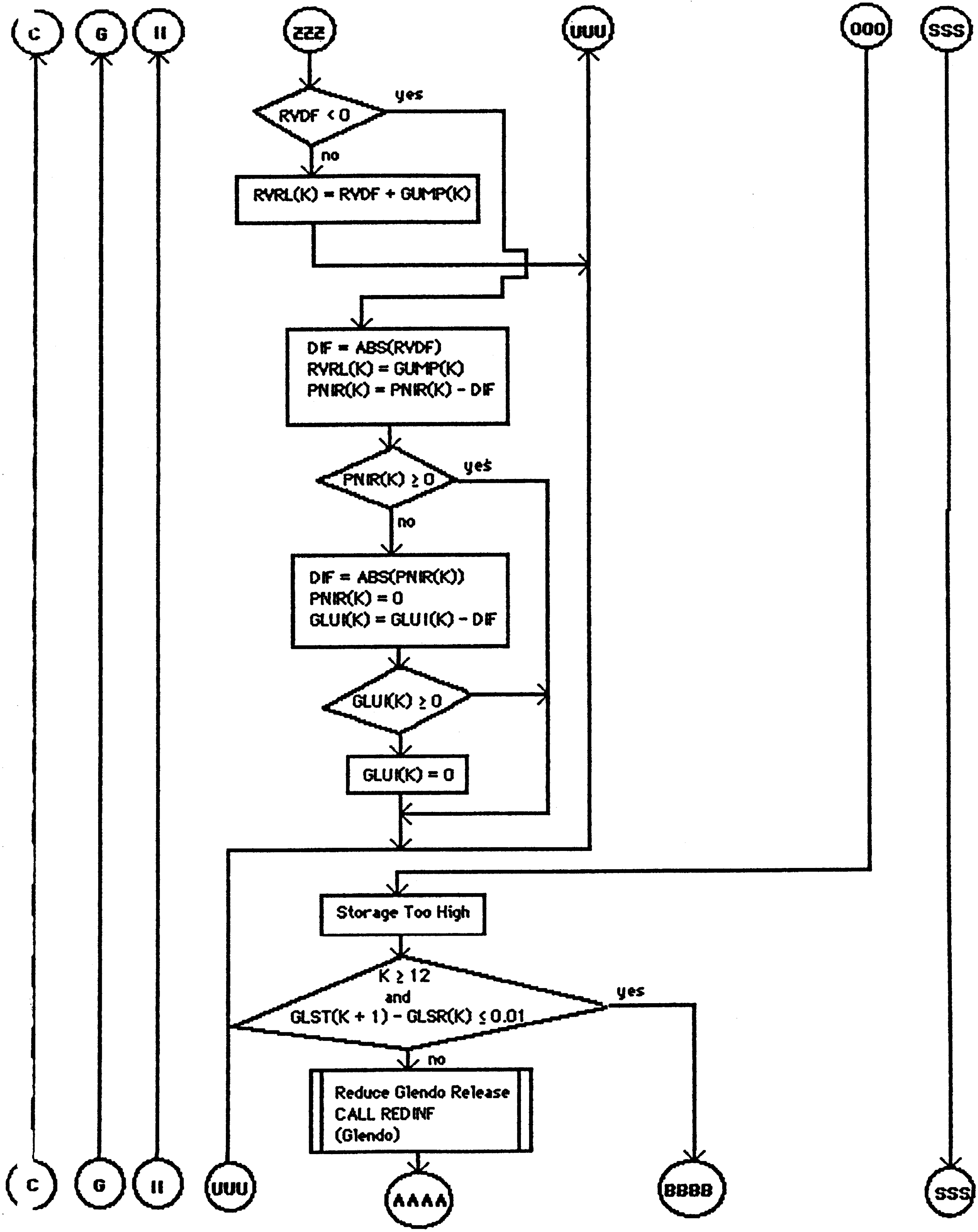

C
G
II
TTT
GGG
HHH
KKK
JJJ
LLL
UUU
GLTR(K) - GLXT(K) < 0.005
yes
GLTR(K) = GLTR(K) + GUDIFF
no
GLRL(K) = GLRL(K) + GUDIFF
GLST(K + 1) = GLST(K + 1) - GUDIFF
Check Guernsey Storage
GUSL(K) < 0.005
yes
no
GURL(K) = GURL(K) + GUSL(K)
GUSL(K) = 0
K < 6
yes
no
ABS(GUST(K + 1) - GUSR(K)) < 0.01
yes
no
Storage Not On Requested Level
DIFF(K + 1) - GUSR(K)
yes
DIFF < 0
no
Storage Too Low
DIF = ABS(DIFF)
DIFF = 0
yes
no
Excess Water from Glendo Min. Flow Assigned to NPIR
TTT
II
G
C
YYY
PPP
OOO
NNN
MMM
LLL
UUU

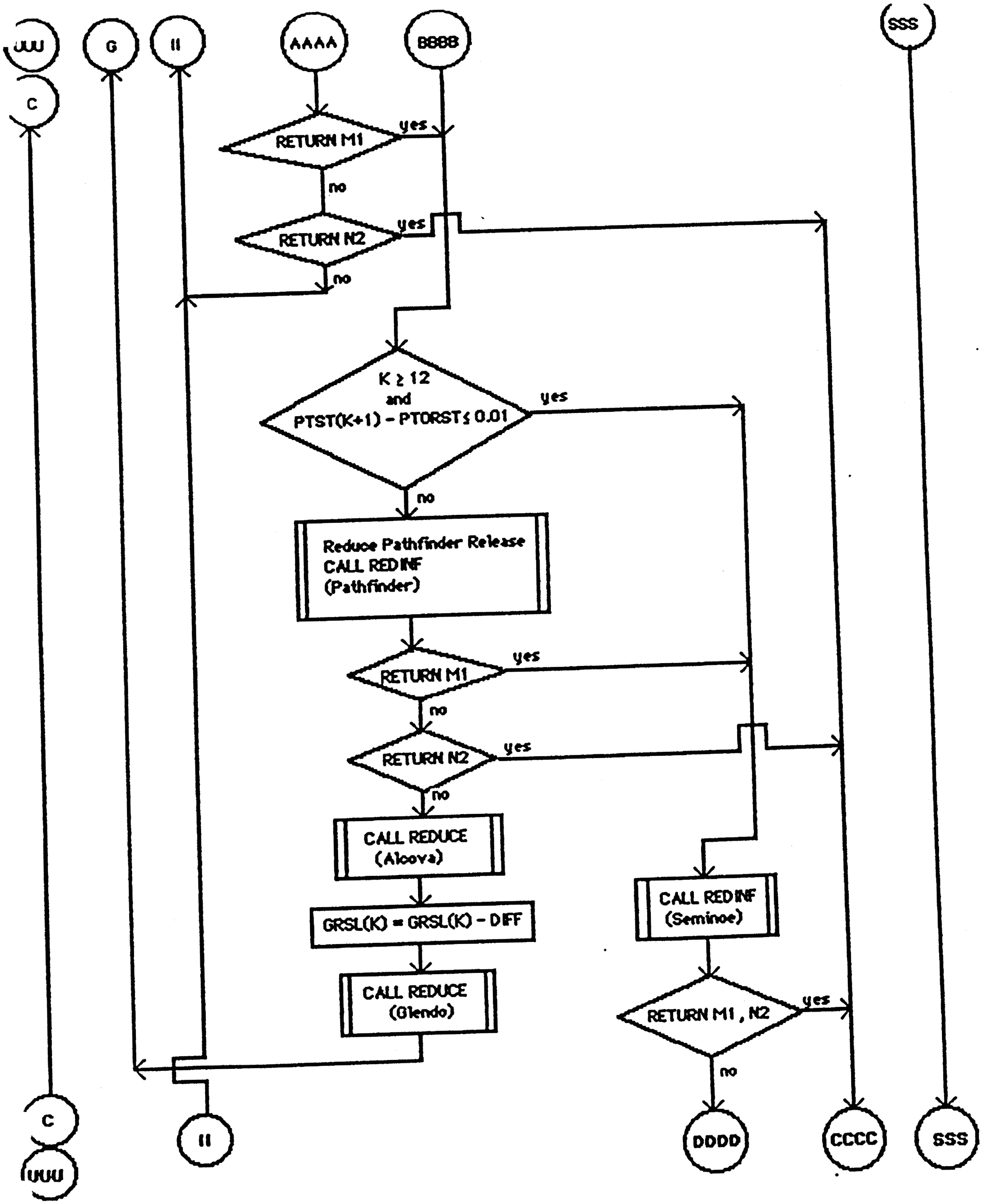

C
G
II
VVV
TTT
PPP
OOO
NNN
QQQ
MMM
III
LLL
UUU
yes
TOUT < GUTREQ
no
GUSL(K) = GUSL(K) + TOUT - GUTREQ
GURL(K) = GURL(K) - TOUT - GUTREQ
Check River Water in Storage for
Release as Excess Water
RVST(K + 1) = RVST(K) + RVGN(K) - RVRL(K)
yes
RVST(K + 1) < 0.005
no
yes
RVST(K + 1) ≥ GUSL(K) + 0.005
no
GURL(K) = GURL(K) + GUSL(K)
RVRL(K) = RVRL(K) + GUSL(K)
PNAC(K) = PNAC(K) + GUSL(K)
RVST(K + 1) = RVST(K) + RVGN(K)
+RVRL(K)
GVSL(K) = 0
GURL(K) = GURL(K) + RVST(K +1)
RVRL(K) = RVRL(K) + RVST(K +1)
PNAC(K) = PNAC(K) + RVST(K +1)
GUSL(K) = GUSL(K) - RVST(K +1)
RUST(K +1) = 0
Adjust for Large
Difference
GURL(K) = GURL(K)
+ GUTREQ + TOUT
yes
GURL(K) ≥ 0
no
GUTR(K) = GUTR(K) + GURL(K)
GURL(K) = 0
SSS
RRR

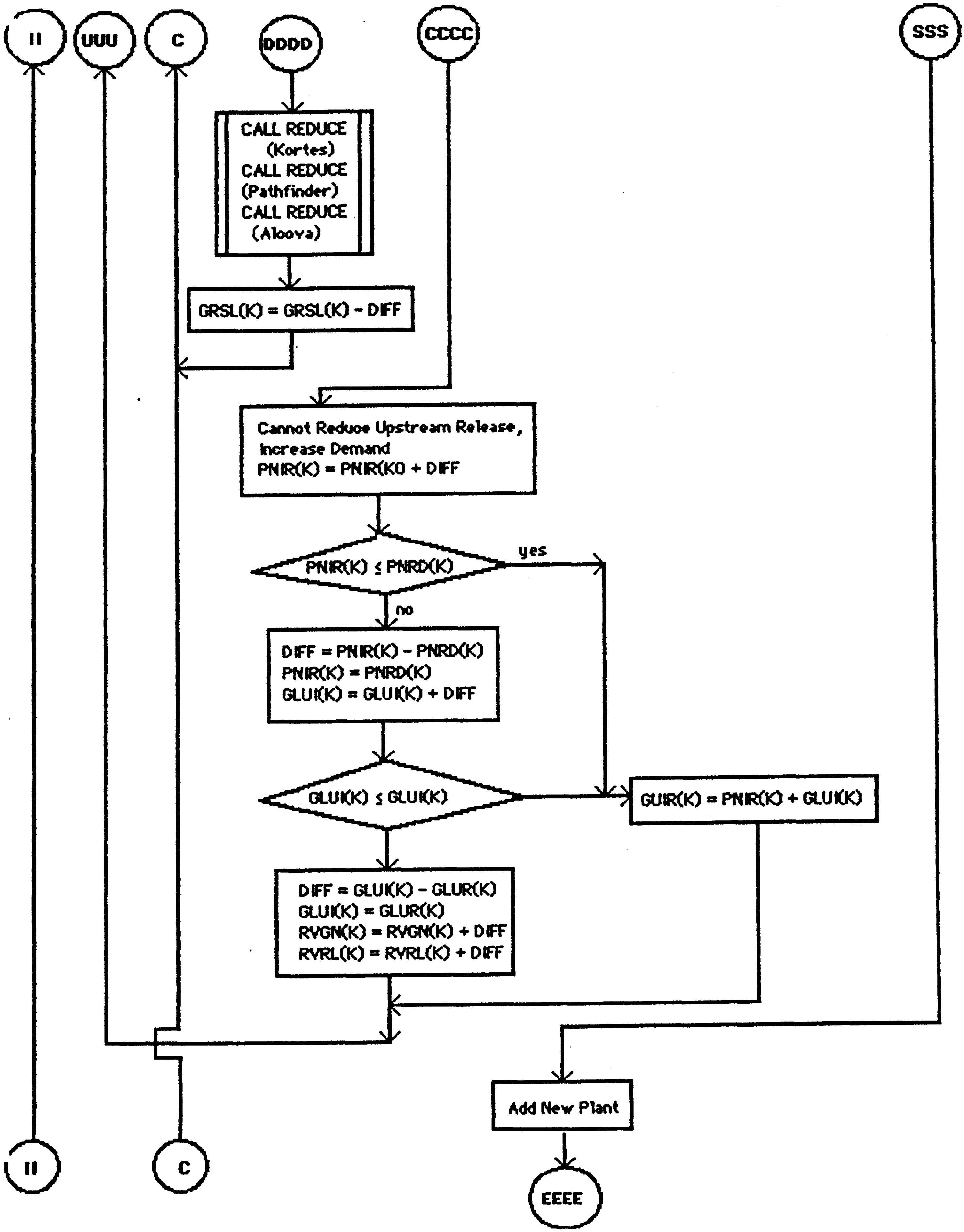

C
G
II
OOO
PPP
SSS
VVV
TTT
RRR
LLL
UUU
ABS(OLDTR - GUTR(K)) < 0.01
and
ABS(OLDRL - GURL(K)) 0.01
yes
no
OLDTR = GUTR(K)
OLDRL = GURL(K)
Cannot Adjust Release ,
Adjust Demand
yes
PNIR(K) > PNRD(K) - 0.005
no
PNIR(K) = PNIR(K) + TOUT - GUTREQ
yes
GLUK(K) > GLUR(K) - 0.005
no
GLUK(K) = GLUK(K) + TOUT - GUTREQ
GUSL(K) = TOUT - GUTREQ
GUTR(K) = GUTR(K) - GUSL(K)
II
G
OOO
C
PPP
SSS
UUU

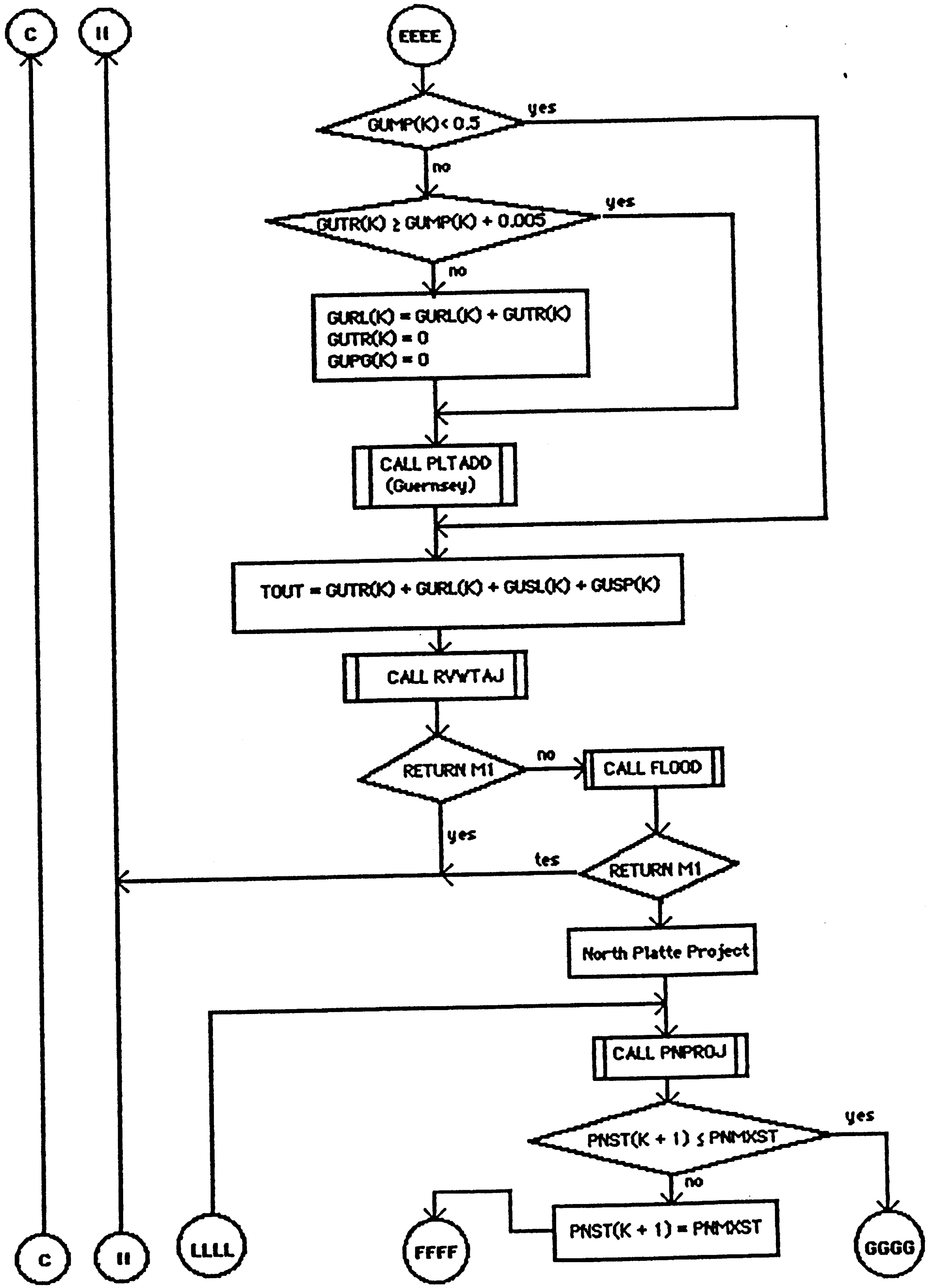

C
G
II
PPP
OOO
SSS
UUU
K ≥ 12
and
GLST(K +1) - GLSR(K) ≤ 0.01
yes
no
Try to Increase Glendo
Release
CALL ADDINF
(Glendo)
RETURN M1
yes
no
RETURN N2
yes
K > 12
and
PTST(K +1) - PTDRST < 0.01
Try to Increase Pathfinder Release
CALL ADDINF
(Pathfinder)
RETURN M1
yes
no
RETURN N2
yes
no
CALL AUGMNT
(Alcova)
C
G
II
VVV
XXX
YYY
OOO
SSS
UUU

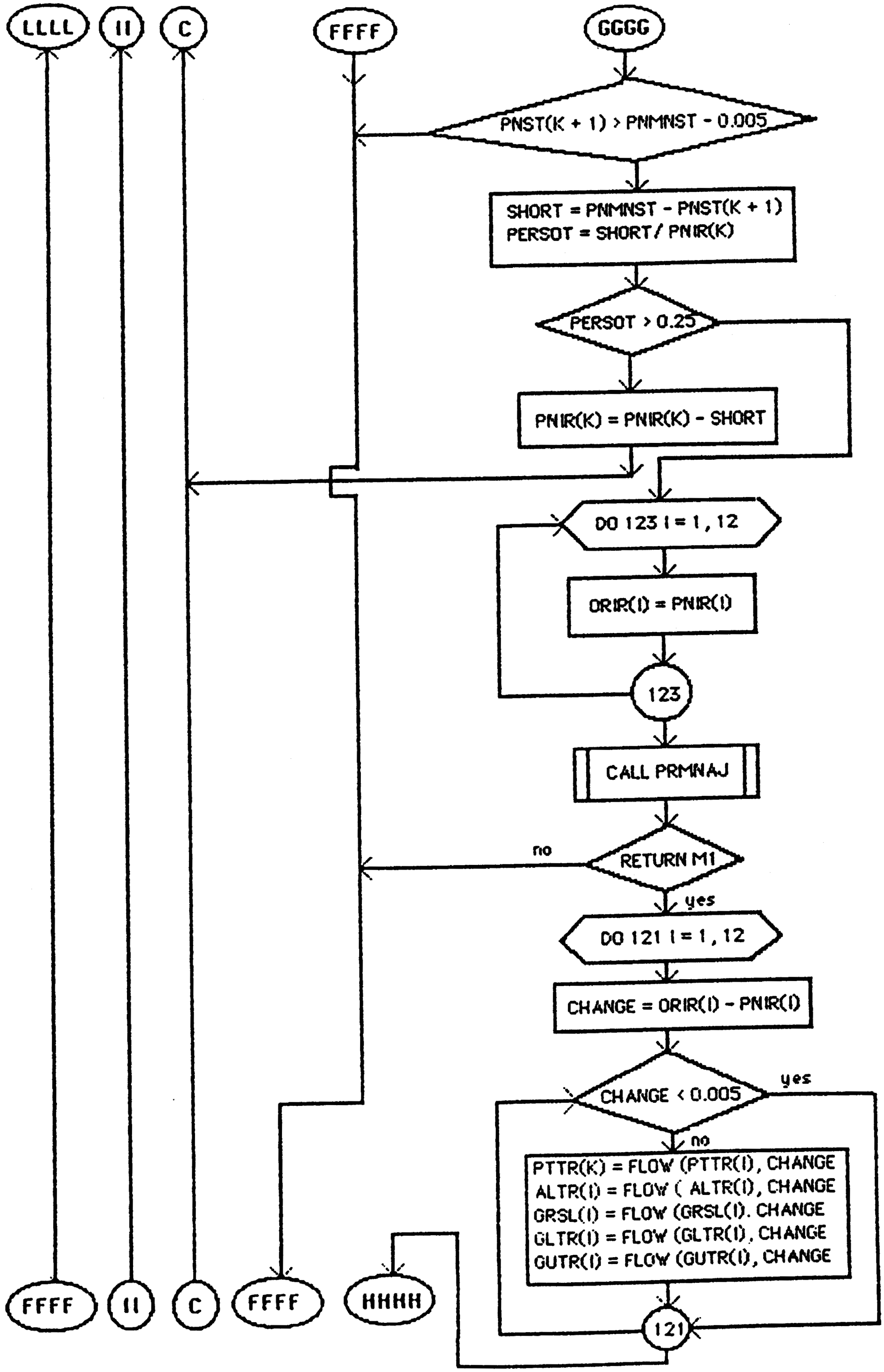

II
C
G
VVV
YYY
XXX
OOO
SSS
UUU
GRSL(K) = GRSL(K) + DIF
CALL AUGMNT (Glendo)
Try to Increase Seminoe Release CALL ADDINF (Seminoe)
RETURN M1, N2
yes
no
CALL AUGMNT (Kortes) CALL AUGMNT (Pathfinder) CALL AUGMNT (Alcova)
GRSL(K) = GRSL(K) - DIF
CALL AUGMNT (Glendo)
Cannot Increase Upstream Release, Reduce Demand RVDF = RVRL(K) - GUMP(K) RVDF = RVDF - DIF
II
C
G
ZZZ
OOO
SSS
UUU

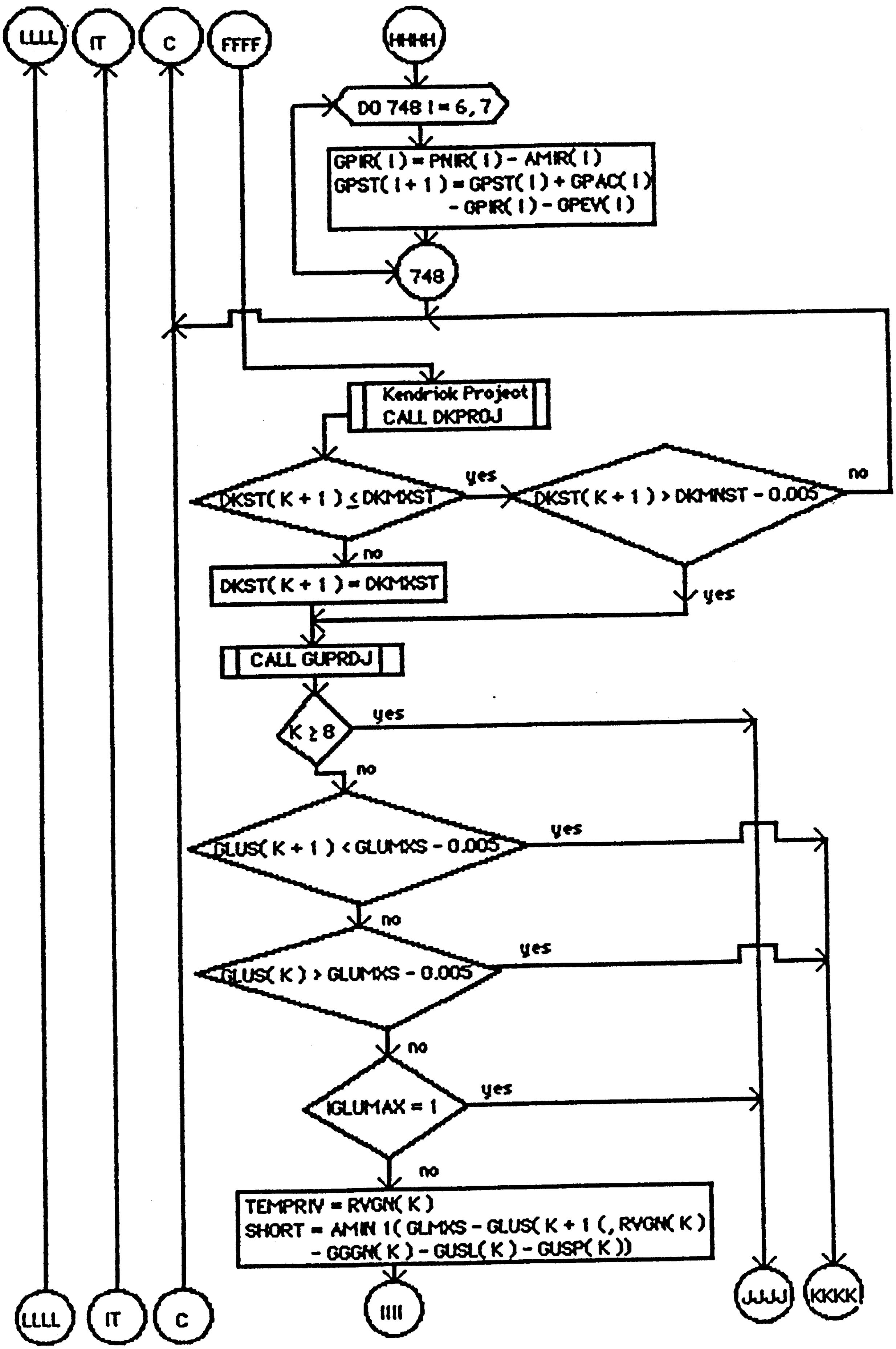

C
G
II
ZZZ
UUU
OOO
SSS
RVDF < 0
yes
no
RVRL(K) = RVDF + GUMP(K)
DIF = ABS(RVDF)
RVRL(K) = GUMP(K)
PNIR(K) = PNIR(K) - DIF
PNIR(K) ≥ 0
yes
no
DIF = ABS(PNIR(K))
PNIR(K) = 0
GLUI(K) = GLUI(K) - DIF
GLUI(K) ≥ 0
GLUI(K) = 0
Storage Too High
K ≥ 12
and
GLST(K + 1) - GLSR(K) ≤ 0.01
yes
no
Reduce Glendo Release
CALL REDINF
(Glendo)
C
G
II
UUU
AAAA
BBBB
SSS

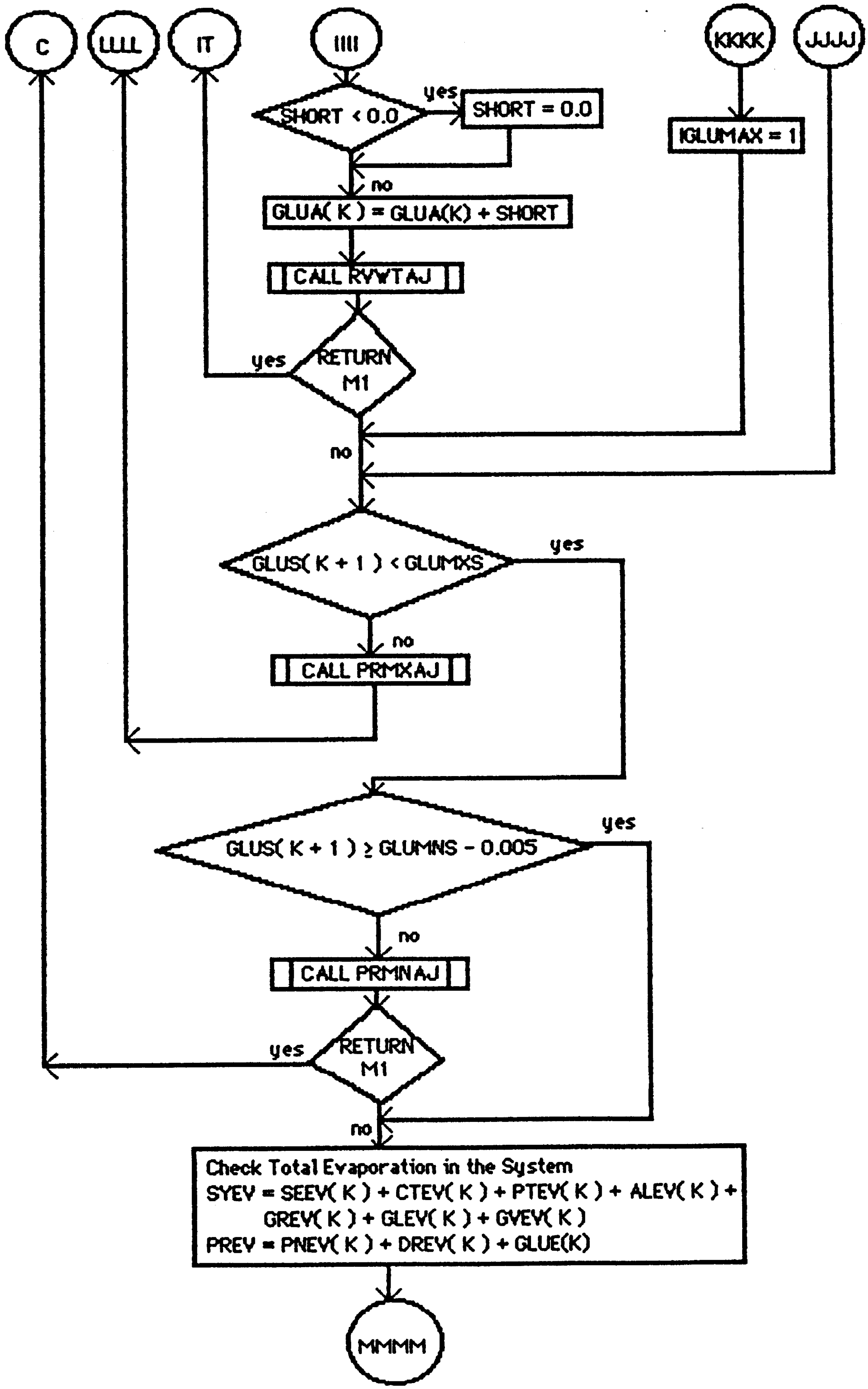

UUU
C
G
II
AAAA
BBBB
SSS
RETURN M1
yes
no
RETURN N2
yes
no
K ≥ 12
and
PTST(K+1) - PTORST ≤ 0.01
yes
no
Reduce Pathfinder Release
CALL REDINF
(Pathfinder)
RETURN M1
yes
no
RETURN N2
yes
no
CALL REDUCE
(Alcova)
GRSL(K) = GRSL(K) - DIFF
CALL REDUCE
(Glendo)
CALL REDINF
(Seminoe)
RETURN M1, N2
yes
no
C
UUU
II
DDDD
CCCC
SSS

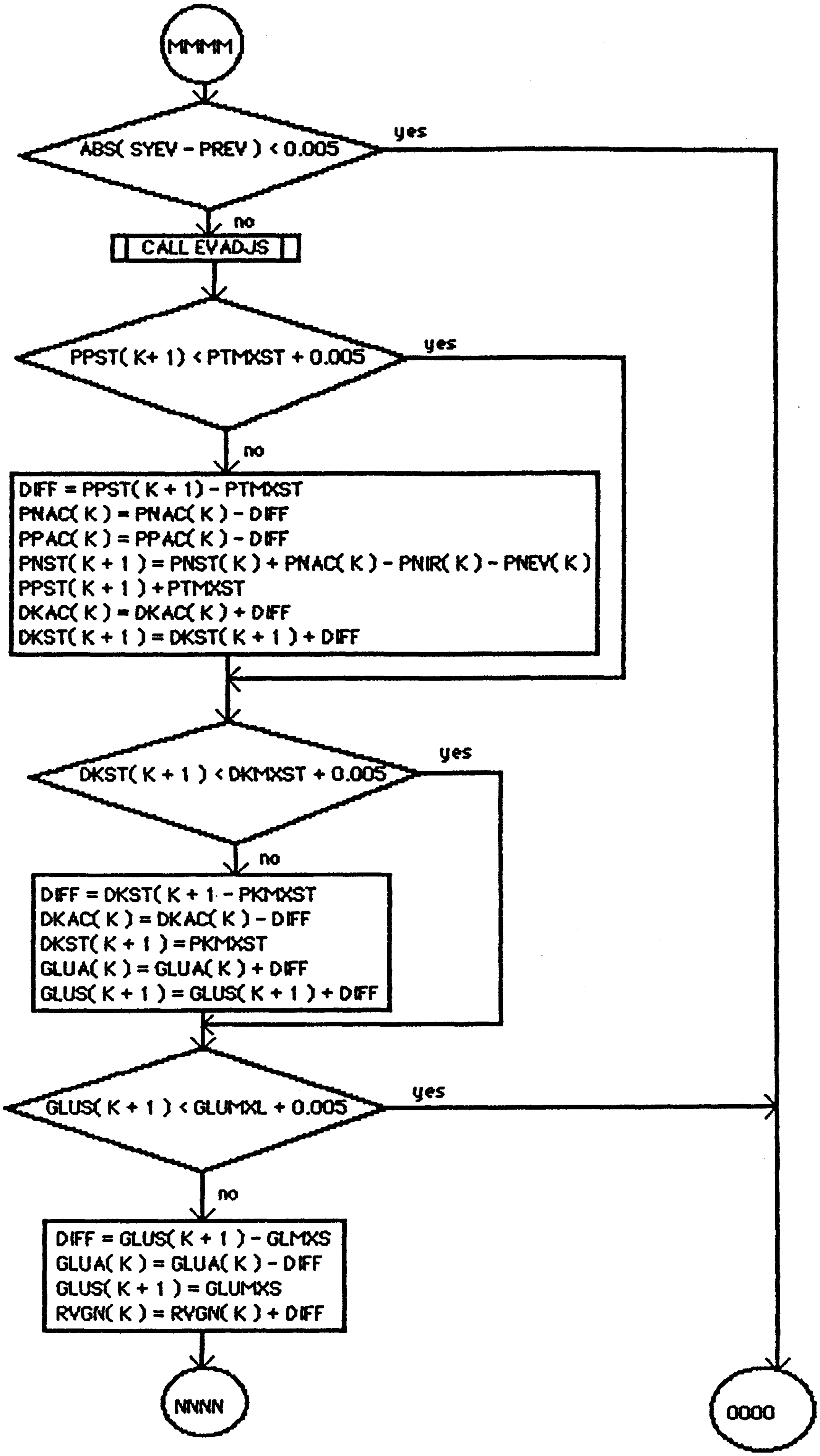

II
UUU
C
DDDD
CCCC
SSS
CALL REDUCE (Kortes)
CALL REDUCE (Pathfinder)
CALL REDUCE (Alcova)
GRSL(K) = GRSL(K) - DIFF
Cannot Reduce Upstream Release, Increase Demand
PNIR(K) = PNIR(KO + DIFF
PNIR(K) ≤ PNRD(K)
yes
no
DIFF = PNIR(K) - PNRD(K)
PNIR(K) = PNRD(K)
GLUI(K) = GLUI(K) + DIFF
GLUI(K) ≤ GLUI(K)
GUIR(K) = PNIR(K) + GLUI(K)
DIFF = GLUI(K) - GLUR(K)
GLUI(K) = GLUR(K)
RVGN(K) = RVGN(K) + DIFF
RVRL(K) = RVRL(K) + DIFF
Add New Plant
II
C
EEEE

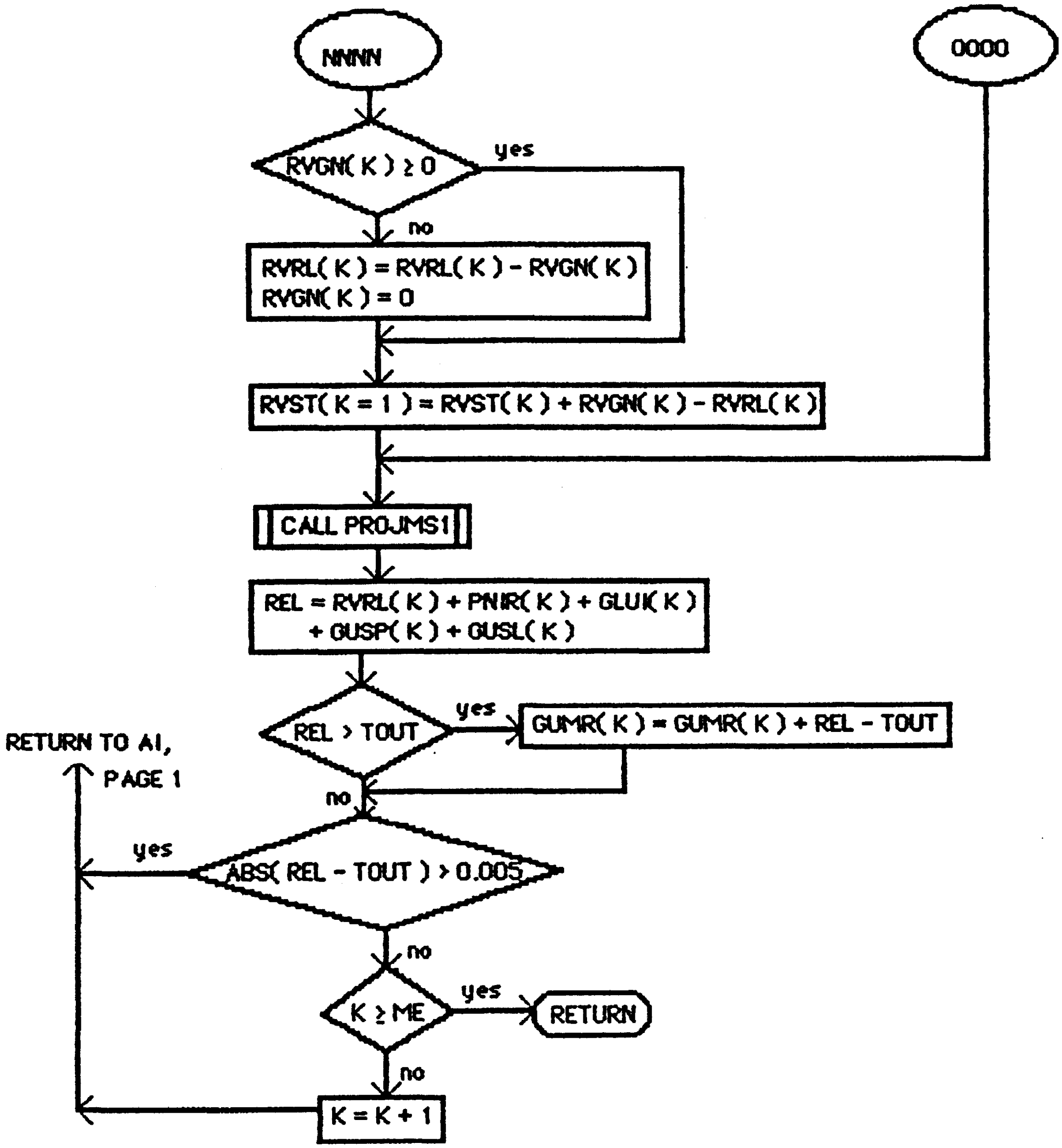

C
II
EEEE
GUMP(K) < 0.5
yes
no
GUTR(K) ≥ GUMP(K) + 0.005
yes
no
GURL(K) = GURL(K) + GUTR(K)
GUTR(K) = 0
GUPG(K) = 0
CALL PLTADD
(Guernsey)
TOUT = GUTR(K) + GURL(K) + GUSL(K) + GUSP(K)
CALL RVWTAJ
RETURN M1
no
CALL FLOOD
yes
tes
RETURN M1
North Platte Project
CALL PNPROJ
PNST(K + 1) ≤ PNMXST
yes
no
PNST(K + 1) = PNMXST
C
II
LLLL
FFFF
GGGG


LLLL
II
C
FFFF
GGGG
PNST(K + 1) > PNMNST - 0.005
SHORT = PNMNST - PNST(K + 1)
PERSOT = SHORT / PNIR(K)
PERSOT > 0.25
PNIR(K) = PNIR(K) - SHORT
DO 123 I = 1, 12
ORIR(I) = PNIR(I)
123
CALL PRMNAJ
no
RETURN M1
yes
DO 121 I = 1, 12
CHANGE = ORIR(I) - PNIR(I)
CHANGE < 0.005
yes
no
PTTR(K) = FLOW (PTTR(I), CHANGE
ALTR(I) = FLOW (ALTR(I), CHANGE
GRSL(I) = FLOW (GRSL(I). CHANGE
GLTR(I) = FLOW (GLTR(I), CHANGE
GUTR(I) = FLOW (GUTR(I), CHANGE
121
FFFF
II
C
FFFF
HHHH


LLLL
IT
C
FFFF
HHHH
DO 748 I = 6, 7
GPIR(I) = PNIR(I) - AMIR(I)
GPST(I + 1) = GPST(I) + GPAC(I)
- GPIR(I) - GPEV(I)
748
Kendrick Project
CALL DKPROJ
DKST(K + 1) ≤ DKMXST
yes
no
DKST(K + 1) > DKMNST - 0.005
no
DKST(K + 1) = DKMXST
yes
CALL GUPROJ
K ≥ 8
yes
no
GLUS(K + 1) < GLUMXS - 0.005
yes
no
GLUS(K) > GLUMXS - 0.005
yes
no
IGLUMAX = 1
yes
no
TEMPRIV = RVGN(K)
SHORT = AMIN 1(GLMXS - GLUS(K + 1 (, RVGN(K)
- GGGN(K) - GUSL(K) - GUSP(K))
LLLL
IT
C
IIII
JJJJ
KKKK

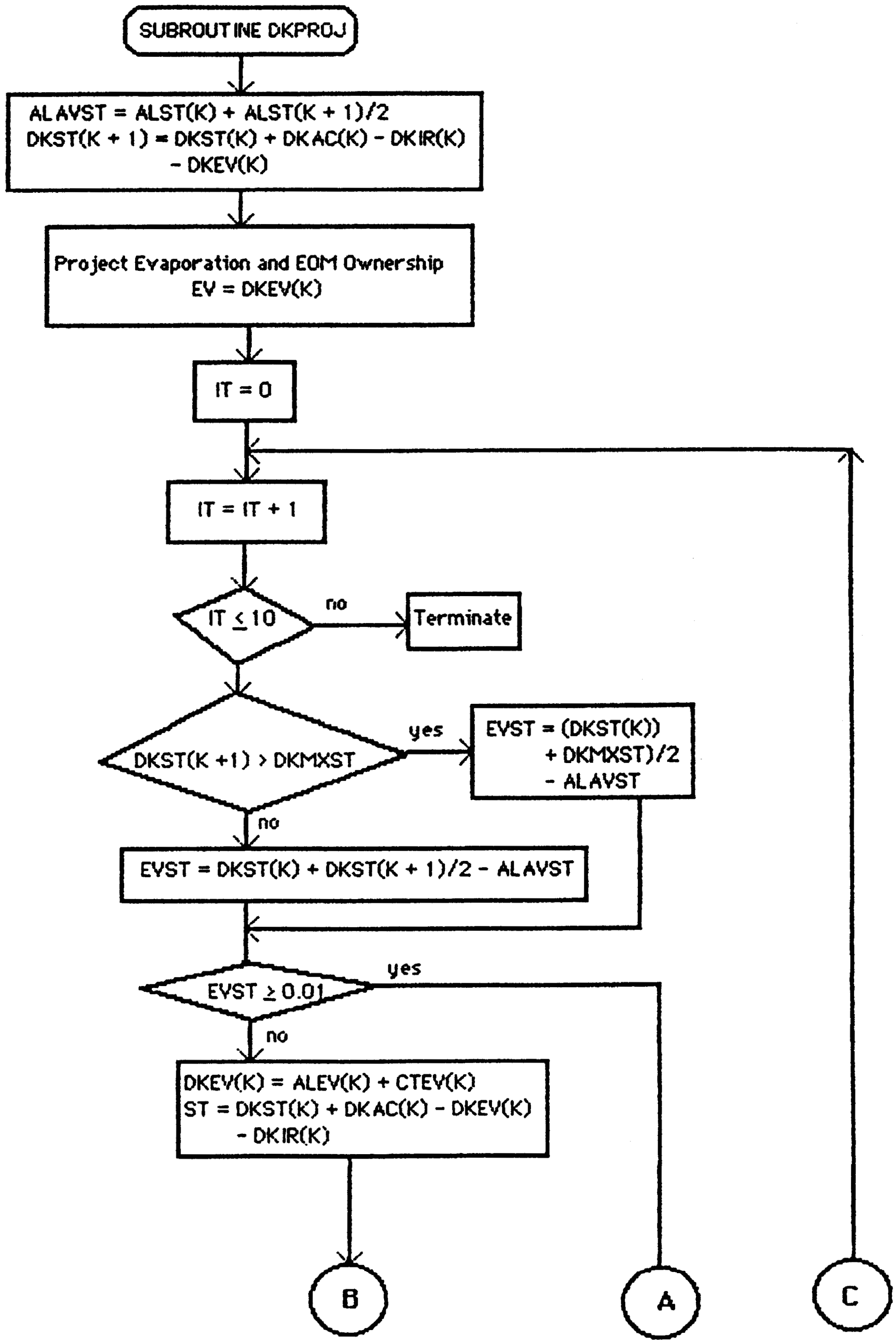

C
LLLL
IT
IIII
KKKK
JJJJ
SHORT < 0.0
yes
SHORT = 0.0
no
IGLUMAX = 1
GLUA(K) = GLUA(K) + SHORT
CALL RVWTAJ
RETURN M1
yes
no
GLUS(K + 1) < GLUMXS
yes
no
CALL PRMXAJ
GLUS(K + 1) ≥ GLUMNS - 0.005
yes
no
CALL PRMNAJ
RETURN M1
yes
no
Check Total Evaporation in the System
SYEV = SEEV(K) + CTEV(K) + PTEV(K) + ALEV(K) + GREV(K) + GLEV(K) + GVEV(K)
PREV = PNEV(K) + DREV(K) + GLUE(K)
MMMM

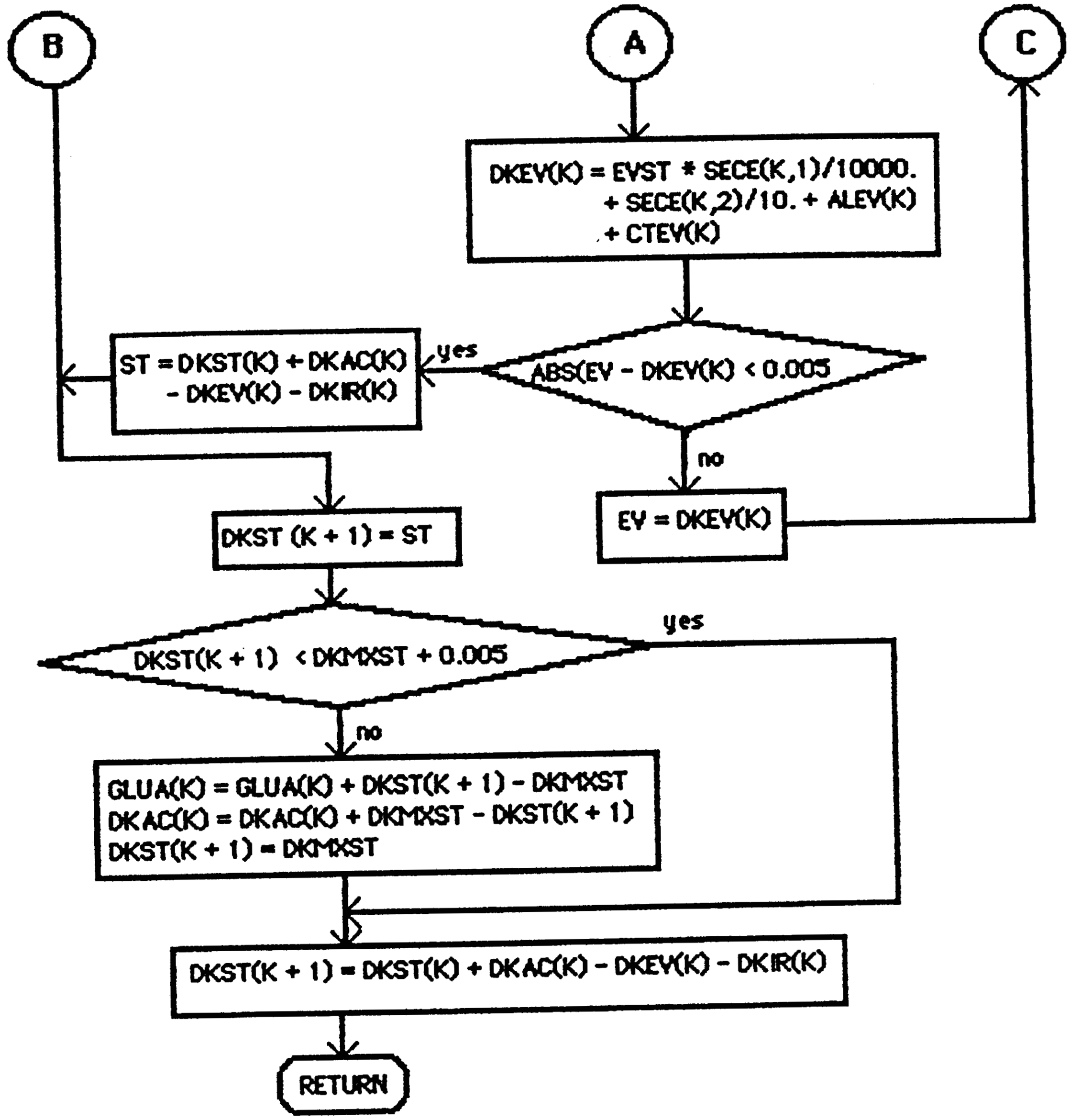

MMMM
ABS(SYEV - PREV) < 0.005
yes
no
CALL EVADJS
PPST(K+ 1) < PTMXST + 0.005
yes
no
DIFF = PPST(K + 1) - PTMXST
PNAC(K) = PNAC(K) - DIFF
PPAC(K) = PPAC(K) - DIFF
PNST(K + 1) = PNST(K) + PNAC(K) - PNIR(K) - PNEV(K)
PPST(K + 1) + PTMXST
DKAC(K) = DKAC(K) + DIFF
DKST(K + 1) = DKST(K + 1) + DIFF
DKST(K + 1) < DKMXST + 0.005
yes
no
DIFF = DKST(K + 1 - PKMXST
DKAC(K) = DKAC(K) - DIFF
DKST(K + 1) = PKMXST
GLUA(K) = GLUA(K) + DIFF
GLUS(K + 1) = GLUS(K + 1) + DIFF
GLUS(K + 1) < GLUMXL + 0.005
yes
no
DIFF = GLUS(K + 1) - GLMXS
GLUA(K) = GLUA(K) - DIFF
GLUS(K + 1) = GLUMXS
RVGN(K) = RVGN(K) + DIFF
NNNN
0000



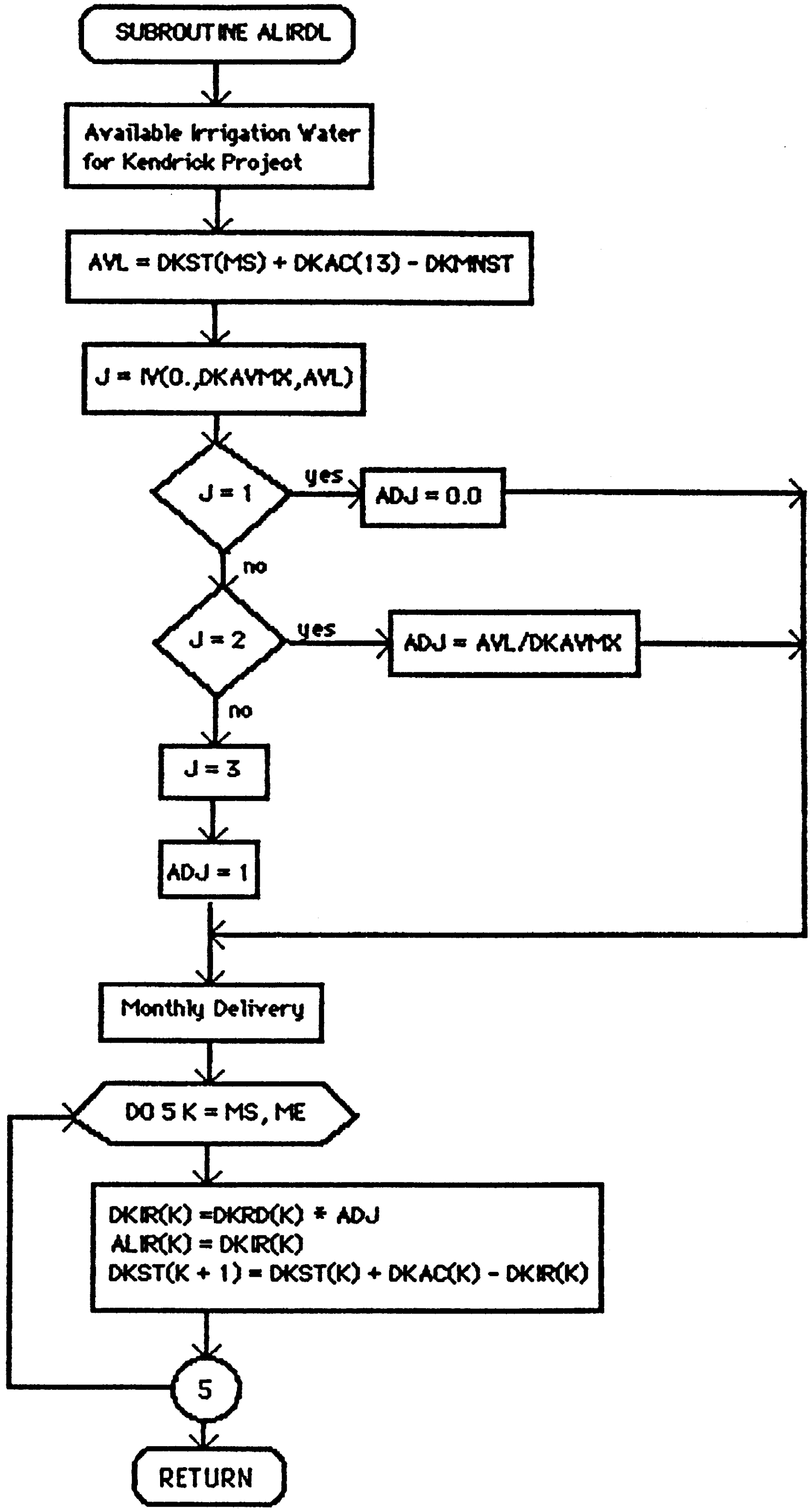
NNNN
0000
RVGN(K) ≥ 0
yes
no
RVRL(K) = RVRL(K) - RVGN(K)
RVGN(K) = 0
RVST(K = 1) = RVST(K) + RVGN(K) - RVRL(K)
CALL PROJMS1
REL = RVRL(K) + PNIR(K) + GLUK(K)
+ GUSP(K) + GUSL(K)
REL > TOUT
yes
GUMR(K) = GUMR(K) + REL - TOUT
no
RETURN TO AI,
PAGE 1
yes
ABS(REL - TOUT) > 0.005
no
K ≥ ME
yes
RETURN
no
K = K + 1

Description: Kendrick Project Ownership Calculation.

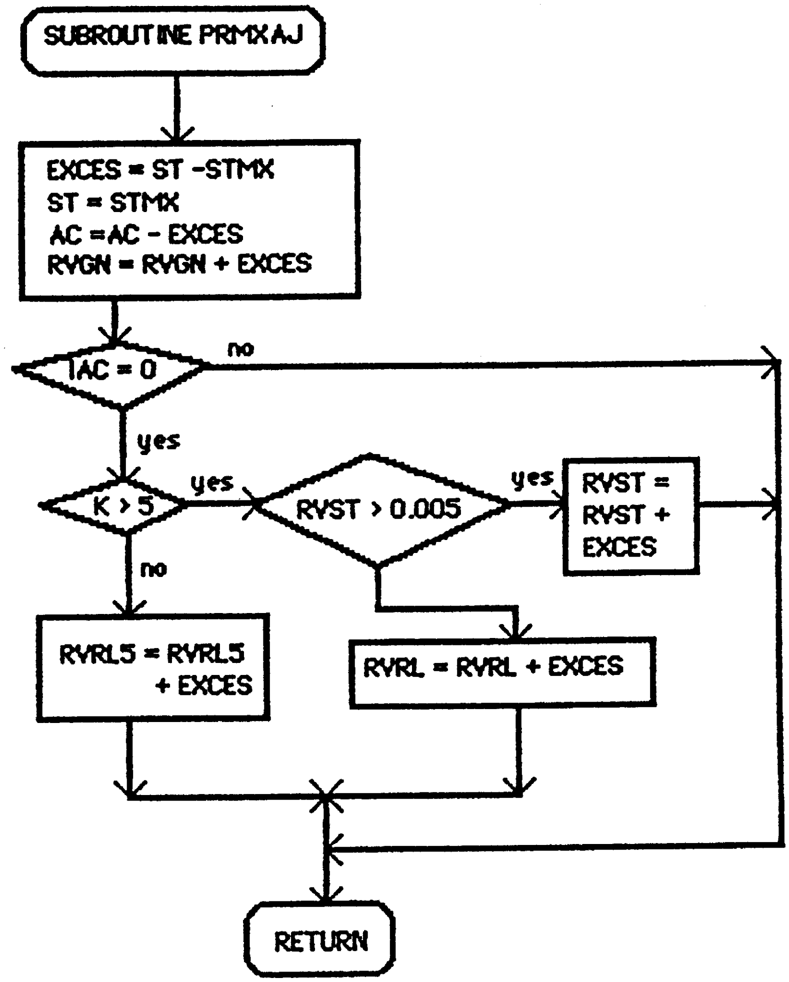



B
A
C
DKEV(K) = EVST * SECE(K,1)/10000.
+ SECE(K,2)/10. + ALEV(K)
+ CTEV(K)
ABS(EV - DKEV(K) < 0.005
yes
no
ST = DKST(K) + DKAC(K)
- DKEV(K) - DKIR(K)
EV = DKEV(K)
DKST (K + 1) = ST
DKST(K + 1) < DKMXST + 0.005
yes
no
GLUA(K) = GLUA(K) + DKST(K + 1) - DKMXST
DKAC(K) = DKAC(K) + DKMXST - DKST(K + 1)
DKST(K + 1) = DKMXST
DKST(K + 1) = DKST(K) + DKAC(K) - DKEV(K) - DKIR(K)
RETURN

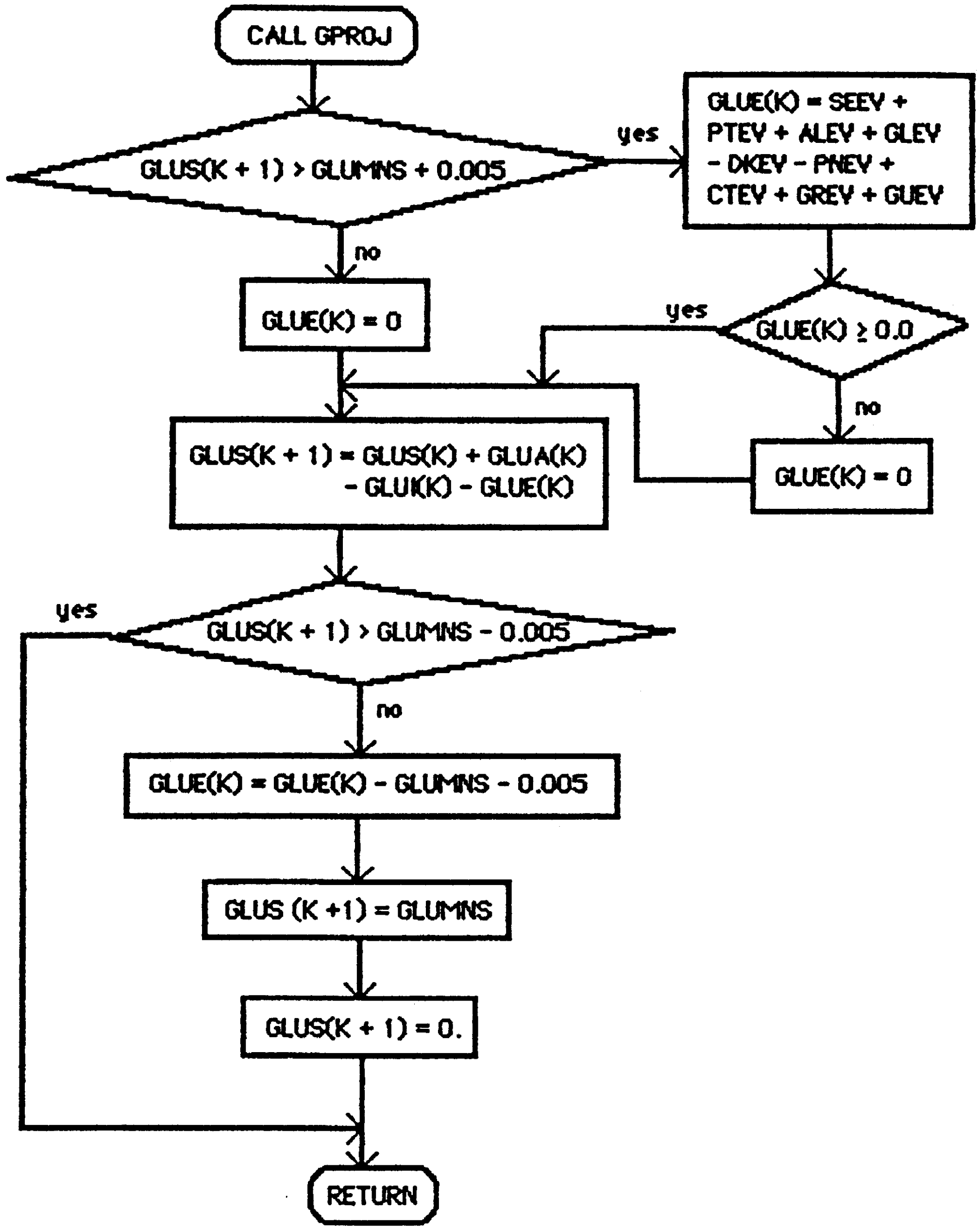
Description: Alcova Irrigation Delivery to Kendrick Project Irrigation is May thru Sept. According to the Amount of Water Available with Maximum given as Input ALIRD



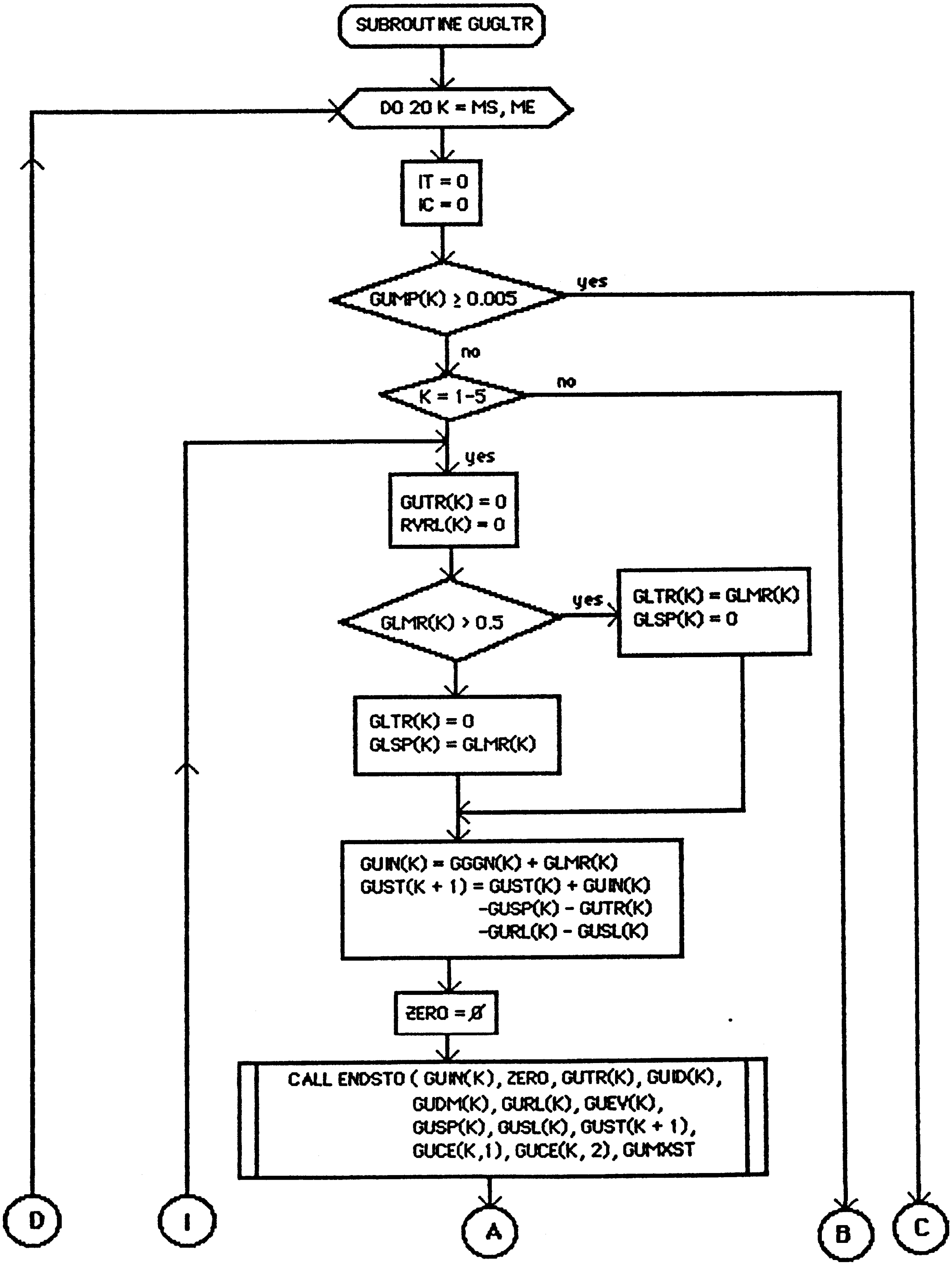
Description: Project Ownership Exceeded the Maximum Allowed. Set the Ownership at Maximum and Release Excess Water as River Water

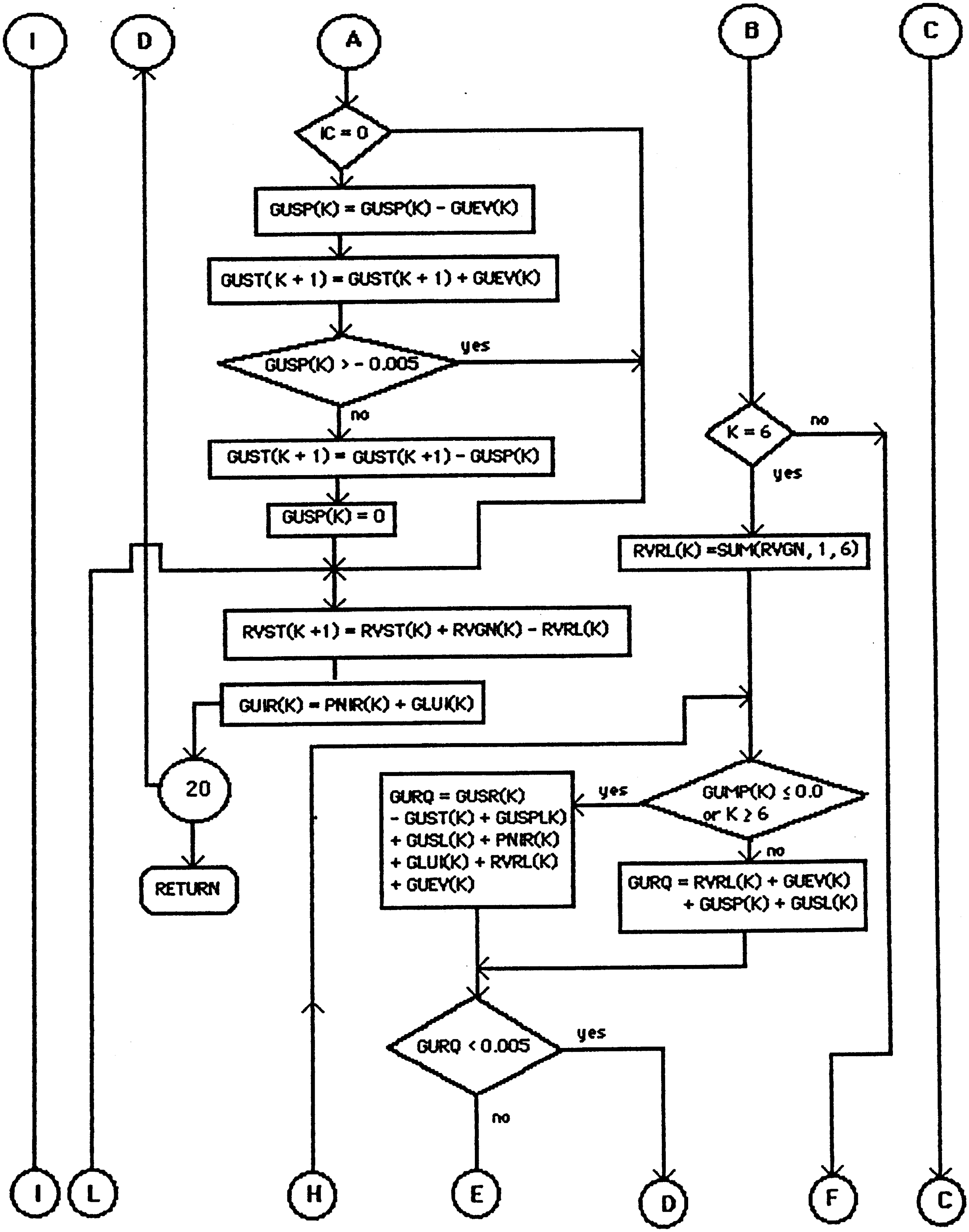


Description: Glendo Unit Project Ownership Accounting

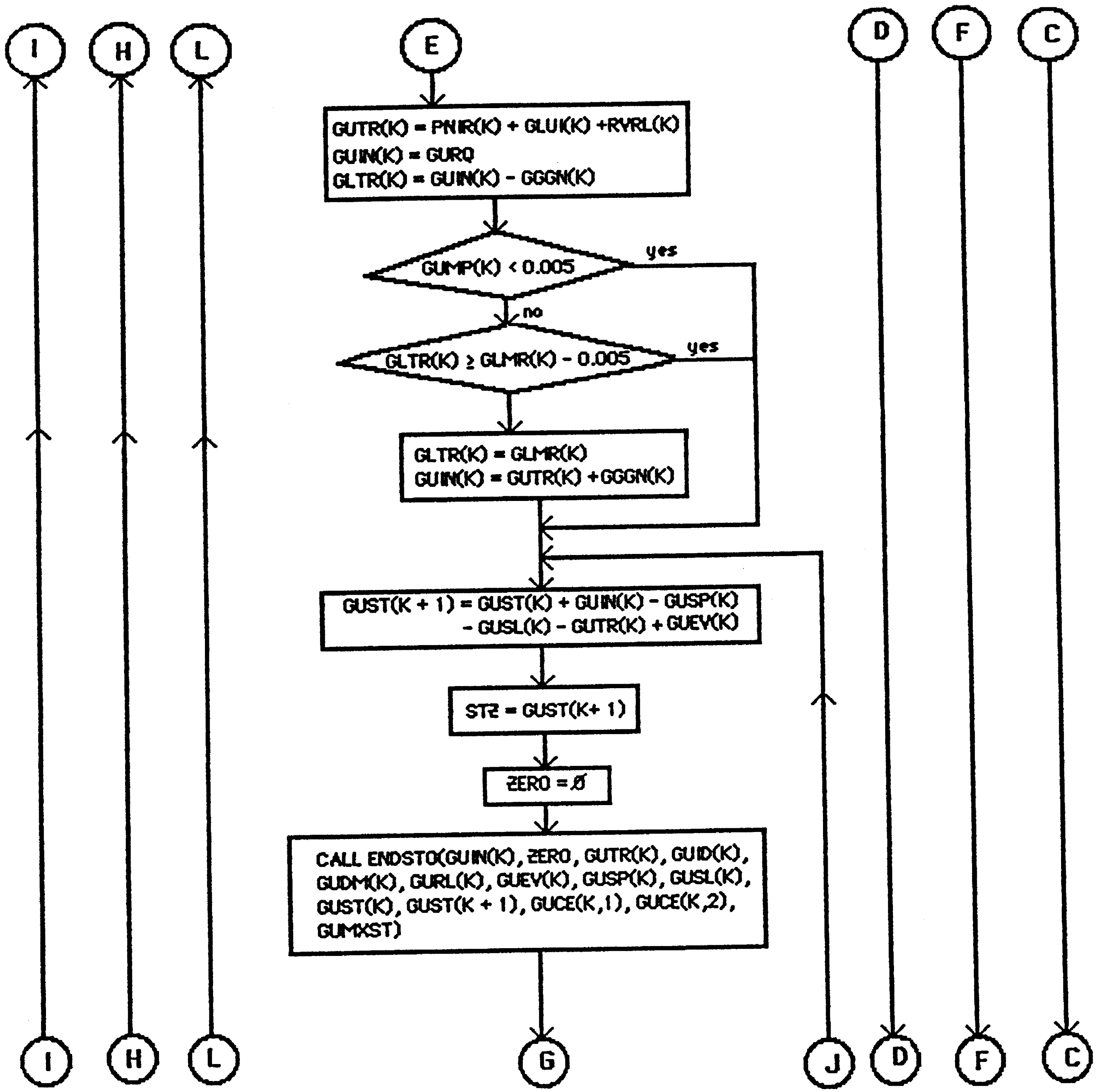


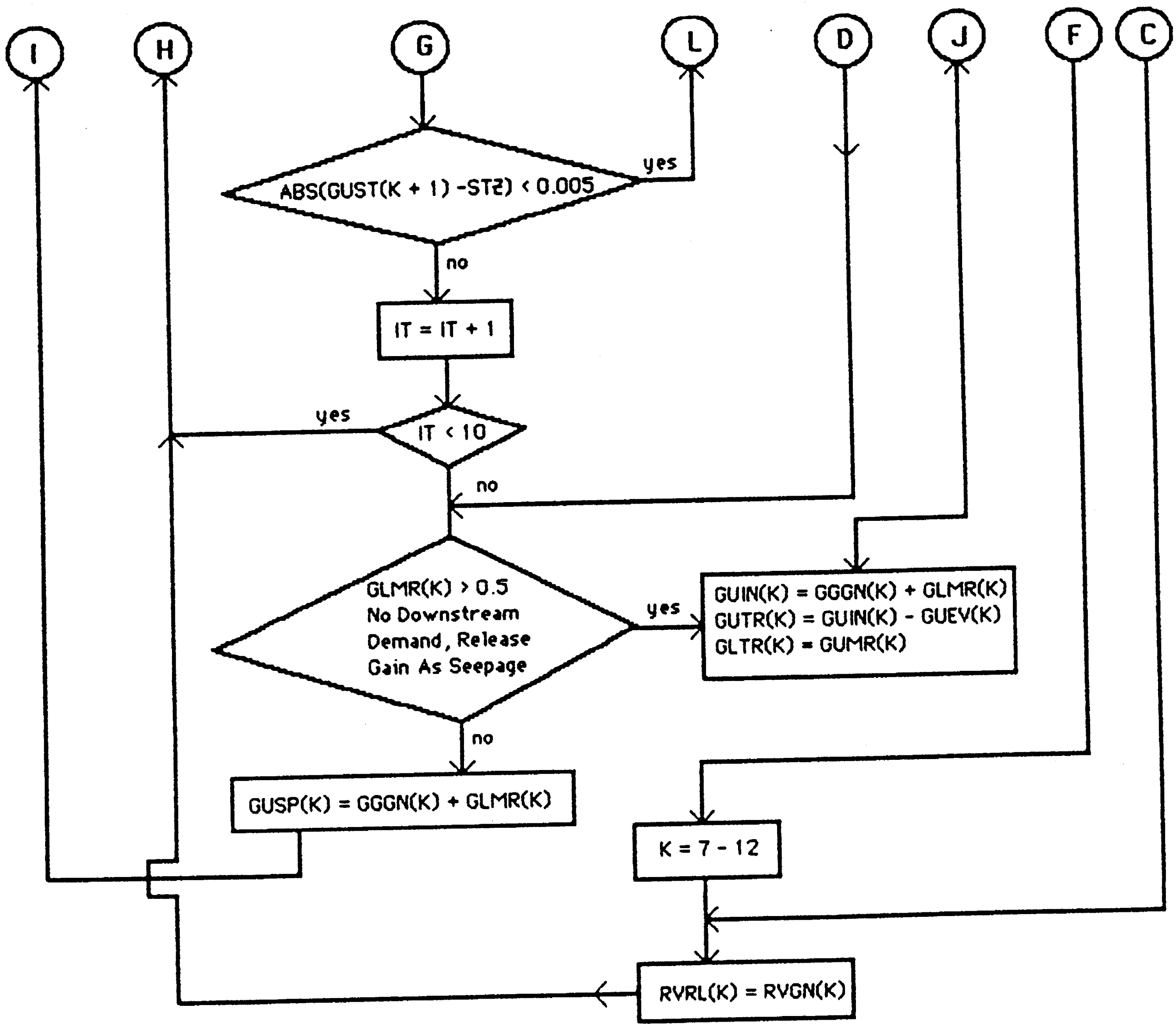
Description: From the Downstream Water Demand Determine Inflow to and Outflow from Guernsey, River Water Release and Outflow from Glendo by Assuming All Water Goes through the Turbine with the Exception of Seepage.



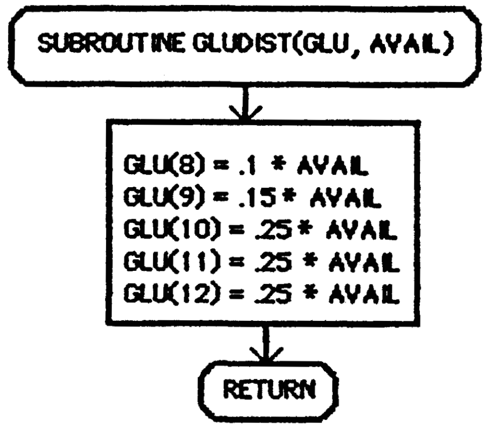


I
D
A
B
C
IC = 0
GUSP(K) = GUSP(K) - GUEV(K)
GUST(K + 1) = GUST(K + 1) + GUEV(K)
GUSP(K) > - 0.005
yes
no
GUST(K + 1) = GUST(K +1) - GUSP(K)
GUSP(K) = 0
K = 6
no
yes
RVRL(K) =SUM(RVGN, 1, 6)
RVST(K +1) = RVST(K) + RVGN(K) - RVRL(K)
GUIR(K) = PNIR(K) + GLUK(K)
20
RETURN
GURQ = GUSR(K)
- GUST(K) + GUSPLK)
+ GUSL(K) + PNIR(K)
+ GLUK(K) + RVRL(K)
+ GUEV(K)
yes
GUMP(K) ≤ 0.0
or K ≥ 6
no
GURQ = RVRL(K) + GUEV(K)
+ GUSP(K) + GUSL(K)
GURQ < 0.005
yes
no
I
L
H
E
D
F
C

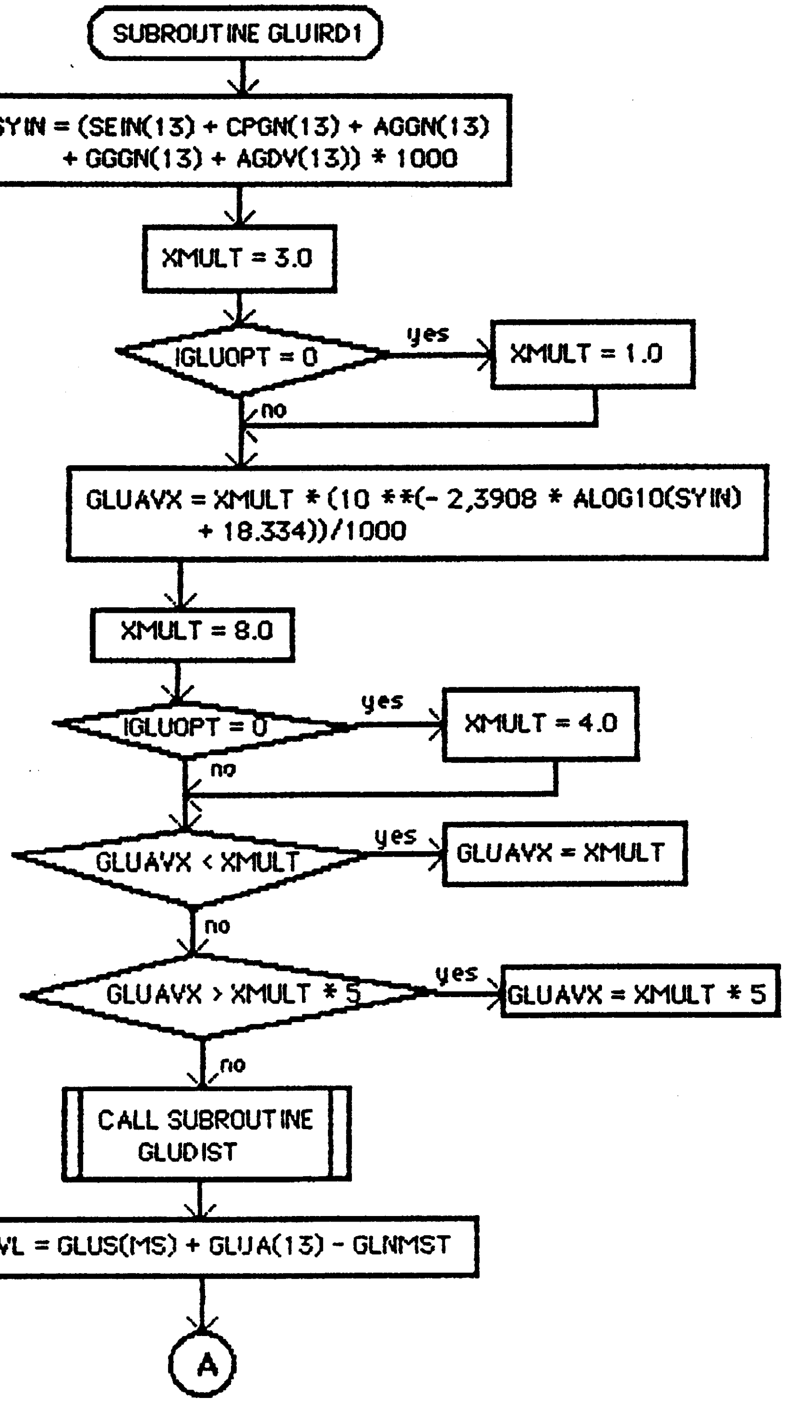

E
I
H
L
D
F
C
GUTR(K) = PNIR(K) + GLUK(K) +RVRL(K)
GUIN(K) = GURQ
GLTR(K) = GUIN(K) - GGGN(K)
GUMP(K) < 0.005
yes
no
GLTR(K) ≥ GLMR(K) - 0.005
yes
GLTR(K) = GLMR(K)
GUIN(K) = GUTR(K) +GGGN(K)
GUST(K + 1) = GUST(K) + GUIN(K) - GUSP(K)
- GUSL(K) - GUTR(K) + GUEV(K)
STZ = GUST(K+ 1)
ZERO = Ø
CALL ENDSTO(GUIN(K), ZERO, GUTR(K), GUID(K),
GUDM(K), GURL(K), GUEV(K), GUSP(K), GUSL(K),
GUST(K), GUST(K + 1), GUCE(K,1), GUCE(K,2),
GUMXST)
I
H
L
G
J
D
F
C

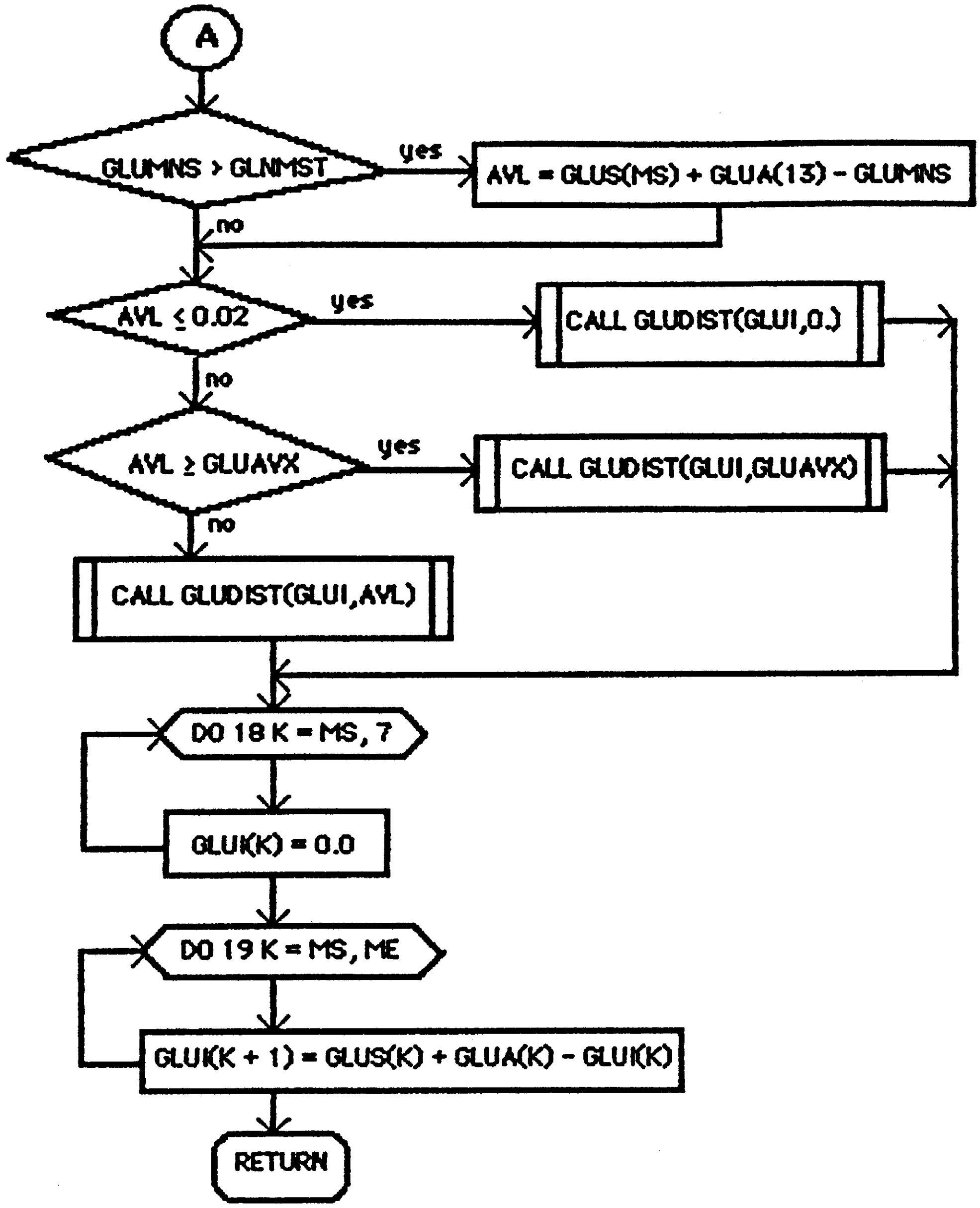

I
H
G
L
D
J
F
C
ABS(GUST(K + 1) -ST2) < 0.005
yes
no
IT = IT + 1
IT < 10
yes
no
GLMR(K) > 0.5
No Downstream
Demand, Release
Gain As Seepage
yes
GUIN(K) = GGGN(K) + GLMR(K)
GUTR(K) = GUIN(K) - GUEV(K)
GLTR(K) = GUMR(K)
no
GUSP(K) = GGGN(K) + GLMR(K)
K = 7 - 12
RVRL(K) = RVGN(K)

DESCRIPTION: Irrigation Season Distribution for Glendo Unit Irrigation Deliveries.

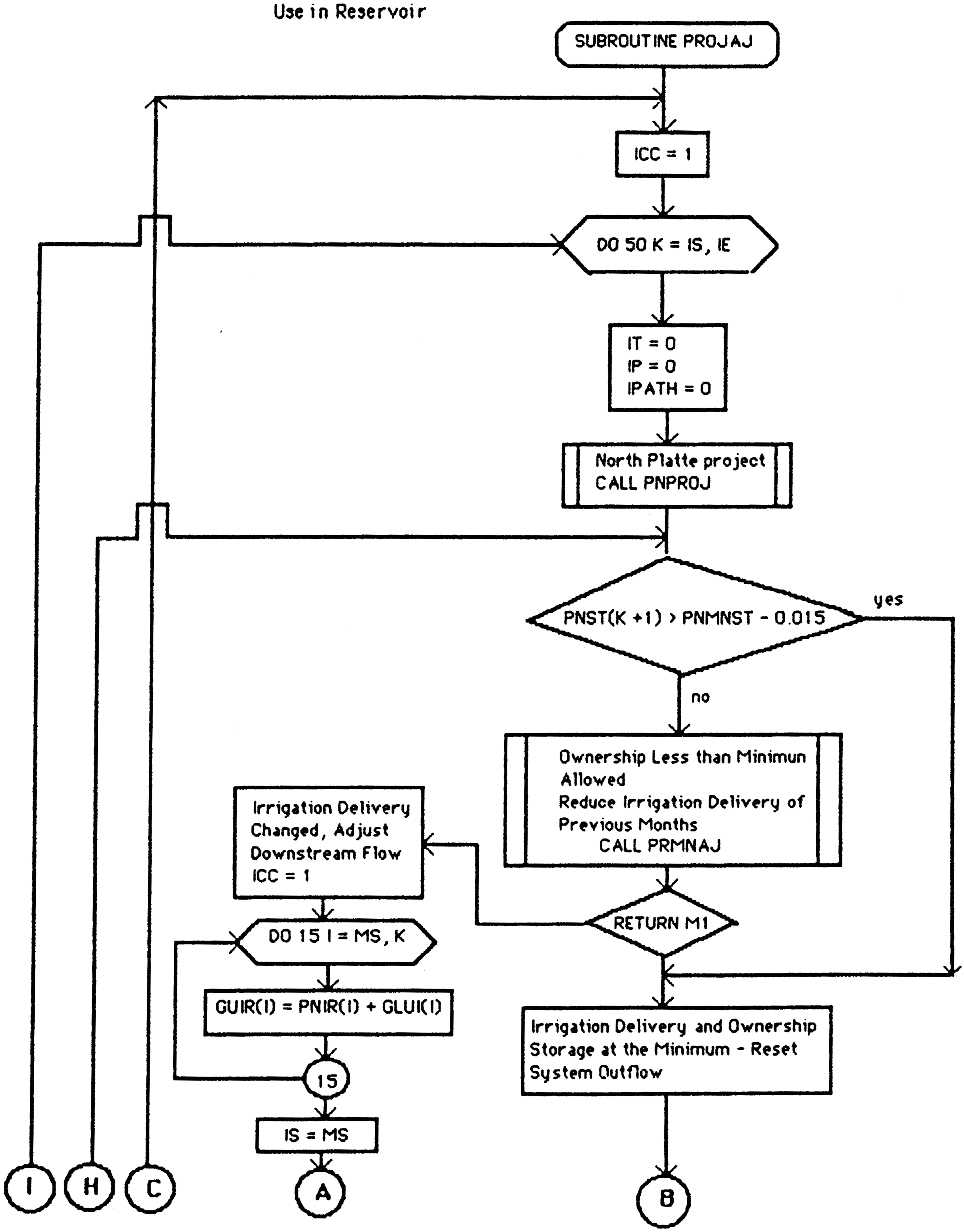


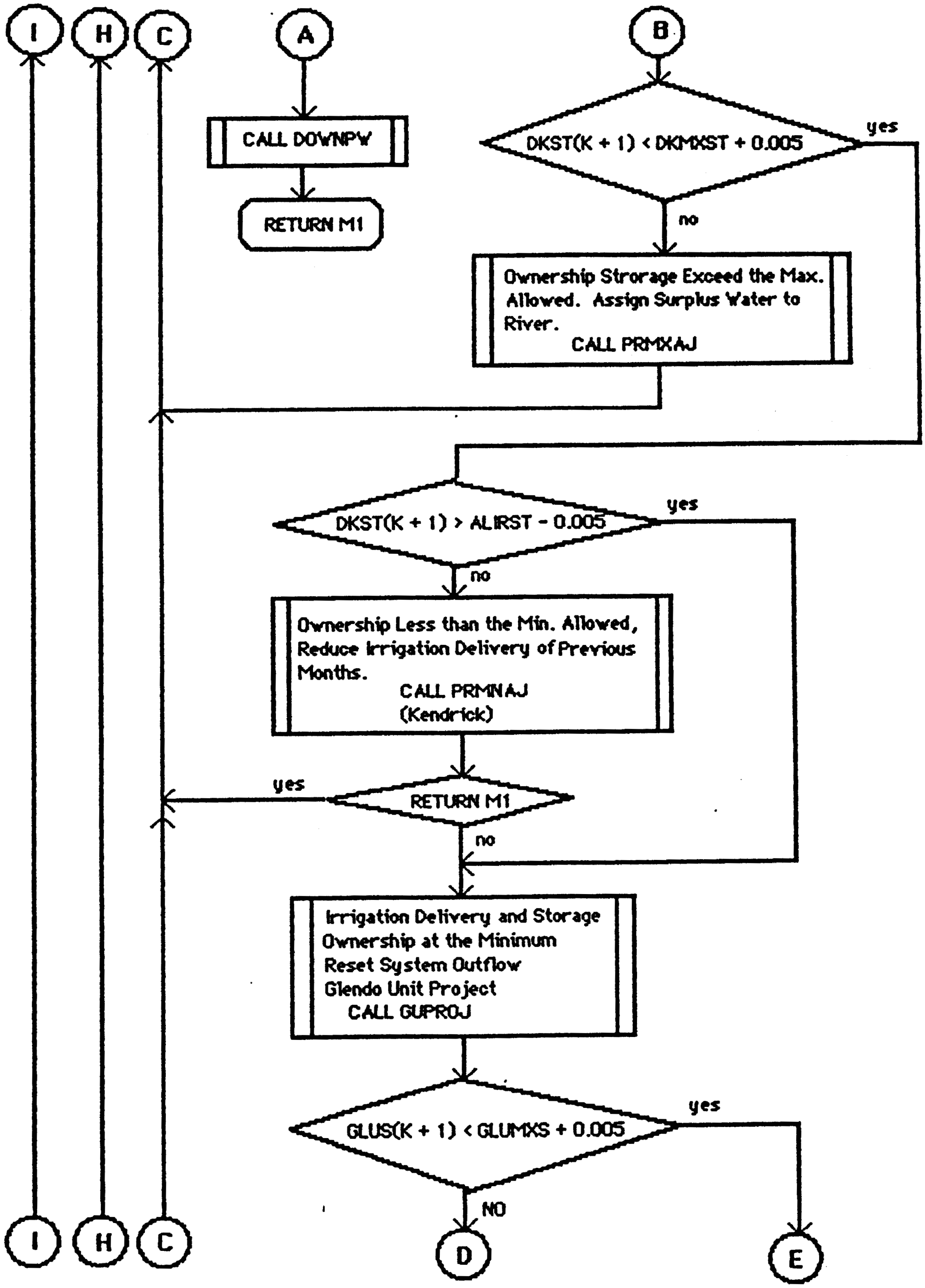
Description : Glendo Unit Irrigation Delivery. Based on Historic Delivery with Adjustment to Increase to Maximum Possible Use (40,000 AF) If GLUOPT = 0 Use Present (1980) 20,000 AF Max. Possible Use.

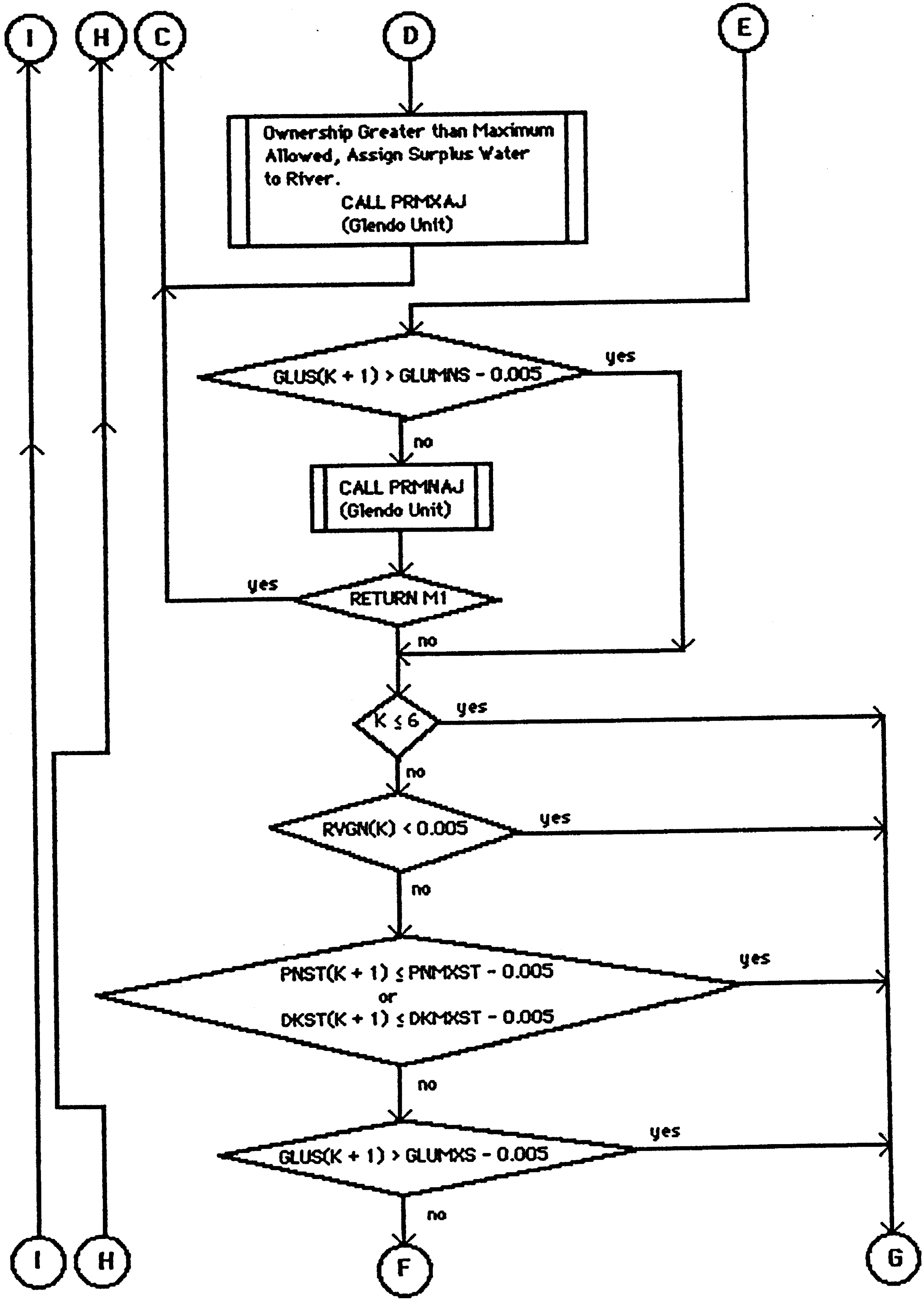


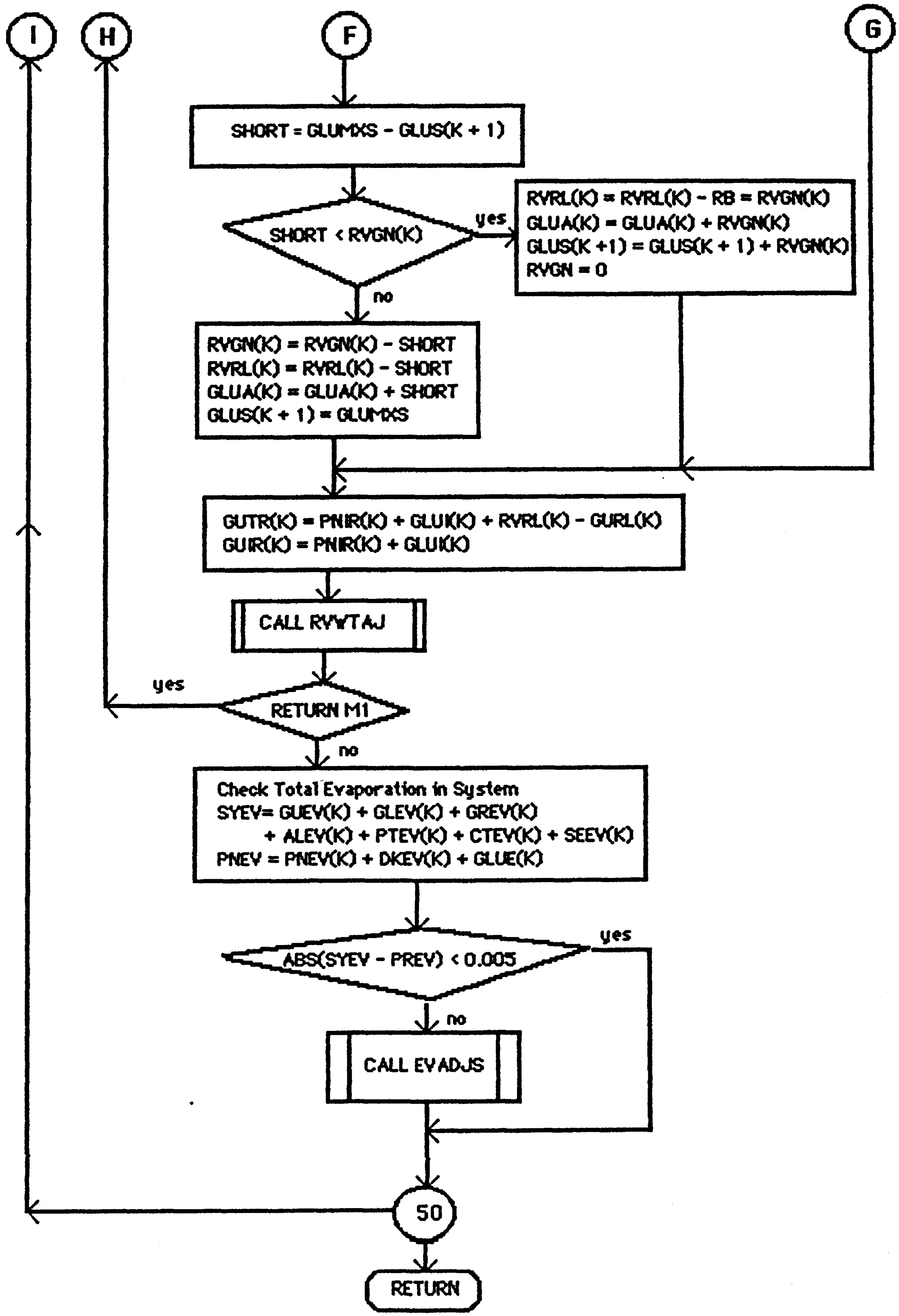

A
GLUMNS > GLNMST
yes
AVL = GLUS(MS) + GLUA(13) - GLUMNS
no
AVL ≤ 0.02
yes
CALL GLUDIST(GLUI,0.)
no
AVL ≥ GLUAVX
yes
CALL GLUDIST(GLUI,GLUAVX)
no
CALL GLUDIST(GLUI,AVL)
DO 18 K = MS, 7
GLUI(K) = 0.0
DO 19 K = MS, ME
GLUI(K + 1) = GLUS(K) + GLUA(K) - GLUI(K)
RETURN

Description: Calculation of Irrigation Projects Owned Storage and Total Delivery to the Project from Reservoir. Then Check the Project Storage and Adjust Water Use in Reservoir

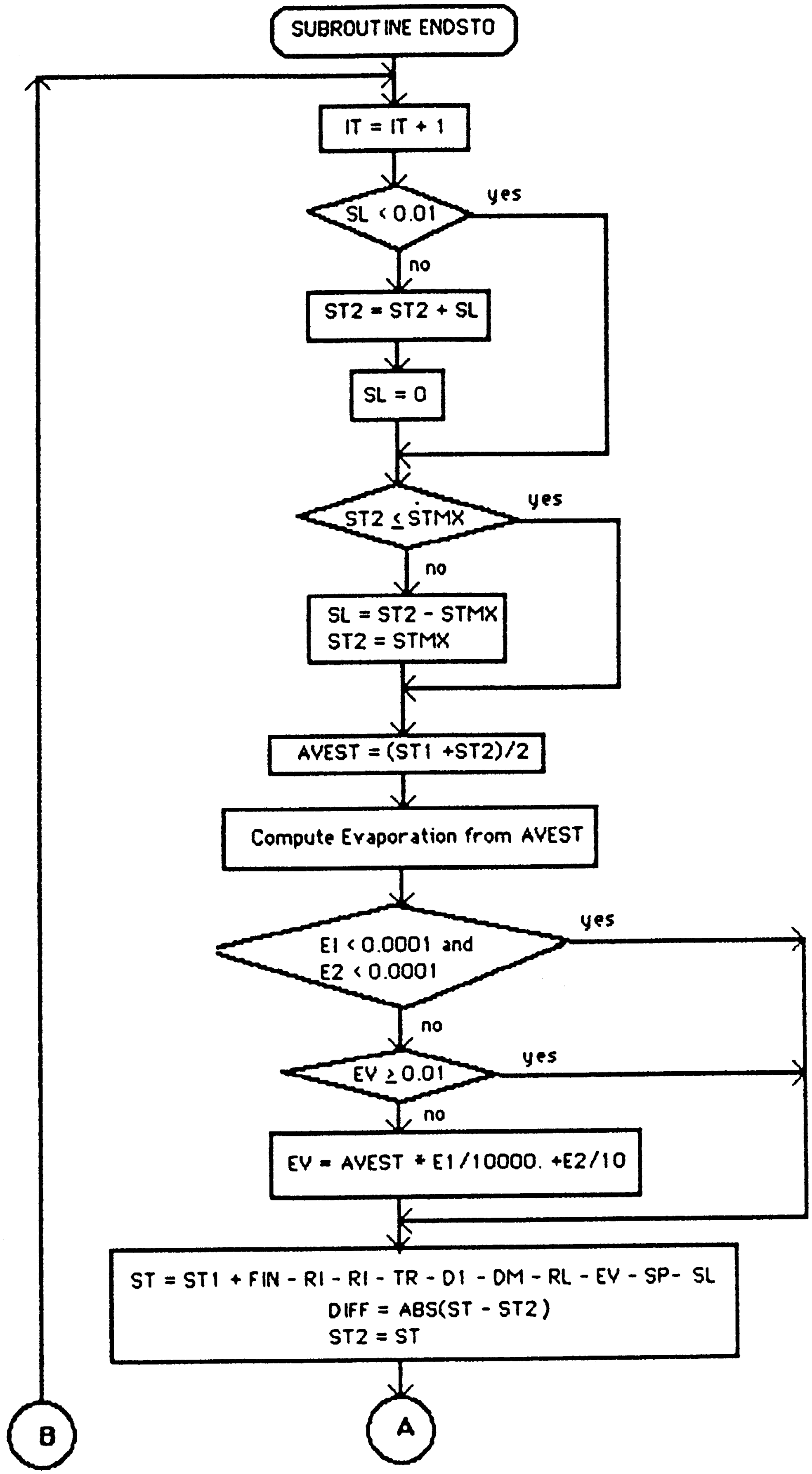


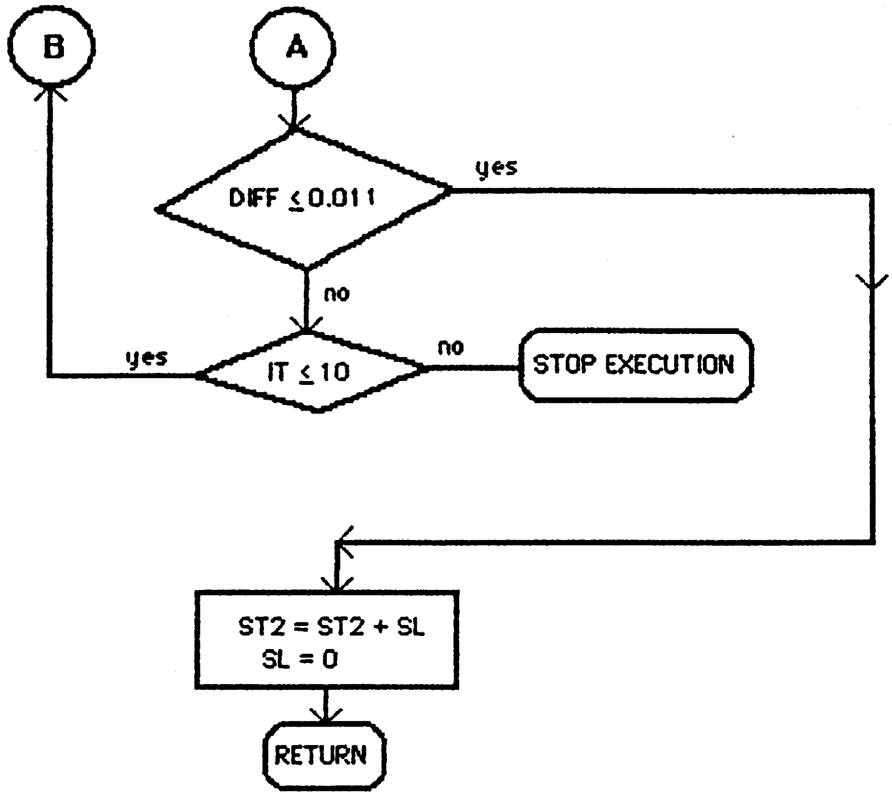

I
H
C
A
CALL DOWNPW
RETURN M1
B
DKST(K + 1) < DKMXST + 0.005
yes
no
Ownership Strorage Exceed the Max. Allowed. Assign Surplus Water to River.
CALL PRMXAJ
DKST(K + 1) > ALIRST - 0.005
yes
no
Ownership Less than the Min. Allowed, Reduce Irrigation Delivery of Previous Months.
CALL PRMNAJ
(Kendrick)
yes
RETURN M1
no
Irrigation Delivery and Storage
Ownership at the Minimum
Reset System Outflow
Glendo Unit Project
CALL GUPROJ
GLUS(K + 1) < GLUMXS + 0.005
yes
NO
I
H
C
D
E


I
H
C
D
E
Ownership Greater than Maximum Allowed, Assign Surplus Water to River.
CALL PRMXAJ
(Glendo Unit)
GLUS(K + 1) > GLUMNS - 0.005
yes
no
CALL PRMNAJ
(Glendo Unit)
RETURN M1
yes
no
K ≤ 6
yes
no
RVGN(K) < 0.005
yes
no
PNST(K + 1) ≤ PNMXST - 0.005
or
DKST(K + 1) ≤ DKMXST - 0.005
yes
no
GLUS(K + 1) > GLUMXS - 0.005
yes
no
I
H
F
G

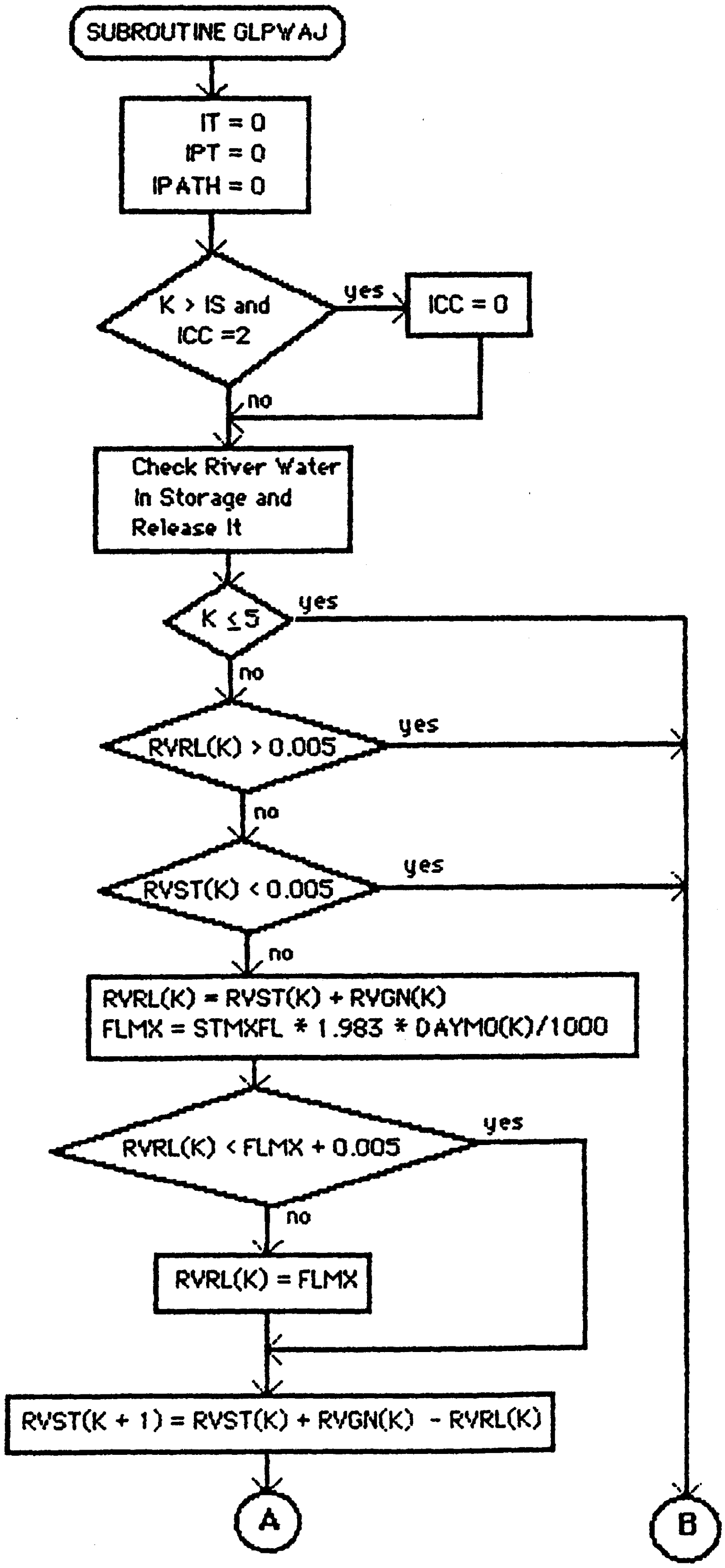

I
H
F
G
SHORT = GLUMXS - GLUS(K + 1)
SHORT < RVGN(K)
yes
RVRL(K) = RVRL(K) - RB = RVGN(K)
GLUA(K) = GLUA(K) + RVGN(K)
GLUS(K +1) = GLUS(K + 1) + RVGN(K)
RVGN = 0
no
RVGN(K) = RVGN(K) - SHORT
RVRL(K) = RVRL(K) - SHORT
GLUA(K) = GLUA(K) + SHORT
GLUS(K + 1) = GLUMXS
GUTR(K) = PNIR(K) + GLUI(K) + RVRL(K) - GURL(K)
GUIR(K) = PNIR(K) + GLUI(K)
CALL RVWTAJ
yes
RETURN M1
no
Check Total Evaporation in System
SYEV= GUEV(K) + GLEV(K) + GREV(K)
+ ALEV(K) + PTEV(K) + CTEV(K) + SEEV(K)
PNEV = PNEV(K) + DKEV(K) + GLUE(K)
ABS(SYEV - PREV) < 0.005
yes
no
CALL EVADJS
50
RETURN

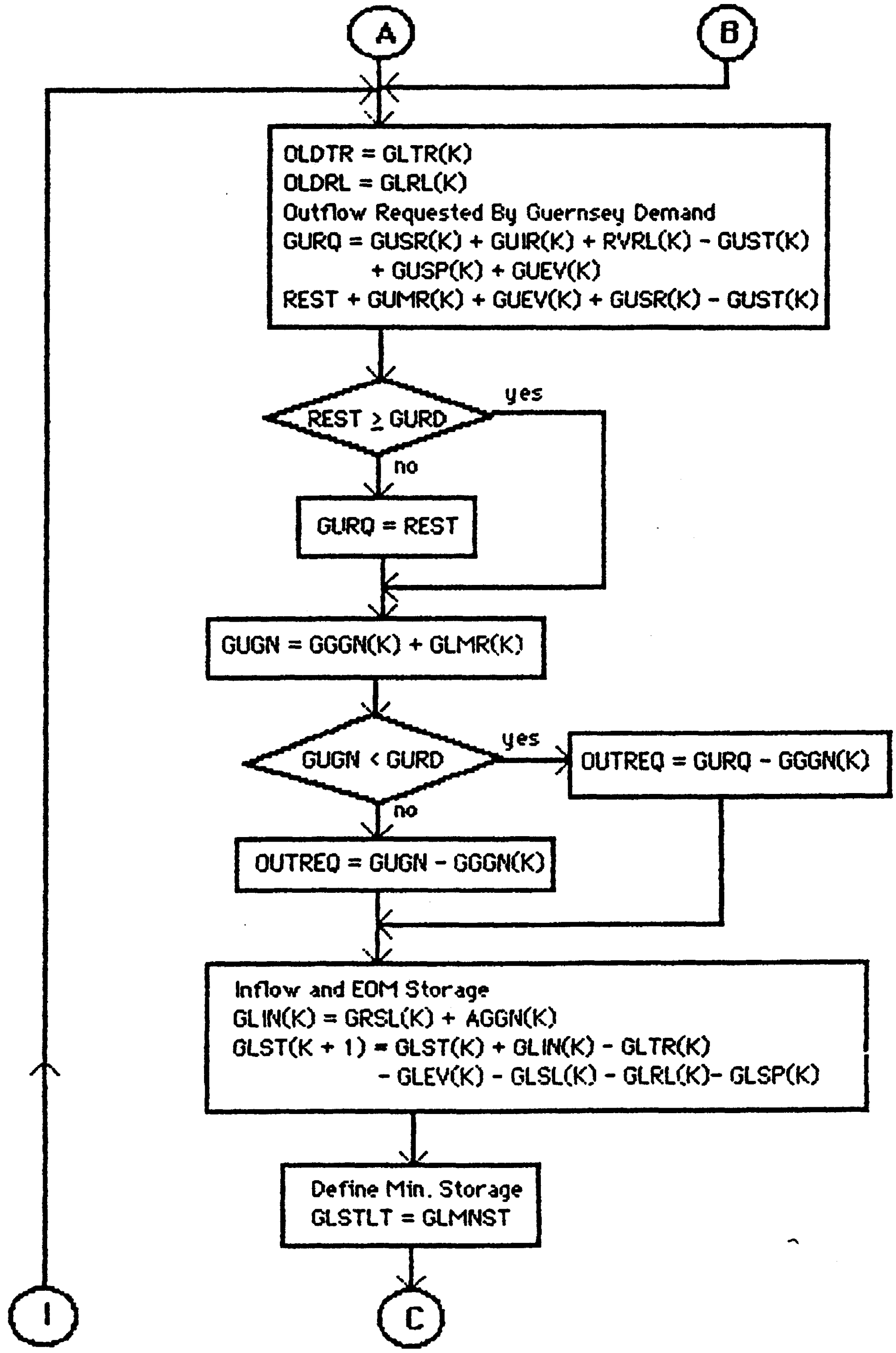
Description: Compute the End of Month Reservoir Storage taking into Account of those Components Expressed as the Function of Averge Storage.

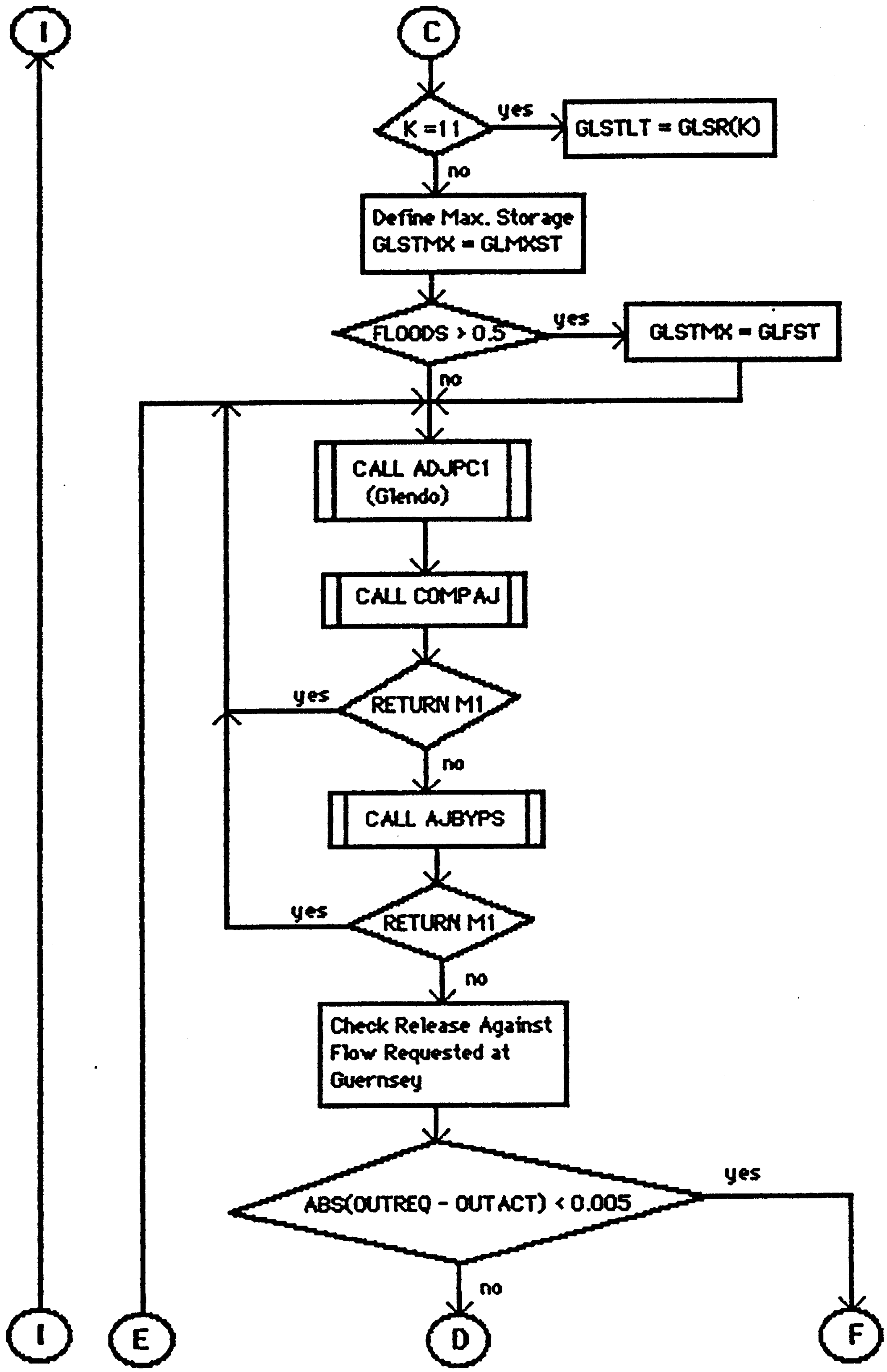


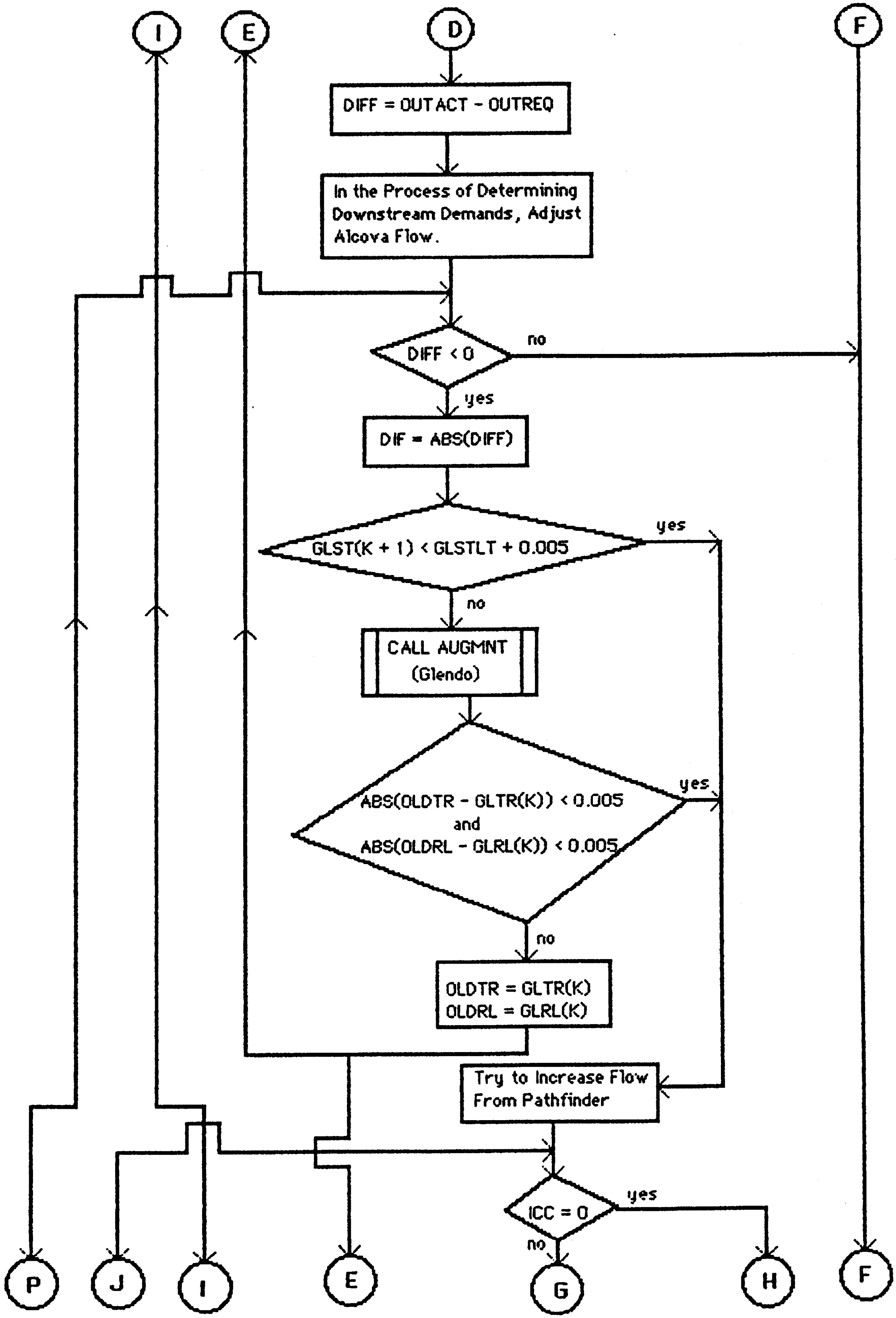

B
A
DIFF ≤ 0.011
yes
no
yes
IT ≤ 10
no
STOP EXECUTION
ST2 = ST2 + SL
SL = 0
RETURN

Description: Computation of Inflow, Storage, Water Use and Power Generation and Adjustment of Alcova and Fremont Canyon Turbine Release According to the Storage in Glendo and Alcova.

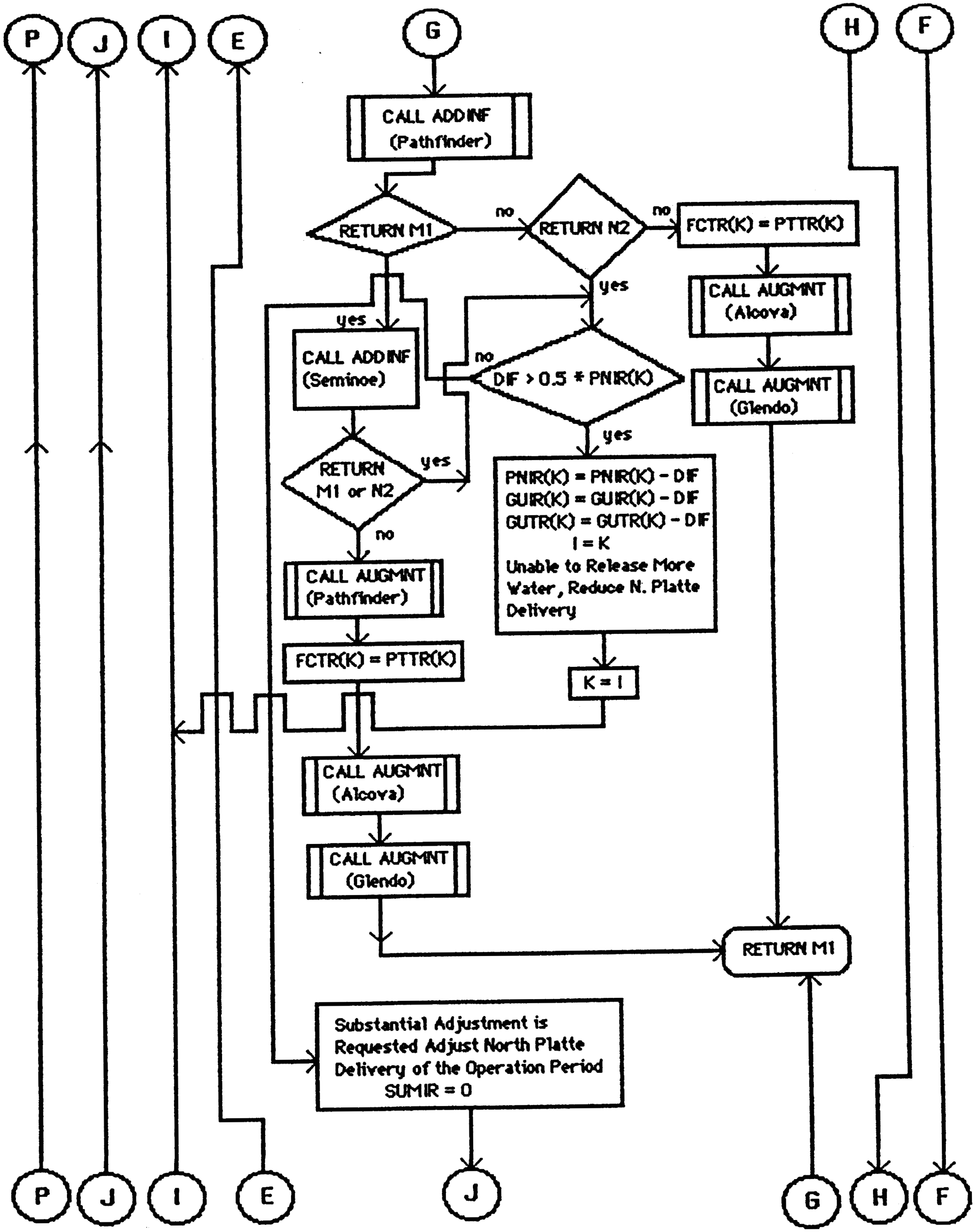


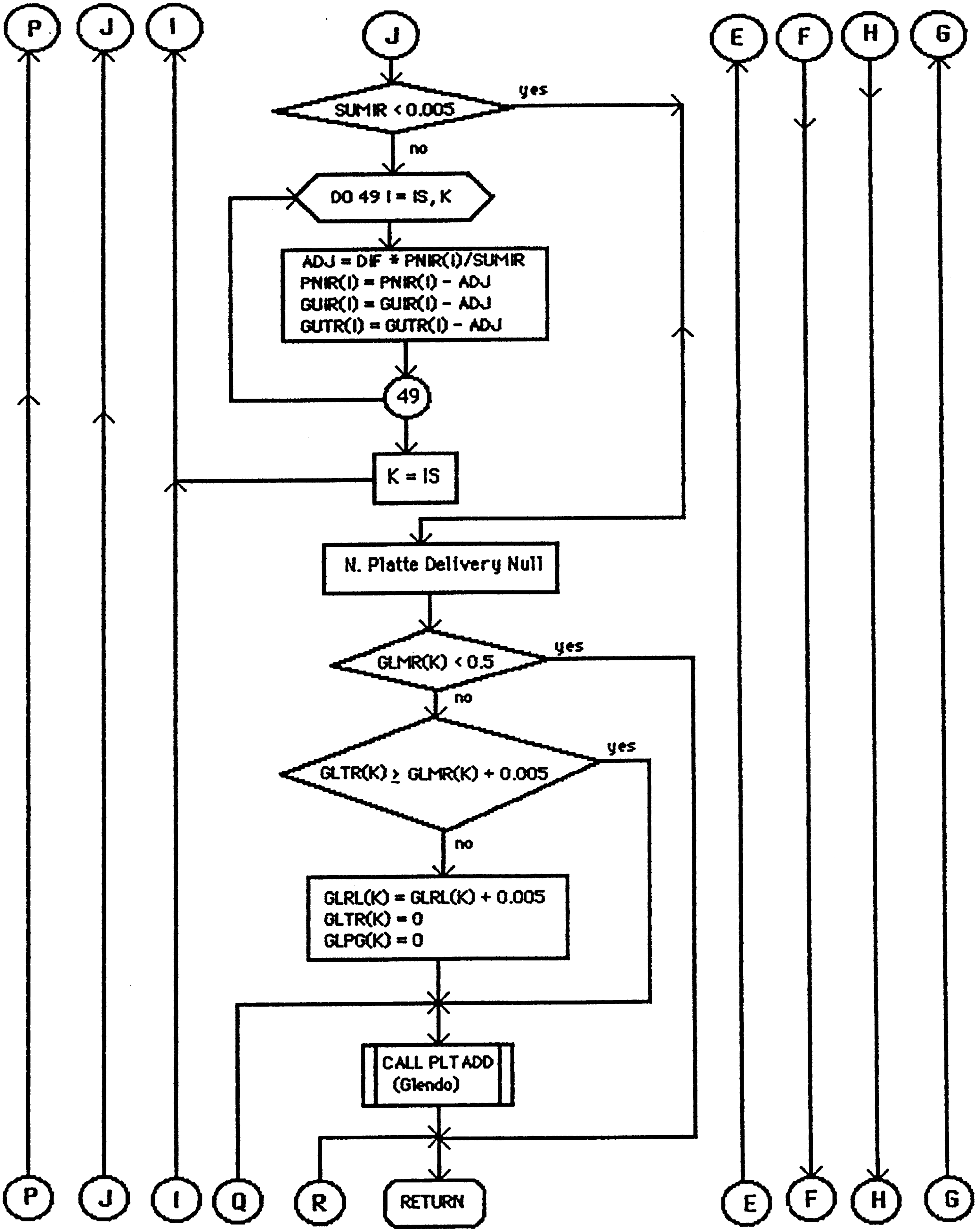

A
B
OLDTR = GLTR(K)
OLDRL = GLRL(K)
Outflow Requested By Guernsey Demand
GURQ = GUSR(K) + GUIR(K) + RVRL(K) - GUST(K) + GUSP(K) + GUEV(K)
REST + GUMR(K) + GUEV(K) + GUSR(K) - GUST(K)
REST ≥ GURD
yes
no
GURQ = REST
GUGN = GGGN(K) + GLMR(K)
GUGN < GURD
yes
OUTREQ = GURQ - GGGN(K)
no
OUTREQ = GUGN - GGGN(K)
Inflow and EOM Storage
GLIN(K) = GRSL(K) + AGGN(K)
GLST(K + 1) = GLST(K) + GLIN(K) - GLTR(K) - GLEV(K) - GLSL(K) - GLRL(K)- GLSP(K)
Define Min. Storage
GLSTLT = GLMNST
I
C

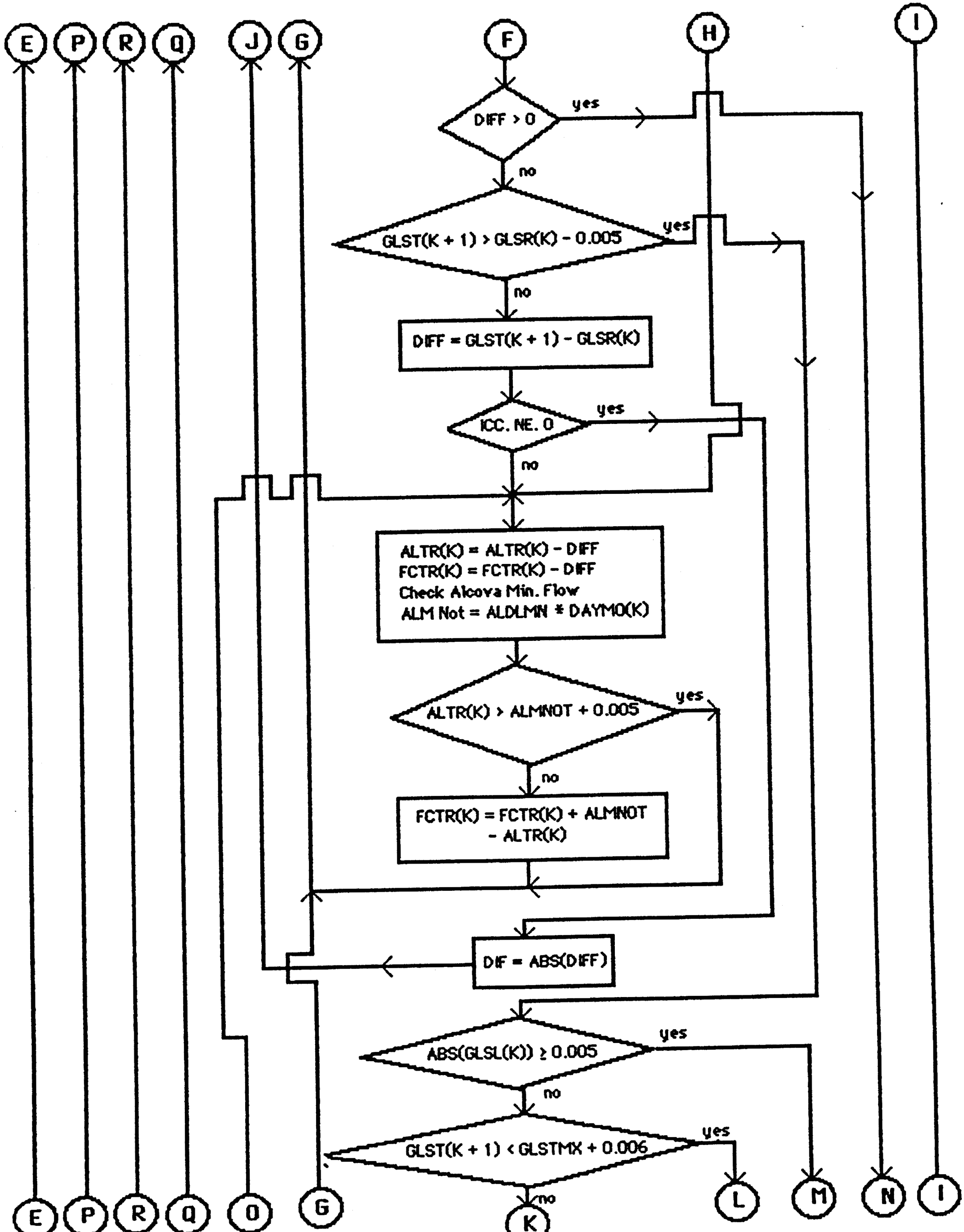

I
C
K =11
yes
GLSTLT = GLSR(K)
no
Define Max. Storage
GLSTMX = GLMXST
FLOODS > 0.5
yes
GLSTMX = GLFST
no
CALL ADJPC1
(Glendo)
CALL COMPAJ
yes
RETURN M1
no
CALL AJBYPS
yes
RETURN M1
no
Check Release Against
Flow Requested at
Guernsey
ABS(OUTREQ - OUTACT) < 0.005
yes
no
I
E
D
F

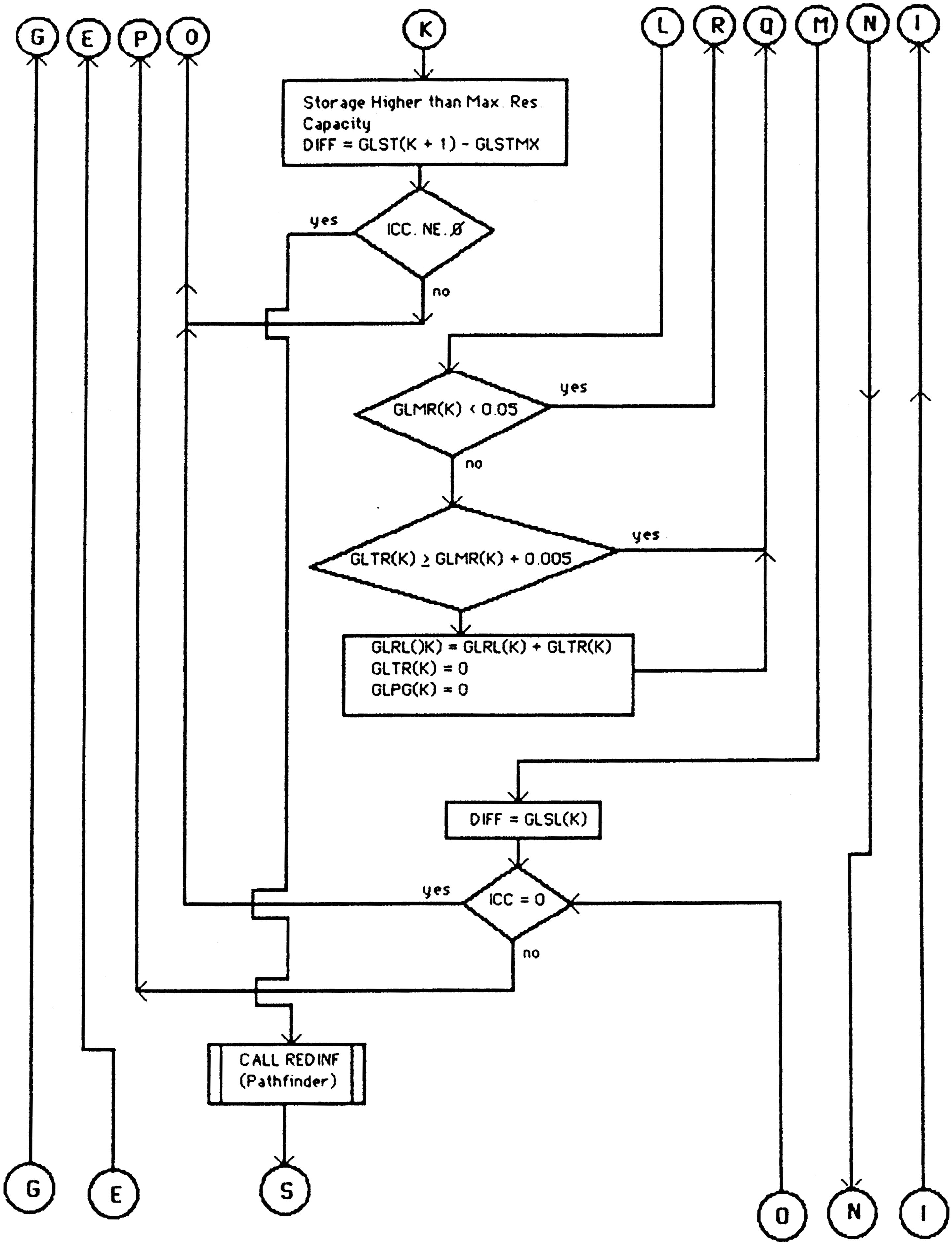


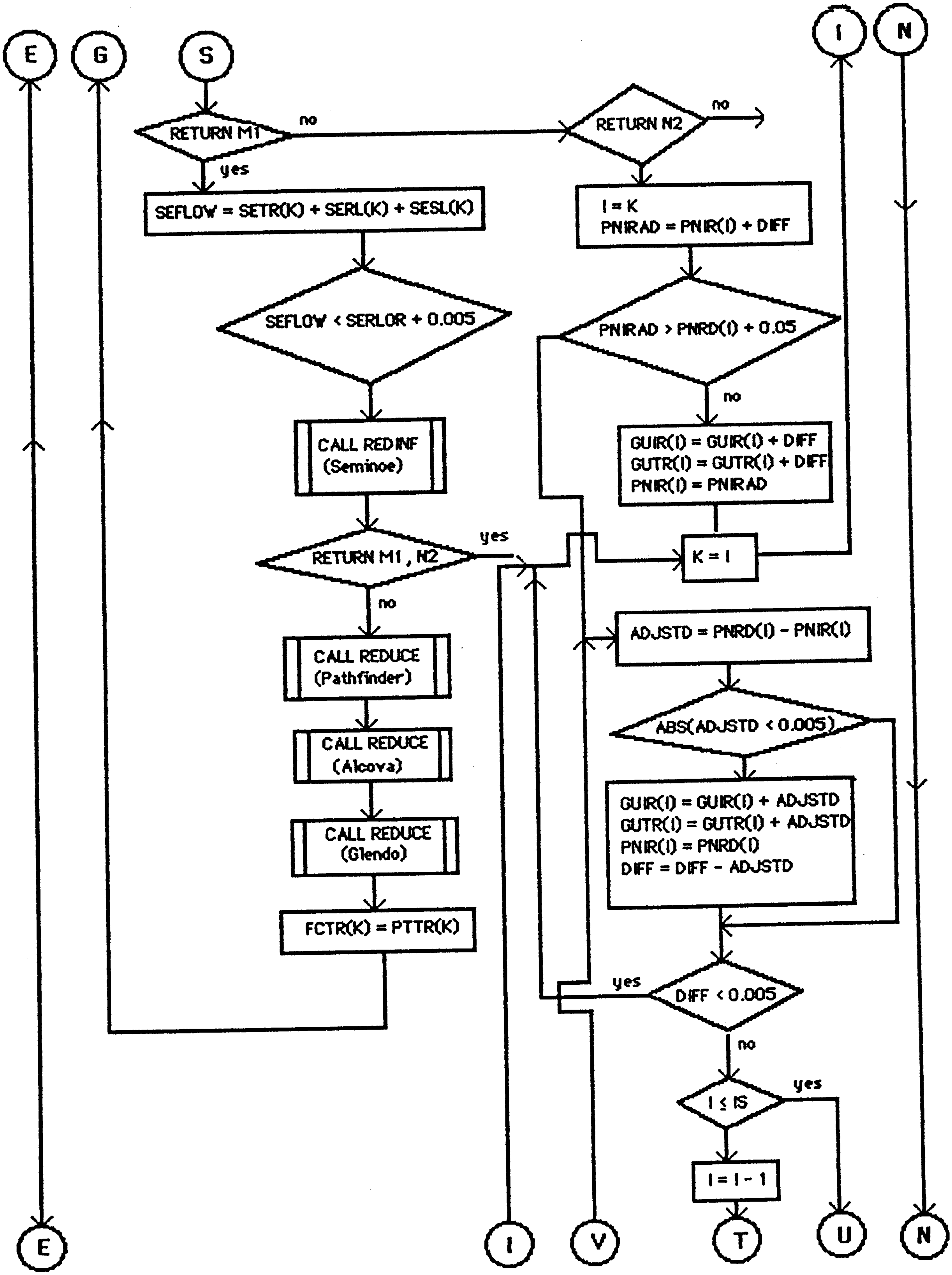
I
E
D
F
DIFF = OUTACT - OUTREQ
In the Process of Determining Downstream Demands, Adjust Alcova Flow.
DIFF < 0
no
yes
DIF = ABS(DIFF)
GLST(K + 1) < GLSTLT + 0.005
yes
no
CALL AUGMNT (Glendo)
ABS(OLDTR - GLTR(K)) < 0.005 and ABS(OLDRL - GLRL(K)) < 0.005
yes
no
OLDTR = GLTR(K)
OLDRL = GLRL(K)
Try to Increase Flow From Pathfinder
ICC = 0
yes
no
P
J
I
E
G
H
F

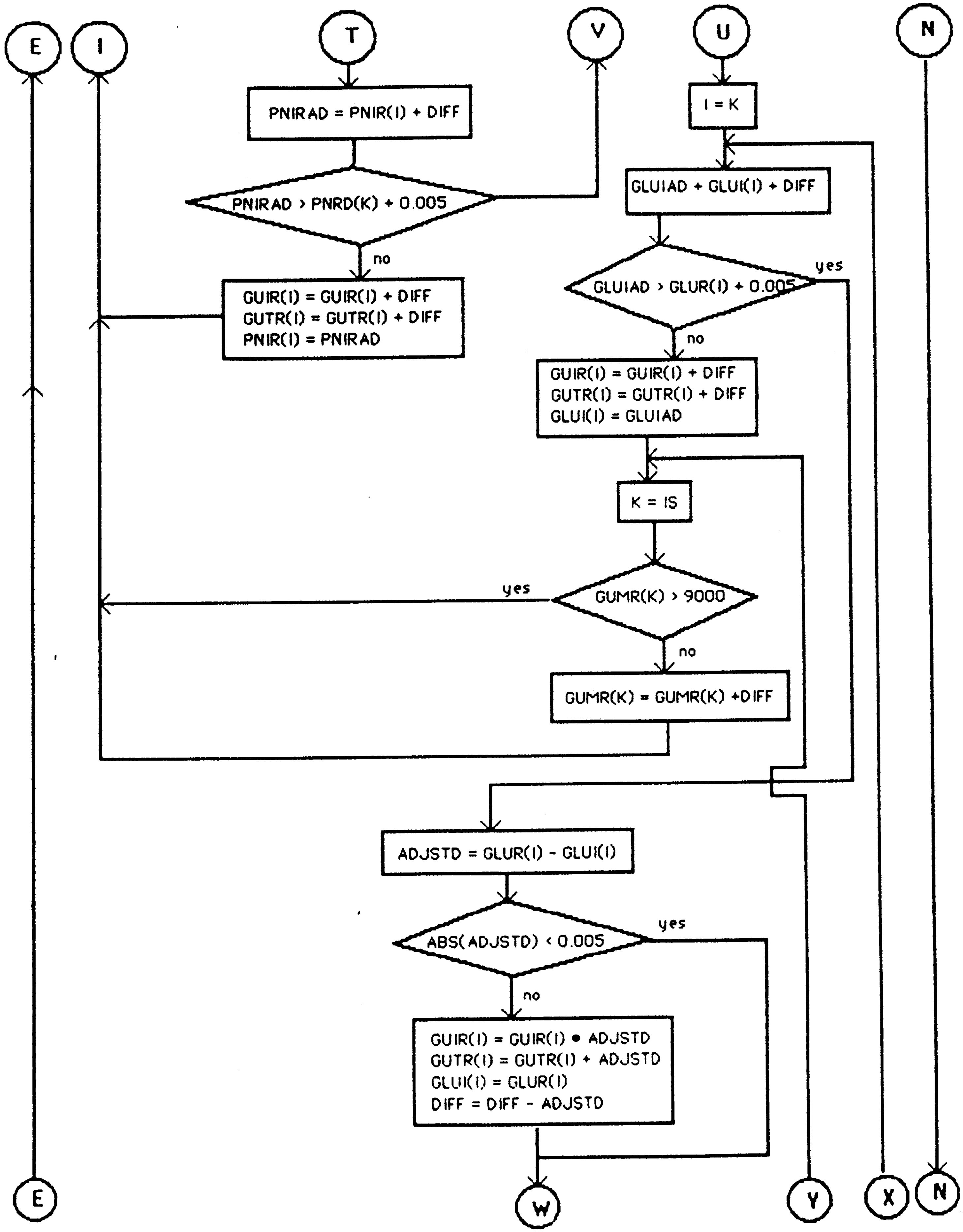

P
J
I
E
G
CALL ADDINF (Pathfinder)
RETURN M1
no
RETURN N2
no
FCTR(K) = PTTR(K)
yes
CALL AUGMNT (Alcova)
yes
CALL ADDINF (Seminoe)
no
DIF > 0.5 * PNIR(K)
CALL AUGMNT (Glendo)
yes
RETURN M1 or N2
yes
PNIR(K) = PNIR(K) - DIF
GUIR(K) = GUIR(K) - DIF
GUTR(K) = GUTR(K) - DIF
I = K
Unable to Release More Water, Reduce N. Platte Delivery
no
CALL AUGMNT (Pathfinder)
FCTR(K) = PTTR(K)
K = I
CALL AUGMNT (Alcova)
CALL AUGMNT (Glendo)
RETURN M1
Substantial Adjustment is Requested Adjust North Platte Delivery of the Operation Period
SUMIR = 0
P
J
I
E
J
G
H
F


P
J
I
J
E
F
H
G
SUMIR < 0.005
yes
no
DO 49 I = IS, K
ADJ = DIF * PNIR(I)/SUMIR
PNIR(I) = PNIR(I) - ADJ
GUIR(I) = GUIR(I) - ADJ
GUTR(I) = GUTR(I) - ADJ
49
K = IS
N. Platte Delivery Null
GLMR(K) < 0.5
yes
no
GLTR(K) ≥ GLMR(K) + 0.005
yes
no
GLRL(K) = GLRL(K) + 0.005
GLTR(K) = 0
GLPG(K) = 0
CALL PLTADD
(Glendo)
P
J
I
Q
R
RETURN
E
F
H
G

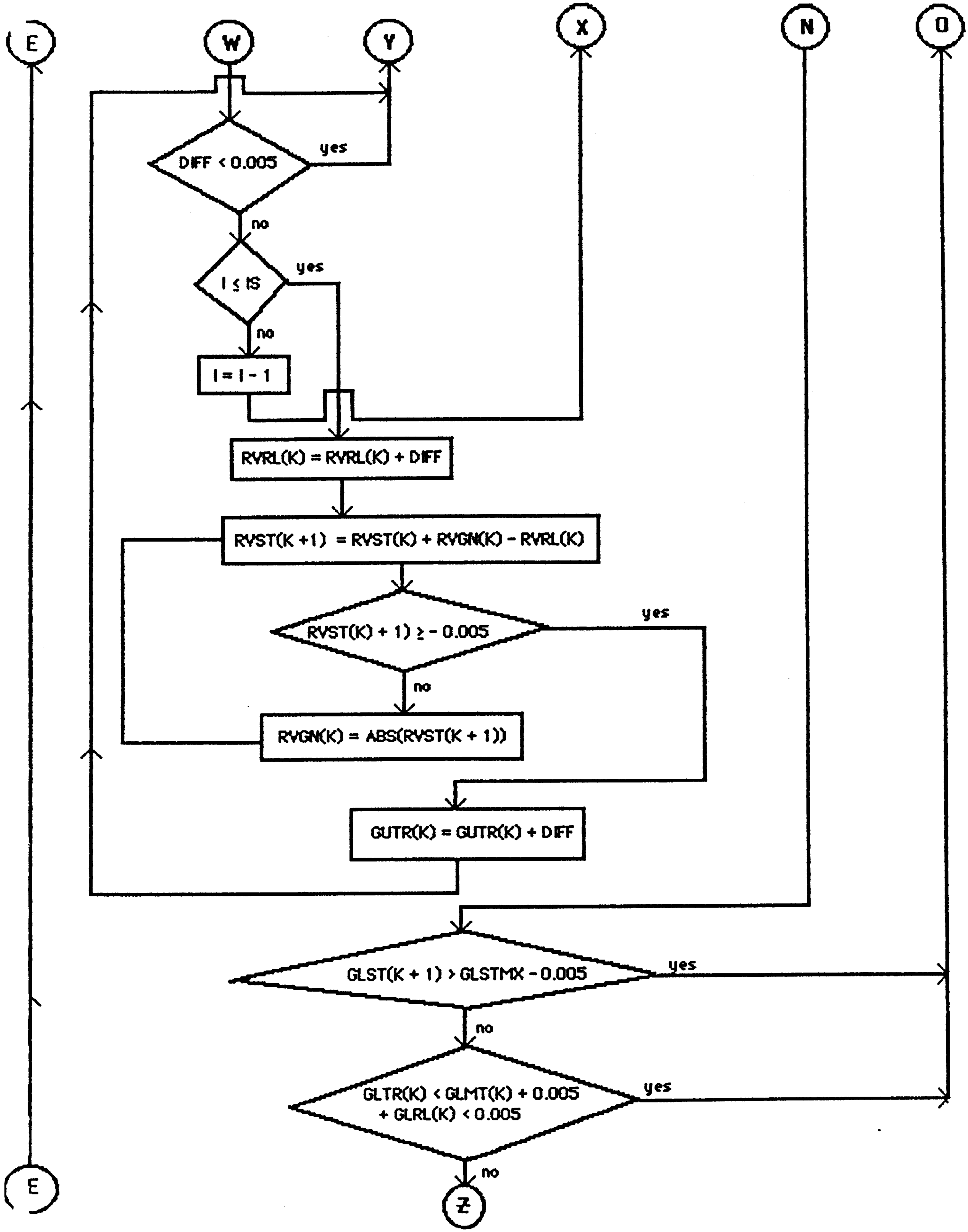

E
P
R
Q
J
G
F
H
I
DIFF > 0
yes
no
GLST(K + 1) > GLSR(K) - 0.005
yes
no
DIFF = GLST(K + 1) - GLSR(K)
ICC. NE. 0
yes
no
ALTR(K) = ALTR(K) - DIFF
FCTR(K) = FCTR(K) - DIFF
Check Alcova Min. Flow
ALM Not = ALDLMN * DAYMO(K)
ALTR(K) > ALMNOT + 0.005
yes
no
FCTR(K) = FCTR(K) + ALMNOT - ALTR(K)
DIF = ABS(DIFF)
ABS(GLSL(K)) ≥ 0.005
yes
no
GLST(K + 1) < GLSTMX + 0.006
yes
no
E
P
R
Q
O
G
K
L
M
N
I

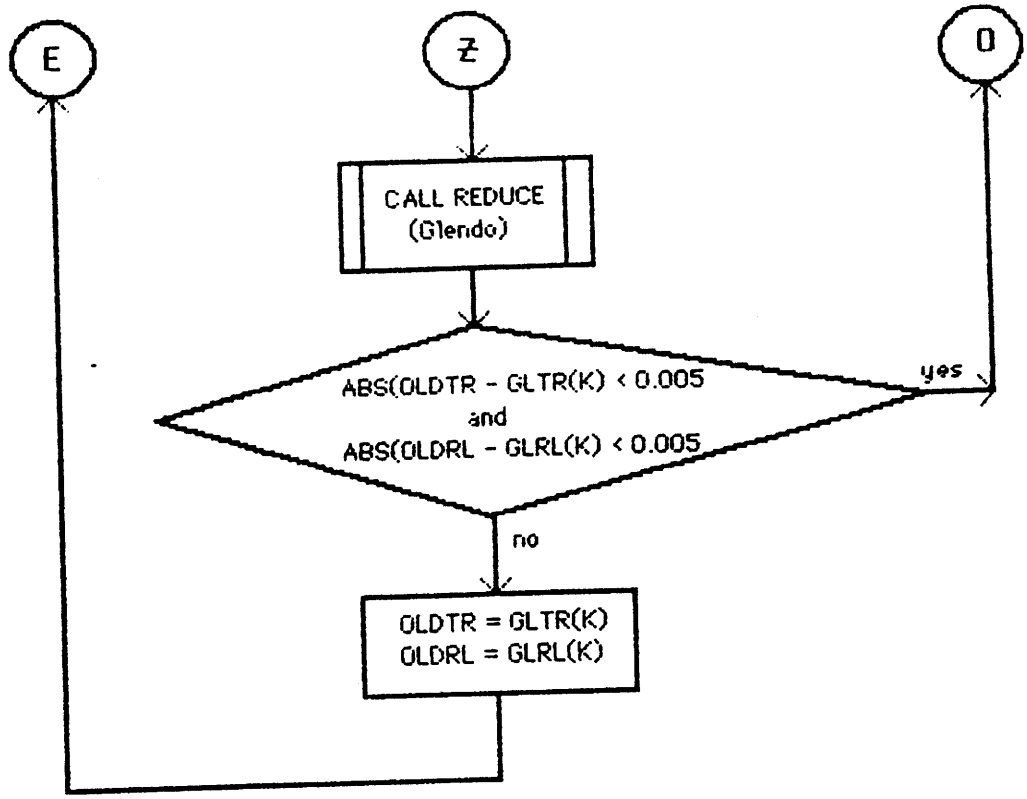

G
E
P
O
K
L
R
Q
M
N
I
Storage Higher than Max. Res. Capacity
DIFF = GLST(K + 1) - GLSTMX
yes
ICC. NE. Ø
no
yes
GLMR(K) < 0.05
no
yes
GLTR(K) ≥ GLMR(K) + 0.005
GLRL()K) = GLRL(K) + GLTR(K)
GLTR(K) = 0
GLPG(K) = 0
DIFF = GLSL(K)
yes
ICC = 0
no
CALL REDINF
(Pathfinder)
G
E
S
O
N
I


E
G
S
RETURN M1
no
yes
SEFLOW = SETR(K) + SERL(K) + SESL(K)
SEFLOW < SERLOR + 0.005
CALL REDINF (Seminoe)
RETURN M1, N2
yes
no
CALL REDUCE (Pathfinder)
CALL REDUCE (Alcova)
CALL REDUCE (Glendo)
FCTR(K) = PTTR(K)
RETURN N2
no
I = K
PNIRAD = PNIR(I) + DIFF
PNIRAD > PNRD(I) + 0.05
no
GUIR(I) = GUIR(I) + DIFF
GUTR(I) = GUTR(I) + DIFF
PNIR(I) = PNIRAD
K = I
ADJSTD = PNRD(I) - PNIR(I)
ABS(ADJSTD < 0.005)
GUIR(I) = GUIR(I) + ADJSTD
GUTR(I) = GUTR(I) + ADJSTD
PNIR(I) = PNRD(I)
DIFF = DIFF - ADJSTD
DIFF < 0.005
yes
no
I ≤ IS
yes
I = I - 1
I
N
E
I
V
T
U
N

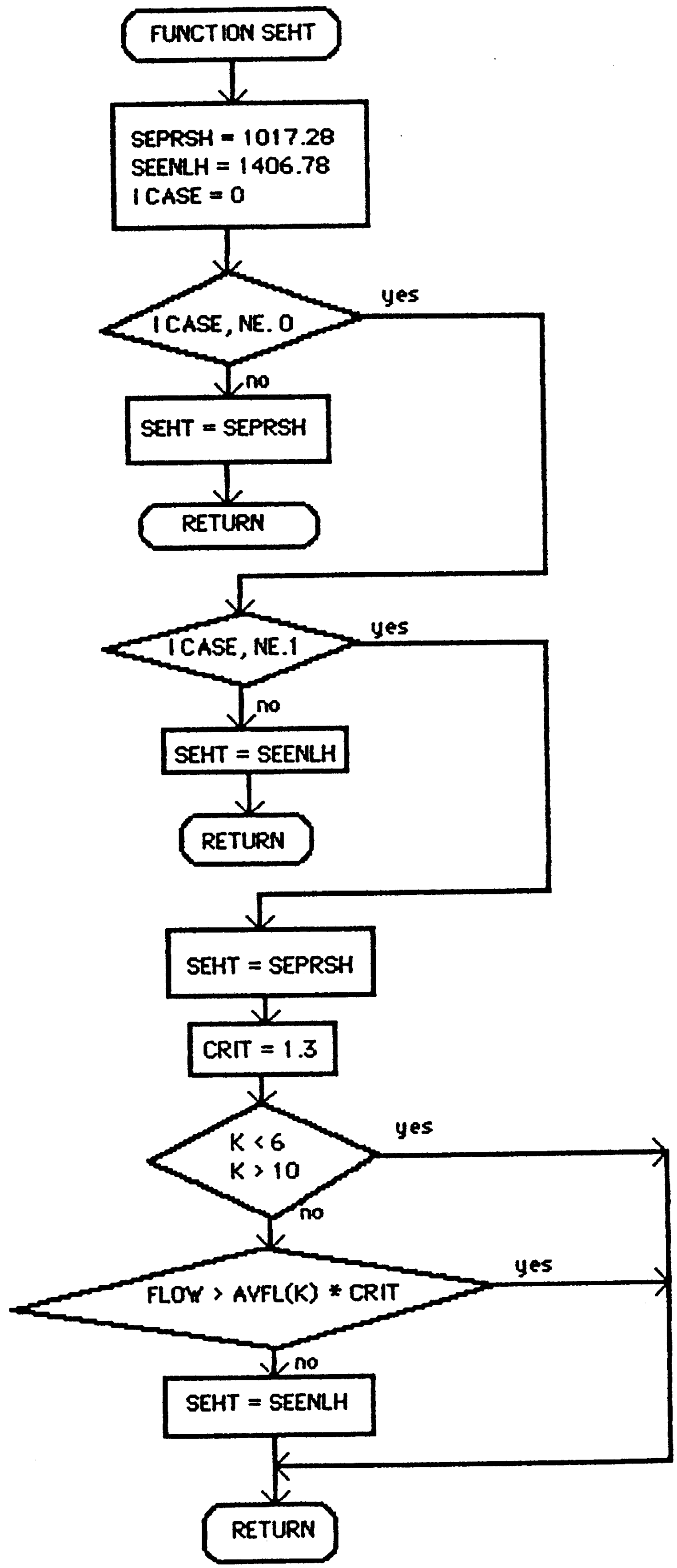


E
I
T
V
U
N
PNIRAD = PNIR(I) + DIFF
PNIRAD > PNRD(K) + 0.005
no
GUIR(I) = GUIR(I) + DIFF
GUTR(I) = GUTR(I) + DIFF
PNIR(I) = PNIRAD
I = K
GLUIAD + GLUI(I) + DIFF
GLUIAD > GLUR(I) + 0.005
yes
no
GUIR(I) = GUIR(I) + DIFF
GUTR(I) = GUTR(I) + DIFF
GLUI(I) = GLUIAD
K = IS
GUMR(K) > 9000
yes
no
GUMR(K) = GUMR(K) +DIFF
ADJSTD = GLUR(I) - GLUI(I)
ABS(ADJSTD) < 0.005
yes
no
GUIR(I) = GUIR(I) • ADJSTD
GUTR(I) = GUTR(I) + ADJSTD
GLUI(I) = GLUR(I)
DIFF = DIFF - ADJSTD
E
W
Y
X
N


E
W
Y
X
N
O
DIFF < 0.005
yes
no
I ≤ IS
yes
no
I = I - 1
RVRL(K) = RVRL(K) + DIFF
RVST(K +1) = RVST(K) + RVGN(K) - RVRL(K)
RVST(K) + 1) ≥ - 0.005
yes
no
RVGN(K) = ABS(RVST(K + 1))
GUTR(K) = GUTR(K) + DIFF
GLST(K + 1) > GLSTMX - 0.005
yes
no
GLTR(K) < GLMT(K) + 0.005
+ GLRL(K) < 0.005
yes
no
E
Z

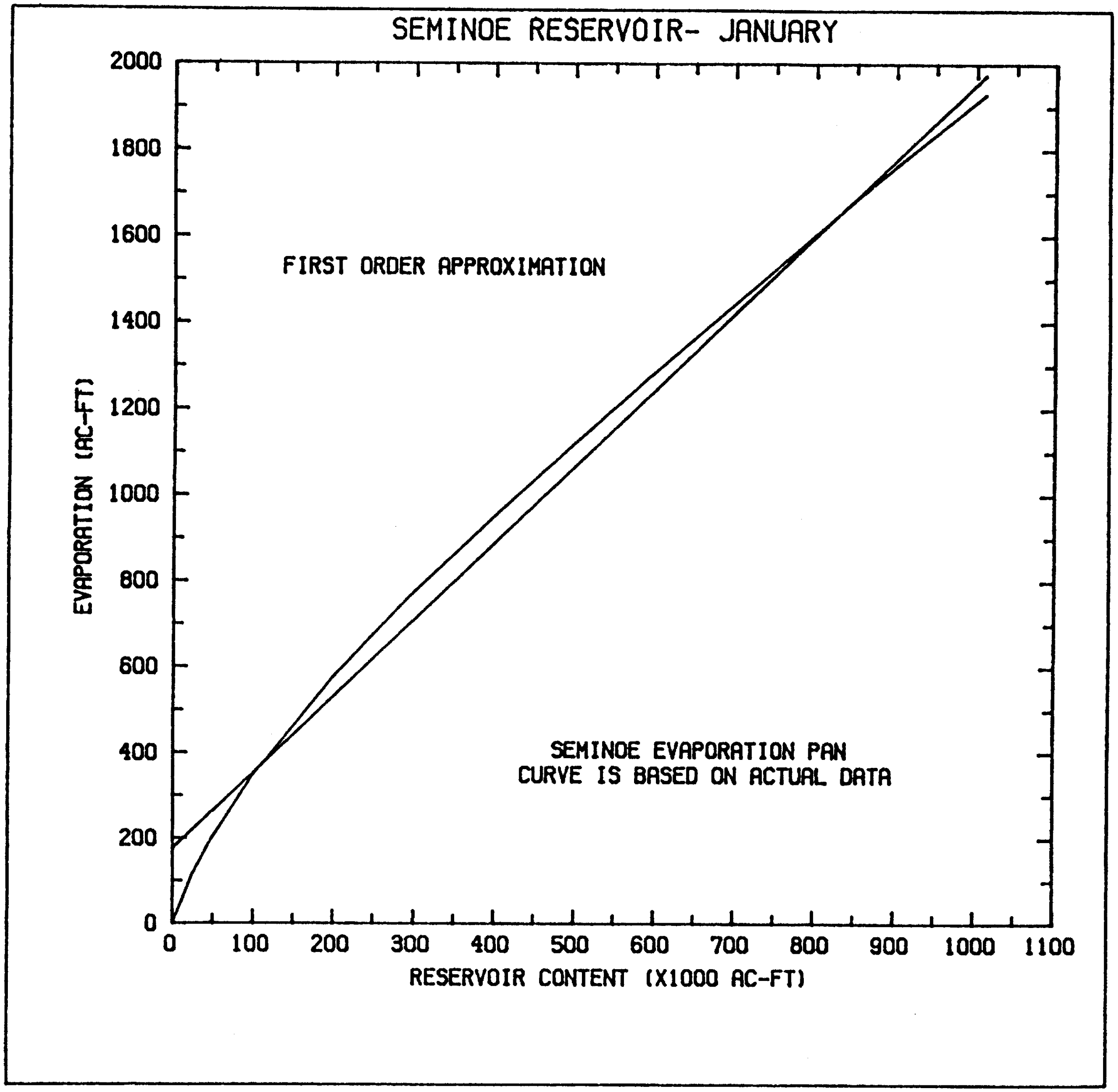

E
Z
D
CALL REDUCE
(Glendo)
ABS(OLDTR - GLTR(K) < 0.005
and
ABS(OLDRL - GLRL(K) < 0.005
yes
no
OLDTR = GLTR(K)
OLDRL = GLRL(K)

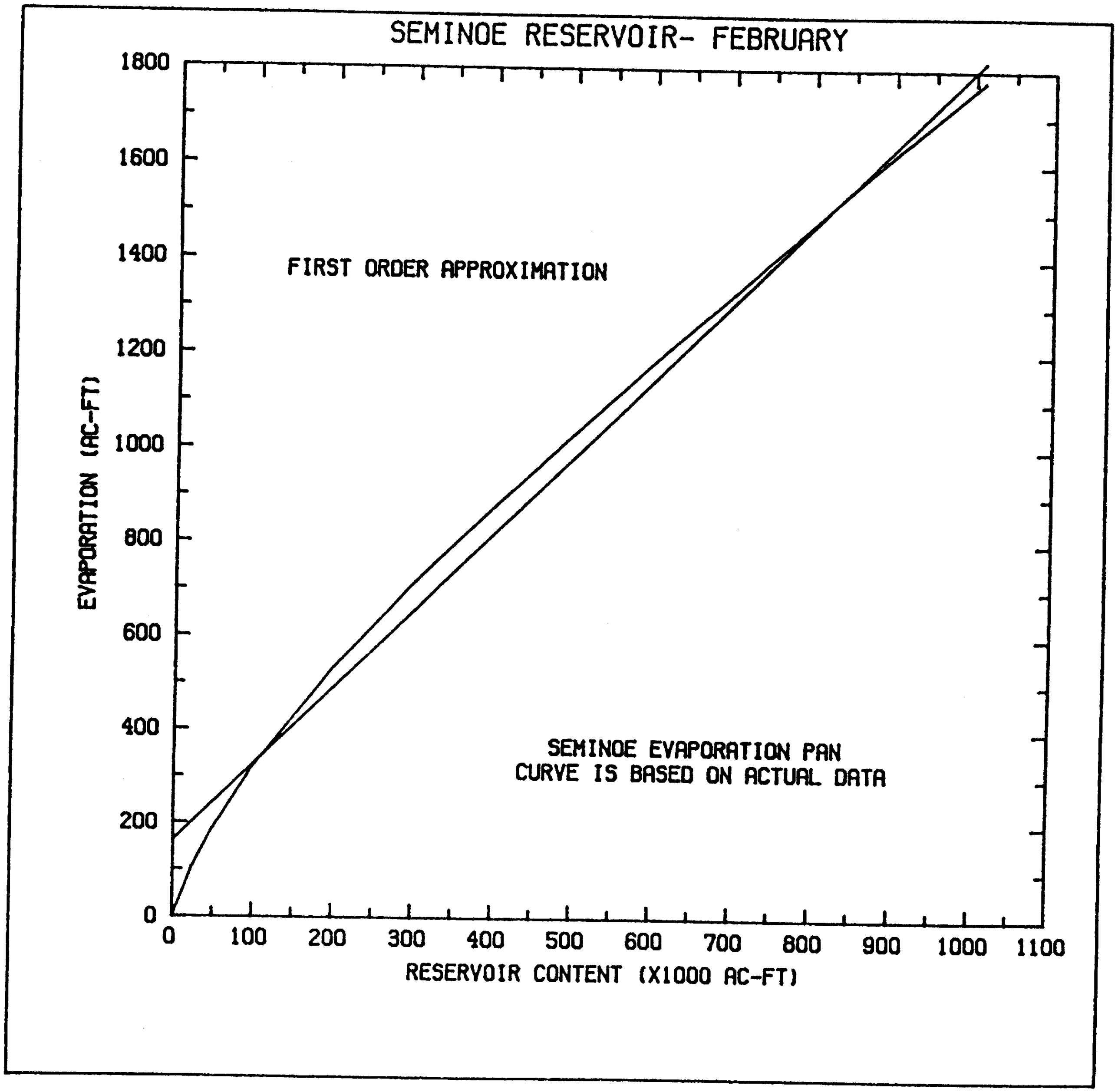
Description: I Case Controls Seminoe Dam Height
= 0 Present Height = CAP 1017.28
= 1 Enlargement Ht. Cap 1406.78
= 2 Enlargement Ht. When Flow Greater than Mean * Crit.

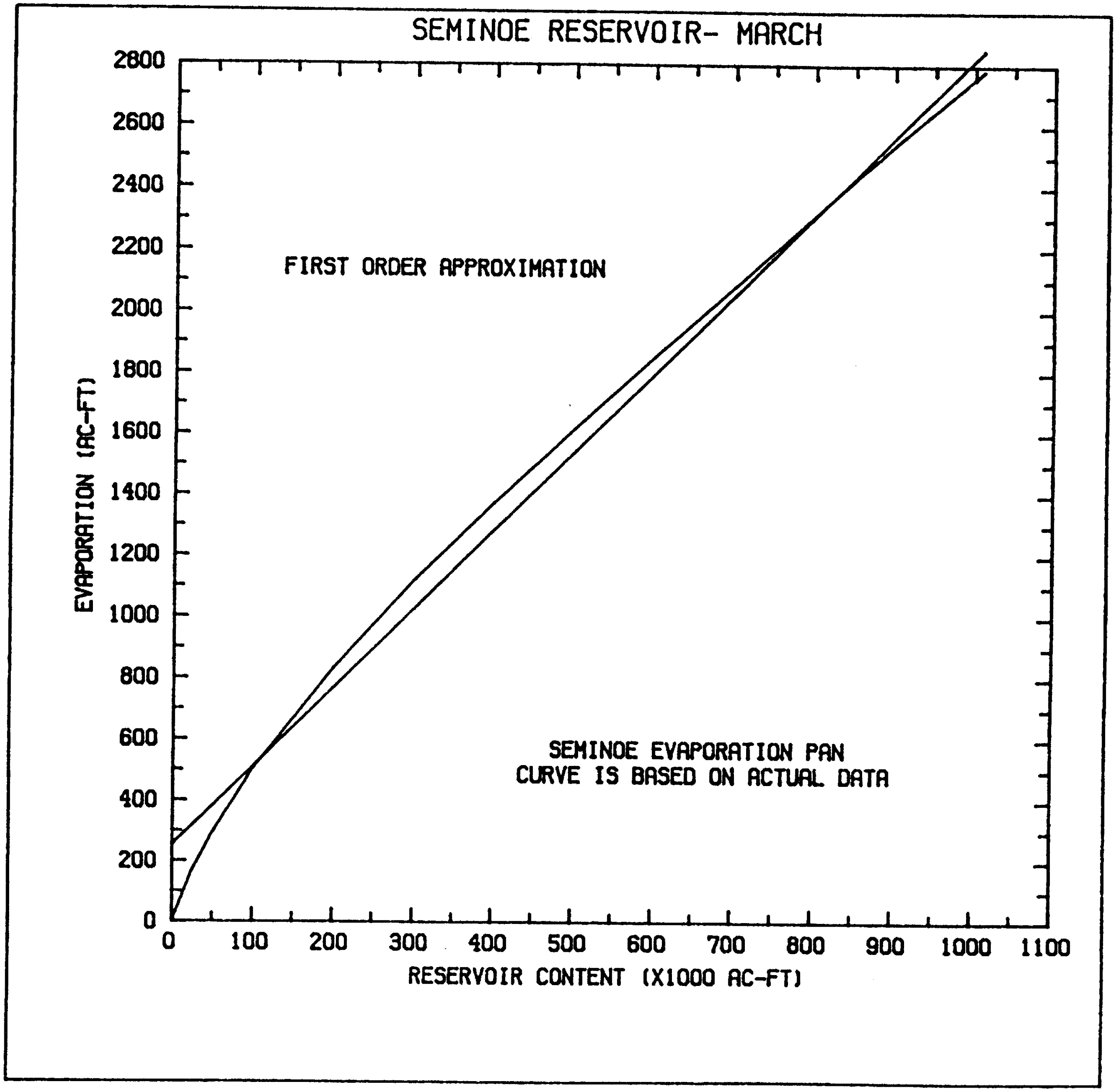


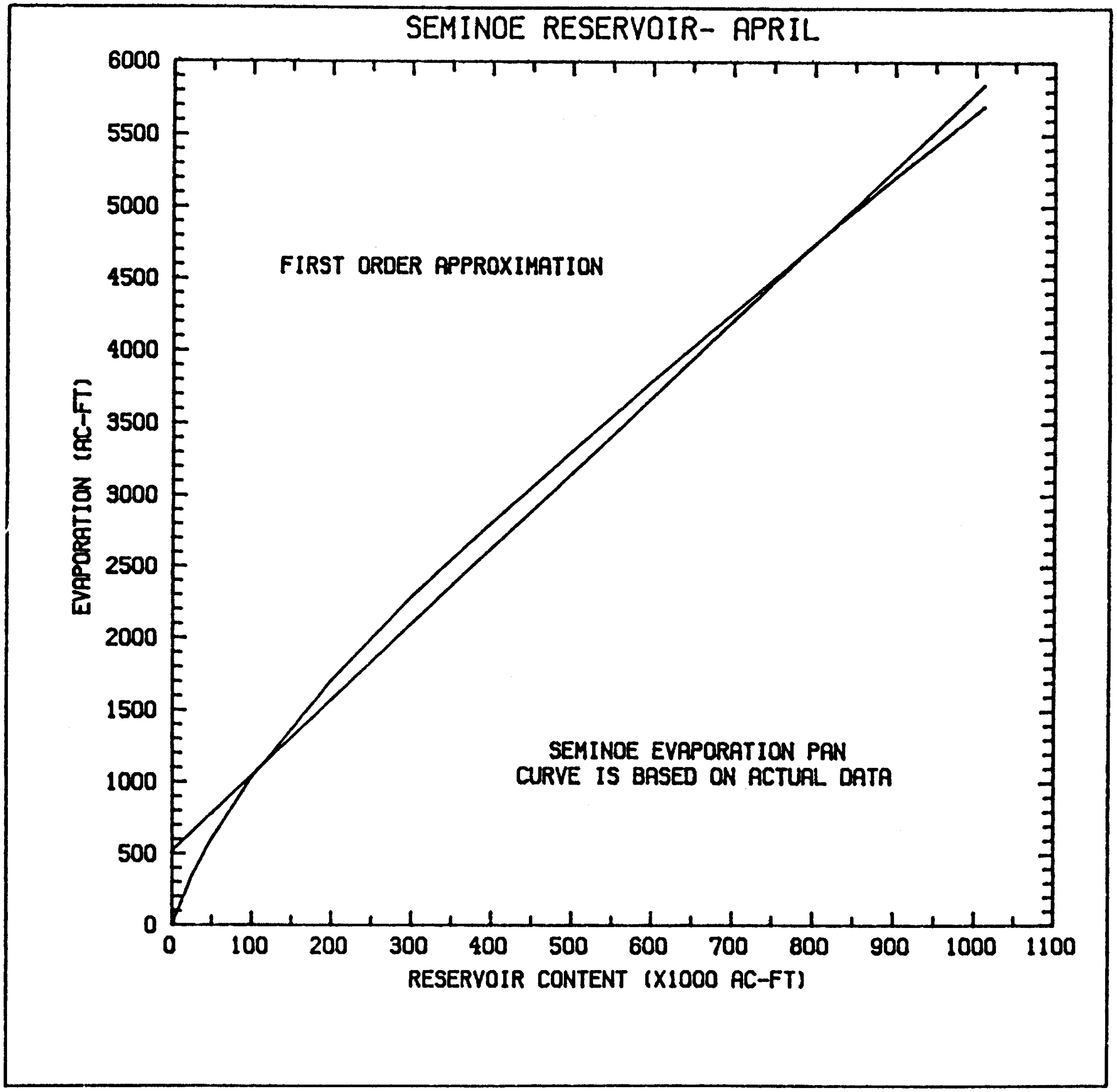
APPENDIX C

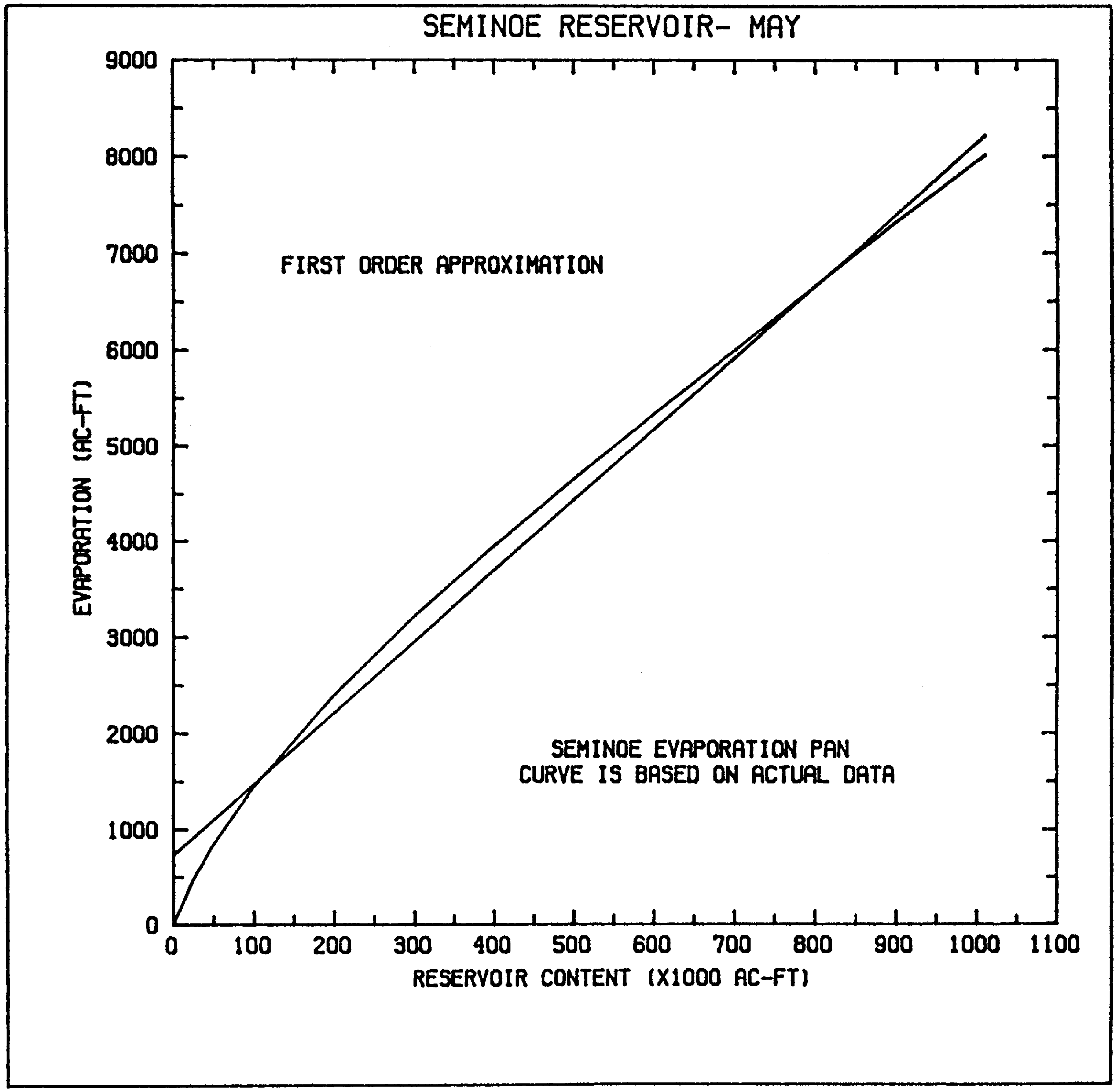
EVAPORATION VERSUS AVERAGE END-OF-MONTH RESERVOIR CONTENT PLOTS

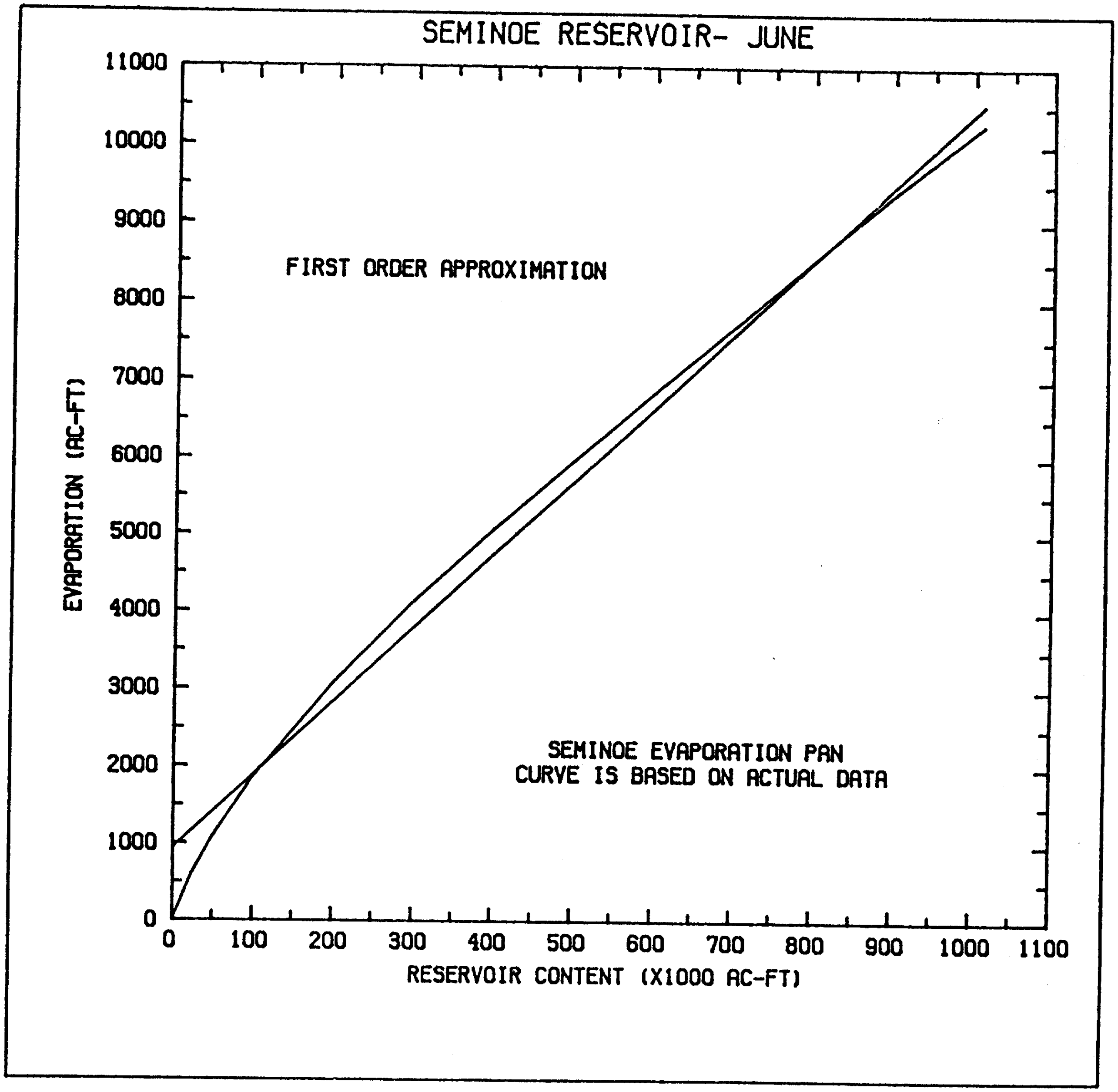

SEMINOE RESERVOIR- JANUARY
2000
1800
1600
1400
1200
1000
800
600
400
200
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)

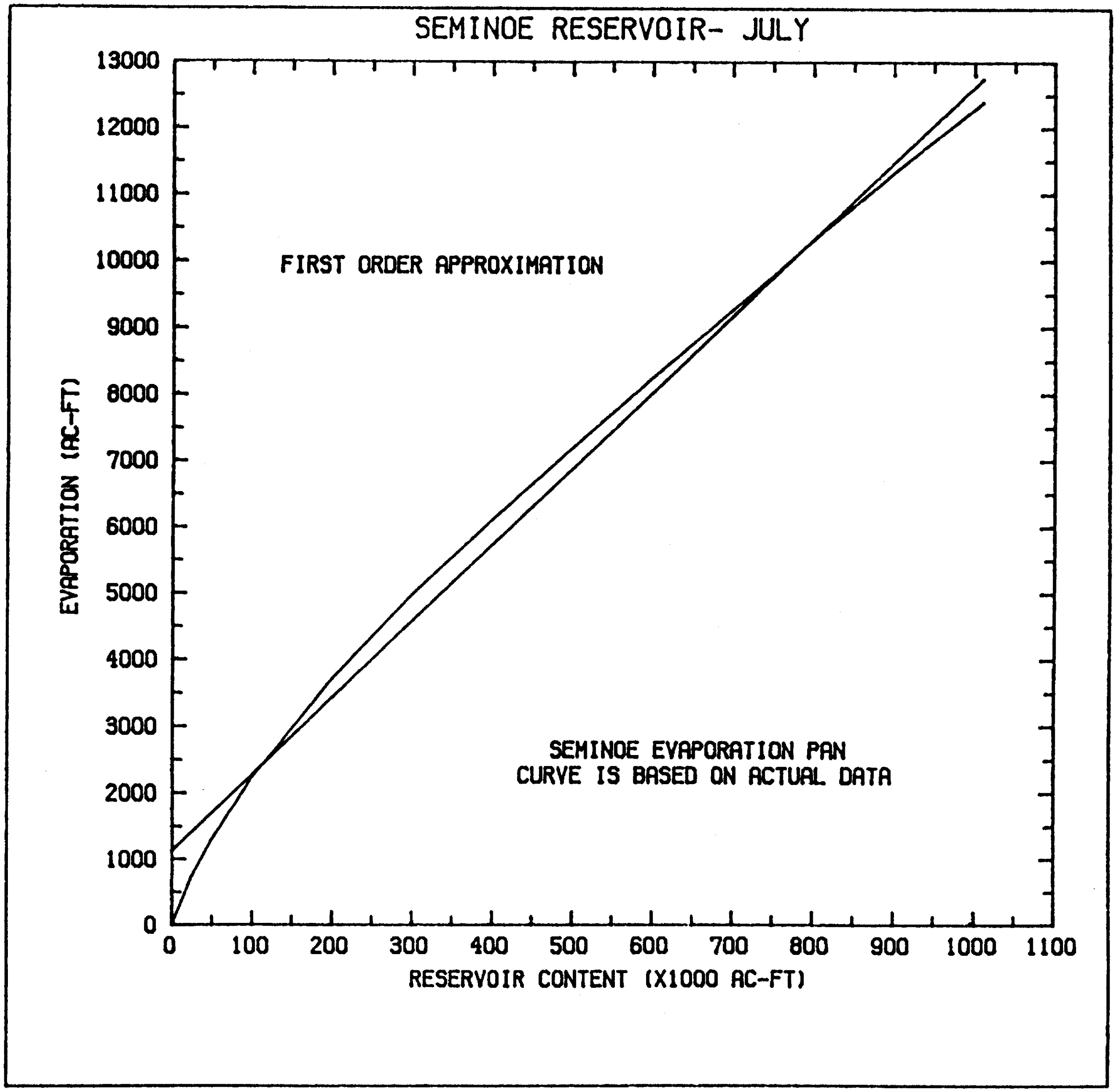

SEMINOE RESERVOIR- FEBRUARY
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
0
100
200
300
400
500
600
700
800
900
1000
1100

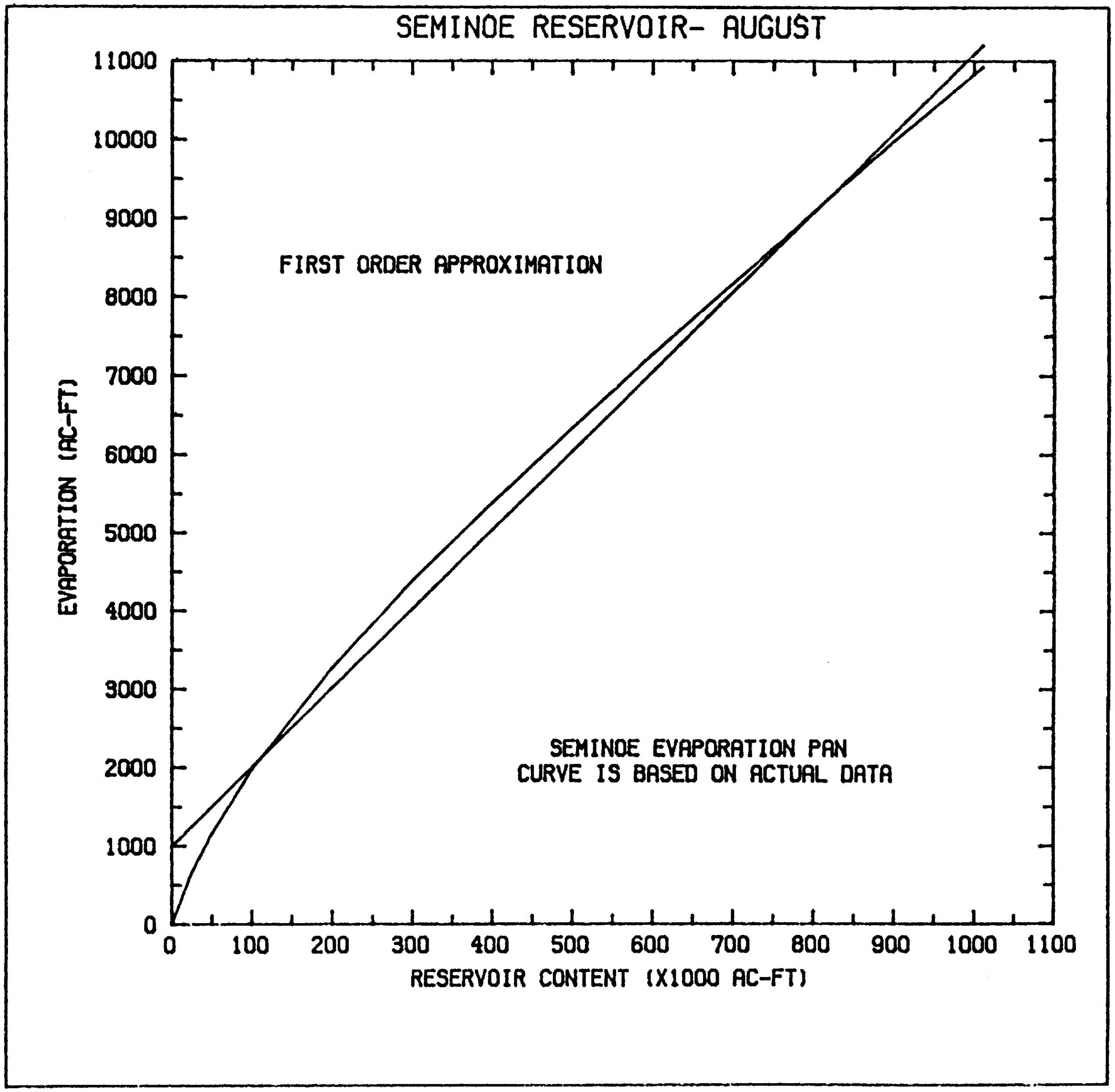

SEMINOE RESERVOIR- MARCH
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
0
100
200
300
400
500
600
700
800
900
1000
1100

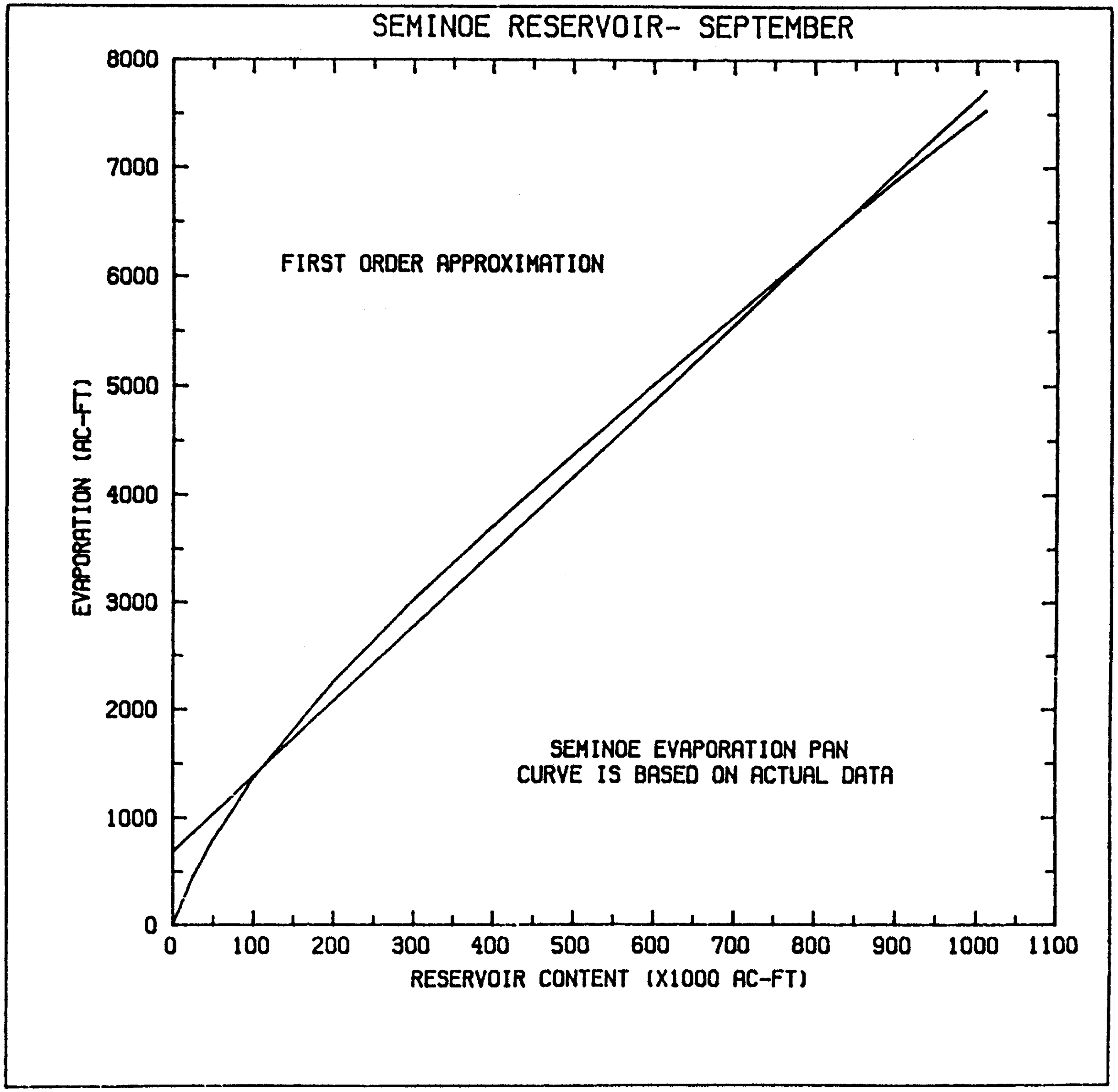

SEMINOE RESERVOIR- APRIL
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
100
200
300
400
500
600
700
800
900
1000
1100


SEMINOE RESERVOIR- MAY
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
0
100
200
300
400
500
600
700
800
900
1000
1100

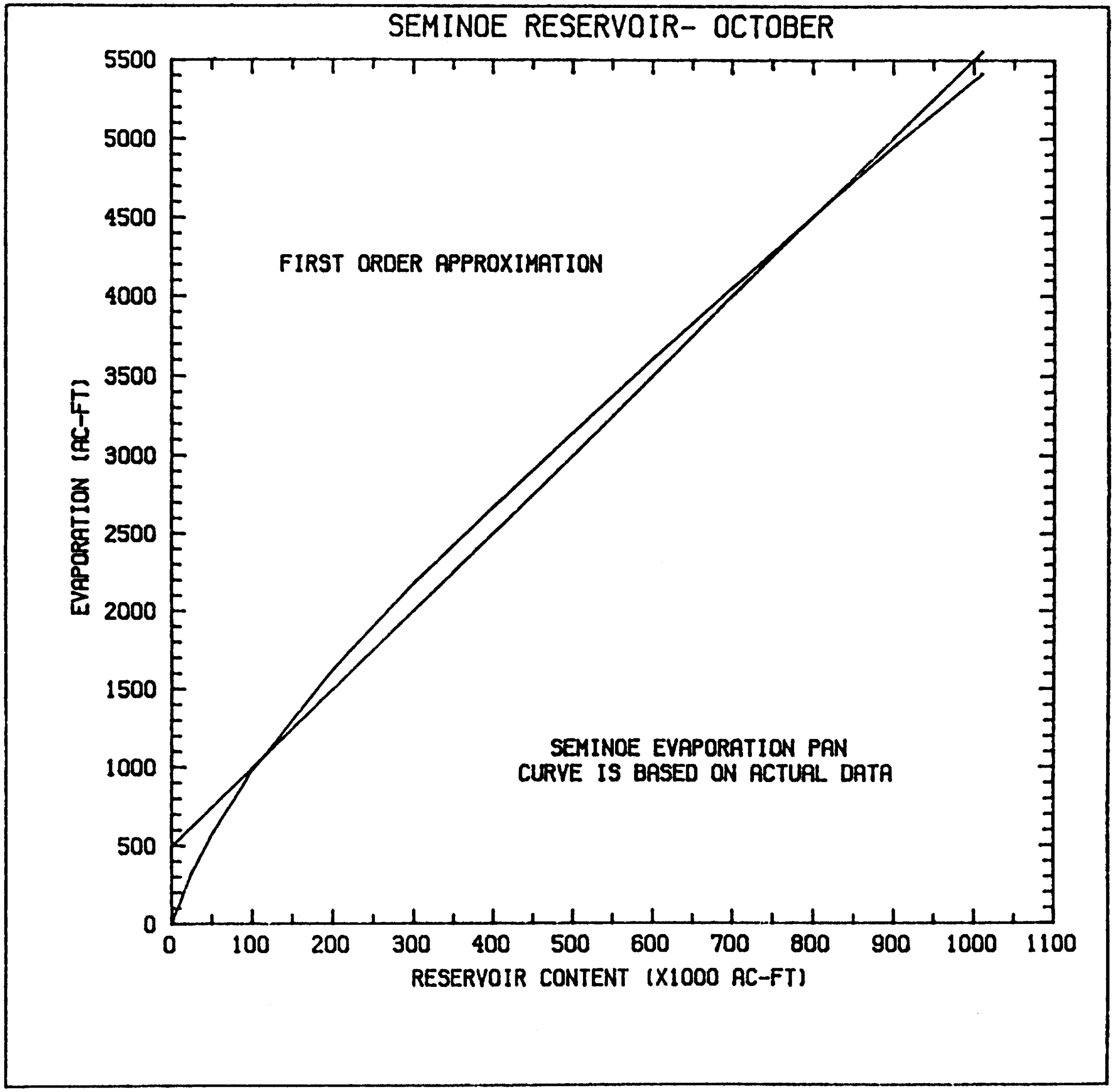

SEMINOE RESERVOIR- JUNE
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)

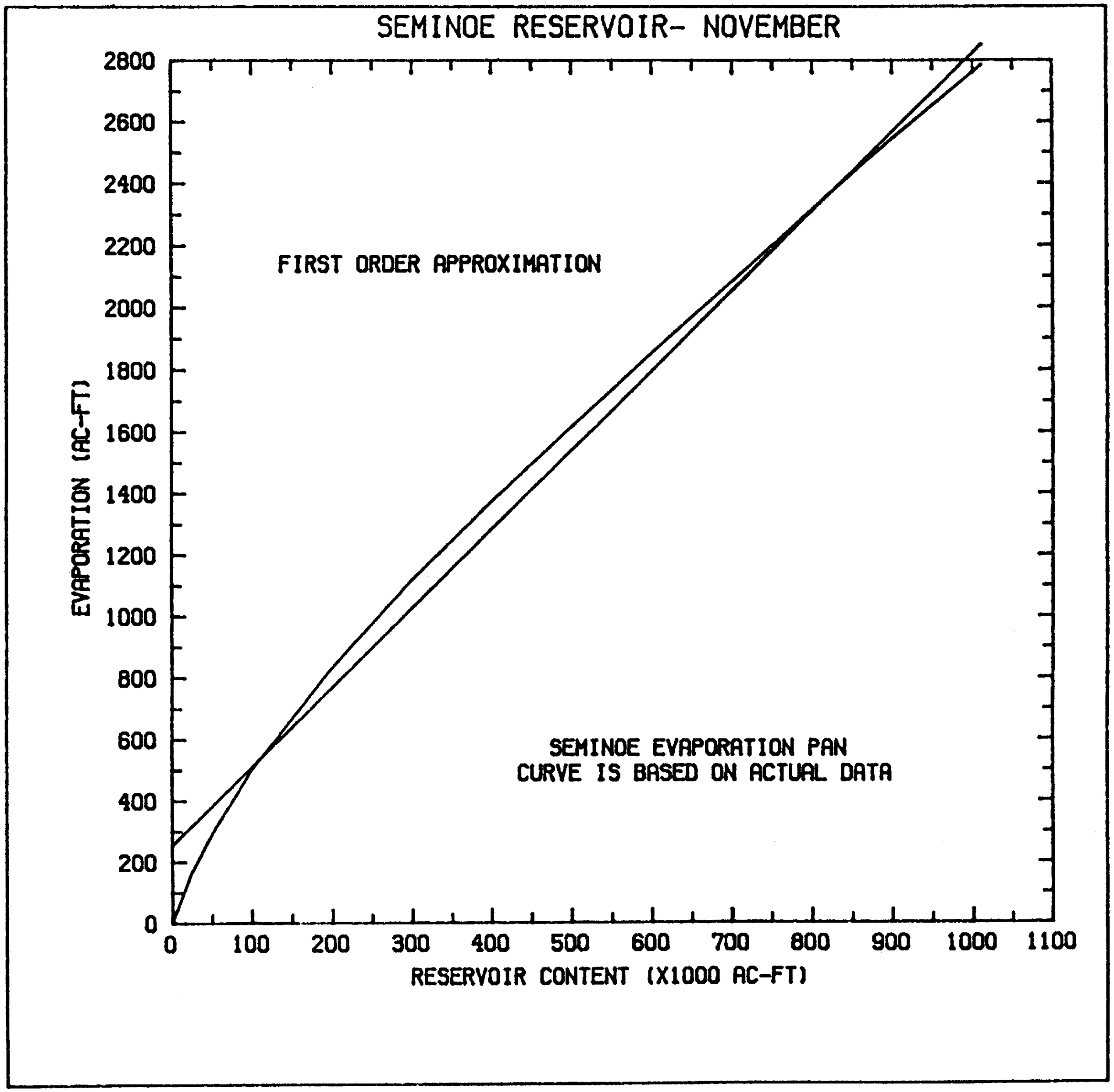

SEMINOE RESERVOIR- JULY
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
0
100
200
300
400
500
600
700
800
900
1000
1100

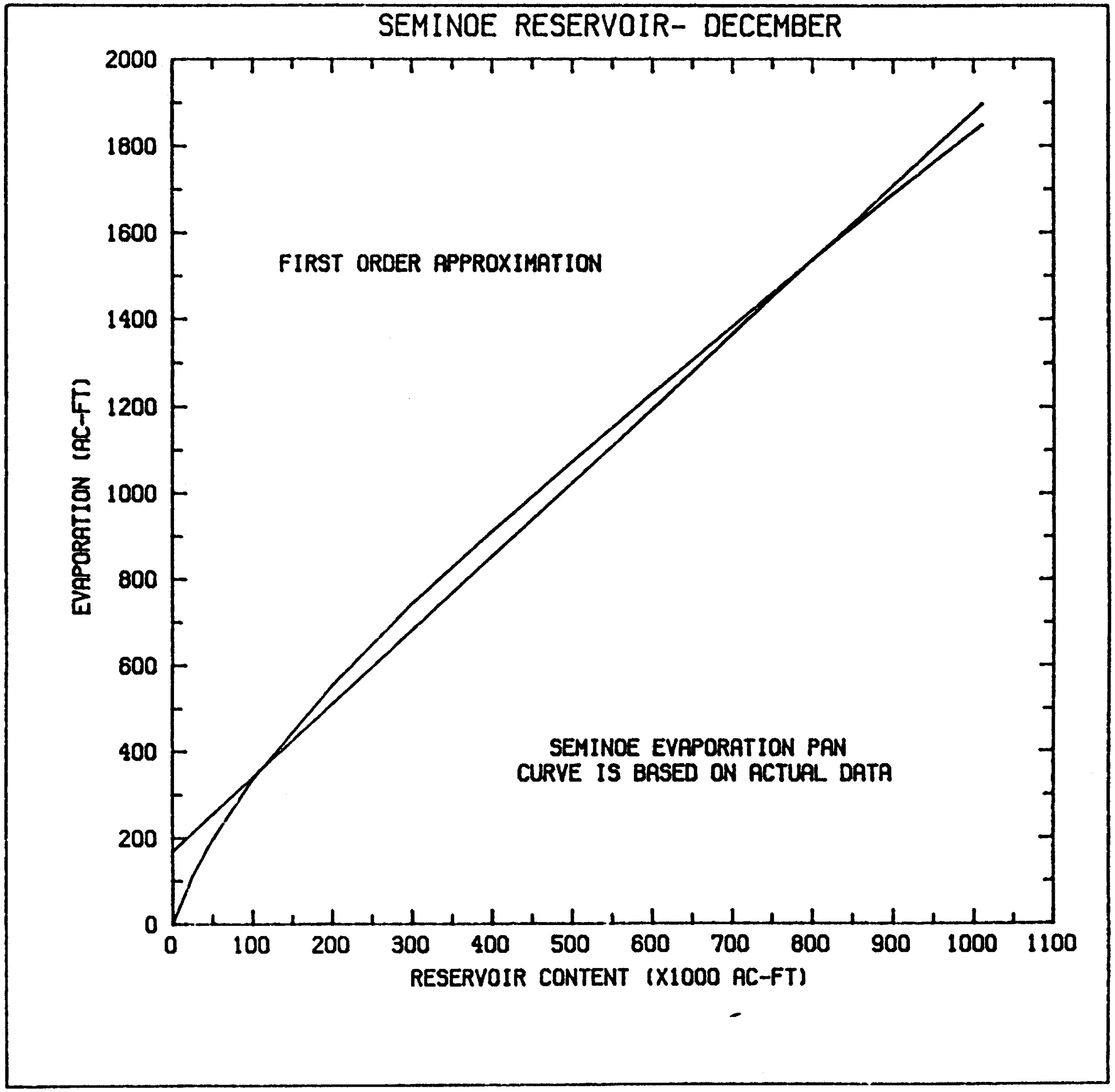

SEMINOE RESERVOIR- AUGUST
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
100
200
300
400
500
600
700
800
900
1000
1100

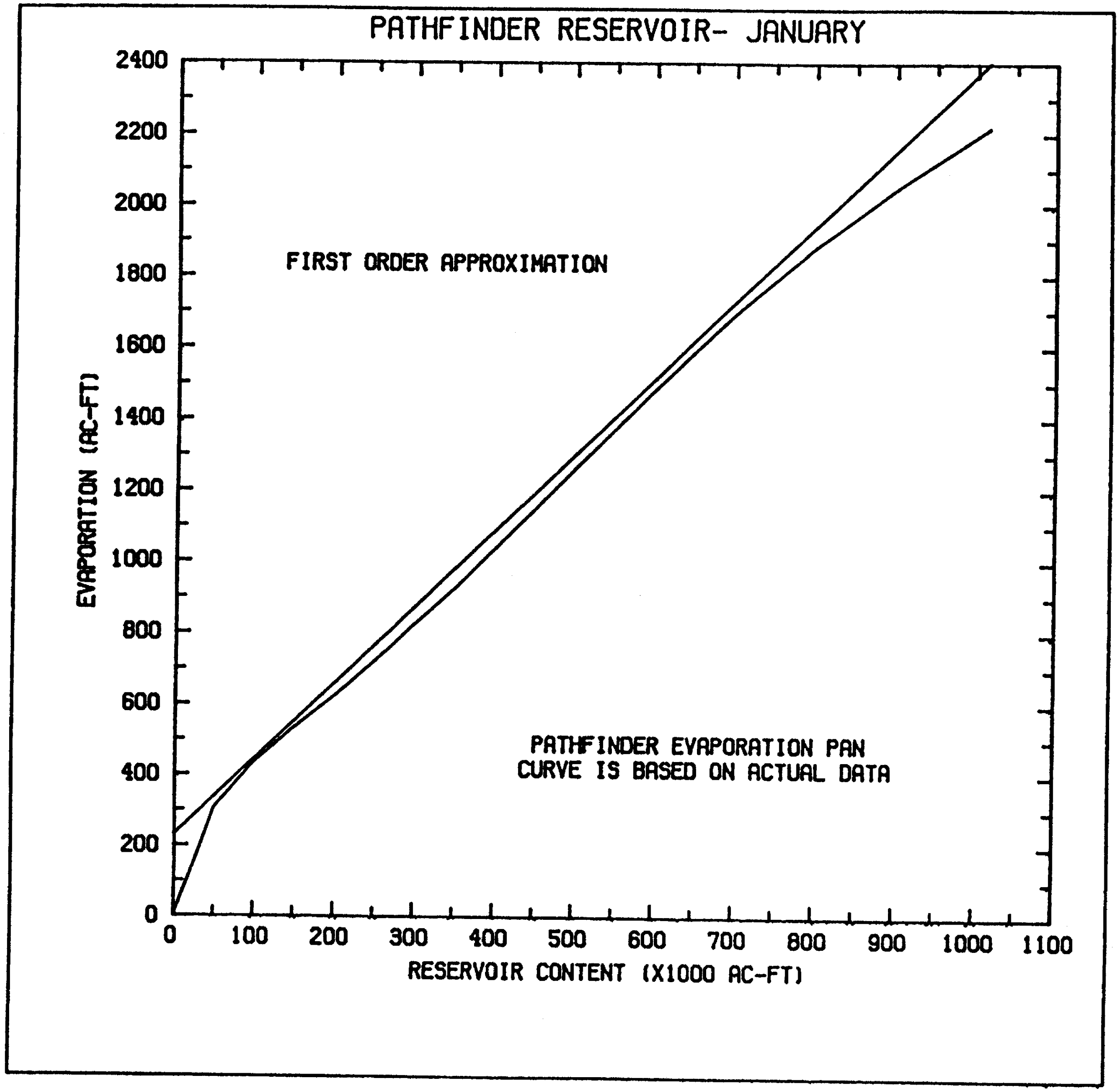


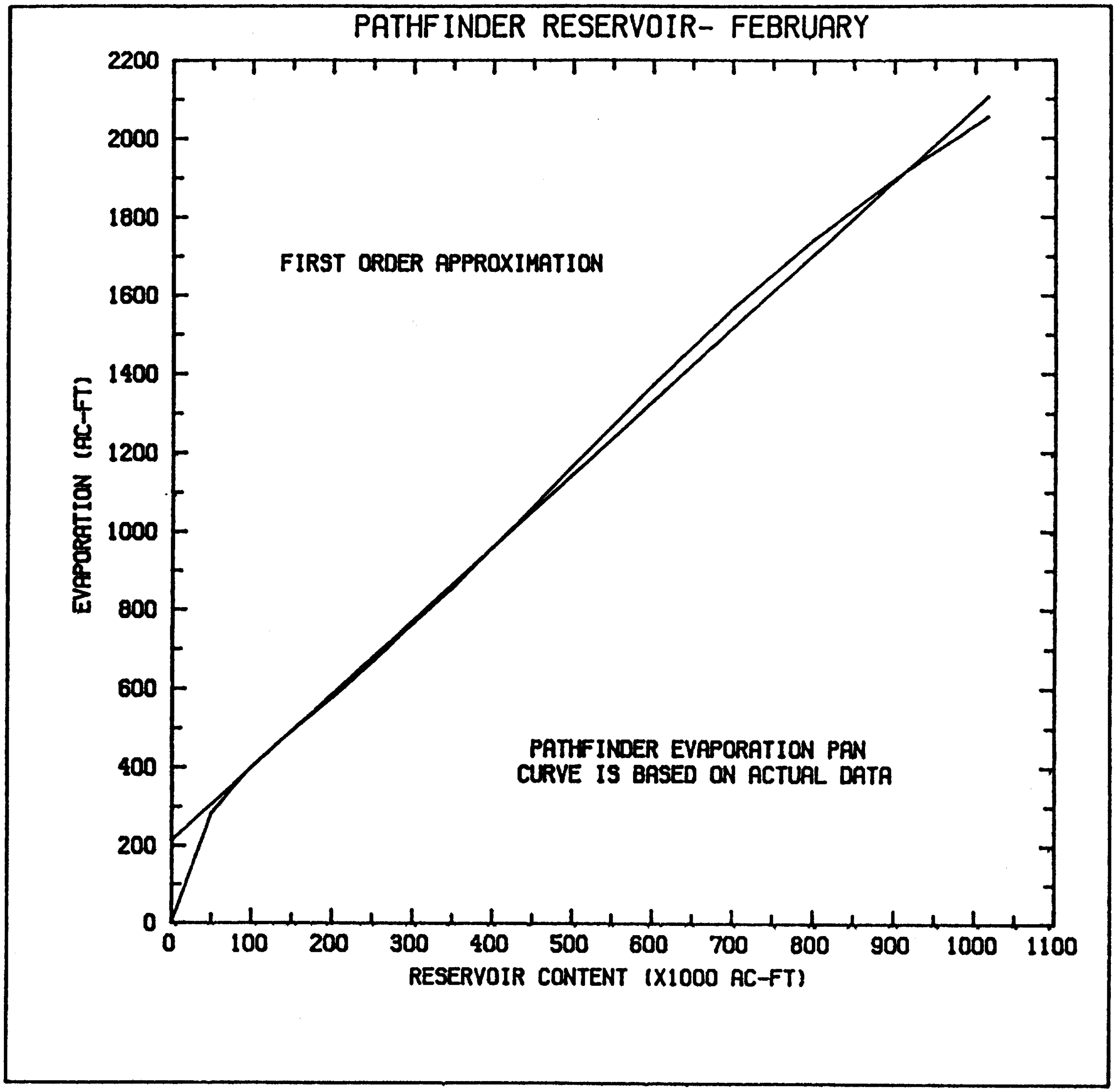
SEMINOE RESERVOIR- SEPTEMBER
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
0
100
200
300
400
500
600
700
800
900
1000
1100

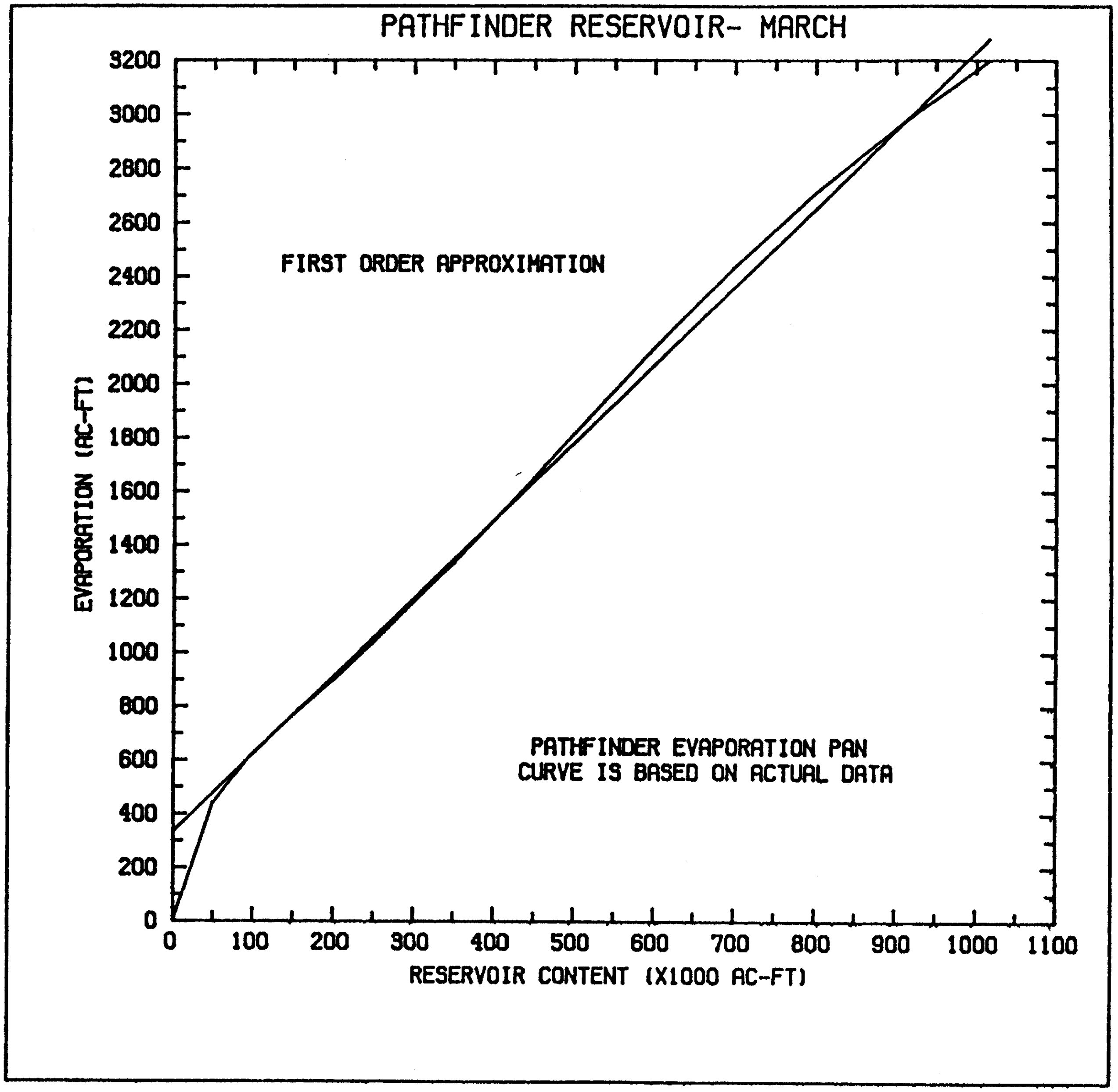

SEMINOE RESERVOIR- OCTOBER
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)


SEMINOE RESERVOIR- NOVEMBER
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
0
100
200
300
400
500
600
700
800
900
1000
1100

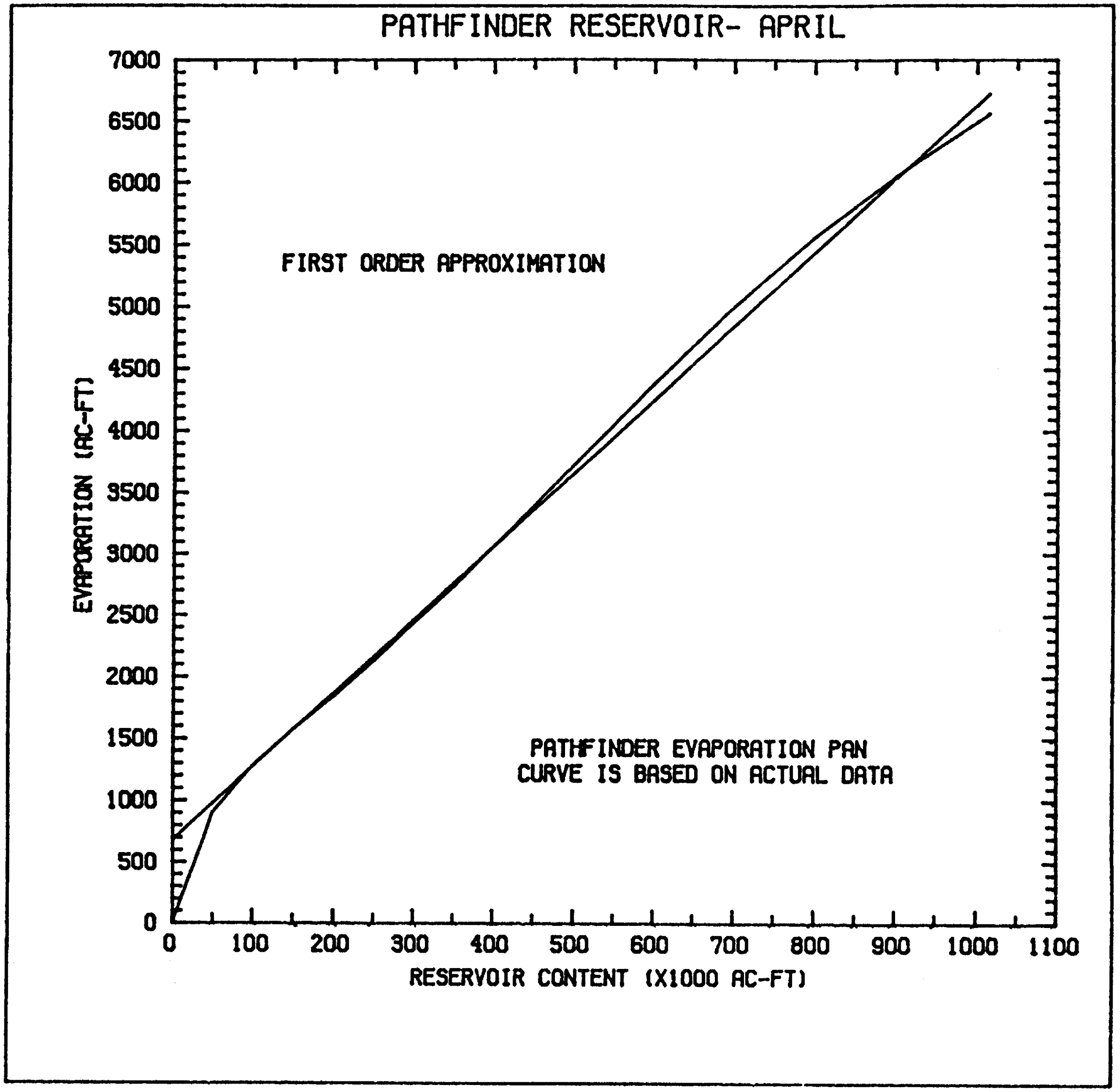

SEMINOE RESERVOIR- DECEMBER
2000
1800
1600
1400
1200
1000
800
600
400
200
0
EVAPORATION (AC-FT)
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)
FIRST ORDER APPROXIMATION
SEMINOE EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA


PATHFINDER RESERVOIR- JANUARY
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
100
200
300
400
500
600
700
800
900
1000
1100

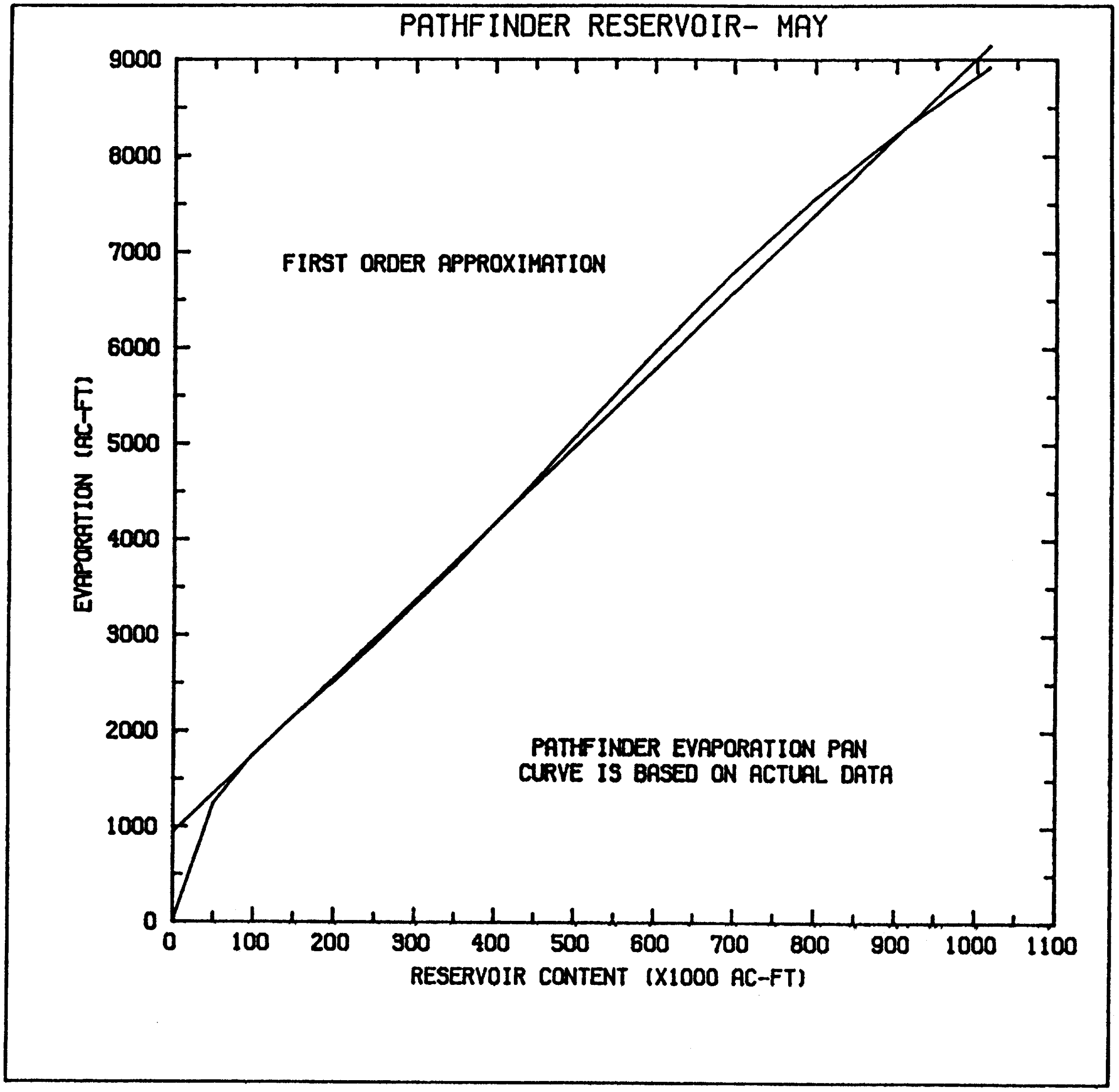

PATHFINDER RESERVOIR- FEBRUARY
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)

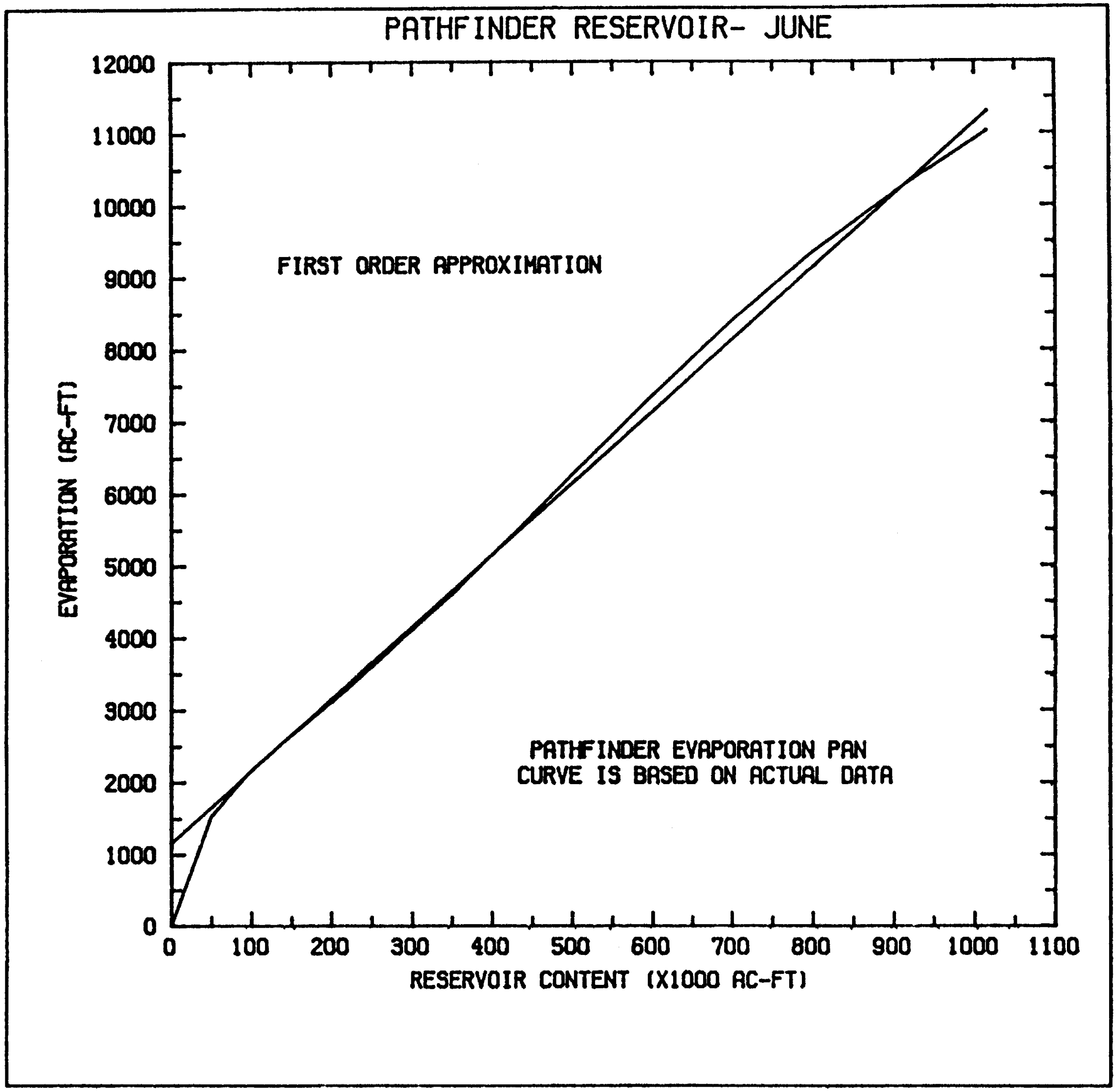


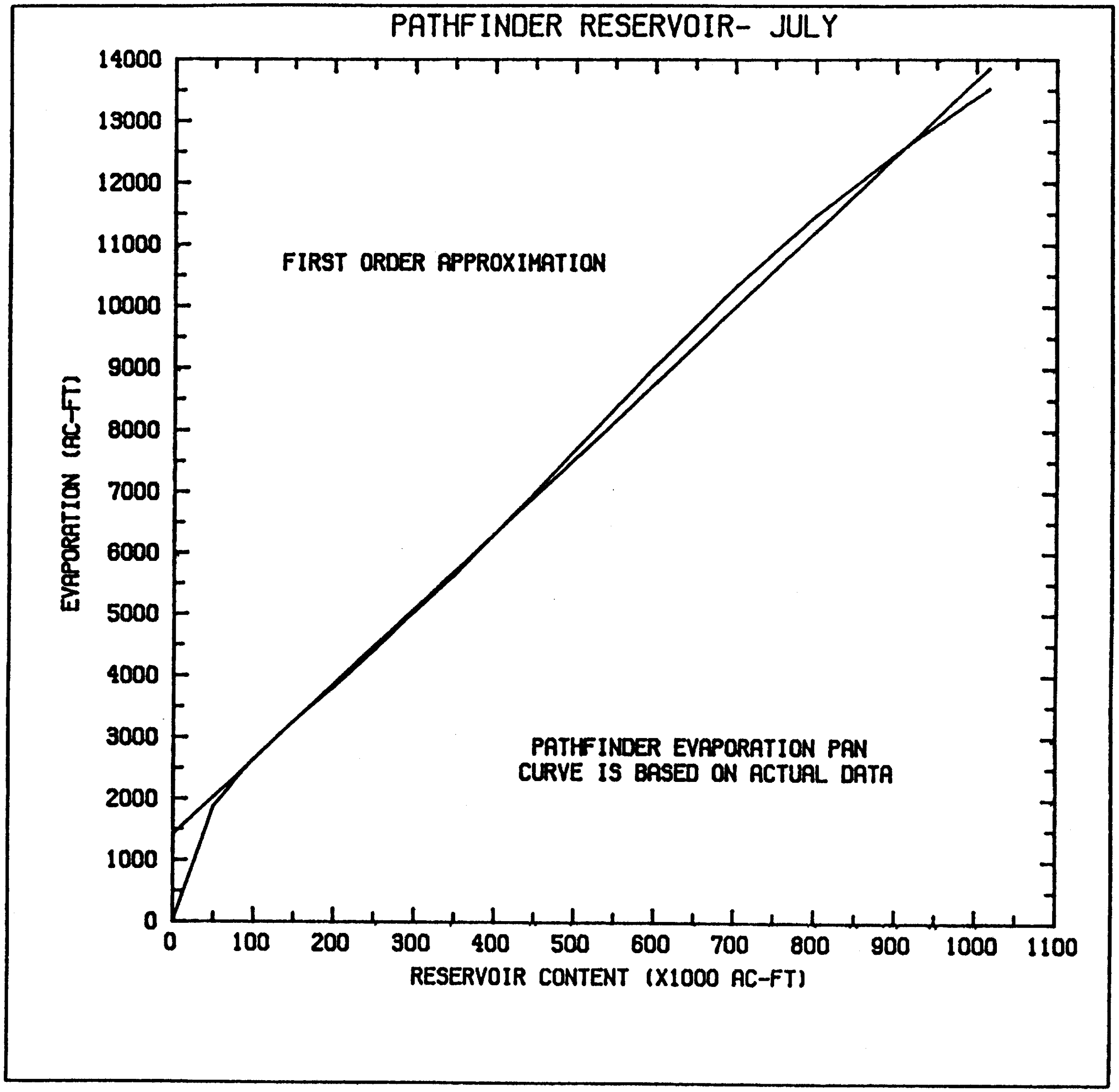
PATHFINDER RESERVOIR- MARCH
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
0
100
200
300
400
500
600
700
800
900
1000
1100

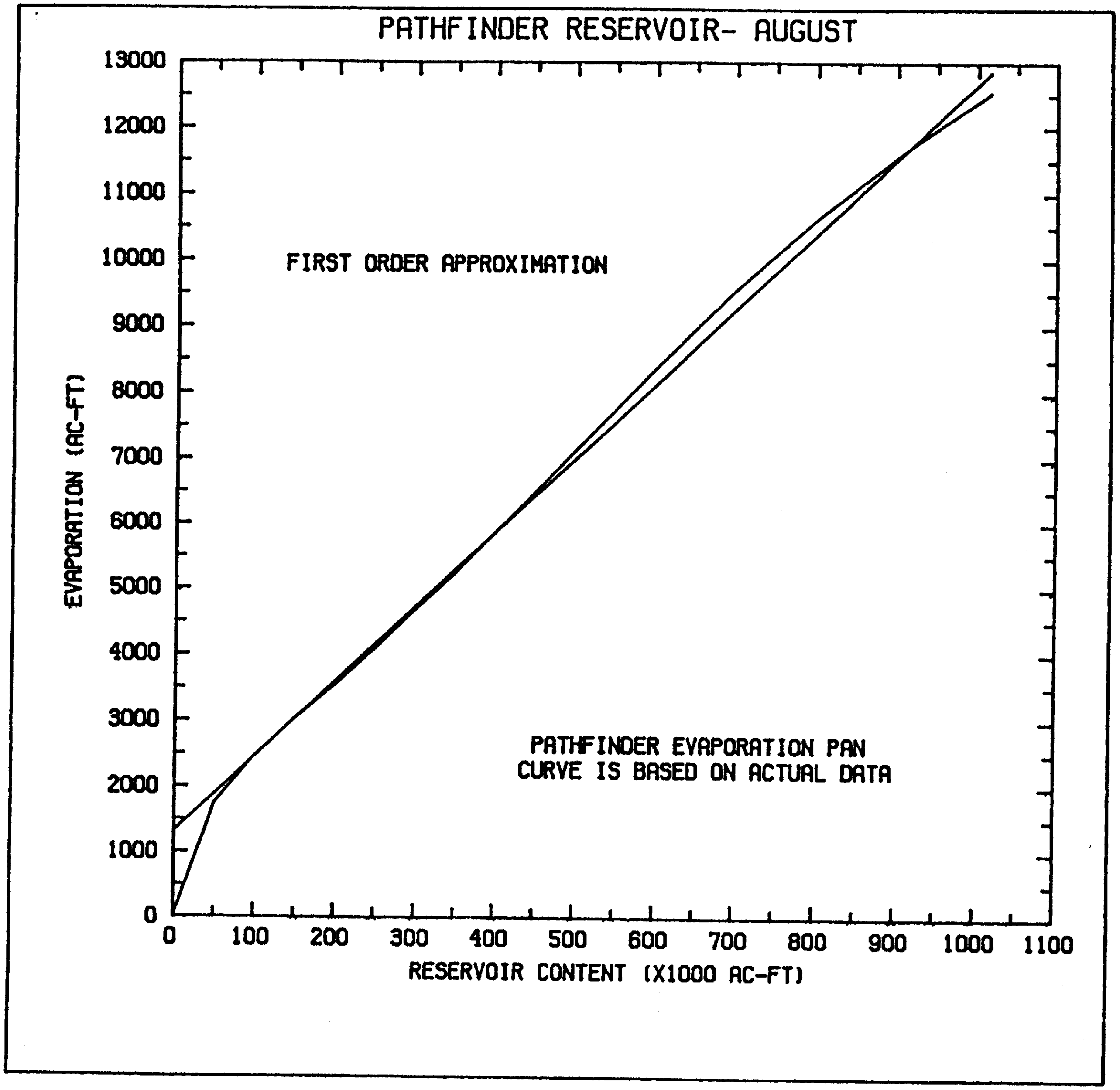


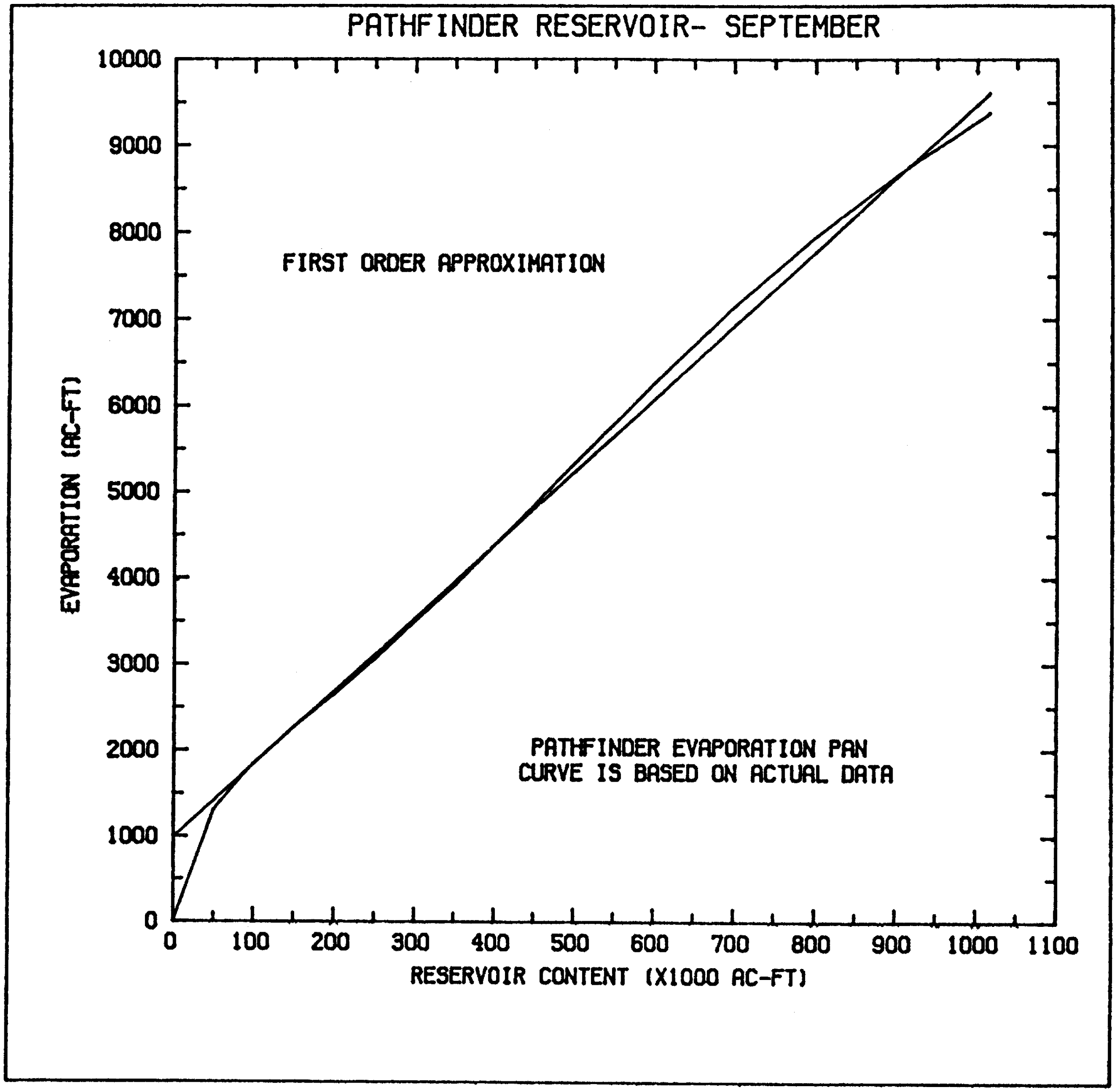
PATHFINDER RESERVOIR- APRIL
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)

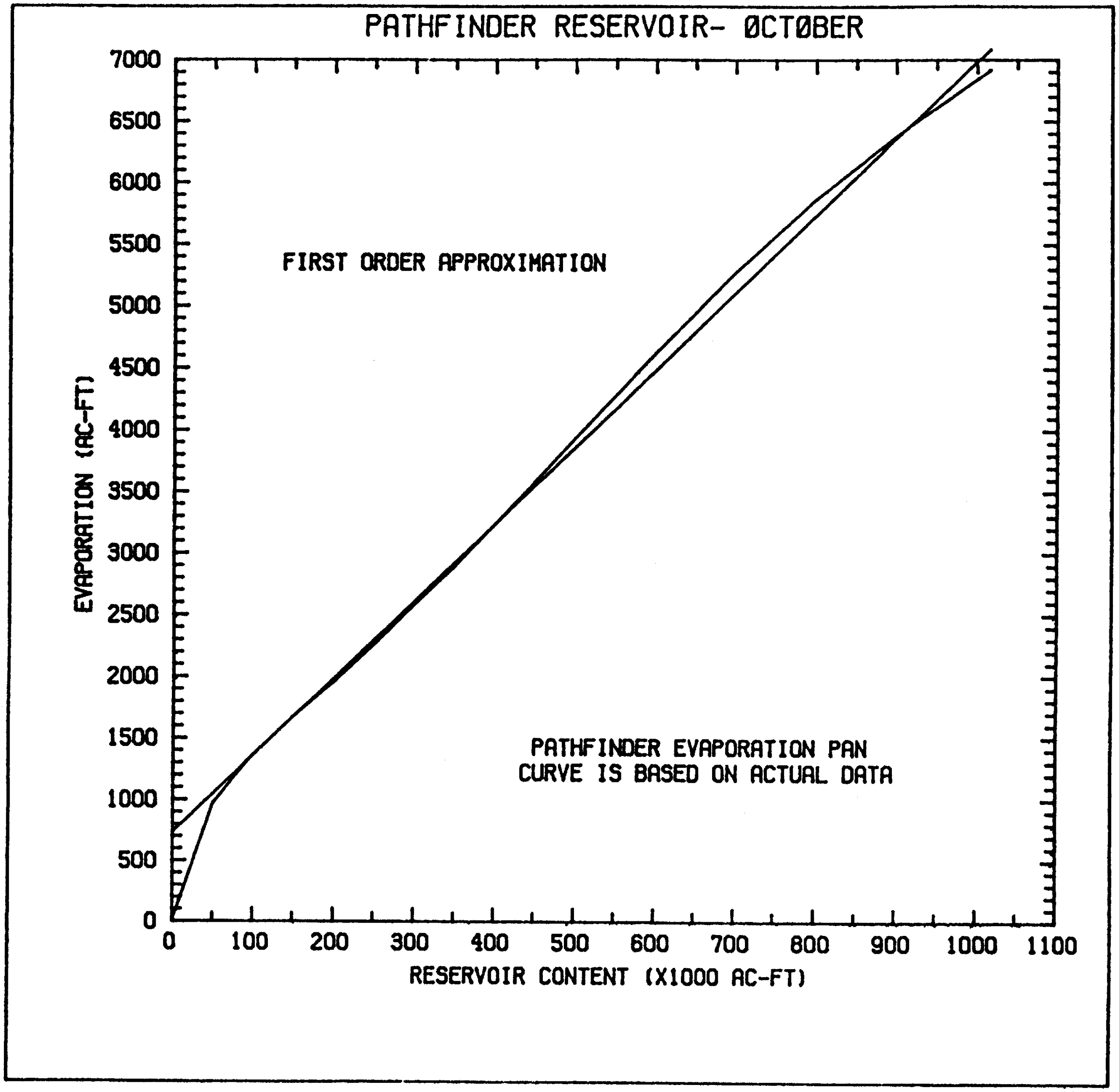

PATHFINDER RESERVOIR- MAY
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
0
100
200
300
400
500
600
700
800
900
1000
1100

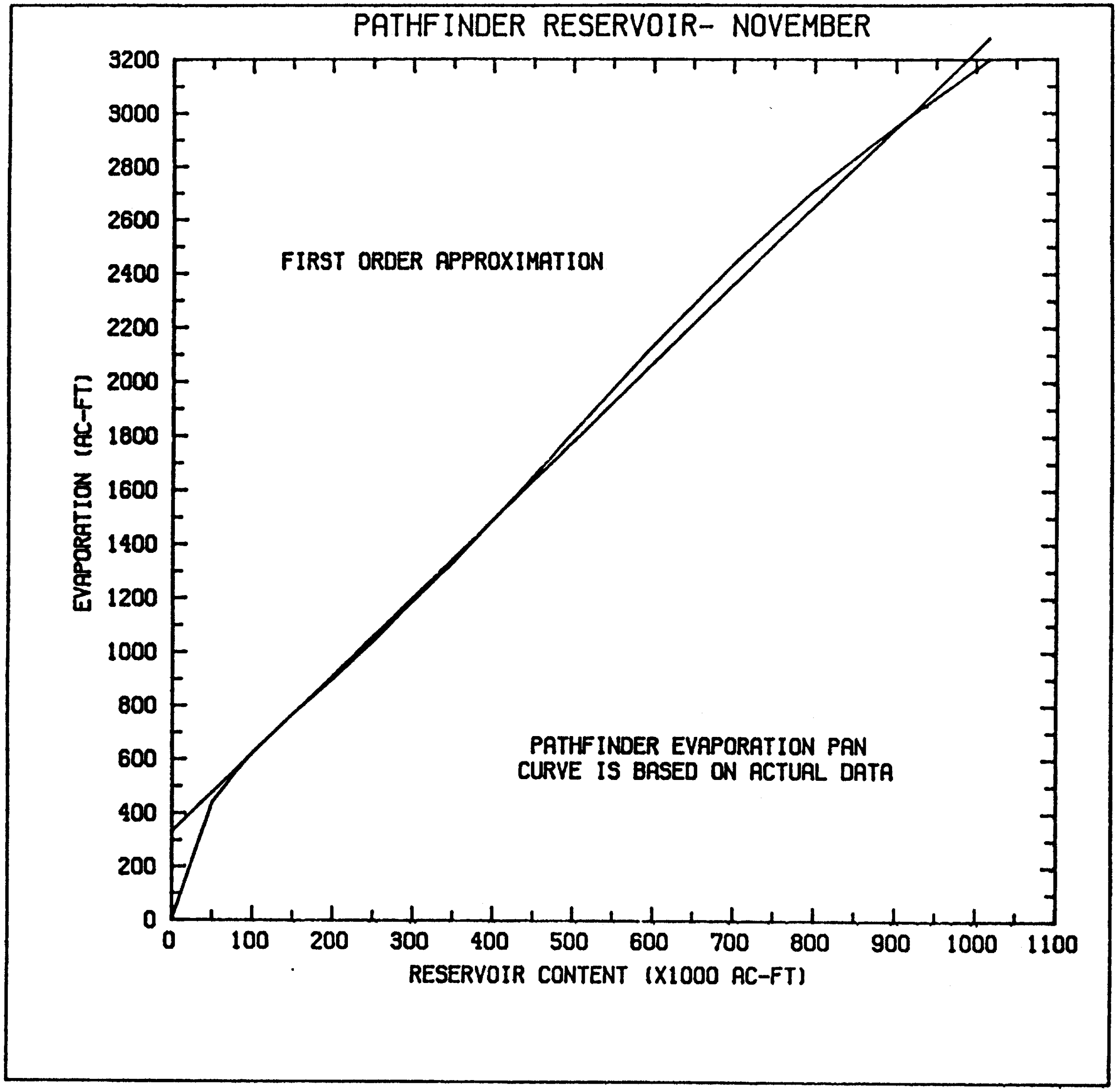

PATHFINDER RESERVOIR- JUNE
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
0
100
200
300
400
500
600
700
800
900
1000
1100


PATHFINDER RESERVOIR- JULY
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)

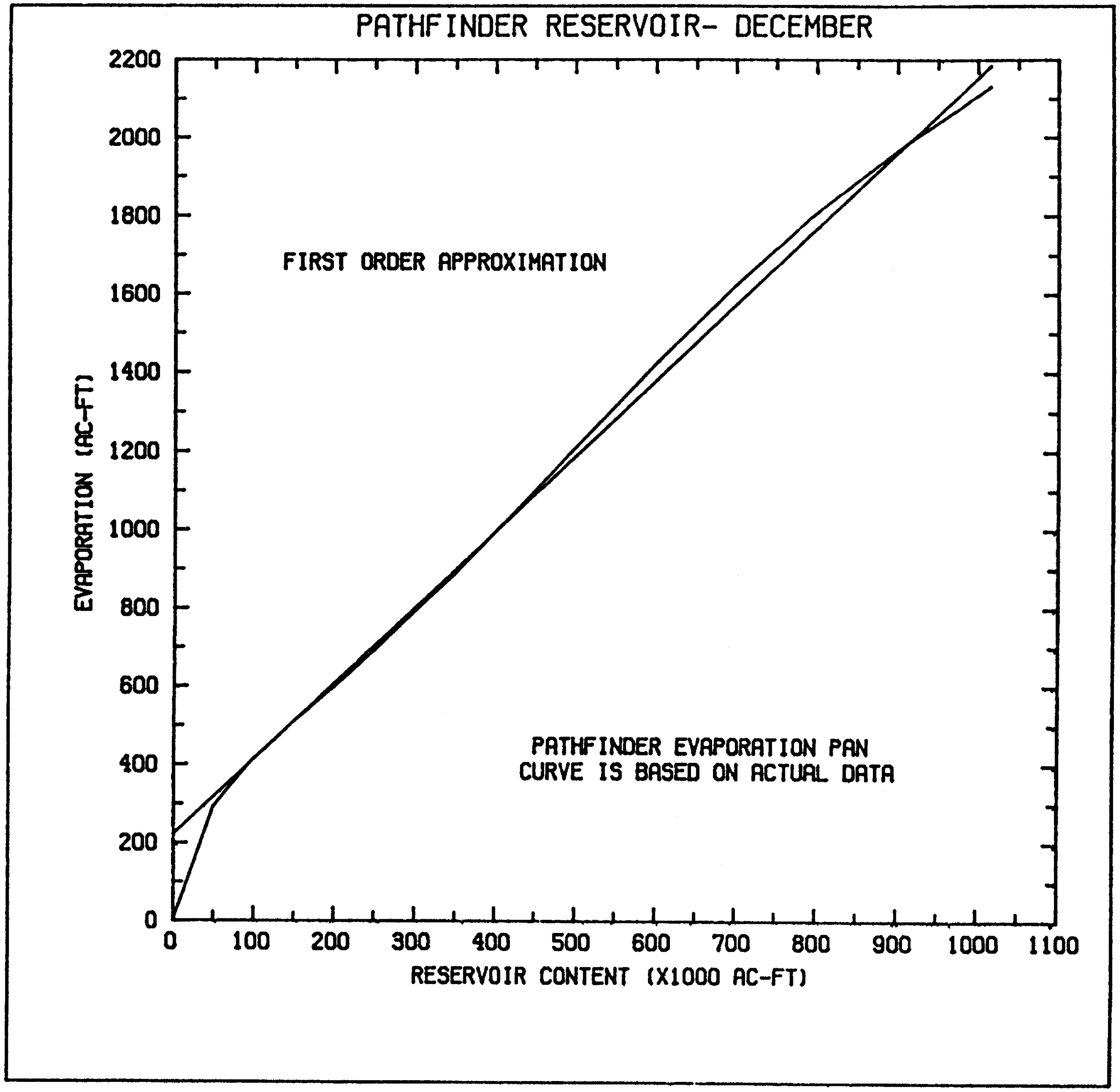

PATHFINDER RESERVOIR- AUGUST
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
0
100
200
300
400
500
600
700
800
900
1000
1100


PATHFINDER RESERVOIR- SEPTEMBER
EVAPORATION (AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
1000
1100
RESERVOIR CONTENT (X1000 AC-FT)

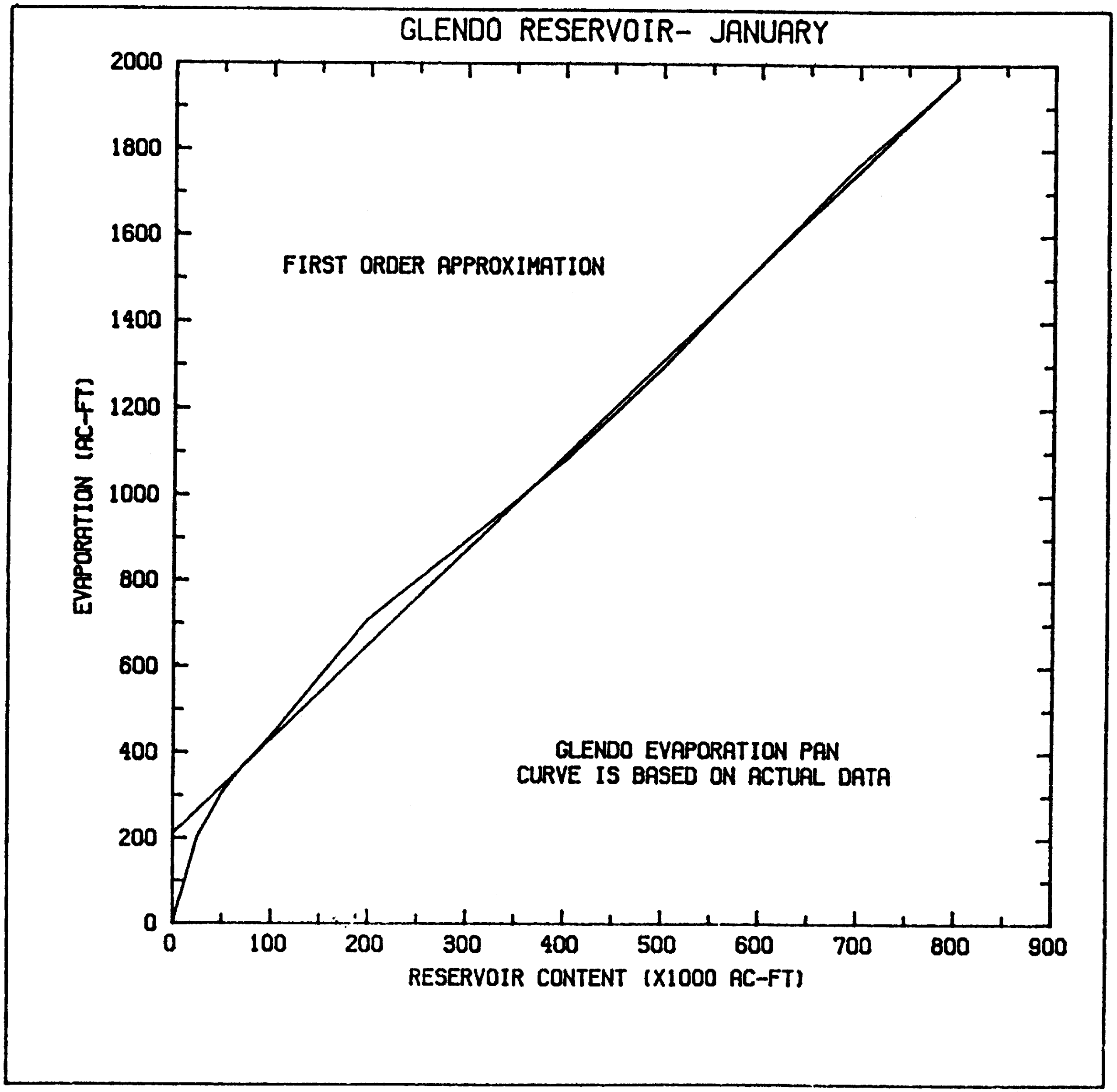

PATHFINDER RESERVOIR- ØCTØBER
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
0
100
200
300
400
500
600
700
800
900
1000
1100



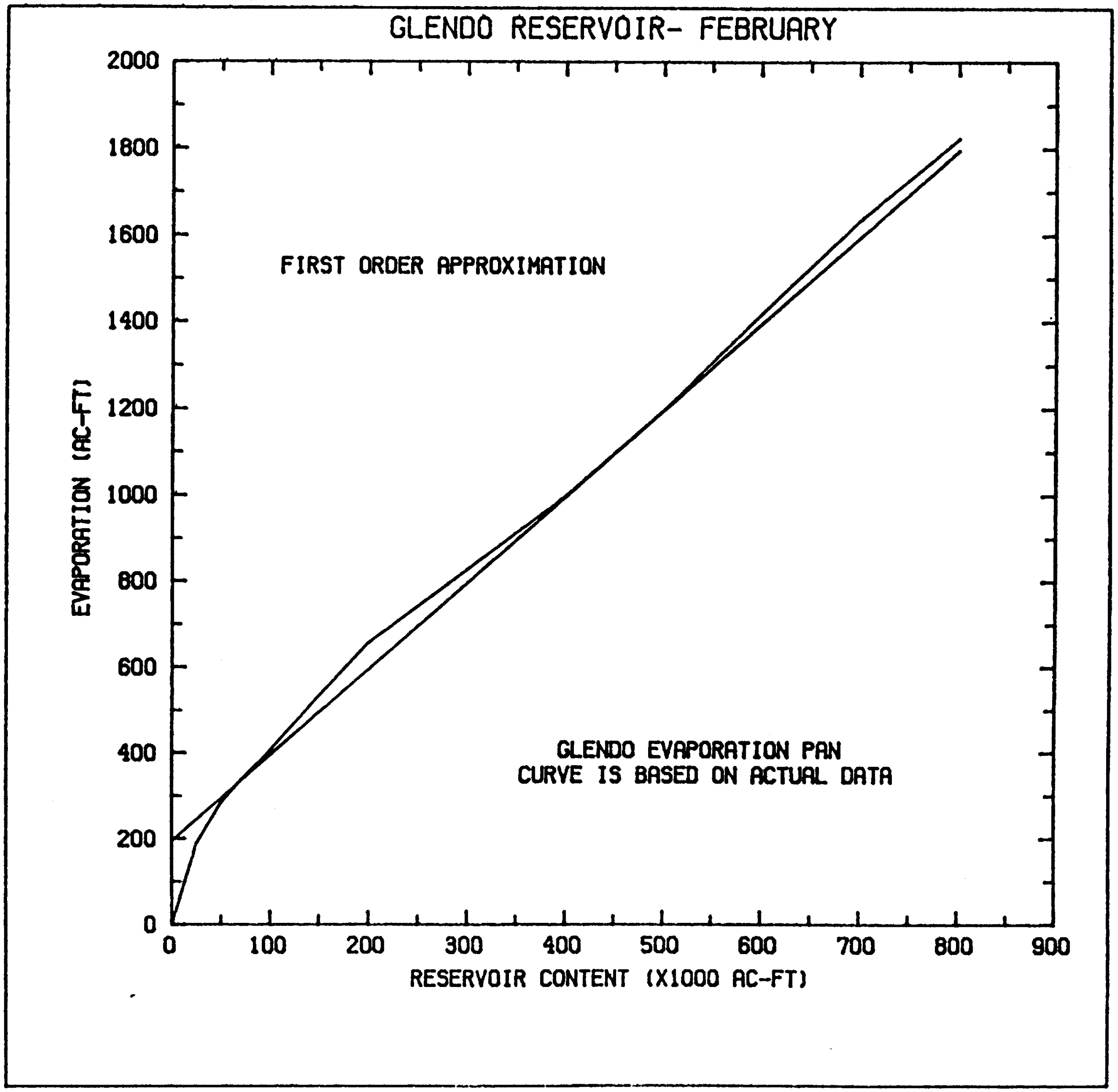
PATHFINDER RESERVOIR- NOVEMBER
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
0
100
200
300
400
500
600
700
800
900
1000
1100



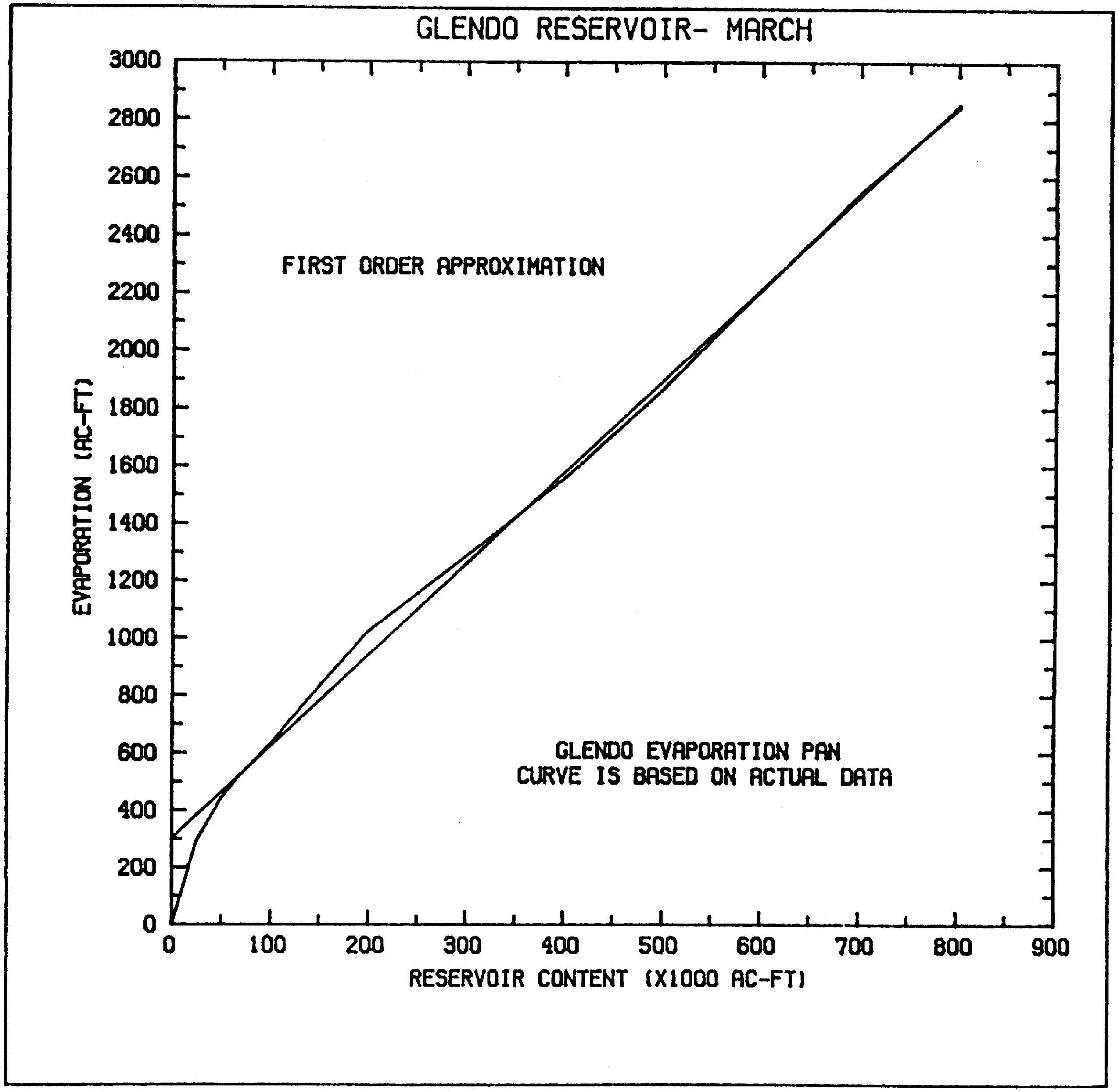
PATHFINDER RESERVOIR- DECEMBER
EVAPORATION (AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
RESERVOIR CONTENT (X1000 AC-FT)
0
100
200
300
400
500
600
700
800
900
1000
1100
FIRST ORDER APPROXIMATION
PATHFINDER EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA

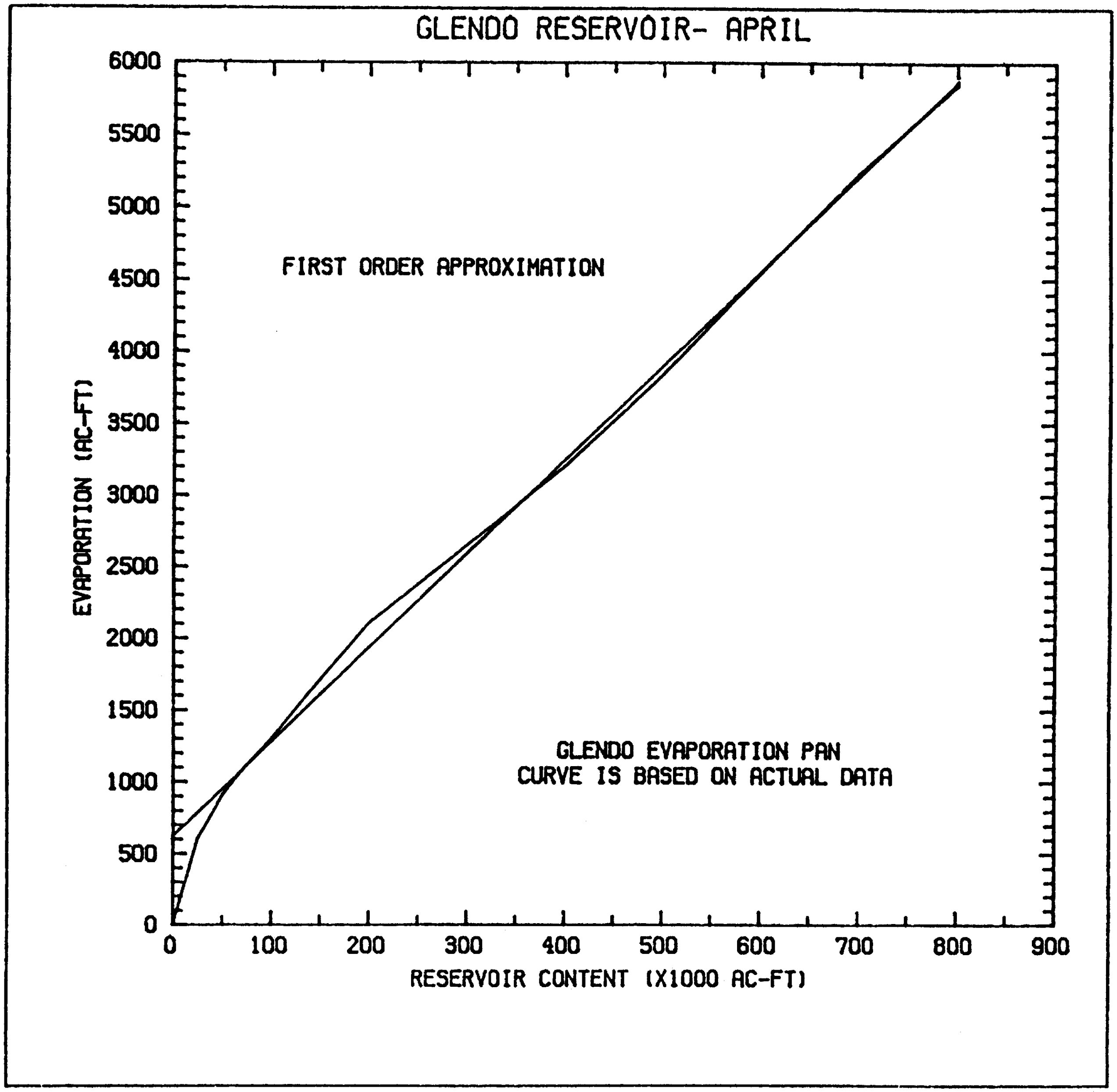


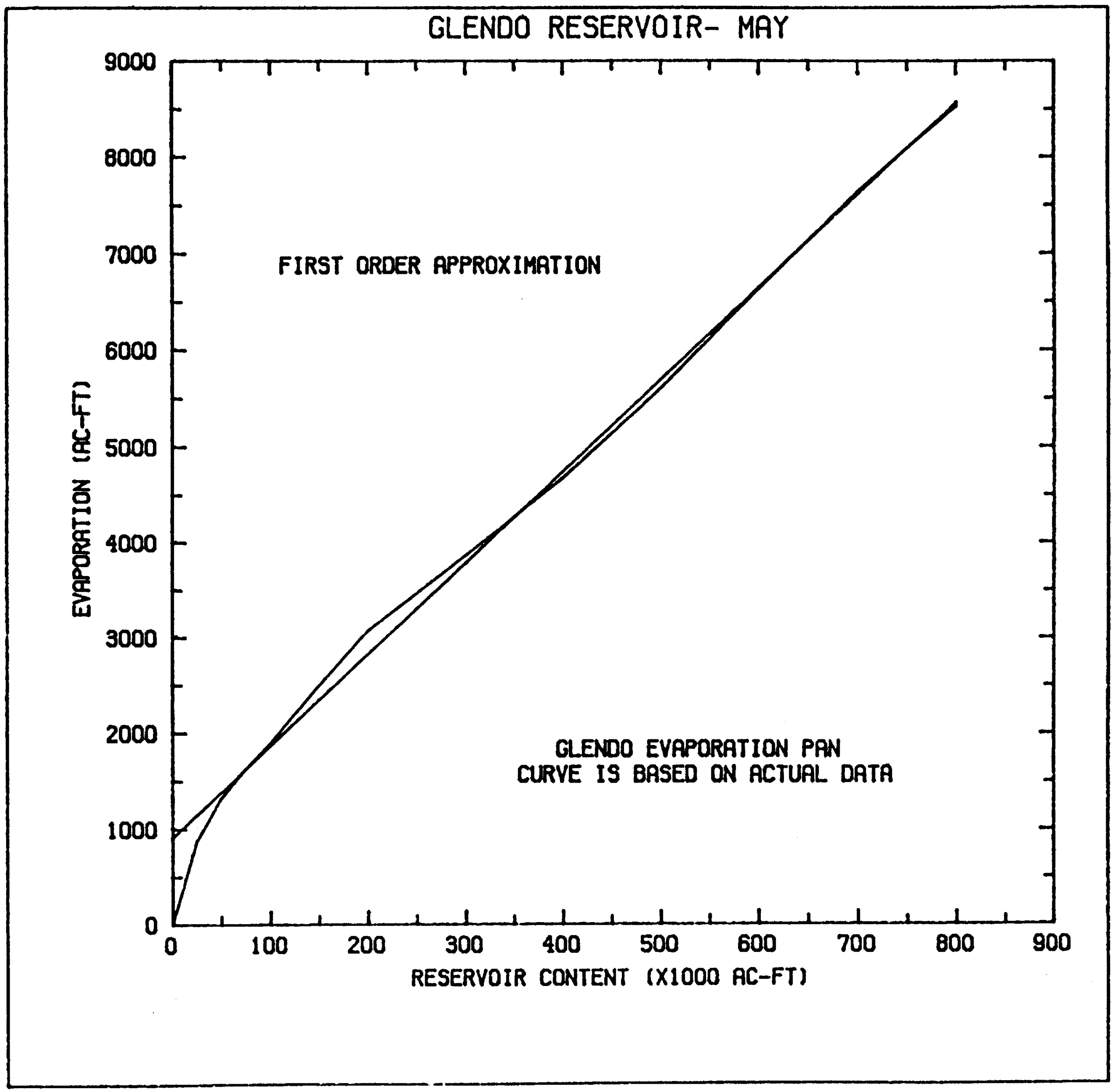
GLENDO RESERVOIR- JANUARY
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
100
200
300
400
500
600
700
800
900

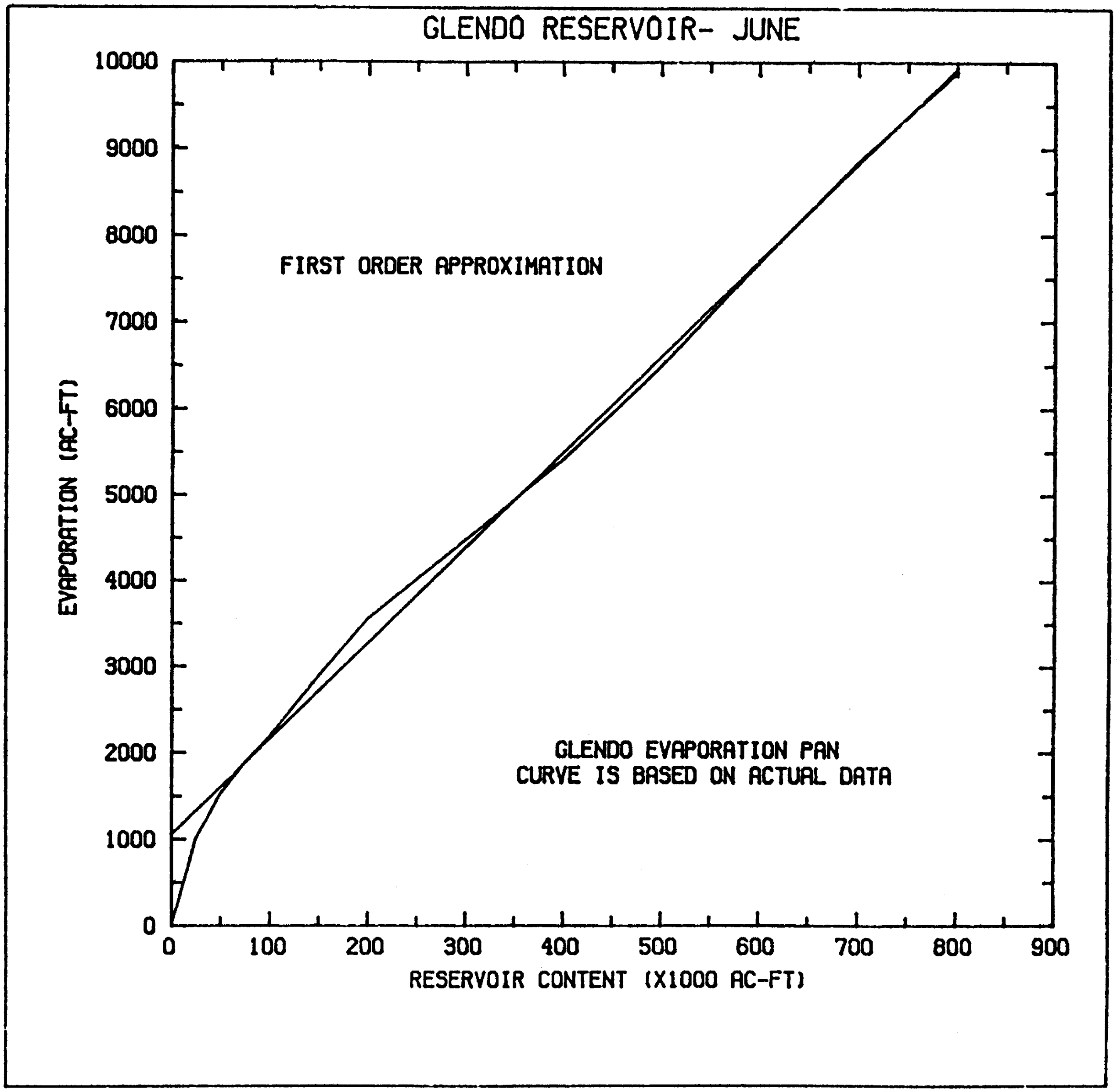


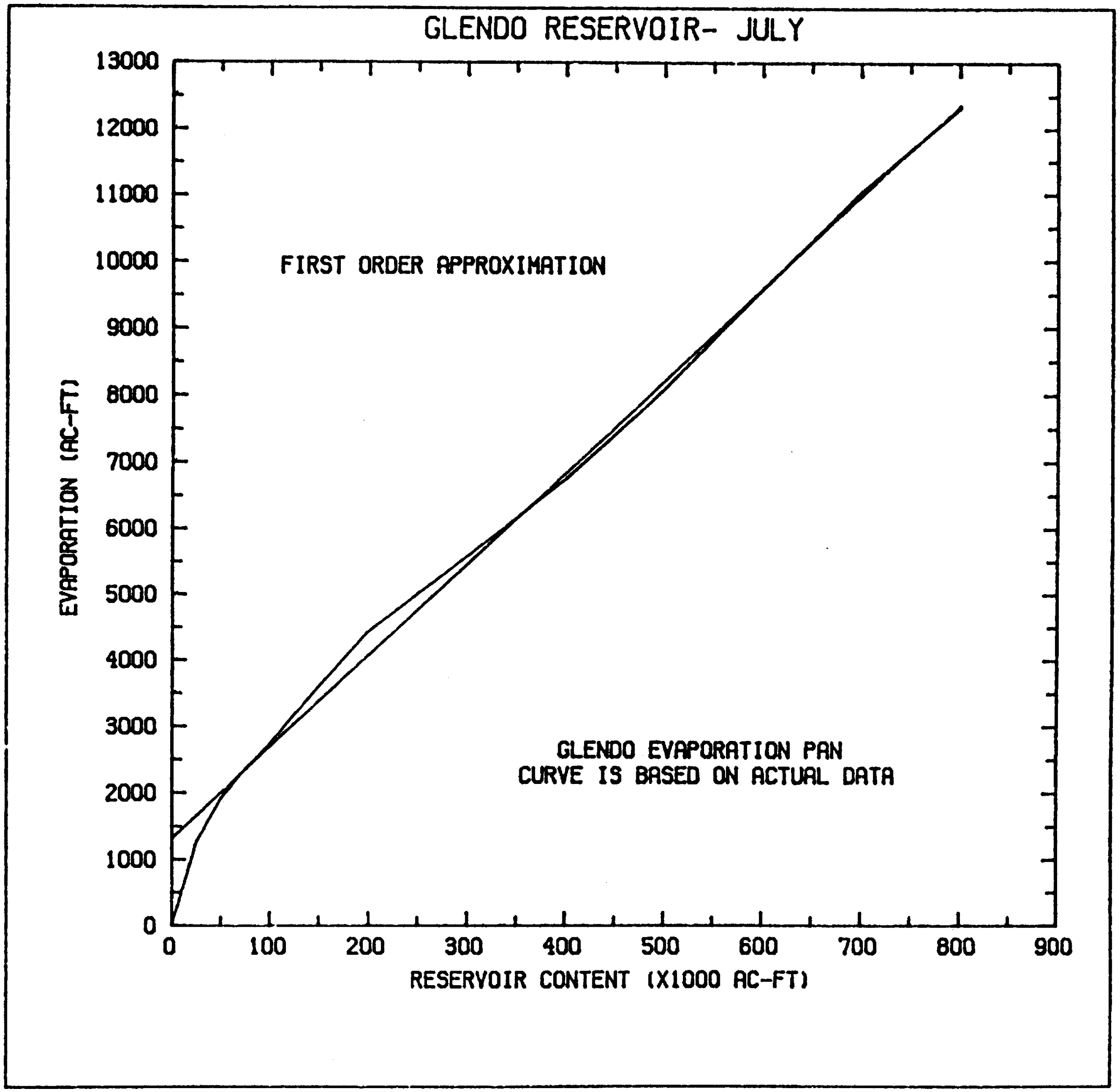
GLENDO RESERVOIR- FEBRUARY
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
100
200
300
400
500
600
700
800
900

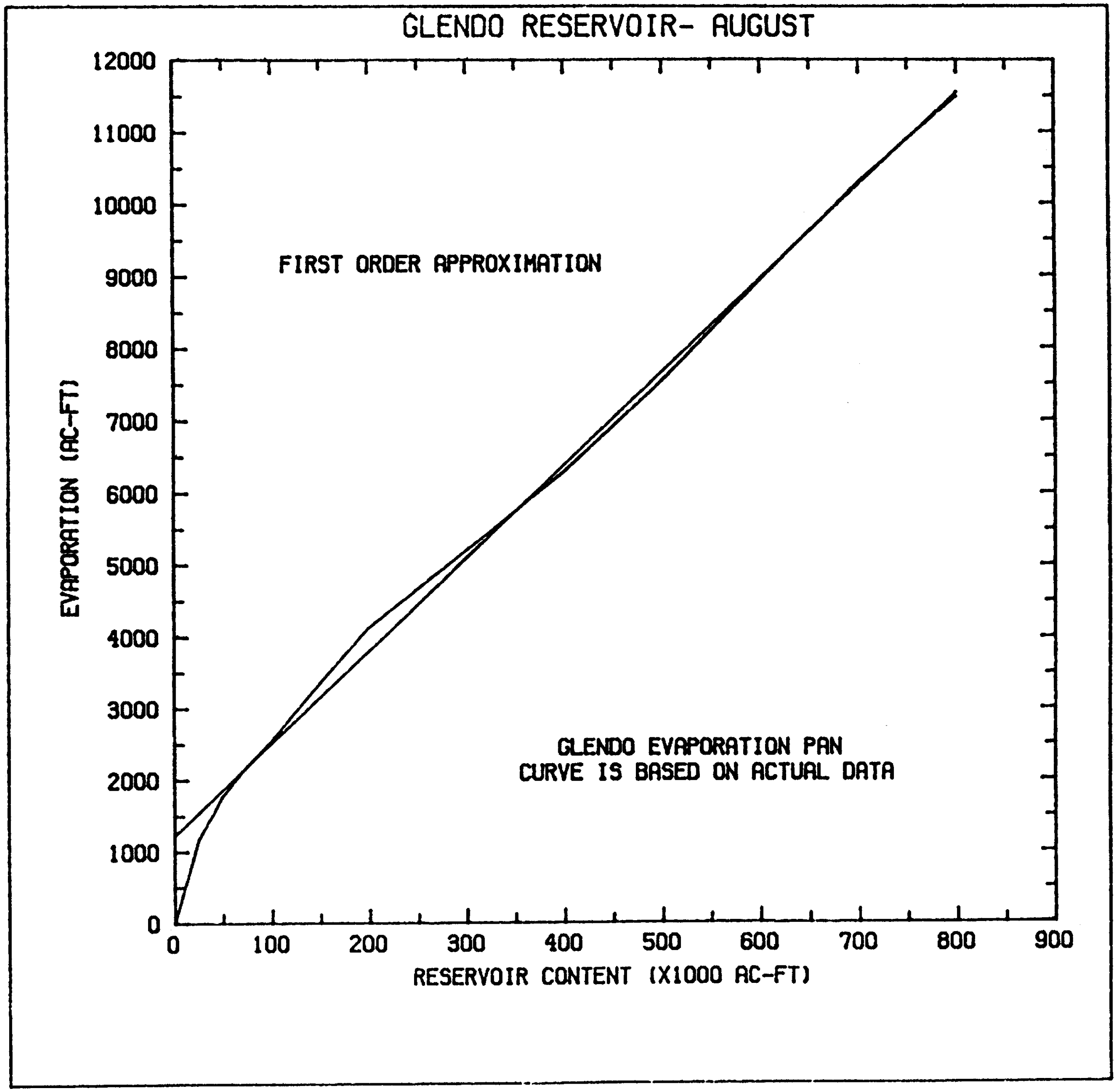

GLENDO RESERVOIR- MARCH
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
0
100
200
300
400
500
600
700
800
900


GLENDO RESERVOIR- APRIL
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
0
100
200
300
400
500
600
700
800
900

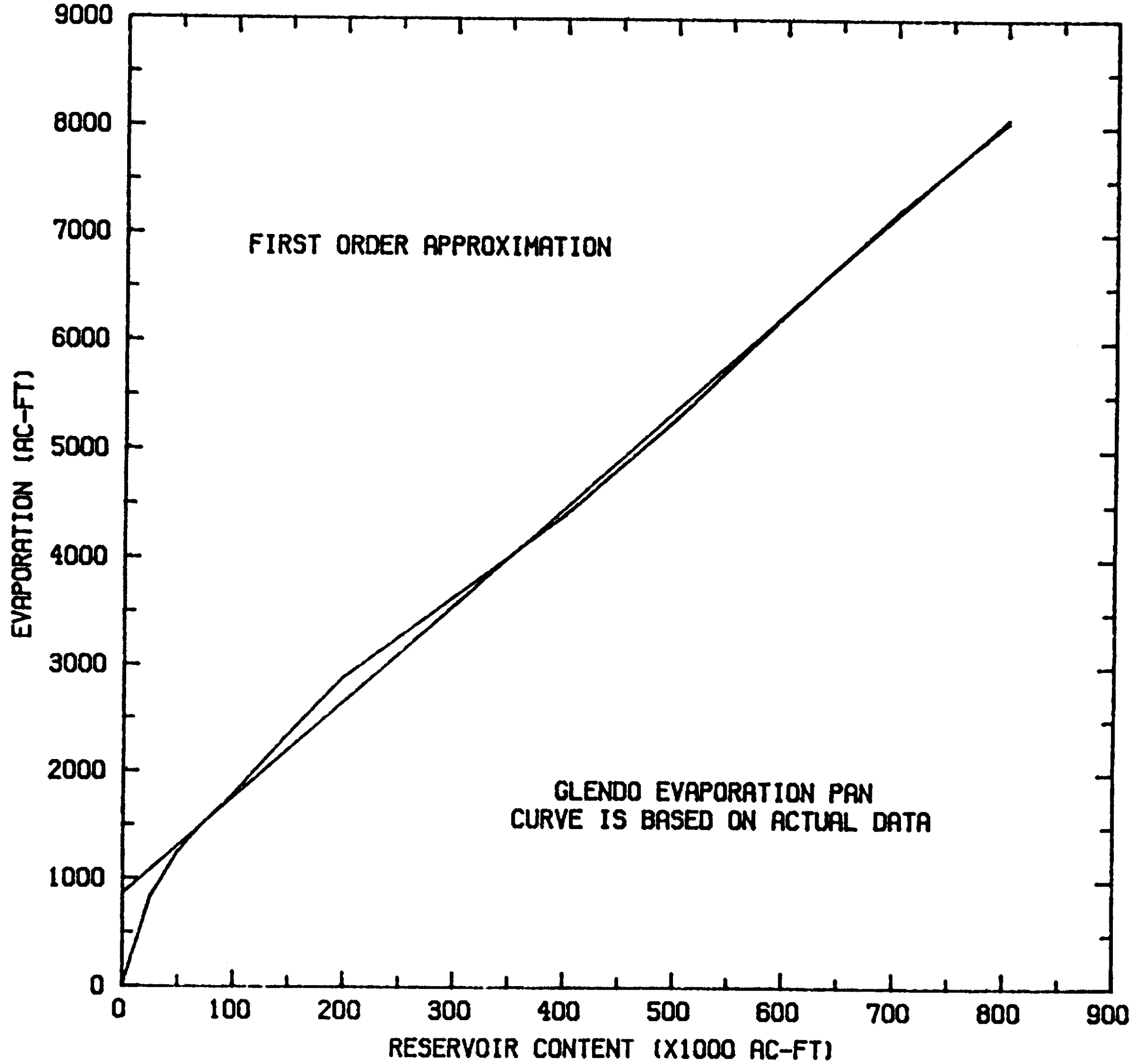

GLENDO RESERVOIR- MAY
EVAPORATION (AC-FT)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
RESERVOIR CONTENT (X1000 AC-FT)

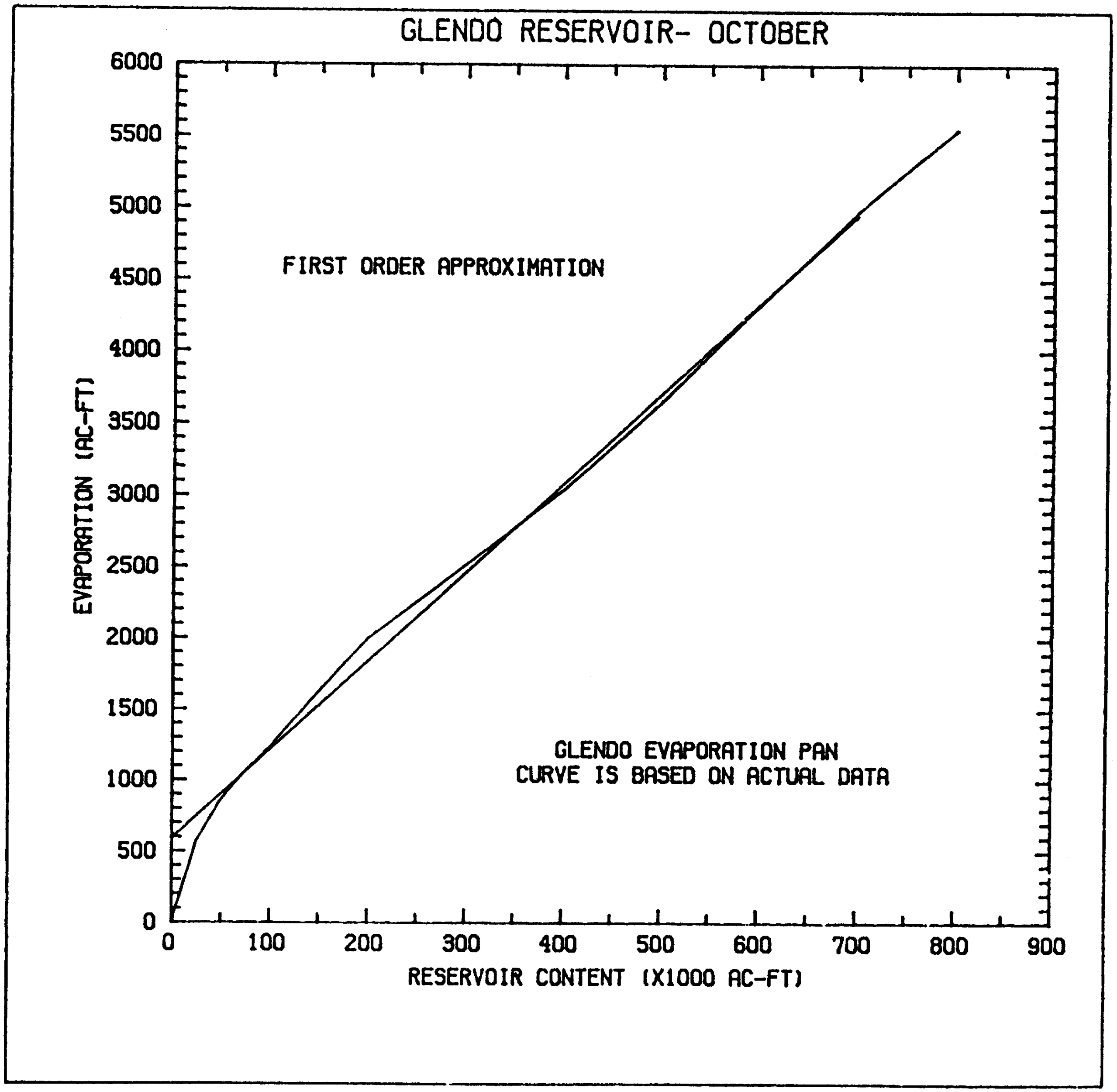

GLENDO RESERVOIR- JUNE
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
0
100
200
300
400
500
600
700
800
900

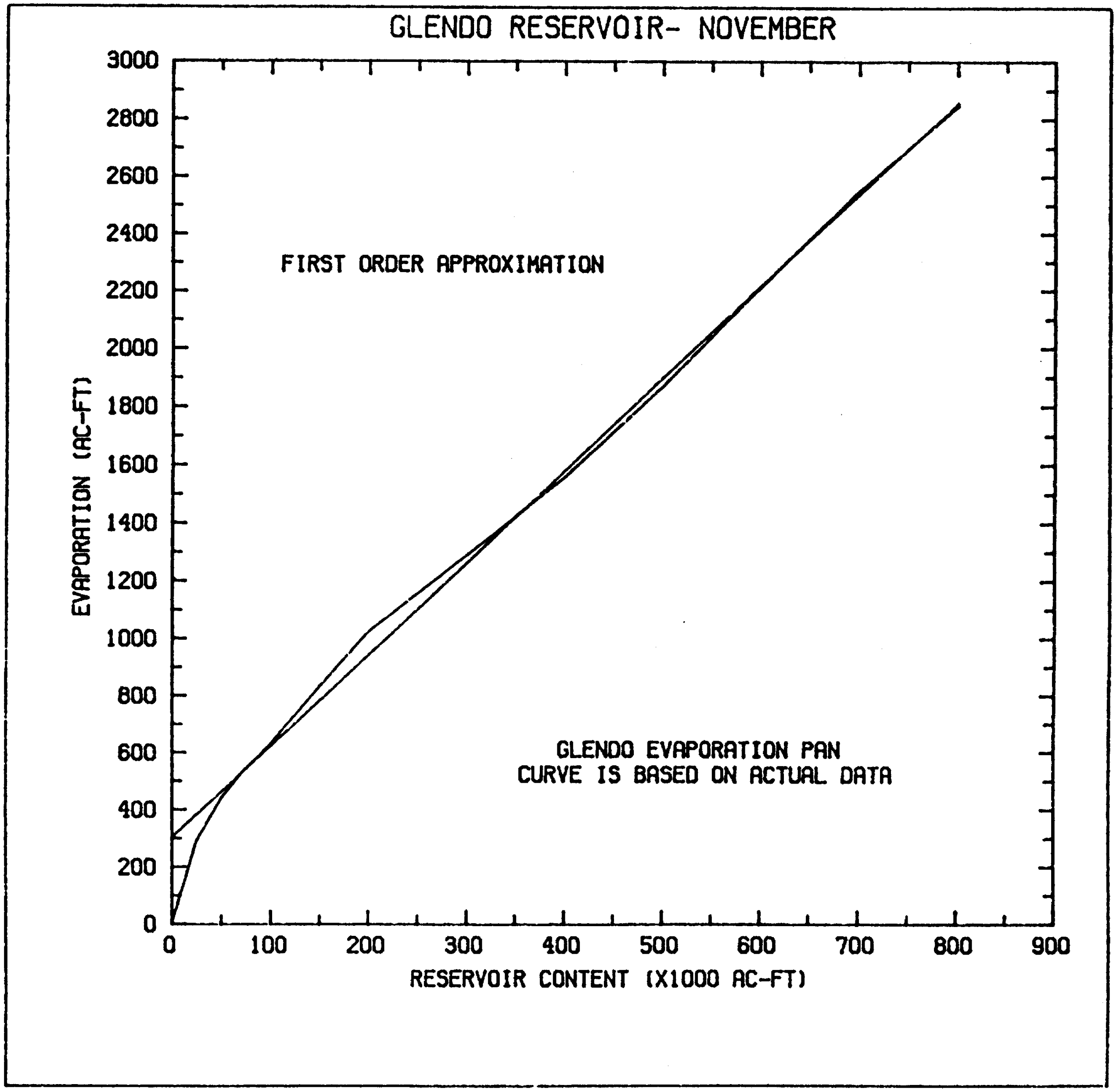

GLENDO RESERVOIR- JULY
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
0
100
200
300
400
500
600
700
800
900

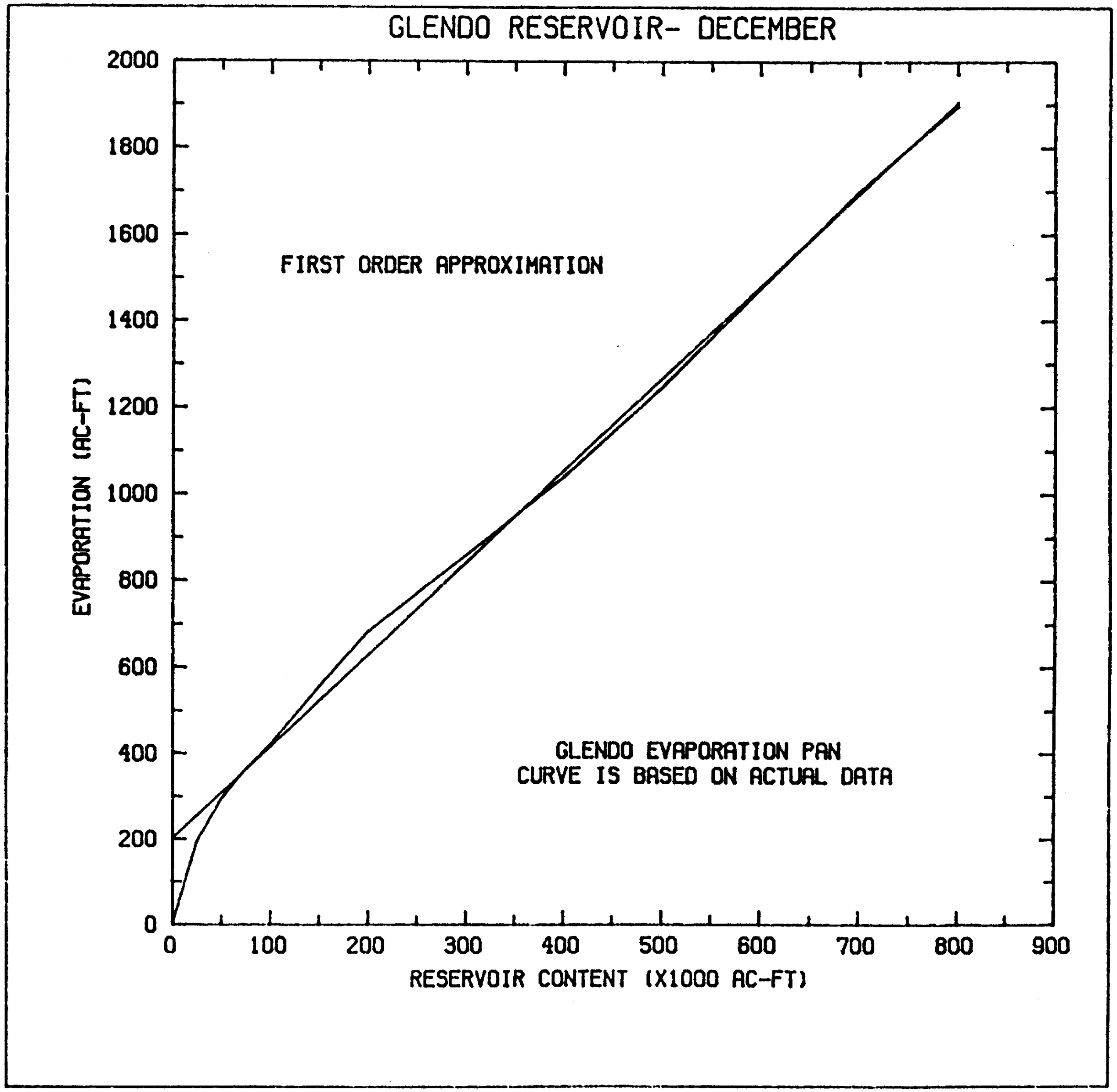

GLENDO RESERVOIR- AUGUST
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
0
100
200
300
400
500
600
700
800
900

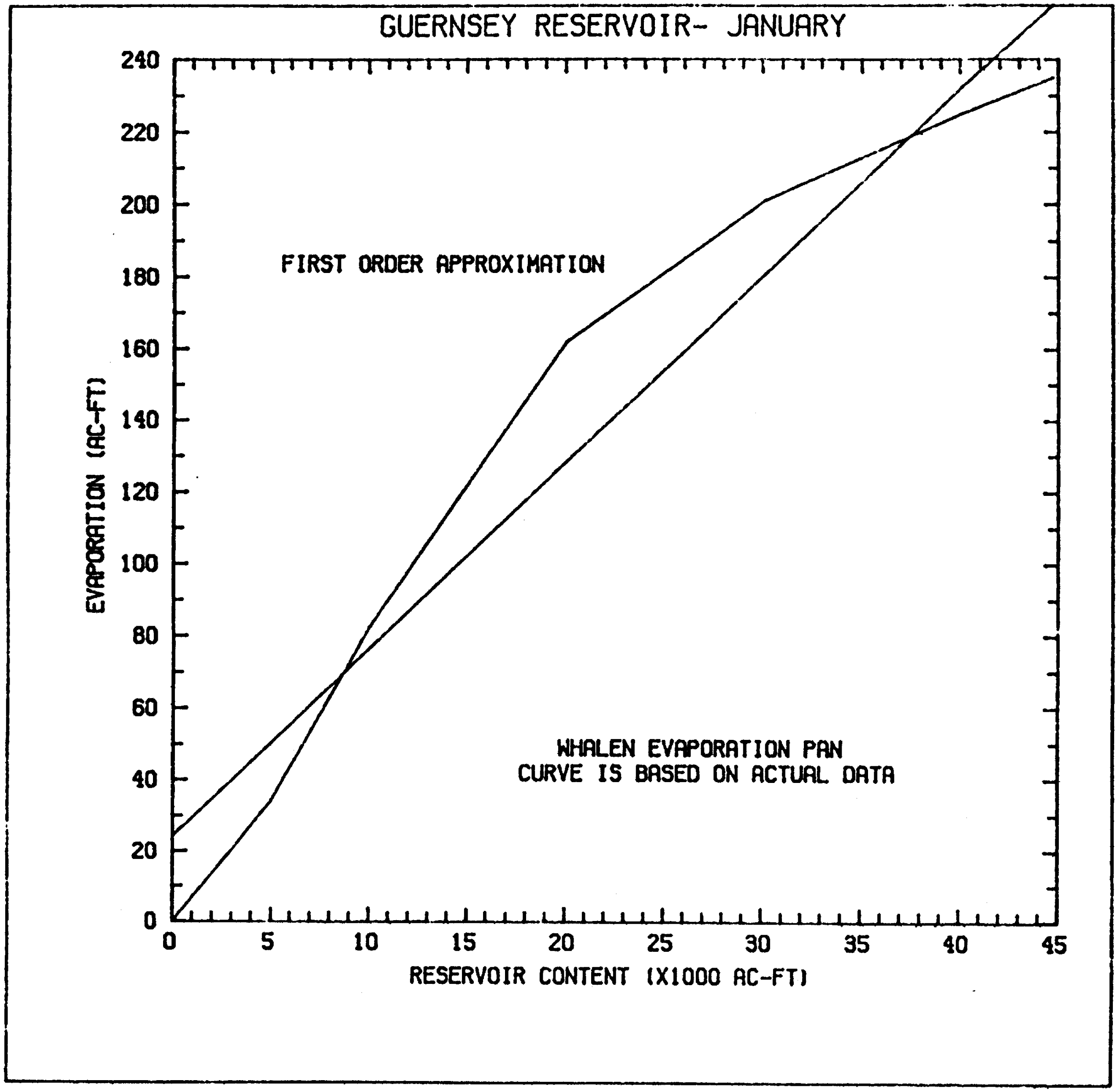
GLENDO RESERVOIR- SEPTEMBER

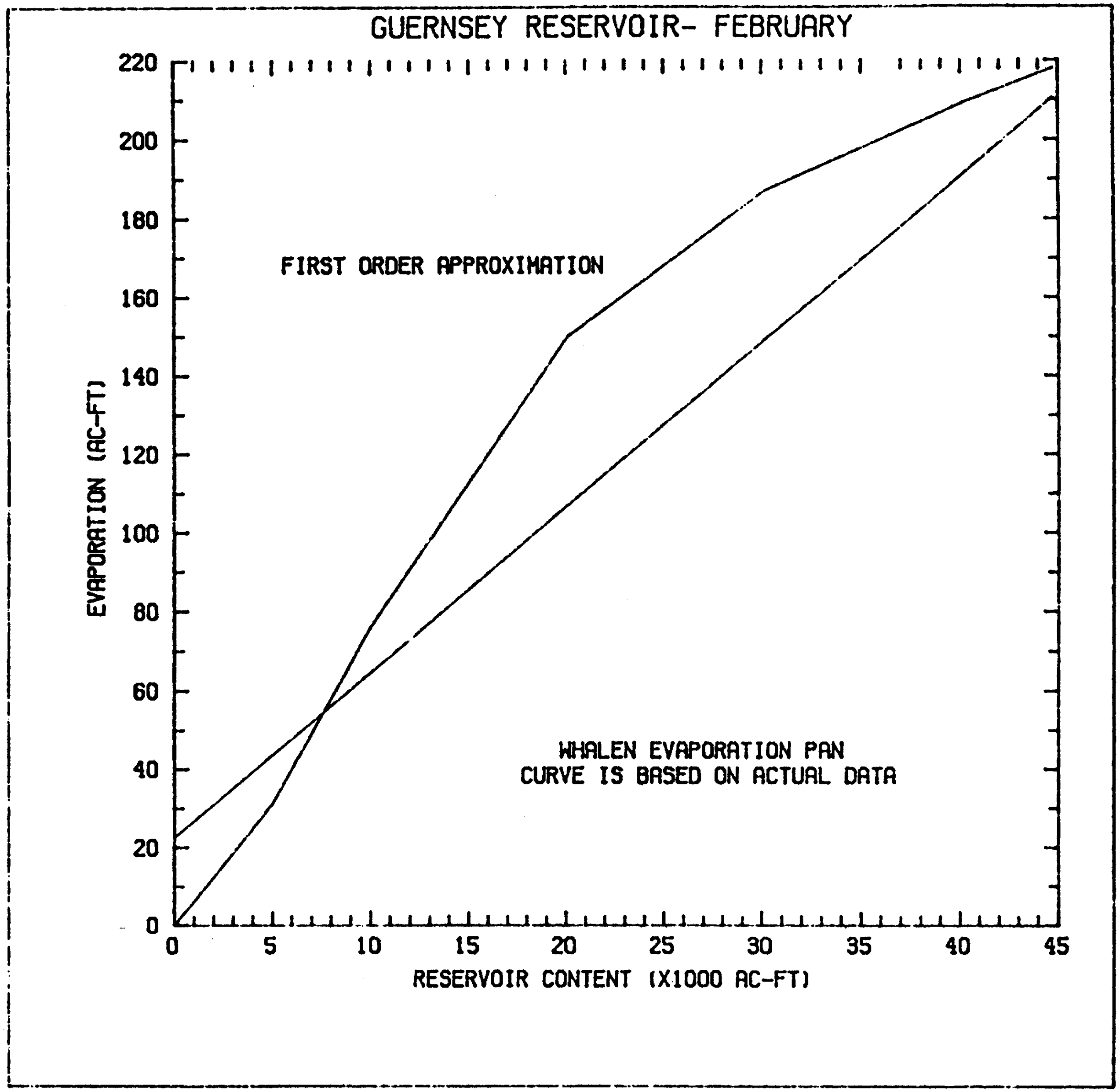


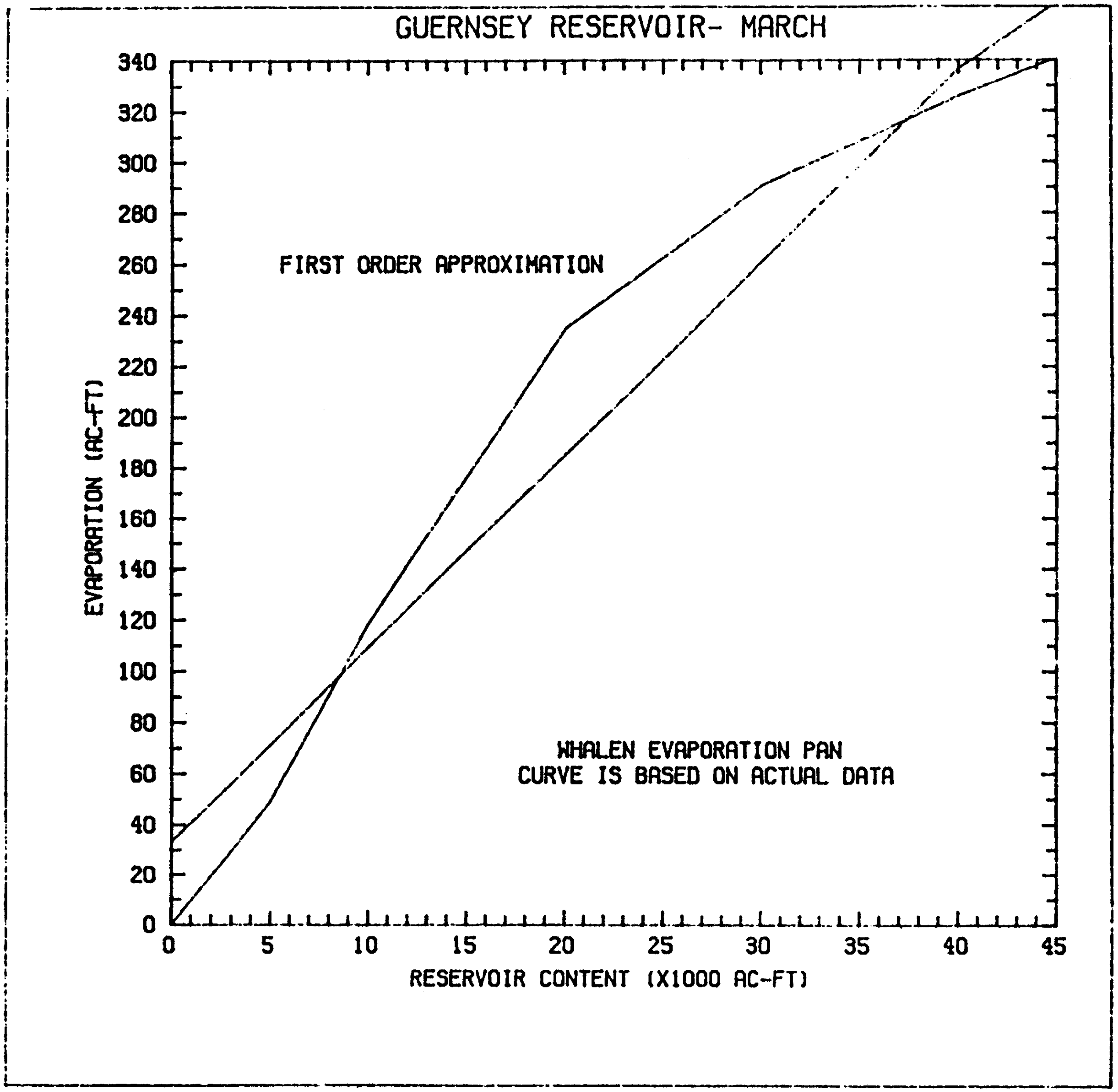

GLENDO RESERVOIR- OCTOBER
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
0
100
200
300
400
500
600
700
800
900

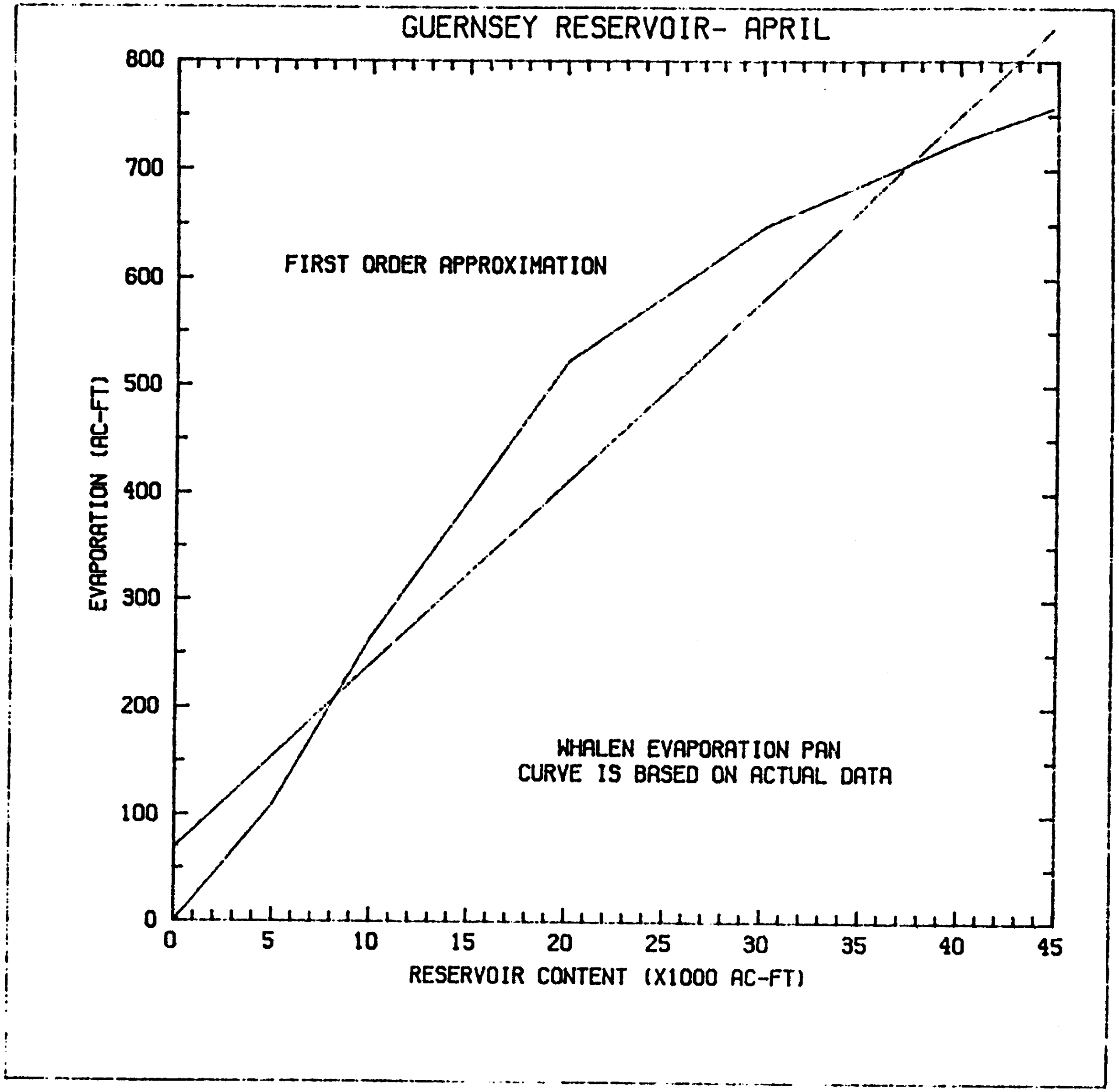

GLENDO RESERVOIR- NOVEMBER
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
0
100
200
300
400
500
600
700
800
900

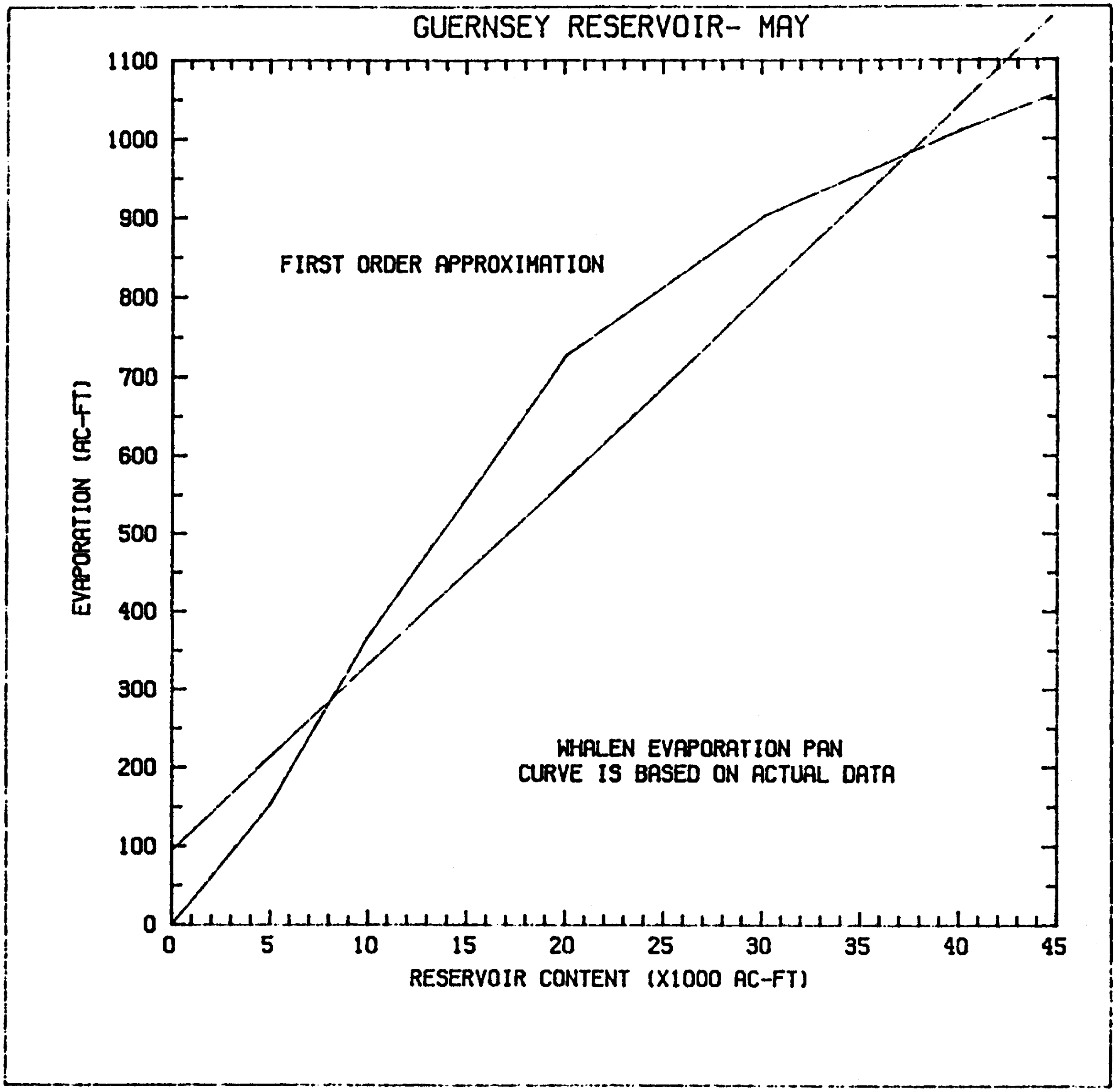

GLENDO RESERVOIR- DECEMBER
2000
1800
1600
1400
1200
1000
800
600
400
200
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
GLENDO EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
100
200
300
400
500
600
700
800
900
RESERVOIR CONTENT (X1000 AC-FT)

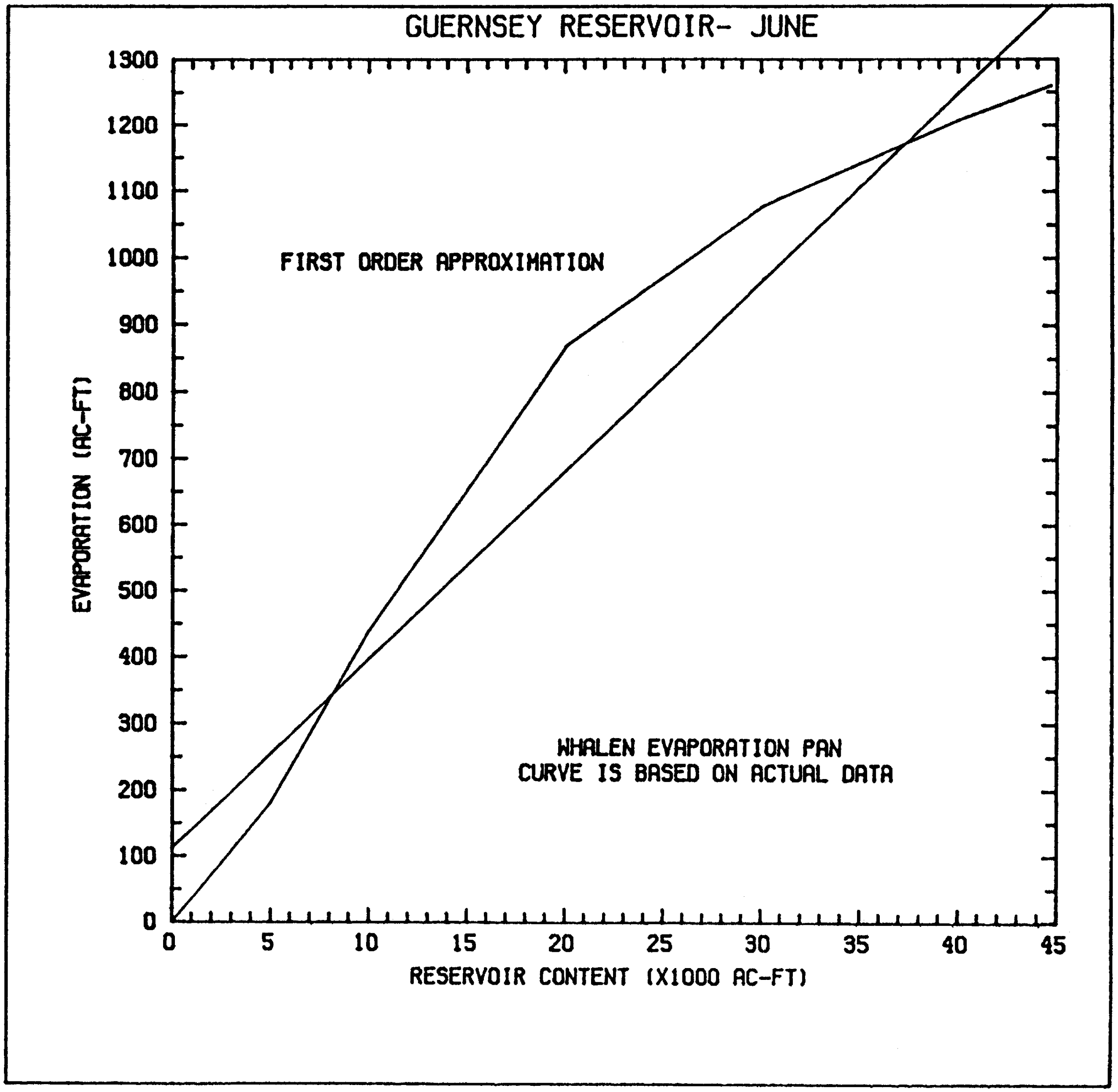

GUERNSEY RESERVOIR- JANUARY
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
20
40
60
80
100
120
140
160
180
200
220
240
0
5
10
15
20
25
30
35
40
45


GUERNSEY RESERVOIR- FEBRUARY
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
20
40
60
80
100
120
140
160
180
200
220
0
5
10
15
20
25
30
35
40
45

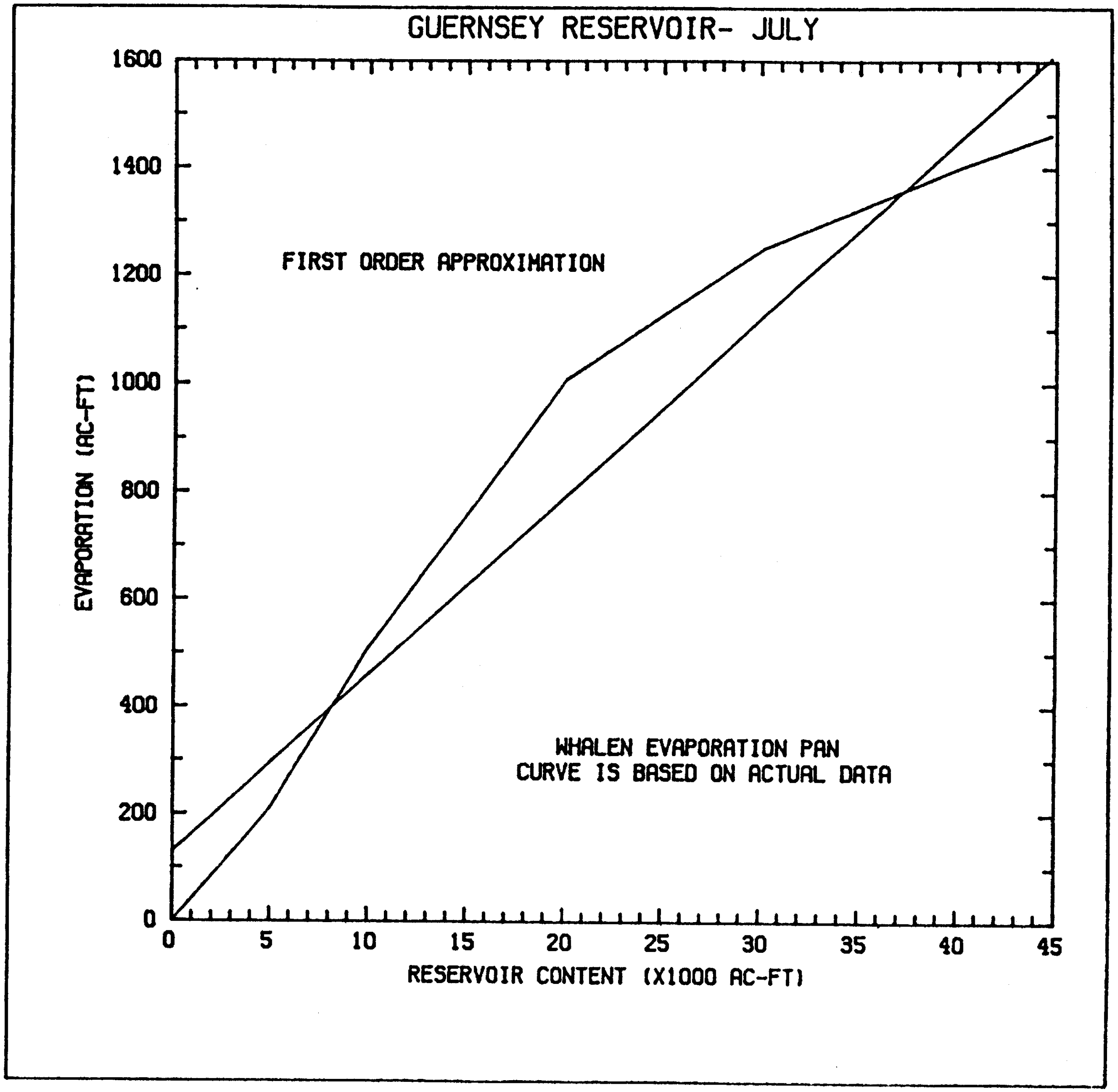

GUERNSEY RESERVOIR- MARCH
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
0
5
10
15
20
25
30
35
40
45

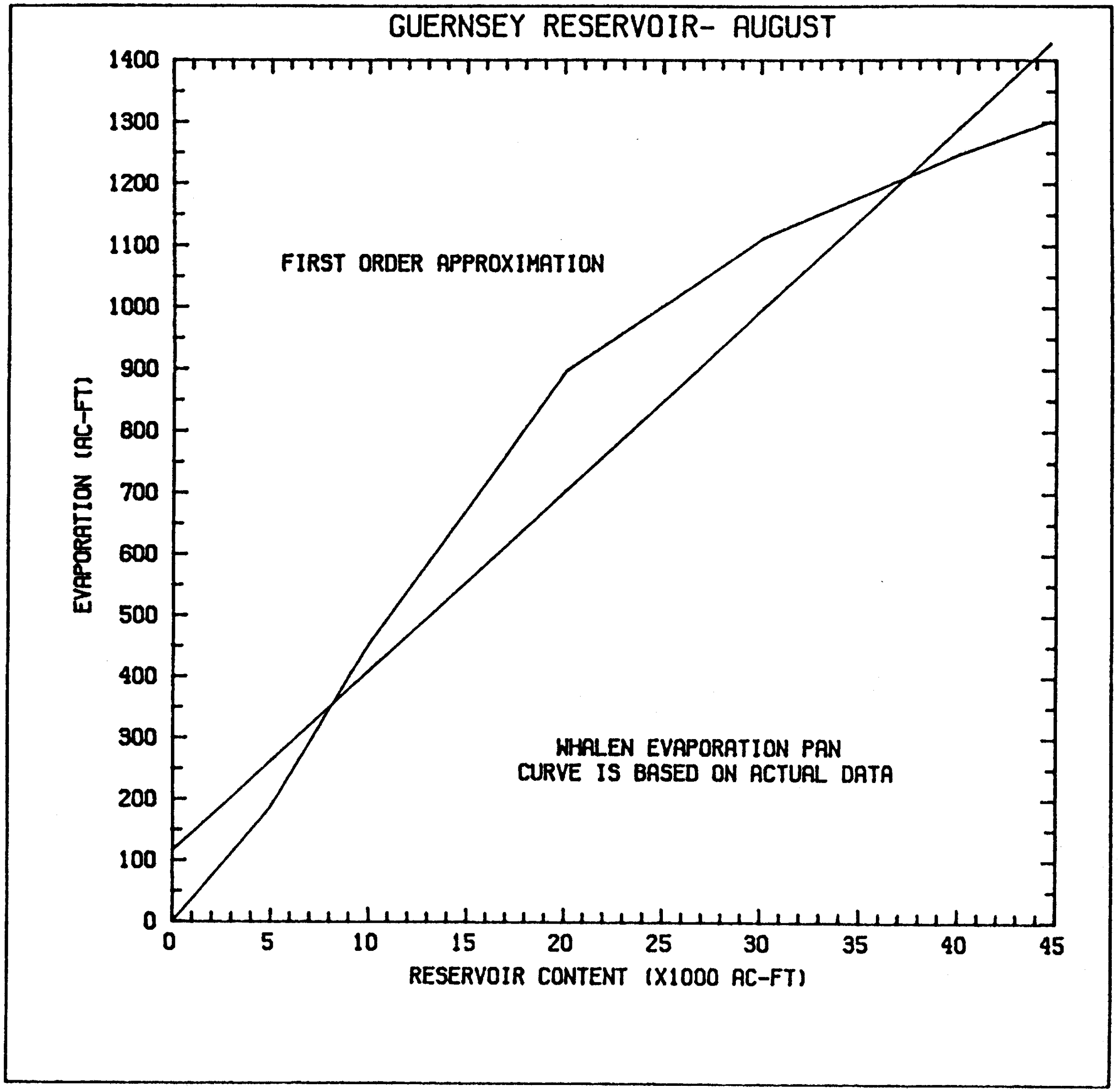

GUERNSEY RESERVOIR- APRIL
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
100
200
300
400
500
600
700
800
0
5
10
15
20
25
30
35
40
45


GUERNSEY RESERVOIR- MAY
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
100
200
300
400
500
600
700
800
900
1000
1100
5
10
15
20
25
30
35
40
45

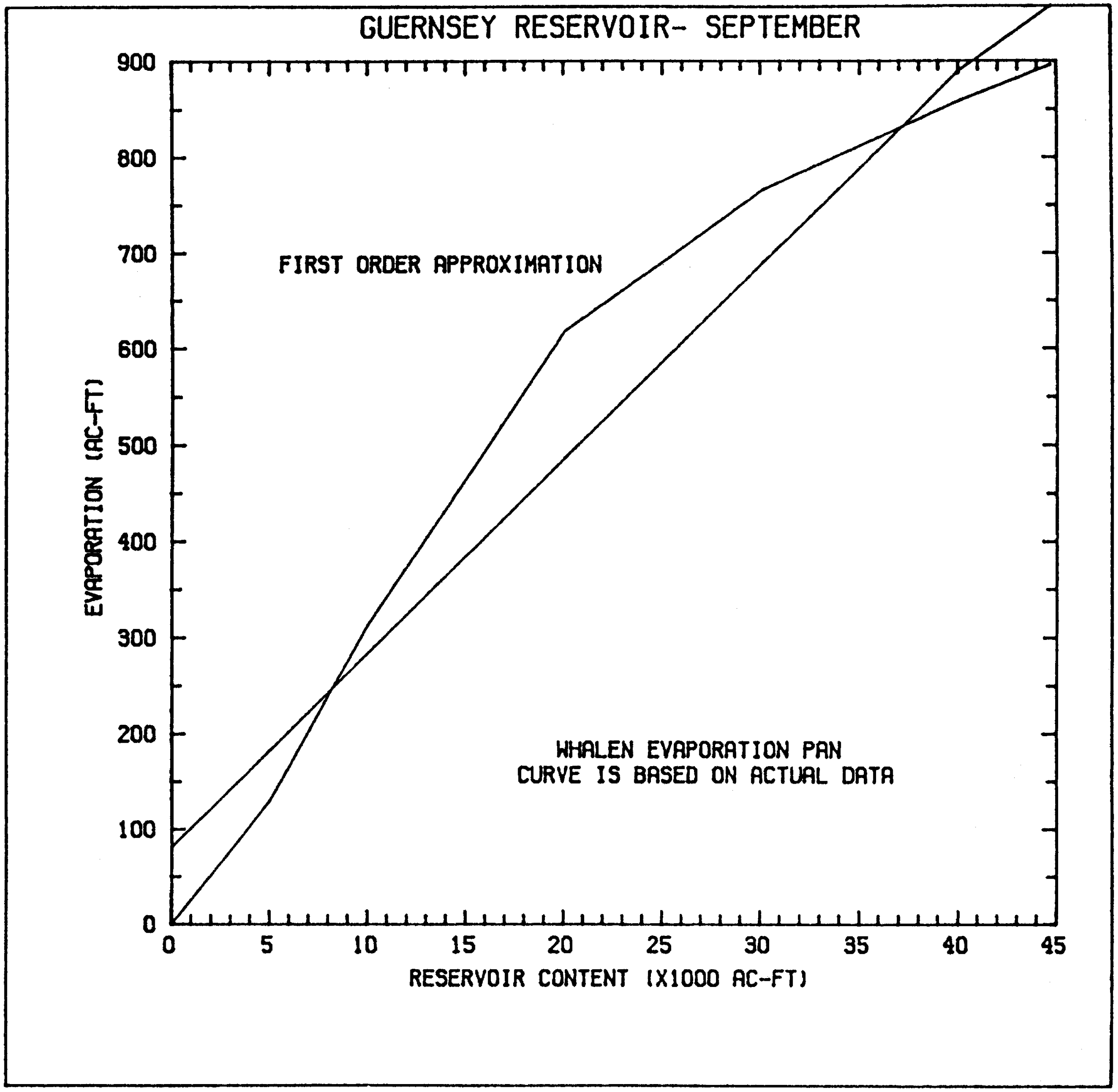


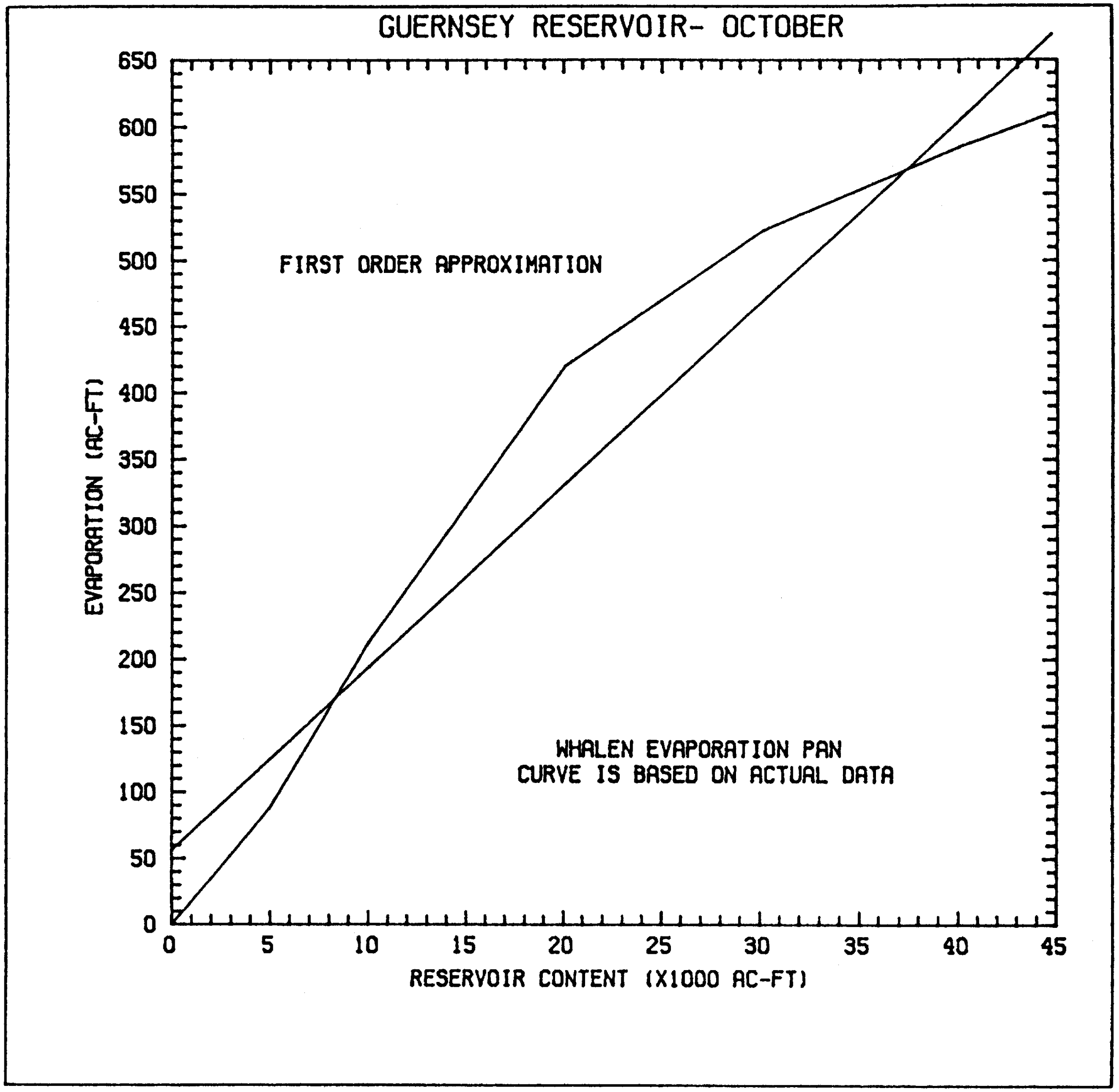
GUERNSEY RESERVOIR- JUNE
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
0
5
10
15
20
25
30
35
40
45

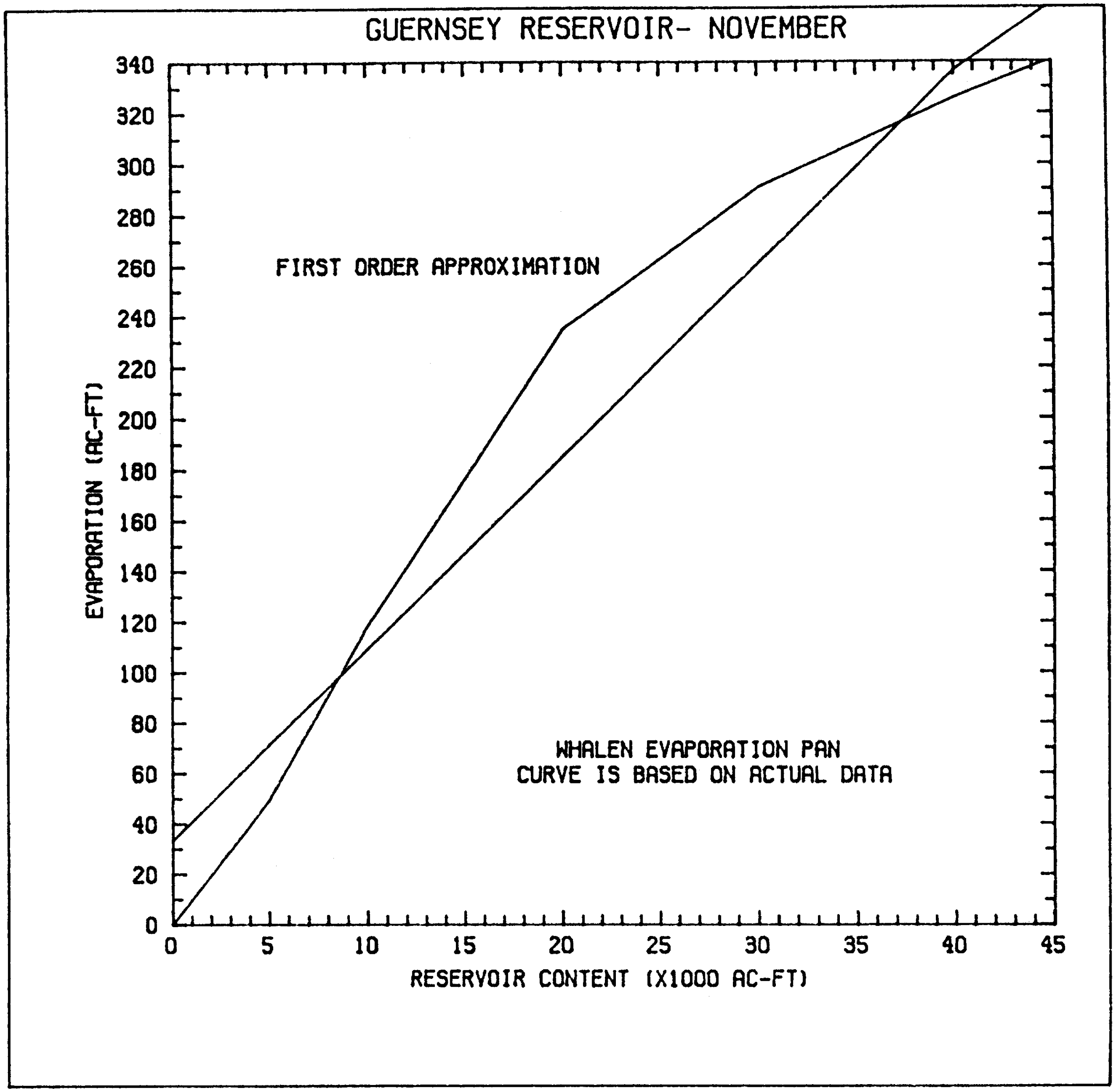

GUERNSEY RESERVOIR- JULY
1600
1400
1200
1000
800
600
400
200
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
5
10
15
20
25
30
35
40
45
RESERVOIR CONTENT (X1000 AC-FT)

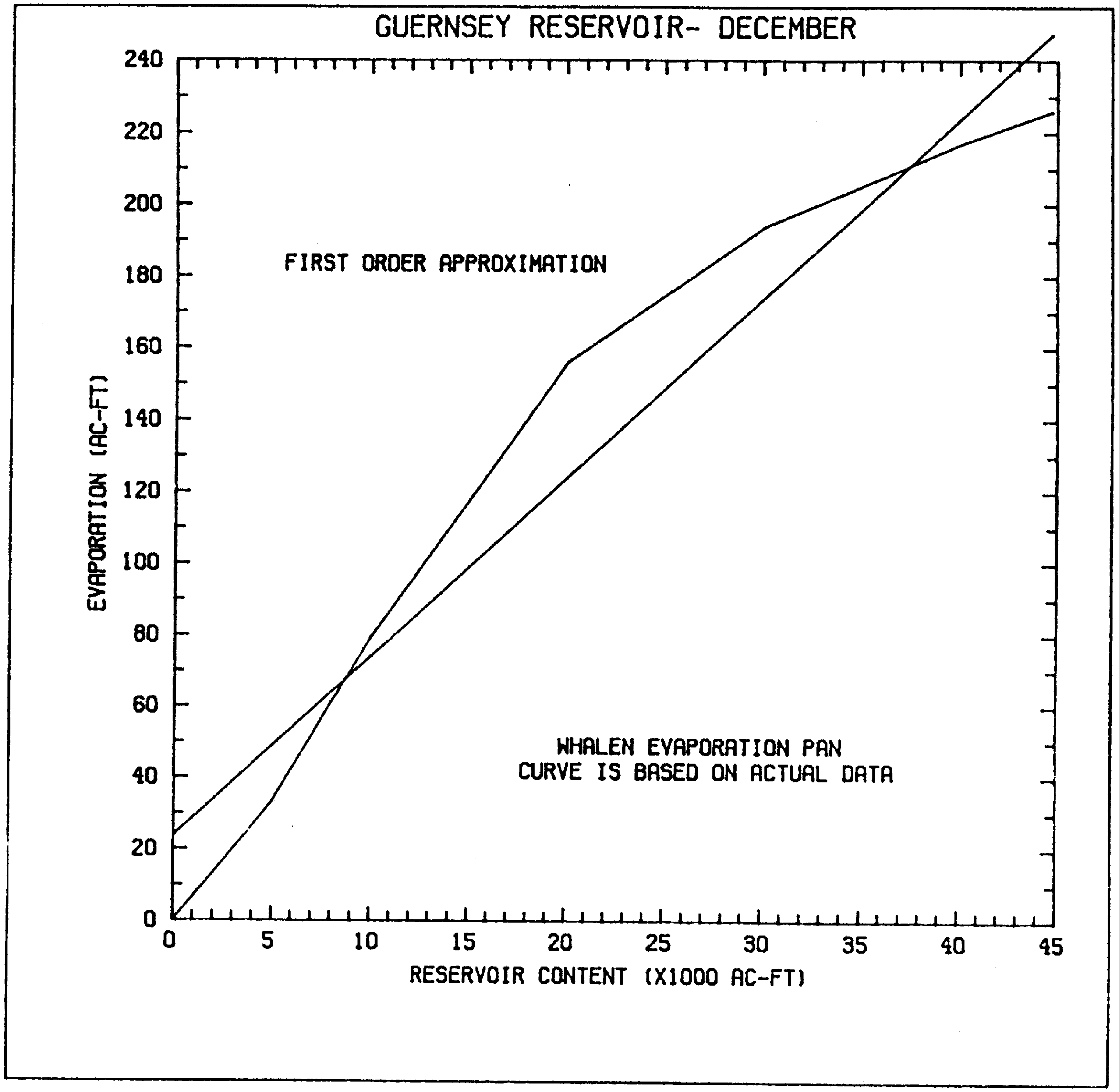


GUERNSEY RESERVOIR- AUGUST
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
0
5
10
15
20
25
30
35
40
45


GUERNSEY RESERVOIR- SEPTEMBER
900
800
700
600
500
400
300
200
100
0
EVAPORATION (AC-FT)
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
0
5
10
15
20
25
30
35
40
45
RESERVOIR CONTENT (X1000 AC-FT)


GUERNSEY RESERVOIR- OCTOBER
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
0
5
10
15
20
25
30
35
40
45


GUERNSEY RESERVOIR- NOVEMBER
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
0
5
10
15
20
25
30
35
40
45


GUERNSEY RESERVOIR- DECEMBER
FIRST ORDER APPROXIMATION
WHALEN EVAPORATION PAN
CURVE IS BASED ON ACTUAL DATA
EVAPORATION (AC-FT)
RESERVOIR CONTENT (X1000 AC-FT)
0
20
40
60
80
100
120
140
160
180
200
220
240
0
5
10
15
20
25
30
35
40
45