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MEMORANDUM REPORT

On

Surface Water Availability in the Caloosahatchee Basin

September, 1974

MEMORANDUM REPORT
ON SURFACE WATER AVAILABILITY IN THE CALOOSAHATCHEE BASIN

RESOURCE PLANNING DEPARTMENT

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INTRODUCTION

The Caloosahatchee River Basin is situated between Lake Okeechobee on the east and the Gulf of Mexico on the west. The basin occupies portions of Lee, and a small portion of Collier and Hendry Counties to the south, and Glades and Charlotte Counties to the north. This report is concerned with that portion of the basin area lying between S-77 at Moore Haven and S-79 (W.P. Franklin Lock and Dam) at Olga. This portion of the basin is approximately 966 square miles and has been sub-divided at the Ortona structure (S-78) into an east and a west basin consisting of 372 and 594 square miles respectively.

Approximately 70% of the land is used for pasture of which 24% is in improved pasture. Of the remaining 30%, about 10% is forested and another 10% is undeveloped, non-forested land; the remaining 10% is in citrus, truck crops and urban use of which citrus and urban use have about equal weight and account for a bit over 5% of the land use.

The Caloosahatchee River (C-43), running roughly east and west, divides the basin approximately in half. Figure 1 presents a map showing the two sub-basins as well as primary physical characteristics. Originally, the Caloosahatchee River was a natural watercourse from Lake Flirt (east of LaBelle) to San Carlos Bay, a distance of approximately 49 miles. In 1884 a canal was constructed by private interests connecting the headwaters to Lake Okeechobee for navigation and water control. From time to time, the river and canal were improved, and in 1918 three combination lock and spillway structures were constructed. These were located at Moore Haven, Citrus Center, and Fort Thompson. The River and Harbor Act of July 3, 1930, authorized improvement of the Caloosahatchee River and Canal. By 1945 the old lock structures had been

abandoned, canal improvements were made and further improvements were authorized. Other authorizations were passed by Congress resulting in the present three structures and canal improvements.

The structures and canal improvements were authorized not only for navigation purposes but for flood protection and water control. Two of the water control benefits specifically cited in the General Design Memorandum (Part IV, Supplement 6) were (1) "eliminating undesirable salinity in the lower Caloosahatchee River", and (2) "raising the prevailing dry-weather water table levels. Considerable benefit...would result from provision of an adequate supply of irrigation water. Water supply for irrigation would have to be furnished from Lake Okeechobee storage".

The main purpose of this study is to identify, quantify and evaluate the hydrologic constraints operating in the study area which have a bearing on surface water allocations for salinity control and for irrigation use as well as navigational uses. A corollary purpose of this study is the establishment of minimum flows from S-79 to the estuarine areas. These requirements, once established, act as hydrologic constraints on the amount of surface water generated within the study area that will be available for beneficial use and allocation.

Recommendations will be made concerning:

1. Guidelines for use in evaluating new surface water withdrawal permits.
2. Treatment of valid surface water withdrawal permits in existence prior to March 1, 1974.
3. Guidelines for salinity control in the reach between S-79 and S-78.
4. Minimum discharges to the estuary from S-79.
5. Guidelines for water supply operations for the Caloosahatchee Basin.

GENERAL

The "Memorandum Report on Surface Water Availability in the Lake Istokpoga - Indian Prairie Area", dated July 1, 1974, presents a general discussion of the amount of surface water which is available in a basin whose water supply can be supplemented by Project storage. In the case of the Caloosahatchee Basin, that storage resides in Lake Okeechobee.

In those basins for which a Project storage component is to be included as an element of the total amount of water available for reasonable beneficial consumptive use in the basin, care must be exercised to preserve and maintain that component. In the case of the Lake Istokpoga - Indian Prairie Area, this was accomplished by establishing minimum flow values for the two major tributaries to Lake Istokpoga; setting these values at high levels and thus severely limiting the amount of water available for beneficial consumptive use in those tributary watersheds.

In the case of Lake Okeechobee the major tributary inflows derive from the following areas:

1. Kissimmee River Basin
2. Fisheating Creek Watershed
3. C-119 (Taylor Creek, Nubbin Slough, Mosquito Creek, et cetera)
4. Indian Prairie Area, including Northwest Shore
5. Northeast Shore pumping stations
6. South Shore, Everglades Agricultural Area pumping stations
7. Inflow to St. Lucie Canal

Minimum flows from the Indian Prairie Area have been established at approximately 38,000 acre-feet annually; thus permitting about 69,000 acre-feet, or 65% of the average annual present inflow from this area to be appropriated for use within the basin. This inflow reduction is insignificant in

terms of total inflow to Lake Okeechobee, particularly in view of the fact that all surplus (including regulatory releases from Lake Istokpoga) will be required to continue to flow into Lake Okeechobee.

Inflows from the Northeast Shore pumping stations are insignificant and no minimum flow requirements from this area need be established.

Everglades Agricultural Area flow contributions have already been documented in Technical Publication #74-4, FCD, which shows a long-term inflow/outflow balance for this area. The storage necessary to supply this area's supplemental water requirements is being met by inflow from the area.

Inflow to St. Lucie Canal is presently, under non-regulatory discharge conditions, the equivalent of inflow to Lake Okeechobee. This situation will be changed in about two years. it is not necessary to consider this area as contributing to maintaining storage in Lake Okeechobee in view of the short life of the now existing conditions.

Flows from the Kissimmee Basin, Fisheating Creek and the North Shore all make a substantial contribution to Lake Okeechobee storage and it will therefore be necessary to establish minimum flows at the Lake discharge points for all three basins. This will be done under separate investigations; these values will not be established in this report.

The water considered to be available to the Caloosahatchee Basin consists of two components: (a) water generated within the basin itself, the basin yield, and (b) water in storage in Lake Okeechobee. From the total basin yield component, an amount will be reserved for contingent and unforeseen uses. The remainder, termed "the adjusted basin yield", is to be considered allocable, on a unit land area basis.

The Lake storage component will also be allocable on a unit land area basis. Maximum permissible allocations of this component will be based on criteria which assume storage sufficient to meet reasonable beneficial consumptive

use requirements for all areas receiving supplemental water from Lake Okeechobee. Reductions in use will be keyed to Lake stage and will be applied to uses in the Caloosahatchee Basin in the same fashion as to other uses of Lake Okeechobee water.

It is to be noted that in the case of the Lake Istokpoga - Indian Prairie Area the water reserved for contingent and unforeseen uses was taken from the lake storage component; whereas in the present case the reserved water is being taken from the basin yield component. This was a judgment determination, made for the following reasons:

1. Unadjusted basin yield values are higher in the Caloosahatchee Basin.
2. Downstream requirements for stored water in Lake Okeechobee are more pressing in other areas than in the Caloosahatchee Basin.
3. In the Indian Prairie case reserving lake storage was the practical equivalent of reserving basin yield.
4. In the Indian Prairie case it is more likely that contingent and unforeseen needs will develop in the area around Lake Istokpoga and its tributaries than on the Indian Prairie.

BASIC DATA

Land use data was compiled (Table 1) from basic land use maps for the years 1957 and 1972. The areas in each basin under the following eight categories: urban, improved pasture, rough pasture, truck, citrus, forested natural, and non-forested natural, and sugar cane areas, were obtained from the maps. A linear relation was assumed for land use in the intervening years.

Flow through structures S-77 and S-79 are published by the U.S. Geological Survey in Water Resources Data for Florida. These records include an estimate for seepage and lockage. Records were extended or filled as necessary from data supplied by the U.S. Corps of Engineers or from a discharge-rainfall relationship as noted in Table 2. The relationship used was to multiply the average monthly discharge by the ratio of the month's rainfall to the average of that month's rainfall.

Preliminary analysis using the available records for S-78 indicates that the flow calculated from this data is of inadequate quality to be used in its present form. The U.S.G.S. is now in the process of analyzing these records and when they become available, should prove a valuable addition to this study.

Regulatory releases from Lake Okeechobee which were made to control stages in the lake are presented in Table 3. These records were derived from a record of communications between the U.S. Corps of Engineers and the F.C.D.

Precipitation (Table 4) is the weighted average by the Thiessen Method, of eight rainfall stations distributed as indicated in Figure 1. The names of the stations, co-operating agencies responsible for these studies and the weighting factors are given below:

Station	Agency	West Basin Weighting Factor	East Basin Weighting Factor
Immokalee	Florida Forestry Service	0.060	0.057
Bermont	D.O.	0.192	0
Palmdale	D.O.	0.058	0.102
S-77	Corps of Engineers	0	0.246
S-78	D.O.	0.056	0.470
S-79	D.O.	0.219	0
LaBelle	U.S. Weather Bureau	0.415	0.050
Townsite	F.C.D.	0	0.075

Pan Evaporation (Table 5) was taken from records published by the U.S. Weather Bureau for Moore Haven Lock near S-77.

Channel stages for C-43 were not tabulated as the change in channel storage was assumed to be negligible due to the method used in regulating the three control structures.

BASIN YIELD

For the purpose of this study, basin yield is defined as the monthly volume of water which can be collected from surface and ground water sources for irrigation and downstream uses. This will be interpreted as the amount of water that would reach the channel of C-43 in the absence of diversions for agricultural use. The volume of water which will be allocated for irrigation is the adjusted basin yield, i.e., the volume of water that will be replenished from natural sources over the long term, less an amount reserved for contingent and unforeseen uses.

Basin yield for the period of record is tabulated on a monthly basis for the C-43 watershed in Table 8. The values are based on a water budget of the C-43 channel and are calculated as the summation of net channel discharge out of the basin, plus an estimate of the irrigation withdrawals from the channel. When the calculated value of basin yield was less than zero, the values were truncated at zero.

Net channel discharge is presented in Table 3b. It is calculated as the discharge through S-79 (Table 2b) minus the discharge through S-77 (Table 2a).

An estimate of the withdrawals from C-43 for irrigation is made from theoretical irrigation requirements over the basin. Assumptions implicit on this type of analysis are:

1. Only areas which were classified as intensive pasture, truck, sugar cane or citrus received supplemental water.
2. All supplemental water used came directly from or would have entered C-43 during the month of application.
3. Land use can be interpolated with a linear relationship for years in

which no surveys were made.

4. The procedures used to derive potential evaporation and the portion of rainfall which is effectively used by plants will result in a reasonable estimate of irrigation requirements.
5. The derived irrigation requirements reflect the timing and amount of supplemental water actually applied.

The approach used is to find the monthly deficiency in water required by each crop under irrigation for each irrigation season of record. This deficiency will be multiplied by the area planted to each crop in any given irrigation season to determine the monthly volume of supplemental water required for each year. These deficiency values will be used in estimating irrigation withdrawals during the months November - May. Irrigation withdrawals during other months will be assumed to be non-existent.

Since most of the sugar cane is in the area immediately adjacent to Lake Okeechobee, evapotranspiration requirements for this crop were determined as 0.70 times the pan evaporation at Moore Haven Locks. See Technical Publication No. 74-4, "Supplemental Water Use in the Everglades Agricultural Area", F.C.D., for a discussion of this method.

The report mentioned above confirmed the long-term adequacy of the Blaney-Criddle method for the determination of evapotranspiration requirements for truck crops. The procedure as well as the coefficients required, are detailed in TR21, "Irrigation Water Requirements", Soil Conservation Service.

A large portion of the areas devoted to citrus, improved pasture, and truck lie some distance from Lake Okeechobee. It is felt, in this case, that the pan evaporation at Moore Haven is not representative of conditions over the area of concern. For this reason, other methods were chosen for the determination of evapotranspiration requirements for these crops.

Evapotranspiration requirements for improved pasture were also calculated by the Blaney-Criddle procedure. The procedure was checked by a comparison with the procedure used in Technical Publication #74-4, FCD, with the parameters required taken from records at the Belle Glade Agricultural Experiment Station. This check indicated that the crop growth stage coefficients in the Blaney-Criddle procedure should be modified to 0.44, 0.46, 0.46, 0.58, 0.65, 0.67, and 0.67 for the months November through May inclusive for the area under consideration.

A test of the Blaney-Criddle procedure for citrus proved disappointing in that the predicted evapotranspiration was considerably larger than the limited data available for South Florida would indicate as being appropriate. Since actual data was too sparse to make the necessary corrections to the Blaney-Criddle procedure, constant values for evapotranspiration of citrus of 1.9, 2.6, 2.9, 3.8, 2.4, 2.1, and 2.0 inches for the months November through May were used, see "Memorandum Report on Surface Water Availability in St. Lucie County", FCD, for a discussion of the adequacy of these values.

Evapotranspiration requirements for each crop are listed in Table 6.

Determination of the irrigation requirements from evapotranspiration data must assume some portion of the rainfall over the area is effective in supplying the necessary moisture for evapotranspiration. The procedure used is detailed in Technical Publication #74-4, FCD, along with a discussion of the adequacy of this procedure. Essentially all rainfall is considered as effective in meeting crop needs until the evapotranspiration needs are met on a monthly basis. Any rainfall which is in excess of the crop requirements is either discharged or goes to temporary storage. This is accomplished by considering the summation, of positive values only, of the difference, ET - PRECIPITATION, on a monthly basis as the irrigation requirement for the irrigation season.

Irrigation requirements in acre-feet are listed in Table 7a. The values in this table are the summation for all the crops considered of estimated crop

evapotranspiration (Table 6) minus precipitation (Table 2), times the area devoted to each crop in a particular year (from a linear interpolation of Table 1) for the two sub-basins. Table 7b presents these values converted to inches over the irrigated area. This was accomplished by summing the values for the two sub-basins and dividing by the total area devoted to irrigated crops in the C-43 basin in each year (from a linear interpolation of Table 1). Table 7b is the basis for the total amount of water allocated during periods when restrictions are not applied.

Experience in other watersheds indicates that the full irrigation requirement for pasture is seldom applied to the fields. An estimate of the irrigation water actually applied is presented in Table 7c. These are the values used in calculations of the basin yield. They were derived in a manner similar to Table 7b described above with the exception that only 50% of the required supplemental water for the pasture crops was used.

In the context of this study, the interception of surface or ground water flow before it reaches the channel is considered equivalent to a withdrawal from the channel. The change in channel storage was considered negligible due to the method employed in regulating flow through C-43.

It is necessary to add an estimate of irrigation withdrawals to the net flow out of the basin because irrigation water as well as other releases that come from Lake Okeechobee are all deducted from the flow out of the basin. This would be a proper method for determination of basin yield if all the water that was released at S-77 passed through S-79. It should be obvious that irrigation releases and certain other releases such as those that are used for potable water, do not pass through S-79. Thus, the net flow out of the basin yields an estimate of the basin yield which is too low by an amount equal to the quantity of water that was withdrawn from the channel for consumptive use within the basin, plus an additional amount that was intercepted and "used up" before it

reached the channel. Adding an estimate of the irrigation water applied to the land incorporates irrigation water intercepted in the basin as well as irrigation water derived from the lake. Non-agricultural diversions are not accounted for in this analysis and are considered a "factor of safety" as they would tend to increase basin yield slightly if they were included in the analysis.

It is realized that the two sub-basins delineated on Figure 1 may have significantly different values of basin yield. A preliminary analysis of the data, however, indicated that the flow records of S-78 were too poor to allow the separation of the two areas for determination of basin yields. It is hoped that future improvements in data processing will allow the separation of these basins for this purpose.

For the purpose of this study, minimum downstream flow requirements to maintain estuary conditions as well as supplemental water required to maintain salinity control elevations and proper salinity conditions at the intake for the City of Ft. Myers and Lee County water treatment plants will be considered as a draw on water from Lake Okeechobee and thus do not affect the portion of the basin yield available for allocation to agricultural uses.

It is felt, however, that some reservation should be made for contingent and unforeseen uses. The one-in-ten year low basin yield was arbitrarily selected for this reservation. The monthly allocated volume of basin yield is presented in Table 9. On an annual basis, the reservation approximates 20% of the basin yield.

The portion of the basin yield which may be allocated for surface water withdrawal permits is also presented in Table 9. It is calculated as the monthly basin yield which is expected to be exceeded 50% of the time, on a long term basis, as determined from an empirical frequency distribution with the correction applied for reserved water.

LAKE OKEECHOBEE STORAGE

In addition to the basin yield, some water is available to supplement agricultural requirements from Lake Okeechobee. It is believed that allocation values for the Lake Okeechobee storage component, for irrigation, should be determined by the availability of water in the lake as measured by the lake stage.

Agricultural water use allocations from Lake Okeechobee storage will be based on the maximum beneficial use concept. In the C-43 basin this is to be interpreted as approximately the irrigation requirement (Table 7b) which is exceeded one-in-ten years minus the adjusted basin yield (Table 9). These values in inches are:

NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY
1.5	1.5	1.5	0.9	2.8	3.7	3.0

The one-in-ten year water requirement was selected as the maximum beneficial use criteria because this is near the largest drought frequency for which design of irrigation systems is economical and in this basin it appears that irrigation requirements increase only slightly for the more rare drought occurrences. These values are based on the recent historical cropping patterns and may differ somewhat from individual crop requirements. They also do not reflect efficiencies of transmission or application. It is felt, however, that they are adequate for short-term permitting purposes.

SURFACE WATER ALLOCATIONS FOR AGRICULTURAL USE

As noted in previous reports on surface water availability in other District water supply areas, agricultural water users have two possible means whereby available surface water can be appropriated for reasonable beneficial consumptive use. In the case of the Caloosahatchee Basin these two means are:

1. Directly from the Caloosahatchee River or its tributary streams on an "as-needed" basis; or
2. By impoundment, either:
   (a) through diversions from the Caloosahatchee River or its tributary streams,
   (b) through capture and storage of surface runoff prior to its entry into the River or tributary streams, or
   (c) through a combination of both.

If appropriation is by the first means, some portion of the adjusted basin yield allocable to the user on a unit land area basis will be lost to the user; this portion being that which occurs during the non-irrigation season. This loss is compensated for (from the user's standpoint) by the fact that project water in storage in Lake Okeechobee will ordinarily be available to meet reasonable irrigation season beneficial use requirements.

If appropriation is by the second means, an adequately designed impoundment will permit the non-irrigation season adjusted basin yield to be stored for later beneficial use. In addition, the provision of such a private, off-line impoundment will permit the appropriator to place his full share of the Lake storage component of this allocation in storage when it is available, thereby providing a cushion against the possible reduction in deliveries from Lake storage near the end of the dry season. Offsetting this approach are the

costs involved in developing such storage capability. These costs must be weighed against the comparatively small risk (at this point) of possible periodic late-season reductions in allocations from project storage in Lake Okeechobee.

Regardless of the means chosen for the physical appropriation of the allocated amounts of water, each agricultural water user will be entitled to an allocation on the same unit land area basis. That allocation consists of an adjusted basin yield component and a Lake Okeechobee storage component. The allocation value, in inches/acre, is based on conditions of normal or average water supply availability as to the basin yield portion, and is consistent with the basis for allocation values established for other water supply areas. In addition, for this basin, the condition for the Lake storage component (Lake stage above "critical", as determined by past experience and considered judgment) is one which assumes ample storage, under even comparatively severe conditions, to meet beneficial use requirements. Accordingly, the criterion established for maximum allocation values is based on an estimate of reasonable beneficial use, rather than on water availability limitations as such. Here, again, these values are established as maximums for technical evaluation purposes only; they are not set forth as values of absolute entitlement.

Table 10 lists, by months, the adjusted basin yield unit land area values, the Lake storage unit land area values, and the maximum allocation value, which is the sum of the other two values. The adjusted basin yield values were derived as described in the section entitled "Basin Yield". The maximum allocation was established in accordance with estimated crop requirements based on a once-in-ten year frequency rainfall deficiency. The Lake storage values were derived by subtracting the adjusted basin yield values from the maximum allocation values.

For agricultural users who appropriate water "as-needed", allocations will be on an irrigation season basis and an annual basis. When it becomes necessary to apply water use restrictions, such restrictions will be keyed to Lake Okeechobee stage; that is, to the availability of stored water. It is assumed that when this becomes necessary the actual availability of the basin yield component is zero, and thus, that all supplemental water requirements must be met from Lake storage. Accordingly, restrictions will be applied based on this assumption.

For agricultural users who appropriate water by impoundment, allocations will be on a monthly basis. Permissible monthly appropriations will be for the total monthly allocation, no distinction being made as to source (basin runoff or Lake storage). Appropriations greater than the allowable monthly values will be permitted at any time either surplus water is being discharged from the basin or Lake regulatory discharges are being made. Such appropriations, for the purposes of restoring depleted reservoir storage, can be handled simply by notification by the District to permit holders in this category, and this provision can be incorporated as a part of the permit issued. Restrictions on water appropriations will be applied in the same manner as restrictions on water use for water users in the "as-needed" category.

As noted in the preceding paragraphs, and elsewhere in this report, maximum allocation values on a unit land area basis are predicted on:

(a) a portion of the median basin yield, plus

(b) adequate storage in Lake Okeechobee.

Water use restrictions will be applied when Lake Okeechobee stage reaches specified critical monthly values. Such restrictions, expressed in terms of percentage reduction in the allocated volume, although keyed to Lake Okeechobee stage, will be applied to the total allocated amount not just the Lake storage component.

First-of-the-month critical stages below which restrictions will be placed on withdrawals for consumptive use are:

NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY
12.5	12.1	12.0	11.8	11.6	11.4	11.0

These stages are based on previous experience which indicates that it is possible to meet all demands on the Lake if the Lake stage at the beginning of May is greater than 11.0 feet m.s.l. These stages were determined by adding the summation of the remaining total demand on the lake in the 1970-1971 irrigation season (converted to equivalent feet of stage above 11.0 feet m.s.l.). The remaining demand curve is presented in "Summary of Water Conditions of South Florida Water Storage Areas", FCD, and includes an estimate of "normal" evaporation and rainfall on the Lake.

To summarize: All agricultural water users in this basin (both those appropriating "as-needed" and those appropriating by impoundment) will have the same maximum permissible allocation, with the same share of the basin yield and Lake storage components. Also, both will be subjected to the same restrictions on withdrawals from the surface water/conjunctive shallow groundwater source; these restrictions to be keyed to Lake Okeechobee stage.

One additional factor requires some attention in this report with respect to agricultural users who elect to appropriate water by means of creating impoundments. Occasionally the situation will arise when storage in such an impoundment is depleted and ample storage exists in the Lake, but the Lake is in a non-regulatory discharge condition. The appropriator may wish to withdraw more than his monthly allocation for the purpose of replenishing depleted storage. This should be permitted, at the discretion of the District.

The District has already established a policy precedent for the withdrawal of water from Lake storage to replenish depleted storage in private reservoirs in the case of the FP&L "Project Seminole" reservoir. (See paragraph 1c, page 3, of agreement dated June 8, 1973). This same capability should be available to agricultural users. It is difficult to establish specific guidelines for a potentially wide variety of requirements. Consequently, it is recommended that each case be handled on an individual basis, upon request of the user; the permission to replenish storage during non-regulatory discharge periods being granted as a short-term, temporary permit based on the specific conditions existing at the time of the request.

Existing permits in the basin have been issued on the basis of a maximum monthly allocation of 7.5". It is recommended that all new permits be issued in accordance with the maximum allocations set forth herein, and that consideration be given to using these values for existing permits when they are received for conversion to the new Chapter 373 basis.

SHALLOW GROUNDWATER USE

At this point little is known as to the characteristics of the shallow groundwater (water table) aquifers in this basin. The approach to be taken by the District was outlined in the report on "Surface Water Availability in the Lake Istokpoga - Indian Prairie Area", and was adopted for the St.Lucie County Area. That approach will be applicable to the Caloosahatchee River Basin, on an interim basis, as well.

The prima facie assumptions in regard to criteria for the equivalency between surface water withdrawals and withdrawals from the water table aquifers set forth in the referenced reports will hold for the Caloosahatchee River Basin.

SURFACE WATER AVAILABILITY

On an annual basis, the median unadjusted basin yield is about 13" and the average is about 12" (see Table 8). The summation of the median monthly unadjusted basin yields gives an annual value of a little over 10" (see Table 9). These values are higher than what would be expected from examination of the data presented in "Map Series No. 32, August, 1969", prepared by the U. S. Geological Survey, and from the reasonable correlation obtained between the Map Series data and basin yields derived in other basins studied to date by the District. See Figure 5.

For examples:

1. For the Indian Priarie Area a basin yield of slightly over 3" was obtained. Map Series No. 32 indicates a value for precipitation excess over lake evaporation of 3".
2. For the St.Lucie County Area average and median basin yields of approximately 16" were obtained. This is to be compared with a value of 12" over the bulk of the drainage basin given in Map Series No. 32.
3. For the Everglades Agricultural Area a basin yield of about 16" was obtained. A value approximating 9" is derived from Map Series No. 32.

Map Series No. 32 shows, for the Caloosahatchee Basin, average annual precipitation equal to lake evaporation. The Map Series values, of course, are representative of minimum runoff, since lake evaporation is maximum loss to the atmosphere. Actual runoff will always be greater than the Map Series values. Nevertheless, a yield, or runoff, value for this basin on the order of 12" appears high in view of the correlation of District values with the Map Series data in other areas.

A partial explanation undoubtedly lies in the characteristics of the West Basin, which is unusually well-drained by numerous natural streams. A better grasp of conditions in this basin may be obtained after a longer period of flow measurements and, more importantly, by segregating the yield values of the West and East Basins.

In spite of the comparatively high annual basin yield values, if surface water (and the hydraulically inter-connected shallow aquifers) is to be used as the source of supplemental irrigation water the dependence of the basin on Lake Okeechobee storage is obvious. The adjusted basin yield value for the seven-month irrigation season, from Table 9, is 1.25"/acre. Based on the cropping pattern of the past 10 years both the estimated average and median values for supplemental water application in the basin approximate 5". At present this difference, at least, is made up by drafts on Lake Okeechobee storage.

This demand on the Lake can, in part, be reduced by encouraging the creation of private off-line impoundments for the capture and storage of wet season runoff. However, this may only be a reasonable alternative in the West Basin. Although no data is presently available to support this opinion, due to unsatisfactory discharge measurements at S-78, it is intuitively believed that wet season yield in the East Basin will be too small to make this alternative physically and economically practicable.

With possible future limitations on adding to the storage capability of Lake Okeechobee there is the prospect of placing a limitation on water supply diversions from the Lake to the Caloosahatchee River Basin. In view of this, medium and long-range water supply planning for the basin should emphasize development of the water table aquifers and the artesian aquifer.

MINIMUM FLOWS AND MINIMUM STAGES

Historical minimum discharges to the estuarine area from S-79 have been investigated since 1964 when the structure operation began. Prior to this date, there was no structure to inhibit the encroachment of saline water as far upstream as the La Belle area due to tidal fluctuations and varying quantities of runoff from the basin. Since one of the purposes of the S-79 structure was the elimination of undesirable salinity in this reach, it was not considered germane to this study to incorporate data prior to the installation of S-79.

The discharge data was ranked both including and excluding regulatory discharges from Lake Okeechobee. The lowest two monthly discharges from each set of data were then averaged to obtain a representative low flow for the period of record used. These are presented as monthly discharges in acre feet in the tabulation below:

MONTH	WITH REG.	WITHOUT REG.	MONTH	WITH REG.	WITHOUT REG.
Jan.	1,600	1,600	July	47,000	43,000
Feb.	2,100	2,100	Aug.	40,000	21,000
March	1,000	1,000	Sept.	30,000	30,000
April	500	0	Oct.	17,000	17,000
May	600	300	Nov.	3,900	1,000
June	24,000	24,000	Dec.	600	600

It should be noted that there have been periods of record of 20 days or more when no discharge occurred through S-79 except for leakage and lockages. Frequency plots were attempted on the monthly data, but due to the short period of record, the scatter rendered their use unreliable; hence, this method was abandoned.

The "without regulation" values are selected on an interim basis since it is felt they are probably more representative of minimum flows under "natural" conditions prior to Disston and subsequent improvements for navigation and flood control.

The maintenance of minimum flows, during the more critical months of the dry season, is closely linked with two primary obligations of the Project for the Caloosahatchee River:

1. Maintenance of a salinity control stage upstream of S-79, to provide sufficient positive fresh water head to inhibit saline encroachment in the aquifer; and

2. Provision of water to meet the lockage requirements at S-79; this obligation deriving from the Okeechobee Waterway navigation project.

During the critical months of the dry season, meeting the above two obligations requires a draft on Lake Okeechobee storage. In actuality, the provision of water for locakges is simply one phase of the primary obligation to maintain salinity control stage; the water required to maintain stage consisting of that needed to, (a) replace evaporation loss between S-78 and S-79, and (b) replace water loss via lockages.

Maintenance of required minimum flows, during these same periods, would also represent a draft on Lake Okeechobee storage. However, available data indicates that a major portion of the dry season minimum flow requirement will be met by lockages. The following table compares minimum flows with estimated discharge volume via lockages:

Month	Min. Flow (A.F.) W/O Regulation	*Lockage Discharge(A.F.)	Lockage % of Min. Flow
Nov.	1,000	790	79%
Dec.	600	760	127%
Jan.	1,600	830	52%
Feb.	2,100	810	39%
March	1,000	960	96%
April	0	900	-
May	300	810	270%
	6,600	5,860	89%

* See following Section, "Salinity and Lockages", for discussion.

The minimum flow values for the dry season do not, on the basis of the above comparison, appear to represent an excessive draft on Lake storage above that required for maintenance of navigation (lockages).

The minimum flow values, "without regulation", given in the tabulation on page 22 are to be established for the Caloosahatchee Basin. These are flows as measured at S-79 and are to include lockages as well as discharges at the spillway. For this purpose total spillway discharge will be used; that is, Lake regulation discharges will be included in determining whether or not minimum flow requirements are being met. Releases from Lake Okeechobee to meet minimum flow requirements at S-79 are to be terminated at any time Lake stage reaches the "critical" monthly stages given on page 17.

The purpose of setting the minimum flow requirement is to establish at an early date the principle that some increment of Lake storage must be reserved for maintaining seasonal freshwater flows to the Caloosahatchee Estuary. It is expected that for some considerable period of time into the future runoff from the basin will ordinarily meet wet season minimum flow

requirements. The principle being established, therefore, relates primarily to dry season flows.

The requirements set out herein are based almost completely on judgment and cannot even be considered a statistical determination. They are not supported by biological or other ecological studies. Additional hydrologic data analysis must be performed together with ecological studies. Accordingly, these requirements are to be considered interim in nature until additional investigations are completed.

In regard to minimum stages in C-43, there are two channel reaches to be considered: S-77 to S-78; and S-78 to S-79. A minimum stage of 3.0 ft. msl. in the S-78 to S-79 reach has been established by the Project documents for salinity control purposes. This minimum stage should be adopted by the District under Chapter 373.

Minimum stage in the S-77 to S-78 reach is determined by Lake stage at lower Lake elevations. The practical effect of establishing a minimum stage in this reach would also be to establish a minimum stage for Lake Okeechobee; that is, to set a stage below which no further withdrawals from the Lake would be permitted. At this point the District is not prepared to establish such a stage and consequently it is recommended that a minimum stage for the S-77 to S-78 reach of C-43 not be established.

SALINITY AND LOCKAGES

The reach of the Caloosahatchee River upstream from S-79 to the Hendry County line has been designated as Class I water (suitable for potable use) and, as such, chlorides are not to exceed 250 mg/l throughout its depth. Since this reach of the river, prior to the completion of S-79, was subject to the influx of highly saline waters from the Gulf, the water was unsuited for irrigation or potable water use. After the construction of S-79, some residual salinity undoubtedly remained and to this was added the salt that was passed through into the upstream channel as a result of lockages. The 250 mg/l of chlorides are exceeded during low flow periods near the bottom of the channel but the exceedance is less frequent near the surface. The river now serves as a water source for the potable water system for Lee County and as a supplementary source for the water system of the City of Ft. Myers. These potable water intakes are constructed to withdraw surface water and are located about 3/4 of a mile upstream of S-79. The Lee County system has the least tolerance to high chlorides since this water is processed immediately at the plant and then distributed through the system while the City of Ft. Myers pumps the water into a diked area where it infiltrates to recharge the ground water for the well field.

The river in this reach is also used as a source of water for irrigation. A unique requirement for non-potable water of almost potable water quality is Yoder Brothers Flower Farm which supplies a major portion of the country's chrysanthemum slips for greenhouse use as well as some other flower varieties.

Prior to this year (1974), the records available for a definitive proposal for salinity control during low rainfall-flow periods were not suitable. However, during April, May, and June of 1974 a close record was made during this period of parameters that could affect the saline content of the upper strata of the river.

One of these parameters is lockages at the S-79 structure. These lockages are shown on Figure 3 along with those at S-78. These were examined to establish a trend, if one were indicated, both on a monthly pattern and a yearly total usage. Both showed distinct trends and allowed a possible use projection for year 1983 (10 years from last year's record). The average and projected lockages are illustrated by the following tabulation:

MONTH	AVG.	1983	MONTH	AVG.	1983
JAN.	455	1,190	JULY	489	1,220
FEB.	432	1,160	AUG.	429	1,160
MARCH	636	1.370	SEPT.	345	1,080
APRIL	554	1,290	OCT.	357	1,090
MAY	427	1,160	NOV.	402	1,130
JUNE	464	1,200	DEC.	357	1,090

The total water use for lockages at S-79 for year 1973, based on 0.7 acre-feet per lockage, was found to be 5,268 acre-feet and the projected 1983 lockage is 9,900 acre-feet. The total water discharged through S-79 for year 1973 was 586,930 acre-feet; the lockage requirement representing only 1% of the total. It can be assumed that the total yearly discharge through S-79 would be approximately the same in 1983. Therefore, the projected 1983 lockage requirement would approximate 2% of the total S-79 discharge.

Salinities just downstream of the lock at S-79 range from 500 mg/l for high discharge periods to 2,000 mg/l for low discharge periods. During a lockage the equivalent of about one ton of salt is transferred from downstream to the upstream side of the structure. This highly saline water, about 2% heavier than fresh water, settles toward the bottom and with repeated injections, forms a layer roughly wedge-shaped lying on the canal bottom. These repeated injections have caused a wedge tip to move upstream as far as five miles during periods of minimal flow.

The detailed record available for May, June, and July of 1974 was analyzed. This record covers an extremely dry period followed by a high rainfall period. During April and the first portion of May, S-79 was closed but releases from Lake Okeechobee were being made to replace lockage, irrigation, and evaporation losses in an attempt to maintain the salinity control stage of 3.0' m.s.l. However, the releases made were insufficient as evidenced by the upstream stage readings. During early May, some reduction in irrigation draw on C-43 was encountered in the western basin and a slight increase in channel storage was noted from an upstream stage of 2.84 feet m.s.l. to the optimum of 3.0 feet m.s.l. on the 12th of May, 1974. The chlorides in the upper level showed a corresponding reduction of 410 mg/l to 293 mg/l (May 1 to May 12, respectively). The discharge was stopped at S-78 and initiated at S-79 to maintain stage since the runoff in the west basin exceeded the withdrawal requirements. This resulted in the continued reduction of chlorides in the upper stratas.

The U.S.G.S. maintains a continuously recording conductivity meter at the east end of the S-79 lock fender which indicates the salinity approximately 15 feet below the water surface. A ratio (bottom and top) between the water plant intake readings (surface) and this meter will approximate 1.25, except during high discharges. On the 26th day of June, releases of approximately 6,000 cfs, which caused this ratio to drop below 1.0 the following day, indicated that the deeper, more saline strata possibly was being flushed into the estuary. By the end of June, both the water plant salinities and those at the lock recorder were below 50 mg/l.

Referring to Figure 4 and the plot of salinities, it can be seen that a base figure of 50 mg/l can be obtained after a violent flushing. If this is considered as nominally a homogeneous mix, as indicated during the July segment, then upon cessation of the discharges, the more saline water would gravi-

tate to the bottom and establish the previously mentioned ratio as higher than one.

Based on an analysis of conditions in 1974, a proposed operation for salinity control upstream of S-79 (at the potable water supply intakes) suggests itself. The basic requirements appear to be: (a) as closely as practicable a sustained rate of flow at S-78 throughout the dry season, and (b) a short-term sustained high rate of flow through S-79 no later than mid-June. The first requirement should tend to regulate the rate of salinity buildup, which will occur due to the lockages. The second requirment will provide not only for flushing of the upper layers but may, as well, flush out a portion of the deeper trapped high salinity waters.

Assume that the month of November is started with the salinity reading at the water plant between the 50 and 70 mg/l level and the reading at the S-79 recorder such that the ratio of bottom to surface ranges between 1.25 and 1.50. With these conditions, water should be released through S-78 to the west basin on a steady basis to provide water for the irrigation, lockages, potable water, and minimum flow releases through S-79. It should be emphasized that these should be steady release rates and not periodic slugging which would cause the lower, higher saline waters to well up to the surface. The approximate requirements are shown in Table 11. At the end of May, or upon the advent of heavy rains, approximately 12,000 acre-feet of water should be released through S-79 for approximately one week. This will generate channel velocities of approximately 0.6 fps. Of this quantity of water, 40% to 50% should pass through S-78. It is anticipated that the draft on Lake Okeechobee should not exceed 0.2 of a foot for reduction of salinity to the 50 to 70 mg/l base. In fact, in many years, as in 1974, regulatory lake stage reduction is required to enter the summer or wet season at a safe level.

Because of the fact that the reach of C-43 upstream of S-79 is designated as Class I waters, it is believed that the District has the responsibility to maintain this quality, particularly with respect to salinity. Accordingly, the water required to maintain this quality becomes a legitimate draft on Lake storage. The establishment and maintenance of minimum flows is one, possibly minor, expression of this responsibility. The other expression of this responsibility is the release of water from the Lake, if necessary, to flush salinities at the end of the dry season or whenever salinities build up to levels exceeding PHS standards. Water supply planning for Lake Okeechobee must include this potential water demand for quality control.

WATER SUPPLY AND WATER USE ACCOUNTING

The objective of any program for water supply and water use accounting is to continuously assess estimated demand against available supply for the purpose of determining whether or not a potential water shortage condition exists and, if so, the magnitude of that shortage and the nature of the water use restrictions to be imposed.

Considering the meteorological and hydrologic characteristics of South Florida, the probability is that water shortage conditions will only occur during the normal dry season and then, in the latter months of that season. This is not to say that the roots of a water shortage condition in the dry season may not lie in conditions which developed in the preceding wet season. It is simply to say that when and if it becomes necessary to apply water use restrictions, it is most likely that such action will occur at some point during the later months of the dry season.

With this in mind, it becomes obvious that water users within the Caloosahatchee Basin should be subject to the same restrictions, in the event of a water shortage, as other users of Lake Okeechobee water since during that period the surface water users in the Basin are completely dependent on Lake Okeechobee storage. It is possible that, through application of somewhat more stringent restrictions in this Basin, the District could encourage or even force a greater use of the water resources available within the Basin itself (i.e., the creation of impoundments, the aquifer systems). This may prove to be a desirable objective and the use of the regulatory authority to achieve this objective may be warranted. However, this would be a major policy decision and it is not believed that the District is prepared to make such a decision at this time; moreover, the need to make this decision now is not apparent. The time to make this decision will be after the potential of Lake Okeechobee is more completely assessed and once the District has:

(a) clearly established the means whereby it will monitor and enforce water use restrictions; and

(b) established the operational means whereby, in the Caloosahatchee Basin, it can regulate releases at S-77 and S-78 consistent with whatever water use restrictions are imposed.

These two items are of critical importance since it is unproductive, and undermines credibility, to establish restrictions (particularly those which will appear inequitable to the user) without the ability to enforce them.

Accordingly, this report recommends the adoption of a water shortage plan for the Caloosahatchee Basin which will be applicable to all users of Lake Okeechobee water.

The water supply and water use accounting method suggested for Lake Okeechobee is that which has been outlined elsewhere("In Depth Report"; "Summary of Water Conditions of South Florida Water Shortage Areas"). The demand curve (remaining demand) used is that for the 1970-71 dry season. The 1973-74 dry season demand data indicate that the 1970-71 curve is still valid as representing a current picture of demand during a severely deficient rainfall condition.

The single remaining demand curve represents the full satisfaction of estimated critical dry season demands on Lake Okeechobee. It is recommended that similar demand curves be plotted for 90%, 80%, and 70% satisfaction of demand. These supply/demand curves are to be maintained either by the Regulation Division or by the Department of Field Services; preferably the latter. The staff of the Resource Planning Department can furnish any information required as to the manner in which these curves are to be constructed.

Water use restrictions are to be applied whenever the Lake Okeechobee available supply curve intersects the remaining demand curve which represents 100% satisfaction of demand. The percentage of reduction to be applied will

be based on an assessment of the rate of storage depletion in relation to the 90%, 80%, or 70% satisfaction curves.

Notification of impending water shortage conditions can, and should, be given prior to the intersection of the supply curve with the demand curve having been reached. A one to two weeks notification would appear to be in order. Here, again, the date of notification can be judged by projecting the time at which the supply curve will intersect the demand curve, using the current rate of storage depletion.

PERMIT CLASSIFICATION

The general system of permit classification adopted for the Lake Istokpoga-Indian Priarie Area and the St.Lucie County Area will be applied to the Caloosahatchee River Basin.

The area to which the permit classification system will apply is that which is generally delineated on Figure 1, with the exception of those areas outside the present boundaries of the District in Charlotte, Lee and Collier Counties. Those areas can be incorporated after July 1, 1975, by amendment to whatever Rules and Regulations may be adopted in this regard.

The recommended system will apply to all users within the boundaries given above. Permits issued to users within these boundaries who withdraw water from C-43, any of its tributaries, or from Lake Okeechobee directly; or who impound diffused surface runoff, will be given the source classsification "S". Permits issued to users who withdraw water from water table aquifers or other aquifers which have substantial hydraulic connection with the surface water system will be given the source classification "G-1".

All other water table aquifer systems will be given the source classification "G-2"; and permits for use of the artesian aquifer system will be given the source classification "G-3".

For purposes of the water shortage plan, and use restrictions imposed thereunder, related to storage availability in Lake Okeechobee, permits having the source classification "S" and "G-1" will be considered as a single source.

The use classifications will be as follows:

1. Domestic
2. Essential Service
3. Public Supply
4. Livestock
5. Agricultural
6. Industrial
7. Mining
8. Recreational

In this basin all of the above uses are either existing or likely to be in existence within the immediately foreseeable future. The extent to which certain of these uses will rely on the surface water and conjunctive groundwater source for their supply is unknown.

The Lake Istokpoga-Indian Prairie report established a rationale both for a generalized use priority and for the application of restrictions in accordance with type of use. That rationale will be followed, insofar as practicable, in the Caloosahatchee Basin.

The use grouping to be used is the same as in the Istokpoga-Indian Prairie case:

1. Domestic and Essential Services
2. Public Water Supply
3. Livestock and Agricultural
4. Industrial and Mining
5. Recreational

It is not foreseen that conditions critical enough to warrant restrictions on uses in group 1 will develop. Accordingly, when it becomes necessary to apply restrictions on the combined "S" and "G-1" source users, permit holders for group 1 uses will be exempt.

Concerning the uses in the other groups it must be initially assumed that when a water shortage in Lake Okeechobee develops and an appropriate percentage of reduction is determined, the reduction percentage applies uniformly to all areas receiving water from the Lake; i.e., the Ag Area, the lower east coast, the area adjacent to St.Lucie Canal, and the Caloosahatchee River Basin. As long as the estimated shortage is on the order of 25% to 35% and the predominant use is either agricultural irrigation or public water supply in all demand areas, then the apportionment of the shortage on the same percentage basis to each of the four demand areas will

not result in any gross inequities in terms of restrictions on individual use categories.

If those two conditions do not obtain, it will then be necessary to consider all four demand areas as a single unit, apportioning the estimated shortage strictly by use category rather than first by area and then, within each area, by use. To illustrate what is involved here the following examples should suffice:

Case 1. At shortages up to 30%, restrictions on agricultural use and public supply are the same. Area A has a demand of 60,000 A.F., all agricultural; Area B has a demand of 40,000 A.F., all public supply. The shortage is 20,000 A.F. (20%). Therefore Area A receives 48,000 A.F., and Area B receives 32,000 A.F.; for a total of 80,000 A.F. (80%). There are no inequities.

Case 2. Area A and B demands and uses the same as in Case 1. The shortage is now 40%, or 40,000 A.F. Applying the shortage uniformly by area first means Area A gets 36,000 A.F., and Area B gets 24,000 A.F. An inequity results: the agricultural users in Area A get more water than they should.

Case 3. At shortages over 30%, only the maximum 30% reduction is placed on public water supplies. Everything else as in Case 2. Shortage is 40,000 A.F. Area B receives 70% of 40,000 A.F., or 28,000 A.F. Remaining shortage of 40,000-12,000 A.F., or 28,000 A.F., is borne by Area A. Area A receives 32,000 A.F., or a 47% reduction.

At present, in all four demand areas involving Lake Okeechobee, agricultural irrigation and public water supply are by far the predominant uses. They are likely to be so for the foreseeable future, with one exception (Project Seminole in Martin County). That one exception can be treated largely outside

this context, however, due to the provision of on-site reserve storage in that installation. Consequently, the adoption on an interim basis of this approach for the Caloosahatchee Basin (and other similar areas) causes no concern with respect to types of use. Therefore, the only concern arises in the event an estimated shortage of available storage in Lake Okeechobee in excess of 25%-35% arises.

It is recommended that for estimated shortages up to 25%, that group 2 and group 3 restrictions be the same and that group 4 restrictions be 5 percentage points higher and group 5 restrictions 15 percentage points higher. The formula to be applied will be of the form outlined under item 1 on page 33 of the "Report on Surface Water Availability in the Lake Istokpoga-Indian Prairie Area."

For shortages between 25% and 35% the formula of item 2, page 34 of the Istokpoga-Indian Prairie report, should be used; with restrictions for group 5 uses equivalently higher.

It is recommended that no specific formula for estimated shortages above 35% be established. This hopefully rare condition should be left to an administrative determination by the Executive Director, approved by the Board, based on conditions at the time.

AGENCY COOPERATION FOR SYSTEM OPERATION

The Caloosahatchee River Basin represents a somewhat unique situation for the FCD in connection with its water management responsibilities under Chapter 373. The Corps of Engineers operates and maintains C-43 and the three structures thereon (S-77, S-78, and S-79) as well as certain of the "Lake Structures". The FCD has the responsibility for water allocations and withdrawals from the river and from Lake Okeechobee while the Corps of Engineers has the responsibility for operation, maintenance, navigation and flood control. With this division of responsibilities and the complexities of evaluation of the many parameters involved with proper total water management, the need for smooth coordination not only between these two prime agencies, but also the U. S. Geological Survey, U. S. Weather Bureau, and other specialized agencies and local authorities, becomes obvious.

There are two specific areas, touched on in the preceding sections of this report, which require attention in terms of interagency coordination, and in particular with the Corps of Engineers. These are:

1. The maintenance of minimum flows at S-79 and the maintenance of flows at S-78, both for the purpose of controlling elevated salinities above S-79; and the provision of flushing flows at S-79 at the end of the dry season; and

2. The procurement and reporting of discharges at S-77, S-78, and S-79, the lockages at S-79, and the upstream stage at S-79 on a timely basis so that a program for physically adjusting releases from the Lake consistent with water use restrictions can be devised.

It is suggested that the necessary liaison in these two areas be the responsibility of the Department of Field Services, together with the responsibility for developing a coordinated operating program with the Corps of Engineers.

In order for an operating procedure under item 2 to be effective, the Regulation Division will have to procure and maintain accurate records as to location of irrigated areas, land use (crops), and actual water use.

It is anticipated that the Corps of Engineers would supply to the FCD rainfall, gate positions, stages and lockages; the U. S. Geological Survey salinities; Lee County salinities at their intake and quantity of water withdrawn and delivered to the mains; City of Ft. Myers quantity of water withdrawn from C-43 and well fields; and quantity of water to distribution mains; U. S. Weather Bureau rainfall, and other agencies and local authorities other data which may be found necessary. The FCD would receive this information and data collected by their field personnel and process all through computer programs to establish the system status and recommended changes and settings to establish the appropriate "safe" conditions. This information would thence be relayed to the Corps of Engineers and other entities as might be timely and/or as agreed upon. If upon receiving the recommendation, the Corps of Engineers concur, they would then institute the appropriate action. The FCD will also take any action that is required on its part.

As can be seen from the large quantity of data to be processed, accurate and timely data reporting is a necessity for proper evaluation and action within the short time frame required. This time frame should consist of the data being received at the FCD processing location by 9:00 to 9:30 in the morning with the appropriate actions being taken by at least 1:00 P.M. This is a very tight schedule which will be especially difficult to meet during the "shake-down" period. In the future, with the advent of a loop covering this area appended to the as yet uncompleted communication and control system, this total water management concept will become more accurate, more rapid, and less costly.

RECOMMENDATIONS

The following recommendations are made:

1. That the District adopt and publish by the appropriate and necessary means the values for:

   (a) Maintenance of minimum flows to the Caloosahatchee estuary at S-79 (see pages 22 and 24).

   (b) Minimum stage in the reach of C-43 upstream of S-79 (see page 25).

2. That the District establish by the appropriate and necessary means those stages in Lake Okeechobee, for the months of November through May only, at which the application of water use restrictions by the Board will be considered (see page 17).

3. That releases from Lake Okeechobee to meet minimum flow requirements at S-79 be terminated at any time Lake stage in the pertinent month reaches the elevations set forth in item 2, above.

4. That new surface water allocations in the basin be made using the maximum values given in this report as a guide (see Table 10).

5. That consideration be given to applying the allocation values of Table 10 to existing permits to be converted; the final decision here to be made by the Executive Director upon the recommendation of the Regulation Division.

6. That the potential for conjunctive use of groundwater from the water table aquifers and surface water be taken into account in considering applications for shallow groundwater use in the basin (see page 19).

7. That an administrative procedure be adopted by the Regulation Division for the notification of impoundment permittees of the availability of surplus water for replenishment of depleted storage (see page 18).

8. That the Department of Field Services (or the Regulation Division) maintain a supply-demand accounting procedure for the purpose of providing notice to permittees of an impending or existing water shortage in the basin (see page 33).

9. That, based on the above accounting procedure, the appropriate staff group within the District determine the extent of the water deficiency and the percentage of total use restriction required (see page 32).

10. That a permit classification system and water shortage plan for the Caloosahatchee Basin be established (see page 34).

11. That all permittees, both old and new, be required to submit monthly reports of water usage in a form satisfactory to the District.

12. That all water use permits in the basin, both old and new, be re-evaluated as a unit at the same time, and no later than mid-1977.

13. That the District accept as a matter of policy the obligation for maintaining Class I water quality with respect to chloride concentration in the reach of C-43 upstream of S-79 (see page 26).

14. That the Department of Field Services establish coordination with the Corps of Engineers, and other agencies, for the purpose of developing and implementing programs for:

(a) salinity control upstream of S-79; and

(b) system operations for regulation of water use in the basin.

(see page 38).

15. That the Regulation Division, with the assistance of the Resource Planning Department as necessary, develop and institute a program for agricultural land use and water use accounting in the basin (see page 39).

16. That the following further studies be undertaken by the Resource Planning Department:

(a) investigation of the hydraulic relationships between the shallow aquifer systems and the surface water system.

(b) characteristics of the Floridan Aquifer, including its use potential, in the basin.

(c) alternative means for salinity control above S-79.

(d) rating of S-78, and determination of the yield of the East Basin.

(e) investigation of the estuarine environment downstream of S-79 in relation to fresh water flows at S-79.

LAND USE IN ACRES

YEAR	URBAN	PASTURE	IMPROVED PASTURE	TRUCK	CITRUS	NATURAL FOREST	NATURAL NON FOREST	SUGAR CANE
			West Basin Total Acreage 380,080					
1957	1,020	316,130	---	880	3,450	26,130	32,470	---
1972	25,810	219,070	58,750	4,870	21,850	24,110	25,430	190
			East Basin Total Acreage 238,290					
1957	410	159,640	---	2,810	100	34,980	40,350	---
1972	1,700	64,160	88,630	1,720	7,050	35,580	33,420	6,030
			Total Basin Acreage 618,370					
1957	1,400	475,770	---	3,690	3,550	61,110	72,820	---
1972	27,510	283,230	147,380	6,590	28,900	59,690	58,850	6,220

TABLE 1

DISCHARGE, C-43 AT MOORE HAVEN, (S-77) IN CFS DAYS

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1964	310	290	660	5,130	3,760	300	310	310	58,490	13,400	1,680	2,980
1965	3,320	280	310	20,310	3,070	1,040	2,760	44,520	300	310	300	310
1966	310	280	57,750	106,110	56,680	82,740	89,330	97,680	17,350	56,830	26,990	4,04[illegible]
1967	1,195	570	4,314	14,620	9,505	150	155	155	150	155	4,298	1,93[illegible]
1968	3,245	3,582	3,899	11,321	2,280	53,845	109,950	94,890	591	513	150	3,887
1969	155	612	81,900	59,845	56,220	56,719	22,335	73,195	150	132,032	161,820	120,229
1970	179,840	121,268	114,225	222,740	40,723	117,245	107,825	37,470	862	1,113	3,748	5,923
1971	4,155	3,437	10,187	15,565	6,014	-1,729	-3,915	-5,586	150	155	1,257	3,[illegible]
1972	4,364	2,572	6,263	6,587	5,953	8,124	8,332	1,793	976	5,084[a]	4,240[a]	992[a]
1973	1,475[a]	140[a]	1,523[a]	4,615[a]	6,103[a]	150[a]	155[a]	155[a]	155[a]	887[a]	3,277[a]	2,438[a]
1974	2,083[a]	5,232[a]	10,042[b]	13,129[a]	9,848[b]	-6,198[b]						

TABLE 2a

NOTE: Records by U.S.G.S. unless otherwise noted. Minus indicates discharge into lake

[a]U.S.G.S. Provisional Data plus 5 cfs day per day estimated for seepage and lockages

[b]Corps of Engineers data plus 5 cfs day per day estimated for seepage and lockages.

DISCHARGE, C-43 AT S-79 IN CFS DAYS

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1964											14,597[b]	10,672[b]
1965	3,690[a]	2,322[a]	31,078[b]	9,078[a]	310[a]	67,289[b]	69,068[b]	60,239[a]	39,029[a]	59,934[a]	17,797[a]	6,[illegible]
1966	15,321[a]	19,911[a]	77,458[a]	155,964[a]	69,480	145,600	174,720	196,840	131,120	91,560	22,266	3,616
1967	3,764	5,539	2,730	300	310	38,998	66,505	53,134	23,937	43,756	3,274	310
1968	1,183	1,703	1,311	300	16,971	168,646	222,250	143,559	32,194	41,732	27,035	14,[illegible]5
1969	6,552	4,430	141,301	63,167	81,653	150,254	66,503	128,758	43,946	209,920	206,070	148,447
1970	232,070	146,871	273,685	239,090	48,798	161,130	156,542	57,576	18,718	14,243	2,952	310
1971	781	1,697	1,740	300	3,508	8,212	30,772	33,608	72,327	38,259	10,714	2,6[illegible]
1972	954	3,168	1,036	3,556	1,752	43,737	16,935	7,071	11,097	2,627[a]	11,056[a]	6,04[illegible]
1973	6,904[a]	16,565[a]	12,249[a]	4,023[a]	310[a]	16,435[a]	50,990[a]	78,640[a]	78,090[a]	27,320[a]	995[a]	3,360[a]
1974	670[a]	690[a]	310[a]	550[a]	5,771[a]	62,132[a]						

NOTE: Records by U.S.G.S. unless otherwise noted; includes 10 cfs-day per day estimated for seepage and lockages

[a]Estimated from Corps of Engineers data

[b]Estimated from rainfall-flow relationship

TABLE 2b

S-77 REGULATORY DISCHARGE IN ACRE-FEET

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1964											0	0
1965	0	0	0	40,005	0	0	48,999	88,222	0	0	0	0
1966	0	0	114,225	210,320	112,419	164,107	193,739	193,739	33,916	111,229	53,353	0
1967	0	0	0	28,878	18,565	0	0	0	0	0	0	0
1968	0	0	0	27,668	0	130,904	300,198	257,207	0	0	0	0
1969	0	0	222,240	118,706	101,826	109,148	32,522	137,817	0	250,117	320,543	241,610
1970	358,143	240,483	226,475	441,783	81,905	232,490	201,960	66,146	0	0	0	0
1971	0	0	0	0	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	15,074	9,024	0	0	0	0	0
1973	0	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0						

TABLE 3a

C-43 NET CHANNEL DISCHARGE OUT
CFS-DAYS

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
1964											12,917	7,692
1965	370	2,042	30,768	-11,232	-3,450	66,249	66,308	15,719	38,729	59,624	17,497	6,548
1966	15,011	19,631	19,708	49,854	12,800	62,860	85,390	99,160	113,770	34,730	-4,724	-429
1967	2,569	4,969	-1,584	-14,320	-9,195	38,848	66,350	52,979	23,787	43,601	-1,024	-1,620
1968	-2,062	-1,879	-2,588	-11,021	14,691	114,801	112,300	48,669	31,603	41,219	26,885	10,958
1969	6,397	3,818	59,401	3,322	25,433	93,535	44,168	55,563	43,796	77,888	44,250	28,218
1970	52,230	25,603	159,460	16,350	8,075	43,885	48,717	20,106	17,856	13,130	-796	-5,613
1971	-3,374	-1,740	-8,447	-15,265	-2,506	9,941	34,687	39,194	72,177	38,104	9,457	-632
1972	-3.410	596	-5,227	-3,031	-4,201	35,613	8,603	5,278	10,121	-2,457	6,816	5,048
1973	5,429	16,425	10,726	-592	-5,793	16,285	50,835	78,485	77,935	26,433	-2,282	922
1974	-1,413	-4,542	-9,732	-12,579	-4,077	68,330						

Calculated as the flow through S-79 minus flow through S-77

TABLE 3b

WEIGHTED AREA PRECIPITATION CALOOSAHATCHEE AREA (INCHES)

WEST BASIN BETWEEN S-79 and S-78

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR
1964	2.85	5.20	1.17	2.15	2.03	9.38	6.65	10.86	5.07	1.65	.60	1.08	48.67
1965	.82	3.25	4.02	3.73	1.84	13.95	9.95	8.39	7.03	6.25	.34	1.31	60.88
1966	3.50	2.73	1.05	3.42	6.00	12.32	7.04	8.48	11.38	2.92	.21	1.22	60.26
1967	2.22	3.36	.28	.08	1.74	12.14	8.20	9.23	5.92	4.44	.67	2.44	50.71
1968	.25	1.98	1.58	.50	10.86	14.62	12.48	6.32	4.39	6.21	3.31	.25	62.75
1969	1.99	2.48	7.56	1.51	4.83	11.53	5.93	9.63	9.09	8.70	.69	4.28	68.23
1970	5.44	2.80	15.00	.63	6.62	5.66	8.22	7.05	5.34	2.37	.36	.53	60.03
1971	.59	1.92	.51	.91	6.59	12.33	8.08	9.21	7.54	6.09	.90	.78	55.44
1972	.97	2.59	1.92	2.94	2.14	11.70	5.21	7.68	4.52	1.67	5.68	1.55	48.56
1973	3.92	2.86	4.69	1.57	1.96	6.24	13.45	9.81	6.17	1.60	1.02	1.85	55.16
1974*	.02	.90	.23	.79	3.89	13.48							

EAST BASIN BETWEEN S-78 and S-77

1964	2.56	4.17	1.09	1.15	2.35	7.19	5.55	8.67	4.53	2.33	.42	.68	40.69
1965	.62	3.92	3.27	1.92	2.00	14.03	8.28	6.46	4.64	6.91	.61	1.48	54.13
1966	3.40	2.82	.54	3.00	5.07	9.72	8.03	9.46	8.02	2.43	.13	.67	53.28
1967	1.25	2.55	.23	.08	1.92	11.93	6.74	6.46	5.55	3.85	.19	2.23	42.97
1968	.41	1.69	1.17	.49	9.47	11.34	9.19	5.47	4.78	5.19	2.73	.22	52.16
1969	1.76	2.04	6.54	.86	5.82	11.88	5.59	7.85	7.26	9.28	.89	3.68	63.46
1970	3.84	2.53	13.91	.07	4.42	7.57	7.62	6.54	4.37	2.31	.26	.33	53.78
1971	.31	1.02	.47	.25	3.57	9.63	7.50	7.58	6.10	4.39	1.71	.65	43.20
1972	.44	1.89	1.53	1.99	3.53	9.93	4.96	5.35	1.66	.86	3.82	1.37	37.33
1973	3.29	2.78	3.69	1.03	3.85	8.38	9.22	8.43	6.54	2.22	.08	1.85	51.36
1974*	.09	1.15	.08	1.24	3.72	14.60							

TABLE 4

* Only Rainfall Records at S-77, S-78 and S-79 are available; therefore, different weighing factors were used

MOORE HAVEN LOCK PAN EVAPORATION IN INCHES

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1964	2.46	4.08	5.76	6.80	7.59	6.53	7.36	6.58	6.84	4.56	3.75	3.23	65.54
1965	3.48	4.17	5.90	7.70	9.46	8.18	7.12	7.47	6.80	5.13	4.41	3.26	73.08
1966	3.12	3.90	6.25	8.17	8.39	8.14	6.38	7.34	6.07	5.82	4.77	3.60	71.95
1967	4.01	4.03	6.71	8.72	9.77	7.38	8.11	7.09	6.68	6.45	4.58	3.81	77.34
1968	3.73	4.03	7.05	7.54	7.69	7.07	8.13	8.06	7.08	6.46	4.51	3.66	75.01
1969	3.93	4.57	5.33	7.46	8.95	7.90	7.79	8.10	6.00	5.98	4.11	3.62	73.74
1970	3.20	4.29	6.02	8.42	9.32	8.91	8.03	8.44	7.91	7.36	4.44	3.91	80.25
1971	3.82	4.89	7.24	8.15	9.42	8.12	7.74	7.37	6.39	5.27	4.81	4.26	77.48
1972	3.90	4.43	6.89	7.73	8.61	7.82	8.85	7.30	7.52	6.88	3.76	4.01	77.70
1973	3.49	3.71	6.75	8.40	9.06	8.13	6.74	6.63	6.22	7.41	5.00	3.54	75.08
1974	4.27	5.14	7.84	8.79									

TABLE 5

CROP EVAPOTRANSPIRATION REQUIREMENTS IN INCHES

YEAR	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY
			IMPROVED PASTURE				
1964-1965	2.12	1.96	1.69	2.35	3.44	4.26	4.80
1965-1966	2.07	1.77	1.55	2.09	3.00	3.77	5.13
1966-1967	1.87	1.60	1.89	2.03	3.42	4.02	5.13
1967-1968	1.95	1.98	1.69	1.73	2.76	4.19	5.09
1968-1969	1.78	1.58	1.68	1.85	2.67	4.17	4.73
1969-1970	1.76	1.52	1.43	1.78	3.12	4.27	4.62
1970-1971	1.70	1.74	1.72	2.18	3.00	3.67	4.94
1971-1972	2.04	2.19	2.14	2.17	3.32	4.02	4.94
1972-1973	2.07	1.90	1.74	1.74	3.45	3.74	4.93
1973-1974	2.23	1.59	1.93	2.03	3.18	4.01	5.09
			TRUCK CROPS				
1964-1965	1.73	2.88	2.76	3.32	4.34	4.71	3.72
1965-1966	1.70	2.23	2.53	2.95	3.78	4.16	3.98
1966-1967	1.53	2.01	3.06	2.87	4.32	4.44	3.98
1967-1968	1.60	2.50	2.76	2.45	3.49	4.62	3.95
1968-1969	1.46	2.00	2.74	2.62	3.36	4.61	3.67
1969-1970	1.44	1.92	2.33	2.52	3.93	4.71	3.58
1970-1971	1.39	2.19	2.80	3.08	3.78	4.06	3.83
1971-1972	1.76	2.76	3.50	3.06	4.19	4.44	3.83
1972-1973	1.79	2.40	2.83	2.46	4.35	4.13	3.83
1973-1974	1.93	2.01	3.15	2.87	4.01	4.43	3.84
			CITRUS				
	2.40	2.10	2.00	1.90	2.60	2.90	3.80
			SUGAR CANE				
1964-1965	2.63	2.26	2.44	2.92	4.13	5.39	6.62
1965-1966	3.09	2.28	2.18	2.73	4.38	5.72	5.87
1966-1967	3.34	2.52	2.81	2.82	4.70	6.10	6.84
1967-1968	3.21	2.67	2.61	2.82	4.94	5.28	5.38
1968-1969	3.16	2.56	2.75	3.20	3.73	5.22	6.27
1969-1970	2.88	2.53	2.24	3.00	4.21	5.89	6.52
1970-1971	3.11	2.74	2.67	3.42	5.07	5.71	6.59
1971-1972	3.37	2.98	2.73	3.10	4.82	5.41	6.03
1972-1973	2.63	2.81	2.44	2.60	4.73	5.88	6.34
1973-1974	3.50	2.48	2.46	2.95	4.47	5.54	6.18

TABLE 6

C-43 SUPPLEMENTAL WATER REQUIREMENT IN ACRE-FEET

YEAR	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	TOTAL IRRIG. REQ'D
				WEST BASIN				
1964-1965	5,496	3,382	3,523	---	---	1,268	9,830	23,500
1965-1966	7,155	2,186	---	---	5,406	1,153	---	15,900
1966-1967	7,880	2,258	---	---	13,679	17,000	14,078	54,895
1967-1968	6,619	---	7,452	---	6,110	16,802	---	36,983
1968-1969	---	7,783	---	---	---	13,380	---	21,163
1969-1970	6,881	---	---	---	---	20,239	---	27,120
1970-1971	9,227	8,167	7,731	2,182	15,711	16,957	---	59,975
1971-1972	8,224	9,628	8,157	---	9,160	6,486	17,518	59,173
1972-1973	---	3,069	---	---	---	15,204	19,987	38,260
1973-1974	9,639	---	15,180	9,032	22,391	23,833	7,590	87,665
				EAST BASIN				
1964-1965	7,223	5,646	4,982	---	415	9,008	10,918	38,192
1965-1966	7,206	1,790	---	---	11,680	3,344	---	24,020
1966-1967	9,798	5,584	3,898	---	16,542	20,229	15,804	71,855
1967-1968	11,128	---	8,448	1,049	10,080	21,208	---	51,193
1968-1969	---	9,513	319	---	---	20,176	---	30,008
1969-1970	6,874	---	---	---	---	28,188	625	35,687
1970-1971	11,852	11,327	11,402	8,927	19,203	25,354	9,077	97,142
1971-1972	3,385	12,654	14,104	2,418	14,185	15,475	9,913	72,134
1972-1973	---	5,257	---	---	---	23,011	7,842	36,110
1973-1974	20,278	---	17,709	8,625	28,628	19,728	10,376	105,704

TABLE 7a

C-43 SUPPLEMENTAL WATER REQUIREMENT
IN INCHES

YEAR	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	TOTAL
1964-1965	1.66	1.18	1.11	0.00	0.05	1.34	2.70	8.04
1965-1966	1.65	0.46	0.00	0.00	1.97	0.52	0.00	4.60
1966-1967	1.82	0.81	0.40	0.00	3.12	3.84	3.08	13.07
1967-1968	1.66	0.00	1.49	0.10	1.51	3.55	0.00	8.24
1968-1969	0.00	1.48	0.03	0	0	2.86	0	4.37
1969-1970	1.08	0	0	0	0	3.81	0.05	4.94
1970-1971	1.53	1.42	1.39	0.81	2.54	3.08	0.66	11.44
1971-1972	0.79	1.51	1.51	0.16	1.58	1.49	1.86	8.90
1972-1973	0	0.53	0	0	0	2.43	1.77	4.72
1973-1974	1.78	0	1.96	1.05	3.04	2.60	1.07	11.53

Table 7b

C-43 ESTIMATED IRRIGATION WATER APPLIED
CFS-DAYS

SEASON	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	TOTAL	IRRIGATED AREA (ACRES)	IMPROVED PASTURE AREA (ACRES)
1964-1965	4,070	2,940	2,860	0	210	2,850	6,330	19,160	92,100	68,800
1965-1966	4,640	1,420	0	0	4,900	1,270	0	12,230	104,200	78,600
1966-1967	5,750	2,640	1,500	0	9,370	11,470	8,990	39,720	116,300	88,400
1967-1968	5,680	0	5,240	530	5,130	11,520	0	28,100	125,500	98,200
1968-1969	0	5,670	160	0	0	10,010	0	15,841	140,600	108,100
1969-1970	4,590	0	0	0	0	14,590	310	19,490	152,800	117,900
1970-1971	6,880	6,270	6,170	3,040	9,490	12,880	4,560	49,290	164,800	127,700
1971-1972	3,970	6,950	6,930	1,220	7,060	6,310	7,120	39,560	177,000	137,600
1972-1973	0	2,780	0	0	0	11,560	8,370	22,710	189,000	147,400
1973-1974	9,240	0	10,430	5,680	15,710	12,240	4,770	58,070	201,100	157,200

TABLE 7c

C-43 ESTIMATED IRRIGATION WATER APPLIED
INCHES

SEASON	NOV.	DEC.	JAN.	FEB.	MARCH	APRIL	MAY	TOTAL
1964-1965	1.05	0.76	0.74	0	0.05	0.74	1.63	4.94
1965-1966	1.06	0.32	0	0	1.12	0.29	0	2.79
1966-1967	1.17	0.54	0.31	0	1.91	2.34	1.84	8.11
1967-1968	1.08	0	0.99	0,10	0.95	2.13	0	5.32
1968-1969	0	0.96	0.03	0	0	1.69	0	2.68
1969-1970	0.71	0	0	0	0	2.27	0.05	3.03
1970-1971	0.99	0.90	0.89	0.44	1.37	1.86	0.66	7.11
1971-1972	0.53	0.93	0.93	0.16	0.95	0.85	0.96	5.31
1972-1973	0	0.35	0	0	0	1.45	1.05	2.85
1973-1974	1.09	0	1.23	0.67	1.86	1.45	0.56	6.86

TABLE 7d

C-43 BASIN YIELD IN INCHES

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL
1964											0.65	0.41	
1965	0.12	0.08	1.19	0	0.11	2.55	2.55	0.60	1.49	2.29	0.85	0.31	12.14
1966	0.58	0.75	0.95	1.96	0.49	2.42	3.28	3.81	4.37	1.33	0.04	0.08	20.06
1967	0.16	0.19	0.30	0	0	1.49	2.55	2.04	0.91	1.67	0.18	0	9.49
1968	0.12	0	0.10	.02	0.56	4.41	4.31	1.87	1.21	1.58	1.03	0.64	15.87
1969	0.25	0.15	2.28	0.51	0.98	3.59	1.70	2.13	1.68	2.99	1.88	1.08	19.22
1970	2.01	0.98	6.13	1.19	0.32	1.69	1.87	0.77	0.69	0.50	0.23	0.03	16.41
1971	0.11	0.05	0.04	0	0.08	0.38	1.33	1.51	2.77	1.46	0.52	0.24	8.49
1972	0.14	0.02	0.07	0.13	0.11	1.37	0.33	0.20	0.39	0	0.26	0.30	3.32
1973	0.21	0.63	0.41	0.42	0.10	0.63	1.95	3.02	2.99	1.02	0.21	0.04	11.69
1974	0.35	0.04	0.23	0	0.03	2.63							

TABLE 8

C-43
BASIN YIELD RESERVATION FOR CONTINGENT USES - INCHES

JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
0.03	0.03	0.02	0.01	0.01	0.42	0.50	0.23	0.40	0.25	0.08	0.03

Based on one-in-ten year probability of a lower basin yield.

C-43
ADJUSTED BASIN YIELD - INCHES

JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
0.14	0.14	0.32	0.10	0.10	1.58	1.60	1.42	1.17	1.10	0.30	0.14

TABLE 9

MAXIMUM PERMISSIBLE ALLOCATION
FOR AGRICULTURAL USE IN
THE C-43 BASIN (INCHES)

MONTH	ADJUSTED BASIN YIELD	FROM LAKE STORAGE	MAXIMUM ALLOCATION
JANUARY	0.14	1.4	1.5
FEBRUARY	0.14	0.8	0.9
MARCH	0.32	2.5	2.8
APRIL	0.10	3.6	3.7
MAY	0.10	2.9	3.0
JUNE	1.58		1.6
JULY	1.60		1.6
AUGUST	1.42		1.4
SEPTEMBER	1.17		1.2
OCTOBER	1.10		1.1
NOVEMBER	0.30	1.2	1.5
DECEMBER	0.14	1.4	1.5
TOTAL YEAR	8.0	13.8	21.8
TOTAL DRY SEASON	1.1	13.8	14.9

TABLE 10

WATER REQUIREMENTS FOR WEST BASIN

MONTH	IRRIGATION(1) ACRE-FEET	LOCKAGE (2) ACRE-FEET	ACRE-FEET POTABLE WATER (3) LEE CO.(4)	FT. MYERS(5)	MINIMUM FLOW THRU S-79 ACRE-FEET
NOV.	14,800	790	750	290	1,000
DEC.	12,200	760	770	300	600
JAN.	14,300	830	770	300	1,600
FEB.	4,000	810	700	280	2,100
MARCH	22,900	960	770	300	1,000
APRIL	35,000	900	740	300	0
MAY	22,800	810	770	300	300

NOTES: (1) Irrigation requirements for one-in-five year drought (estimated)

(2) Projected requirements for lockages in 1983

(3) Potable water requirements as obtained from the Water Supply Studies for the City of Ft. Myers by Black, Crow,& Eidsness, Inc. (Year 1985 Projection).

(4) Requirements have been increased 25% from daily average for seasonal population influx.

(5) Supplemental river water required for Ft. Myers. Requirement less 4 mgd firm dry condition well field yield.

TABLE 11

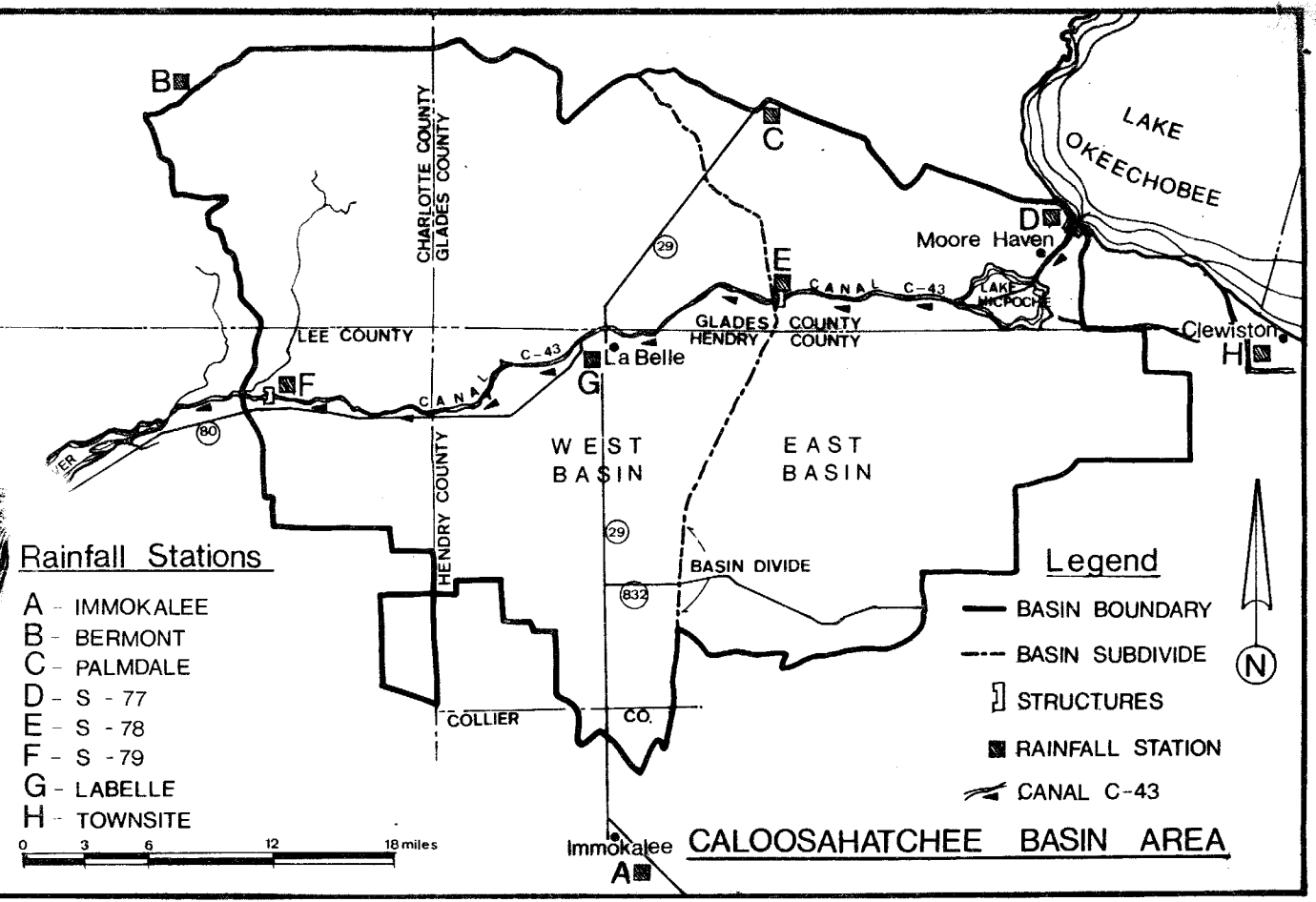
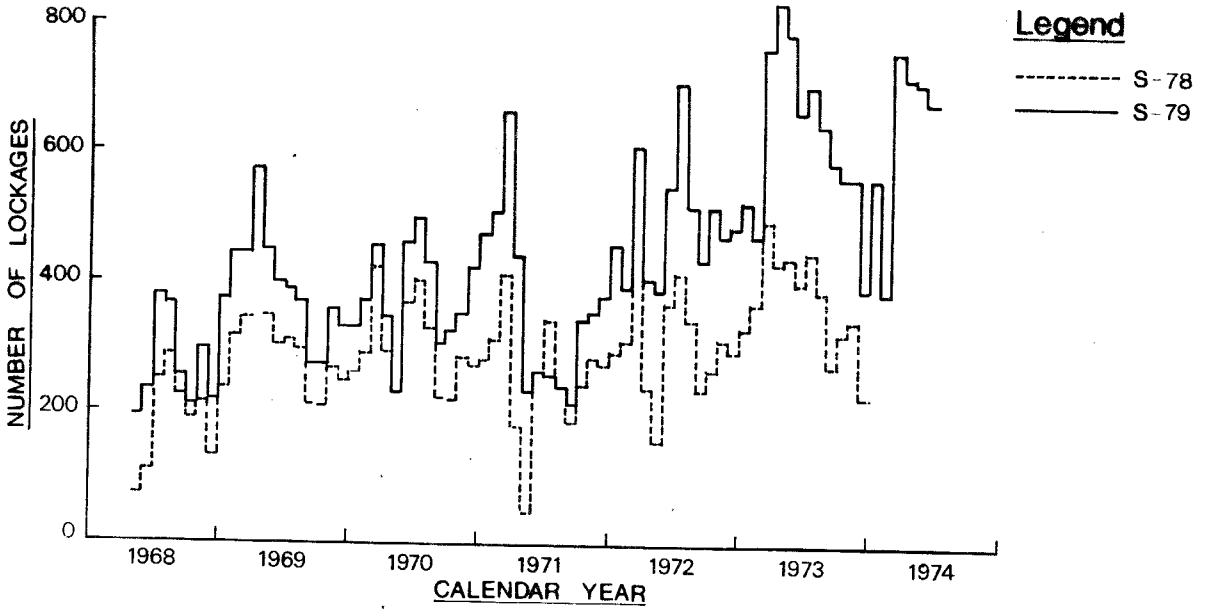
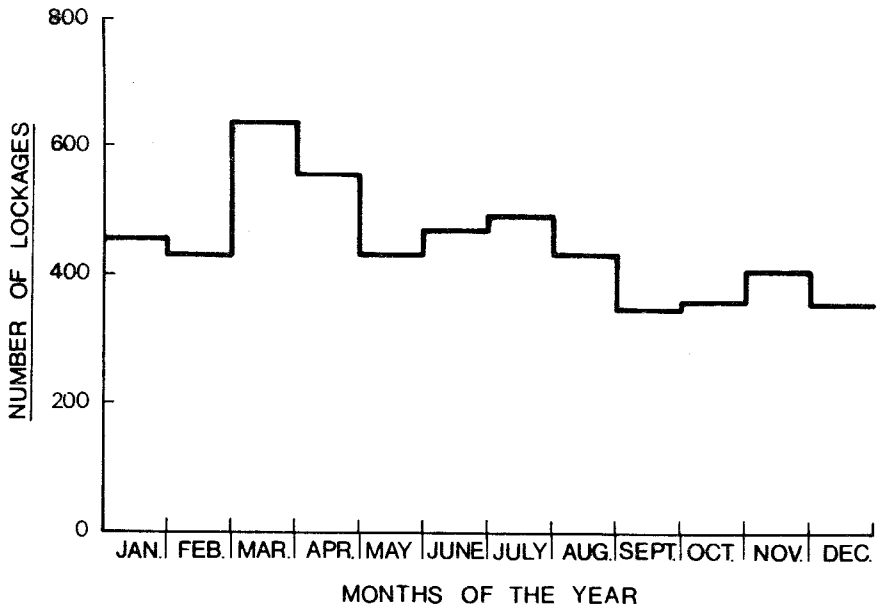

B
C
D
Moore Haven
E
F
G
La Belle
H
Clewiston
LAKE OKEECHOBEE
CHARLOTTE COUNTY
GLADES COUNTY
HENDRY COUNTY
LEE COUNTY
GLADES COUNTY
HENDRY COUNTY
CANAL C-43
LAKE HICPOCHEE
29
80
832
WEST BASIN
EAST BASIN
BASIN DIVIDE
COLLIER CO.
Immokalee
A
Rainfall Stations
A - IMMOKALEE
B - BERMONT
C - PALMDALE
D - S - 77
E - S - 78
F - S - 79
G - LABELLE
H - TOWNSITE
0 3 6 12 18 miles
Legend
BASIN BOUNDARY
BASIN SUBDIVIDE
STRUCTURES
RAINFALL STATION
CANAL C-43
N
CALOOSAHATCHEE BASIN AREA

FIGURE 1



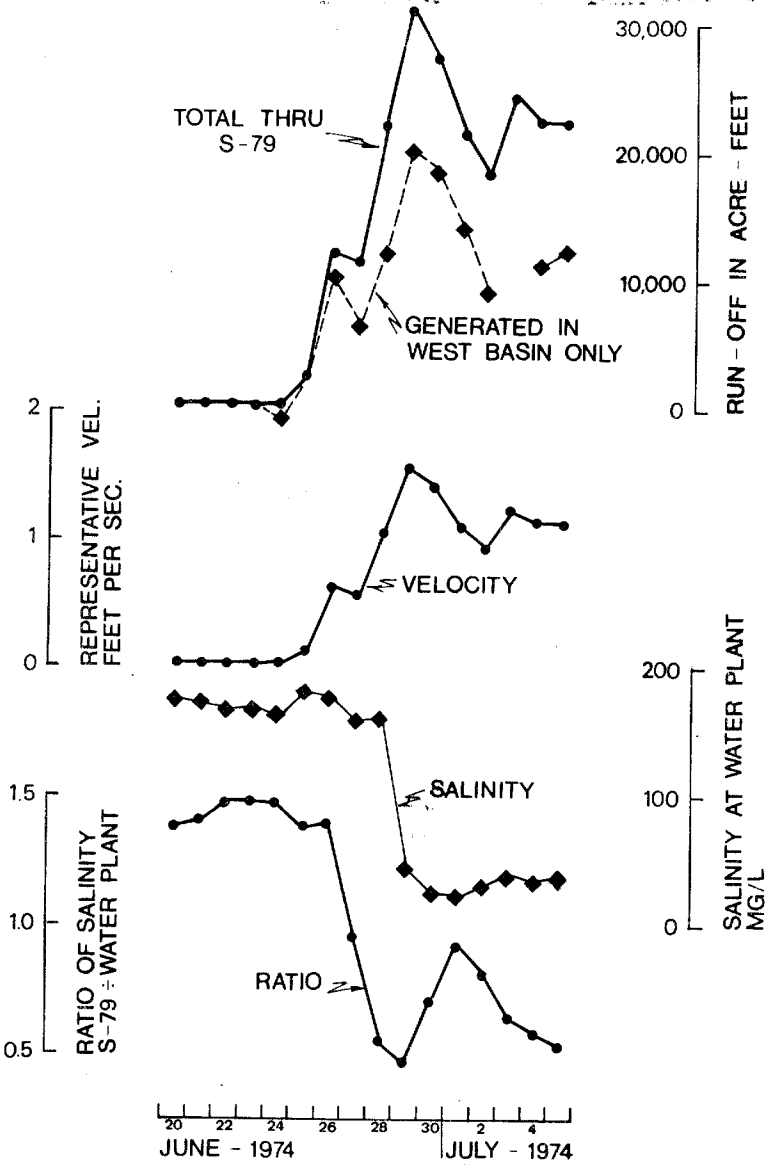
TOTAL MONTHLY LOCKAGES: S-78 AND S-79

FIGURE 2



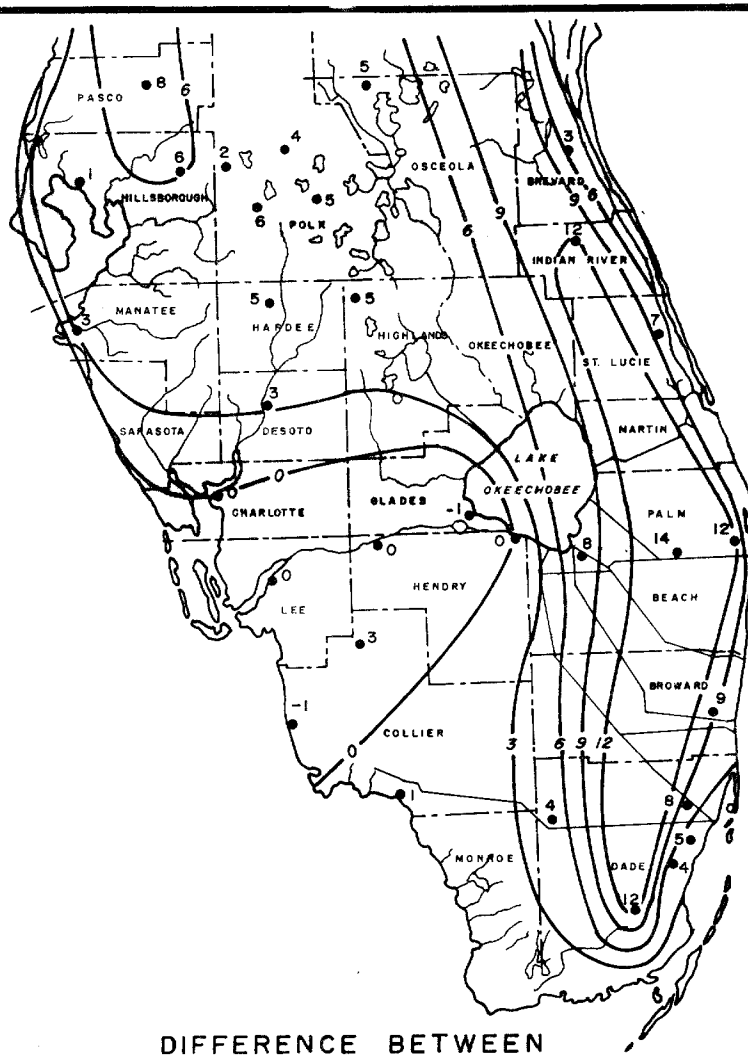
AVERAGE MONTHLY LOCKAGES AT S-79

FIGURE 3



SALINITY PARAMETERS

FIGURE 4



DIFFERENCE BETWEEN
YEARLY RAINFALL AND POTENTIAL
LAKE EVAPORATION IN INCHES
FROM
MAP SERIES No. 32
U.S. GEOLOGICAL SURVEY
AUGUST 1969

FIGURE 5