DRE 146

EXECUTIVE SUMMARY

WATER QUALITY MANAGEMENT STRATEGY
FOR LAKE OKEECHOBEE

PREPARED BY
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

REVISED MARCH 1983

APPROVED BY GOVERNING BOARD
MARCH 11, 1983

ABSTRACT

In the Executive Summary, Water Quality Management Strategy for Lake Okeechobee, December 1981, a wide range of alternatives for reducing nutrient loading to Lake Okeechobee from its drainage basins were evaluated. These included regional and sub-regional storage, on-site storage and other Best Management Practices (BMPs), conventional and advanced (reverse osmosis) treatment plants, and diversions to other receiving waters. Based on an analysis of costs, nutrient removal effectiveness, and impacts on water resources and other factors, the Taylor Creek/Nubbin Slough Basin (S-191) and the S-2 and S-3 basins in the Everglades Agricultural Area (EAA) were targeted for immediate action under the initial phase of the strategy. The preferred alternative proposed for the Taylor Creek/Nubbin Slough basin was on-site management through the implementation of best management practices (BMPs). In the EAA, regional storage of runoff diverted from the S-2 and S-3 basins to the Holeyland tract, with water recycling capability, was the preferred alternative.

The Strategy was accepted by the Governing Board in December 1981 and submitted to DER for review and approval. After an extensive review by some 30 plus agencies and groups over an approximate six-month period, the DER issued a six-month extension to the TOP (until January 10, 1983) in July 1982 in order to address concerns of the state. These concerns were enumerated in a letter from DER to the District dated June 15, 1982 in which the Department indicated the Strategy was conceptually favorable.

To address these concerns, the District prepared two reports: (1) "Taylor Creek Headwaters Project Phase 1 Report; Water Quality", and (2) "Water Quality Management Plan for S-2 and S-3 Drainage Basins in the Everglades Agricultural Area." An "Executive Summary Addendum" summarizing the conclusions and recommendations of these reports was prepared, and was presented and approved at the November 9 and 10, 1982 Governing Board meetings. The documents were subsequently transmitted to DER for review and approval. Since major policy issues are involved, DER has extended the expiration date of the Lake Okeechobee TOP to May 15, 1983 in order to allow time for the Governor and Cabinet to consider the land use and land exchange issues pertaining to the Holeyland and Rotenberger project proposals. Further, there were several requests for a cost-benefit study of the proposed plan. These issues were discussed at the January 7, 1983 Governing Board meeting, and the staff was instructed to prepare this revised Executive Summary of the strategy to clarify the reasons for the preferred course of action.

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I. INTRODUCTION

A. General Overview

This report provides a summary of the District's efforts to develop a water quality management strategy for Lake Okeechobee. The strategy calls for reducing phosphorous and nitrogen inputs to Lake Okeechobee. Both short-term actions, such as a modified pumping schedule for the EAA, and long-term solutions requiring considerable implementation time, are proposed. Due to the magnitude of the proposed plan of action, extensive public and private coordination and cooperation will be essential to its implementation.

B. Goals and Guidelines

Water quantity impacts on the water resources within the District are at least as important as water quality impacts. The primary goals of the District have historically been to minimize flooding during periods of excess rainfall and to maximize water supply storage. Now a third major goal of equal importance is proposed; namely, to maintain and improve the quality of the water resources within the District. Development and implementation of a water quality management strategy for Lake Okeechobee would be a major step toward achieving that goal. For Lake Okeechobee, then, the primary water resource goals are as follows:

...Minimize the impacts of flooding during periods of excess rainfall.
...Maximize water supply storage.
...Improve the water quality of Lake Okeechobee.

These goals were used to guide staff during the process of developing a long-range strategy for managing Lake Okeechobee.

Based upon the primary goals above, certain guidelines evolved during the study deliberations. These guidelines enabled staff to develop and evaluate a range of technical alternatives from both quantitative and qualitative standpoints. The specific guidelines used were as follows:

1. Technical Publication 81-2 (Lake Okeechobee Water Quality Studies and Eutrophication Assessment) was used as the technical foundation for determining water quality limitations for Lake Okeechobee. Specifically, the objective is to reduce nutrient loadings presently entering Lake Okeechobee to acceptable levels.

2. No selected alternative will contain significant diversions or removal of water to tide from Lake Okeechobee or its tributary areas.

3. Losses of water from storage in the Lake Okeechobee tributary system resulting from the application of selected alternatives shall be minimized to the extent possible.

4. Cost-effectiveness (cost per amount of nutrient removed from Lake Okeechobee) shall be used as the major criterion for ranking the various alternatives.

5. Flood protection provided by existing surface water management systems will not be reduced.

6. Environmental, economic, land use, and institutional impacts will be considered in selecting the preferred alternative(s).

II. FINDINGS AND CONCLUSIONS

A. Analysis of Tributaries and Nutrient Sources

District Technical Publication #81-2 provides the technical foundation for determining a systematic, reasonable long-range strategy for managing nutrient inputs to Lake Okeechobee. This report was accepted by the Governing Board in May 1981. Table 1, derived from Technical Publication #81-2, provides a summary of water and nutrient inputs to Lake Okeechobee based on seven years of data. As indicated in the table, the Taylor Creek/Nubbin Slough basin (S-191) contributes a disproportionate amount of total phosphorus compared with its flow input. Similarly, the S-2 and S-3 basins show analagous situations for total nitrogen. Locations of the various inflow points and their tributary areas are shown in Figure 1.

As stated in Technical Publication #81-2, application of the modified Vollenweider model to Lake Okeechobee indicates that in order to meet the excessive loading rates for total phosphorus and total nitrogen, overall reductions of 40 percent and 34 percent in the average annual loadings of total phosphorus and total nitrogen, respectively, must be accomplished.

It is clear from Table 1 that the most reasonable approach to achieve these overall nutrient reductions would be to address those watersheds first which contribute disproportionate nutrient loads compared with their flow inputs. This was accomplished by ranking the watersheds in Table 1 in terms of excessive total phosphorus and total nitrogen loadings. Before the ranking was determined, however, two additional guidelines were necessary to facilitate the evaluation. First, rainfall was considered a "non-controllable" nutrient source. Second, the Upper Kissimmee Chain of Lakes (upstream of S-65) and Lake Istokpoga (upstream of S-68) were considered as receiving waters themselves. This distinction was made because at some point in the future, these lakes will be subject to their own set of water quality limitations. With these guidelines in mind, two different methods were then employed to determine the relative watershed ranking. One method was to rank them according to drainage area (amount of nutrient contributed per square mile of area drained), and the other method was based on annual inflow to Lake Okeechobee (amount of nutrient contributed per acre-foot of water discharged). Both methods resulted in the Taylor Creek/Nubbin Slough basin (S-191) being ranked number one, and the S-2 basin was ranked in the second position with each method. Furthermore, the top seven watersheds were the same for both methods, although the order differed slightly for positions 3-7.

Table 2 presents nutrient loading data for the seven highest ranked (priority) watersheds. Implementation of management actions in these watersheds to achieve the desired load reductions for each would essentially result in meeting the total overall target load reductions of 40 percent total phosphorus and 34 percent total N. Further, it is significant to note that with implementation of actions in the Taylor Creek/Nubbin Slough basin (S-191) and the Everglades Agricultural Area (S-2 and S-3) to achieve the indicated load reductions in each area, approximately 70 percent of the total overall desired load reductions would also be accomplished.

TABLE 1

PERCENTAGE SUMMARY OF WATER, PHOSPHORUS AND NITROGEN INPUTS TO LAKE OKEECHOBEE

Inflow	Water	Total Phosphorus	Total Nitrogen
Rainfall	38.8%	16.7%	24.3%
Kissimmee River	30.9%	20.3%	24.6%
S-2 and S-3	7.2%	6.4%	23.3%
Fisheating Creek	5.8%	9.8%	7.0%
S-71	4.9%	9.0%	6.3%
Taylor Creek/Nubbin Slough (S-191)	4.4%	28.5%	5.8%
S-84	4.0%	1.9%	3.1%
S-72	1.1%	1.7%	1.6%
S-4	1.0%	2.2%	1.7%
S-133 and S-135	1.0%	1.7%	1.1%
S-127, S-129, and S-131	0.8%	1.6%	0.8%
Other Inflows	0.1%	0.2%	0.4%

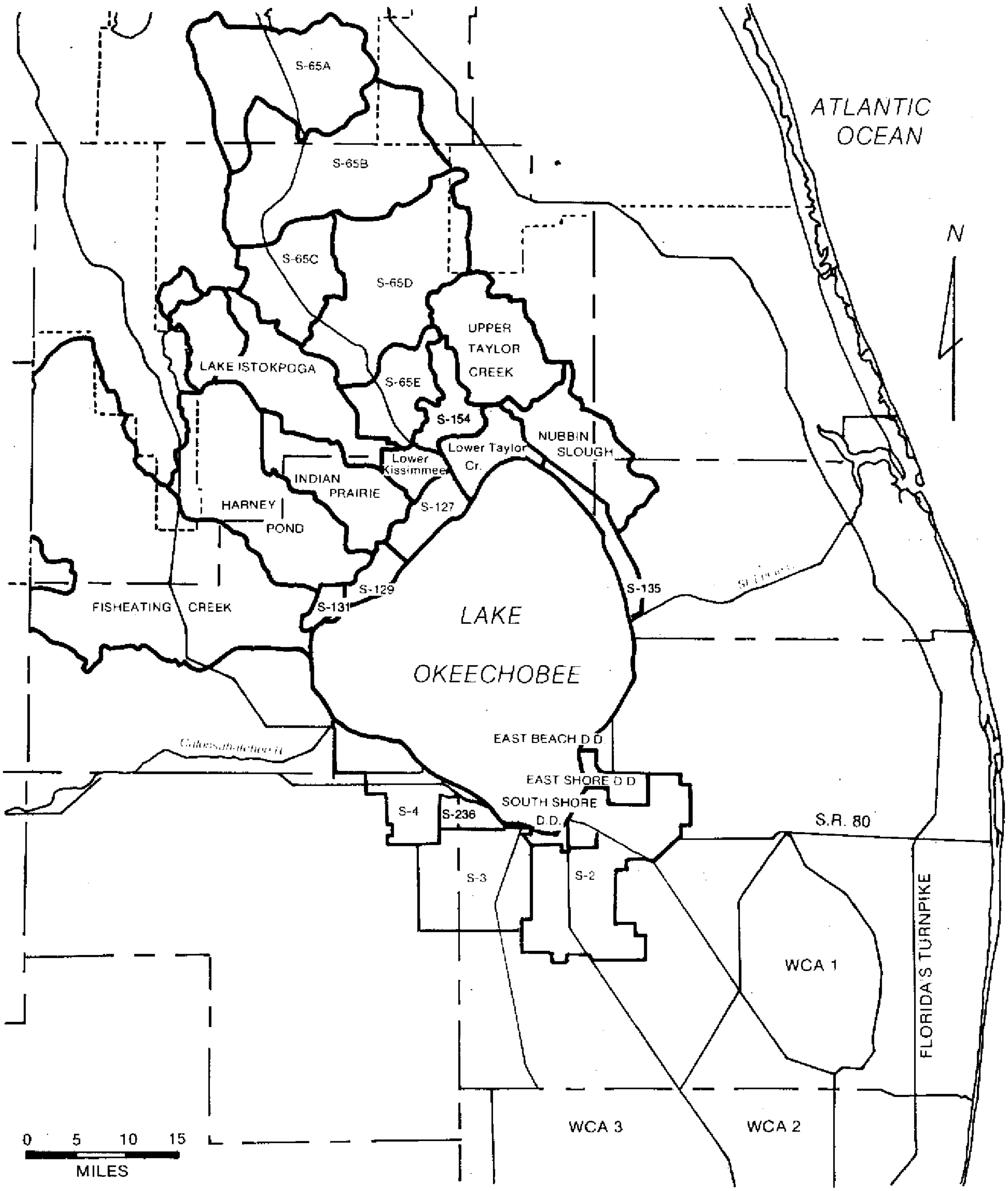

Figure 1 LAKE OKEECHOBEE STUDY AREA

TABLE 2

DESIRED LOAD REDUCTIONS FOR PRIORITY WATERSHEDS[1]

WATERSHED	CURRENT TOTAL P LOAD	DESIRED TOTAL P REDUCTION			CURRENT TOTAL N LOAD	DESIRED TOTAL N REDUCTION		
	Tons	Tons	% for Watershed	% of Total	Tons	Tons	% of Watershed	% of Total
(1) Taylor Creek/ Nubbin Slough	189	168	89%	25.6%	479	302	63%	3.7%
(2) S-2	35	17	49%	2.6%	1548	1392	90%	17.1%
(3) S-3	7	-	-	-	373	278	75%	3.4%
(4) Kissimmee	108	33	31%	5.0%	997	354	36%	4.3%
(5) Harney Pond	47	28	60%	4.3%	323	158	49%	1.9%
(6) Fisheating	65	14	22%	2.1%	575	141	25%	1.7%
(7) S-4	15	8	53%	1.2%	142	80	56%	1.0%
TOTALS	466	268		40.8%	4437	2705		33.1%
	(655)[2]			(40%)[3]	(8148)[2]			(34%)[3]

[1]Based on drainage area load allocation.

[2]Total load from all sources including rainfall, upper Kissimmee chain of lakes, Lake Istokpoga, and other minor sources.

[3]Overall target reduction levels based on Technical Publication #81-2.

After the basin ranking was determined, the next step toward developing long-term solutions was to examine the nutrient sources within each watershed. Based on land use loading rates from previous and on-going studies (Florida Sugarcane League - District cooperative studies, Water Chemistry Division unpublished data, East Central Florida Regional Planning Council studies, etc.) and land use/land cover data developed by the Land Resources Division, average annual loadings for various land uses were calculated for each watershed. It was not surprising to learn that north of the lake, dairies and improved pasture are the dominant land uses and contribute the majority of the total P and total N loads from those watersheds. In the S-2 and S-3 basins, soil type and land use, of which vegetables and sugarcane are the majority, are the dominant factors controlling the total N and total P loadings to the lake. The S-4 basin is approximately one-half improved pasture and one-half sugarcane. It is also noteworthy that natural areas constitute a significant percentage (in excess of 1/3) of the C-38, Fisheating Creek, and S-71 watersheds. Essentially, these natural areas appear to be assimilating a portion of the nutrient loads coming from the more intense land uses, such as improved pasture, in those watersheds (reference "Lake Okeechobee Water Quality Management Plan, Alternatives Evaluation, Revised August 1982").

B. Evaluation of Alternatives

1. Determination of preferred alternatives for major watersheds.

A wide range of technical alternatives were considered during the evaluation process. These alternatives generally included:

a. Regional and sub-regional storage of runoff in each major tributary area.

b. Diversions of flow to other basins from selected tributaries.

c. Conventional and reverse osmosis (R/O) treatment plants.

d. A number of Best Management Practices (BMPs), including on-site runoff storage.

Costs, nutrient reduction potential, and the impact on Lake Okeechobee's water budget were determined for each alternative within the seven priority watersheds except the Kissimmee River[1] and most of the BMPs. It was determined that a quantitative evaluation of BMPs (except on-site storage of runoff) could not be performed due to a lack of information regarding their nutrient removal effectiveness. These BMPs are "common sense" management techniques which could be used to reduce off-site nutrient loadings, as more data become available regarding their nutrient treatment efficiencies. A quantitative evaluation of on-site runoff storage was performed to provide a conservative estimate of the cost and effectiveness of implementing BMPs as compared to the other options listed above.

The various alternatives were then ranked according to cost-effectiveness (capital cost/amount of nutrient removed) for each major watershed, then screened using the guidelines and goals developed during the study. This process eliminated several alternatives and resulted in the proposed alternatives depicted in Table 3. It must be recognized that the desired load reductions for each watershed are the goals to be strived for in implementing the preferred alternatives.

Essentially, the proposed alternative north of the lake involves on-site management of runoff utilizing BMPs in order to achieve the desired load reductions for individual land uses. This approach was selected because:

a. It was the least cost alternative which also met all of the study guidelines.

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[1]There are several options currently being considered by the U.S. Army Corps of Engineers for the Kissimmee River through their current re-study of that basin. Since this effort is still underway, it was deemed inappropriate to perform a complete analysis of Kissimmee River alternatives.

TABLE 3

SUMMARY OF PREFERRED ALTERNATIVES

Watershed	Alternative	Capital Cost $ Million	TOTAL P REDUCTION, TONS After Controls	TOTAL P REDUCTION, TONS Desired	TOTAL N REDUCTION, TONS After Controls	TOTAL N REDUCTION, TONS Desired
Taylor Creek/ Nubbin Slough (S-191)	On-site management	13.2	169.8	168	302.7	302
S-2 and S-3	Holeyland	14.5	38.2	17	1724.6	1670
Harney Pond Canal (S-71)	On-site management	9.1	28.8	28	189.4	154
Fisheating Creek	On-site management	12.9	30.8	14	213.4	141
S-4	Diversion	1.4	13.4	8	127.4	80
C-38[1]	On-site management	30.9	40.7	33	493.2	354
TOTAL OVERALL DESIRED REDUCTIONS		82.0	321.7	268	3050.7	2705

[1]This is only one of many alternatives currently being considered by the U.S. A.C.E. in the re-study of the Kissimmee River and has not been selected as the least cost alternative. The figures are presented for comparative purposes only.

b. Available data demonstrate that this option has an excellent potential for achieving high nutrient removal efficiencies.

c. BMPs can be combined with current drainage practices with minimal impact on overall farming operations.

d. An institutional framework capable of implementing this alternative already exists.

In the EAA (S-2 and S-3), regional storage and water recycling using the Holeyland is the proposed alternative.

There are several reasons for proposing the implementation of this option, as follows:

a. Regional storage of runoff in the Holeyland provides for an additional water storage area for meeting a portion of the water supply demands on Lake Okeechobee and WCA #3.

b. Regional storage and water recycling is the least cost alternative which also meets the guidelines established during the study.

c. Compared with the Interim Action Plan, there is more water available for water supply from Lake Okeechobee on an average annual basis.

d. Regional storage has a greater probability of achieving nitrogen load reductions to Lake Okeechobee than on-site storage due to the treatment capability of one large storage area versus numerous smaller storage areas..

e. Regional storage has the potential to provide more benefits to WCA 3A than the other options. These potential benefits include:

   1) A portion of the excess runoff generated in the S-7 and S-8 basins would be treated to some degree prior to being discharged to WCA 3A.

   2) Some degree of sheet flow over the north end of WCA 3A can be reestablished by discharging excess water from the Holeyland at several locations along the northern levee of WCA 3A.

2. Development and analysis of EAA Master Plan

As indicated in the Abstract of this report, concerns were raised regarding the preferred alternative in the EAA (S-2 and S-3); specifically, the District was directed to address the issue of long term utilization of the Holeyland and Rotenberger areas for runoff management in comparison to continuing the Interim Action Plan (IAP). The staff proceeded to examine this issue by evaluating alternative boundary configurations for the two areas, various water level schedules for each area and the impacts of those levels on each area, irrigation recycling capability, and impacts of each alternative schedule (including the IAP) on the regional water management system (Lake Okeechobee, Water Conservation Areas, and Everglades National Park) from water quantity, water quality, and environmental perspectives. This process resulted in a "Master Plan" proposal for the Holeyland and Rotenberger areas, as set out in the following discussion.

a. Determination of preferred boundary configurations.

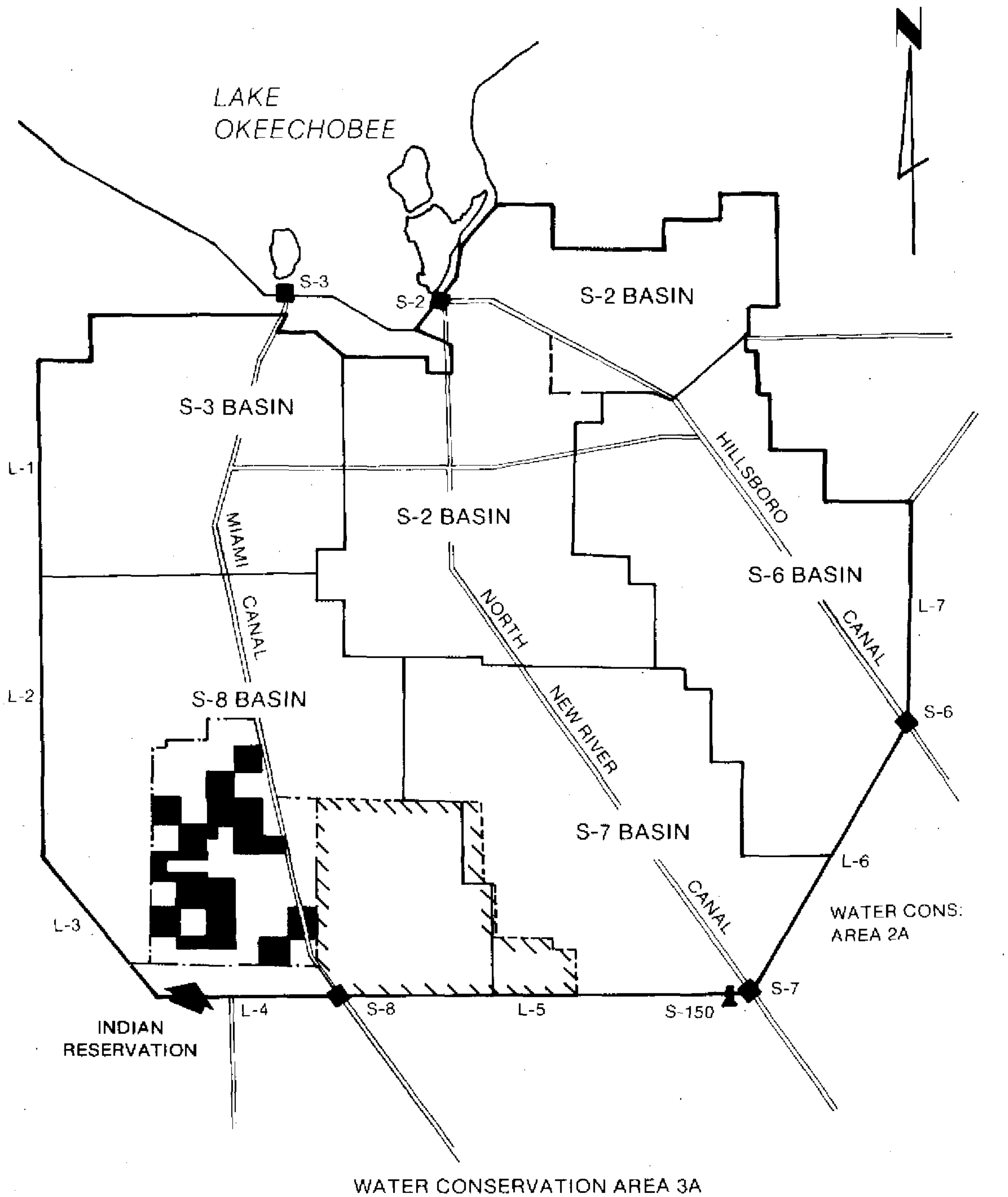
Figure 2 shows the general study area. There are approximately 15 square miles currently in private ownership in the Holeyland and Rotenberger tracts, which is about 16 percent of the total area of these two tracts (95 square miles). Most of the privately owned land is located in the Rotenberger tract west of the Miami Canal. In order to determine the optimal boundary configuration for each area, two alternative configurations for the Holeyland area and six alternative configurations for the Rotenberger area were examined. The major features for each alternative configuration are depicted in Figures 3 and 4. A summary of first costs (construction and land acquisition) and annual operation and maintenance costs for the alternative configurations is provided as follows:

Alternative	Land[1]	Construction	Total First Cost	Annual O & M
Holeyland 1	$ 1,600,000	$14,743,300	$16,343,300	$156,000
Holeyland 2	1,600,000	15,289,300	16,889,300	158,300
Rotenberger 1	6,080,000	3,028,800	9,108,800	93,950
Rotenberger 2	6,322,400	3,964,100	10,286,500	95,710
Rotenberger 3	8,000,000	4,079,600	12,079,600	124,720
Rotenberger 4	8,242,400	4,641,100	12,883,500	126,600
Rotenberger 5	12,800,000	3,537,400	16,337,400	96,900
Rotenberger 6	14,720,000	4,276,100	18,996,100	126,000

Based on cost considerations, the Holeyland 1 configuration (toe area excluded) was selected. For the Rotenberger area, the two least cost options, in terms of construction costs, are Rotenberger 1 (without Indian lands) and Rotenberger 5 (Indian lands included), with an estimated cost differential of $508,600. Although Rotenberger 5 is slightly more expensive (construction costs), there are certain environmental benefits it has which Rotenberger 1 does not have. Specifically, Rotenberger 5 provides for a partial restoration of sheetflow to WCA 3A west of the Miami Canal. In terms of land acquisition, if the Indian lands could be obtained in a land swap, the total first cost of Rotenberger 5 would be reduced to $9,617,400. Based on costconsiderations, Rotenberger 5 is the preferred alternative. If negotiations for a land swap involving the Indian lands is not successful, then Rotenberger 1 would become the preferred alternative.

[1]Includes only the costs for lands not presently in public ownership.

Figure 5 illustrates the major features of the preferred Holeyland project.

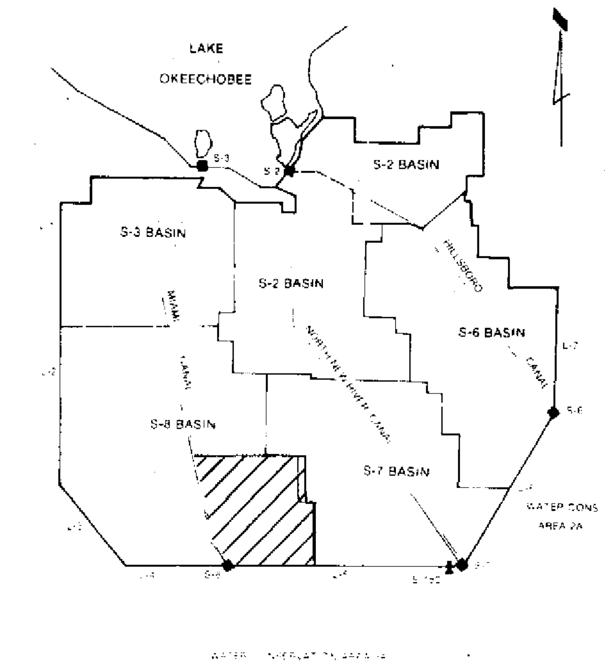


SCALE 1 INCH = 6 MILES

LEGEND

- BASIN DIVIDES
- HOLEY LAND
- HOTENBERGER TRACT
- PRIVATE OWNERSHIPS

Figure 2 GENERAL STUDY AREA

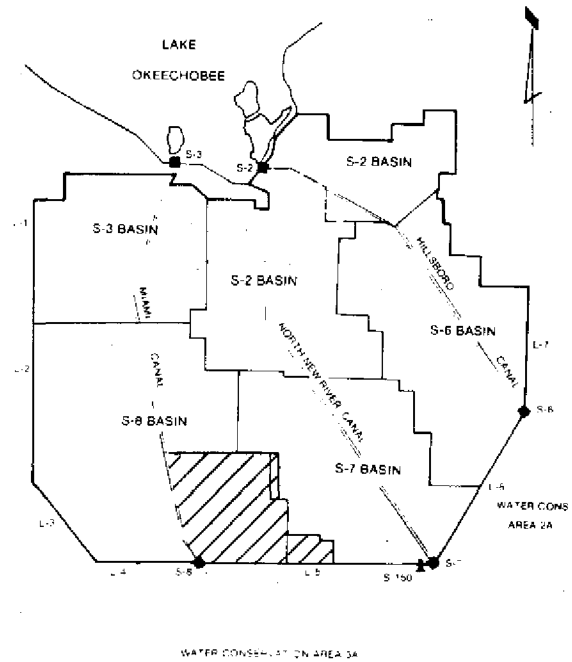


LEGEND

BASIN DIVIDES

HOLEYLAND WATER STORAGE AREA

HOLEYLAND 1



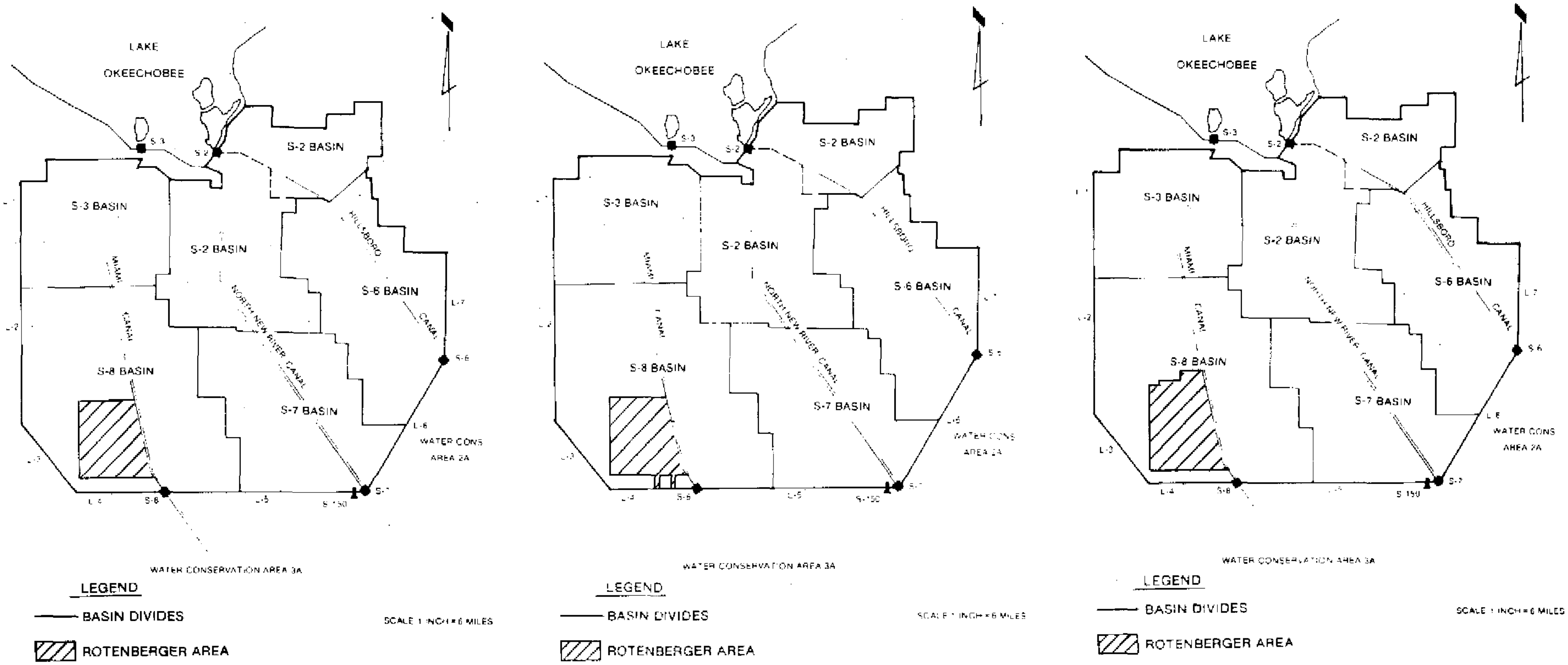
LEGEND

BASIN DIVIDES

HOLEYLAND WATER STORAGE AREA

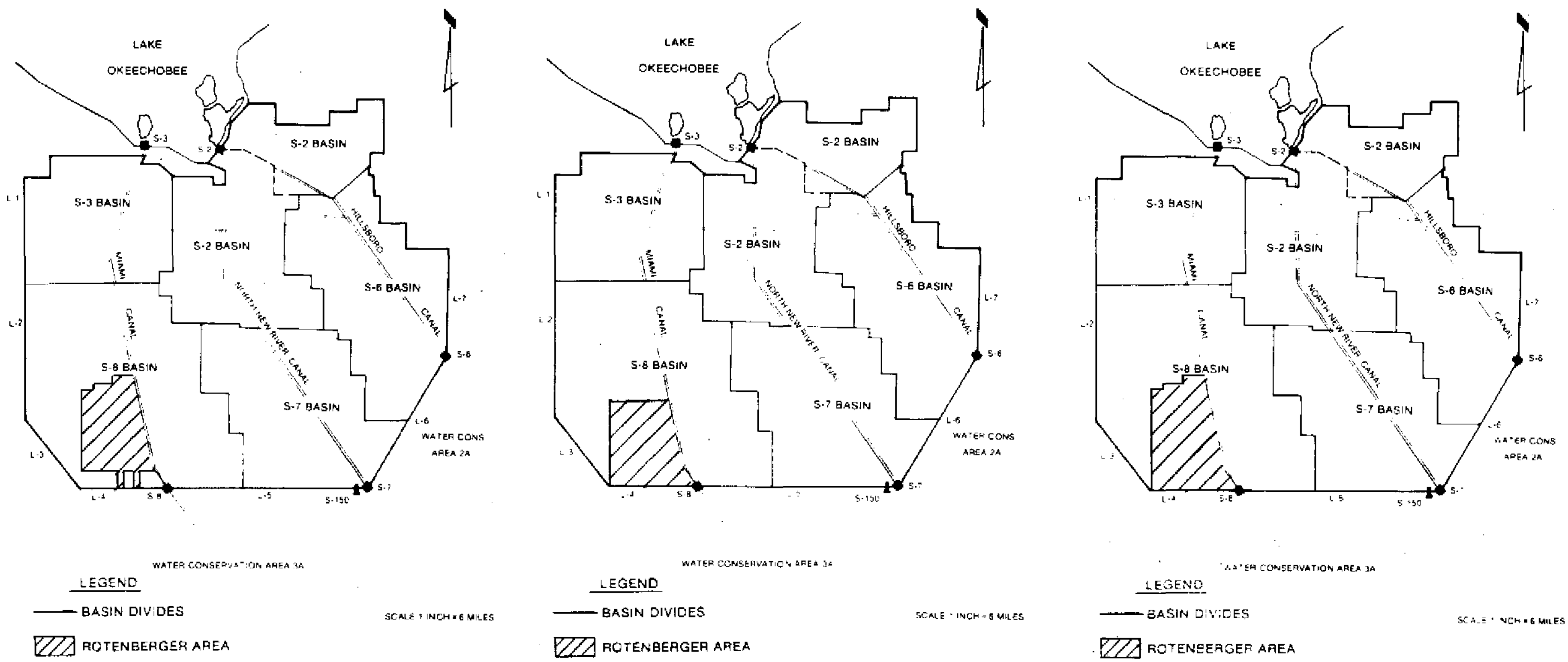
HOLEYLAND 2

Figure 3 HOLEYLAND ALTERNATIVES



ROTENBERGER 1 **ROTENBERGER 2** **ROTENBERGER 3**

Figure 4a ROTENBERGER ALTERNATIVES



ROTENBERGER 4 **ROTENBERGER 5** **ROTENBERGER 6**

Figure 4b ROTENBERGER ALTERNATIVES

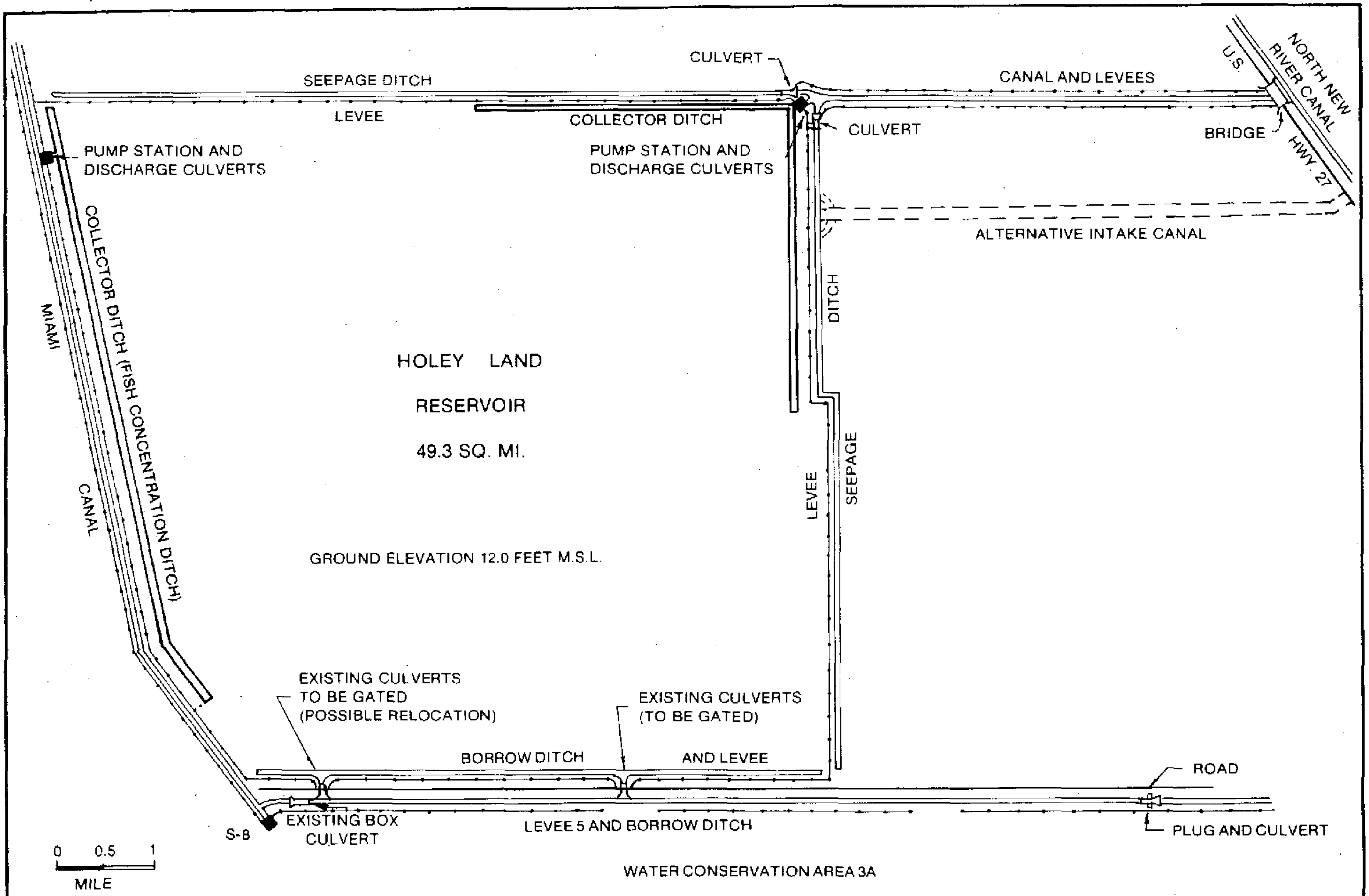


Figure 5 HOLEYLAND RESERVOIR

It must be recognized that this is a preliminary design of the project. As detailed planning and design proceeds, more definitive alignments, locations, dimensions, and costs of facilities will be developed. For example, detailed alignments and designs of the collector/fish concentration canals will be prepared based on water delivery capabilities, fisheries benefits, and other considerations.

Also, a substantial cost savings could result if the alternate eastern intake canal alignment (Gulf + Western Main Canal) can be obtained. This alignment is located approximately one mile south of the previously described alignment. The existing canal in this alignment has an estimated design capacity of 550 cfs, and therefore, would have to be enlarged to handle 750 cfs. At the discharge point to the North New River Canal, there are four existing 49,000 gpm discharge pumps (550 cfs) and one 49,000 gpm 2-way pump which discharge through a double barrel box culvert. A bridge over the discharge canal at U.S. Highway 27 also exists. Acquisition and relocation of these pumps could result in a cost savings.

The general facilities layout for the preferred Rotenberger Project is shown in Figure 6. Levees will be required on the north and will be included as part of the proposed flood relief plan for Hendry County, since planning for this program is proceeding concurrently. That is, a proposed channel will be tied into the Miami Canal on the east and to Levee 3 near the Deer Fence Canal on the west. The alignment of this proposed channel will be along the northern boundary of the proposed Rotenberger Project. The existing Miami Canal levee on the east side and the existing Levee 4 on the south side, as well as the existing levee on the west side (U.S. Sugar Co., Hendry County) are adequate with a crown width of 10 feet at a minimum grade of 18.0 ft msl on the west side.

b. Analysis of impacts of various schedules on Holeyland and Rotenberger areas

1) water quantity

Once the preferred boundary configurations were determined, the following scenarios were analyzed:

Water Regulation Schedules

Holeyland (Figs. 10,11)	Rotenberger Tract (Fig. 9)
2 ft. flat schedule	0-12 inches
3 ft. flat schedule	"
4 ft. "	"
2 ft. fluctuated schedule	"
3 ft. "	"
4 ft. "	"
2 ft. "	0-24 inches
2 ft. "	0-24 inches*

*area includes Manley Ditch.

Figures 7 and 8 illustrate runoff flow directions in the EAA for the proposed Master Plan under moderate and extremely wet conditions.

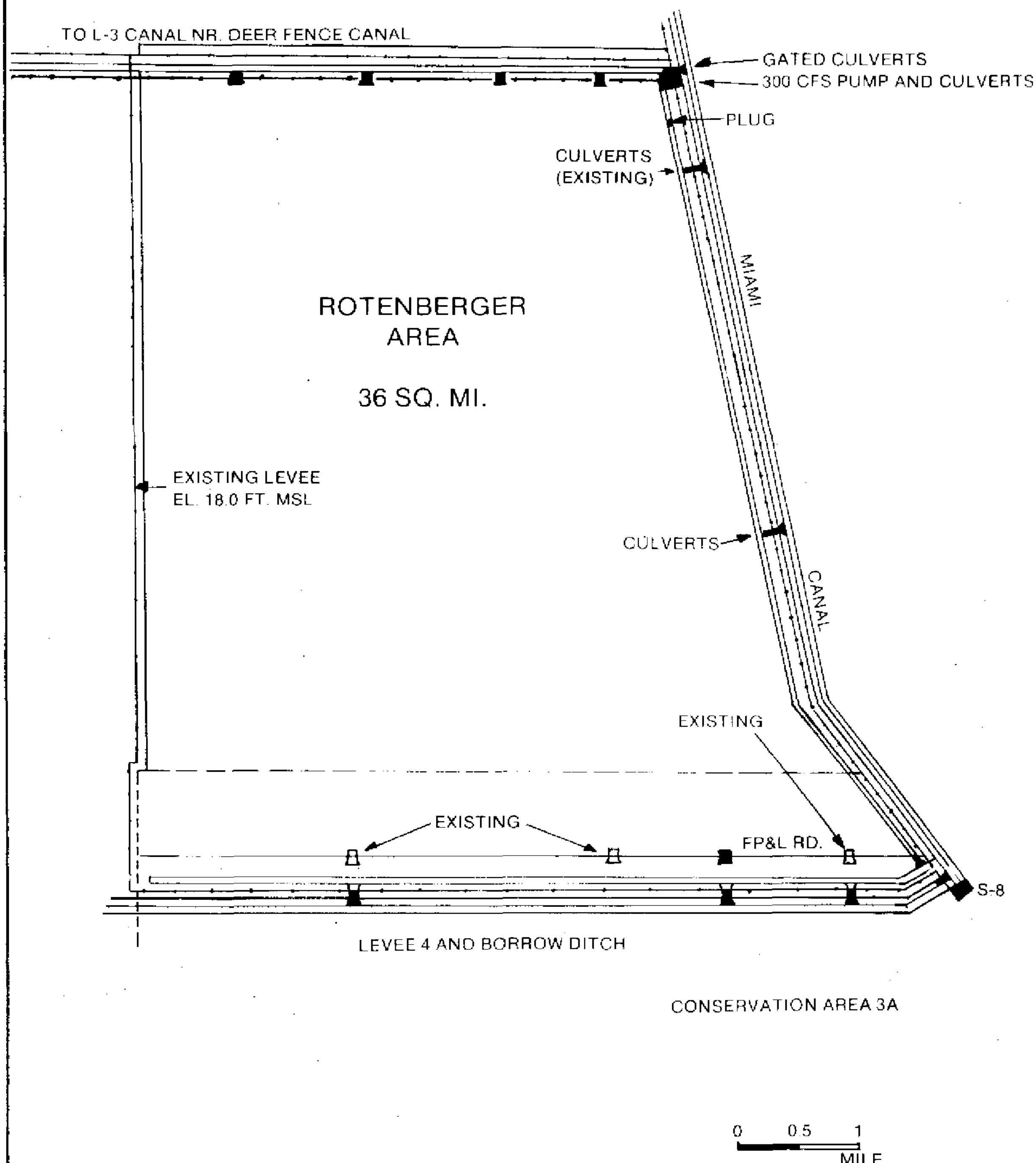


Figure 6 ROTENBERGER AREA

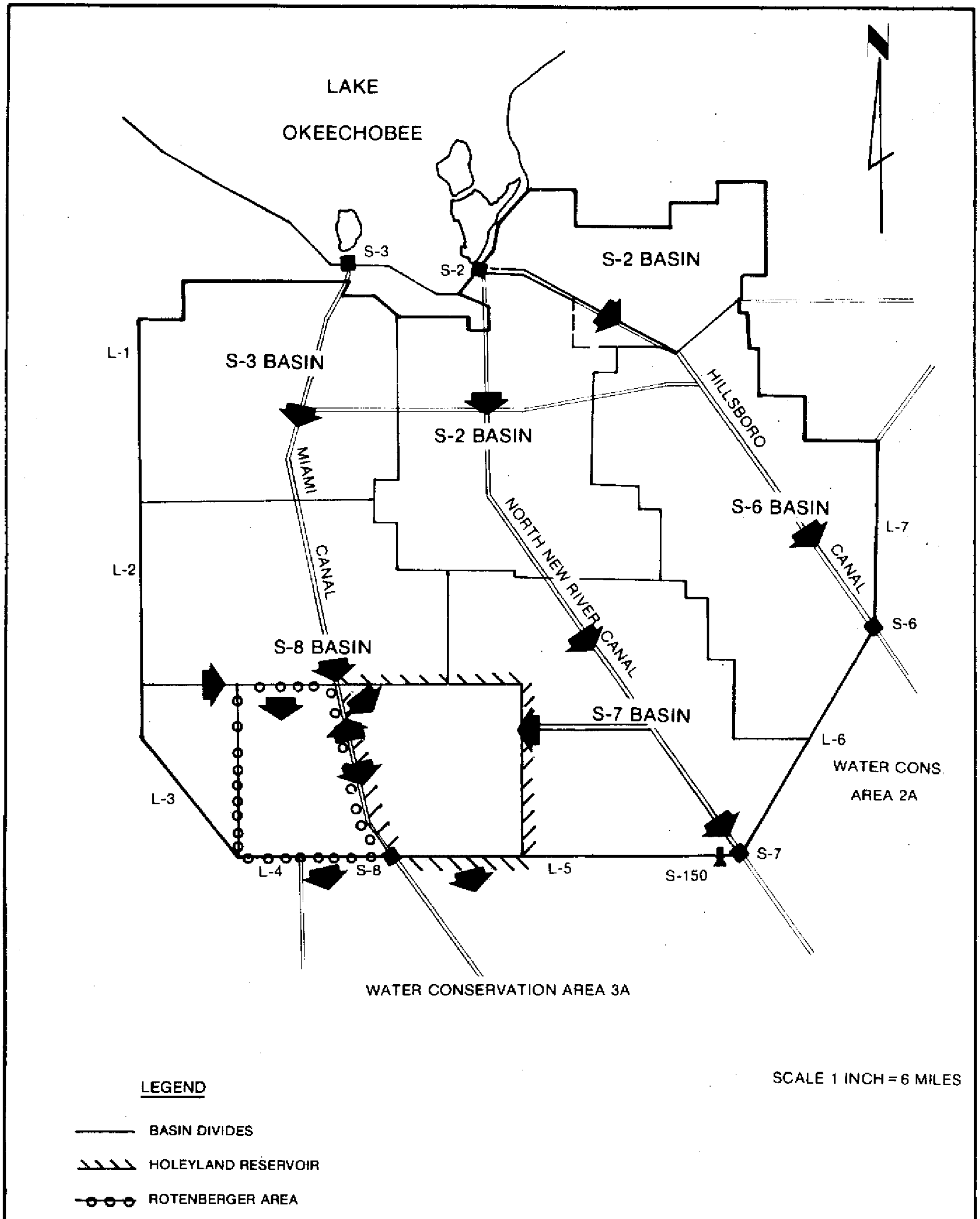


Figure 7 LONG RANGE PLAN, MODERATE RUNOFF CONDITIONS

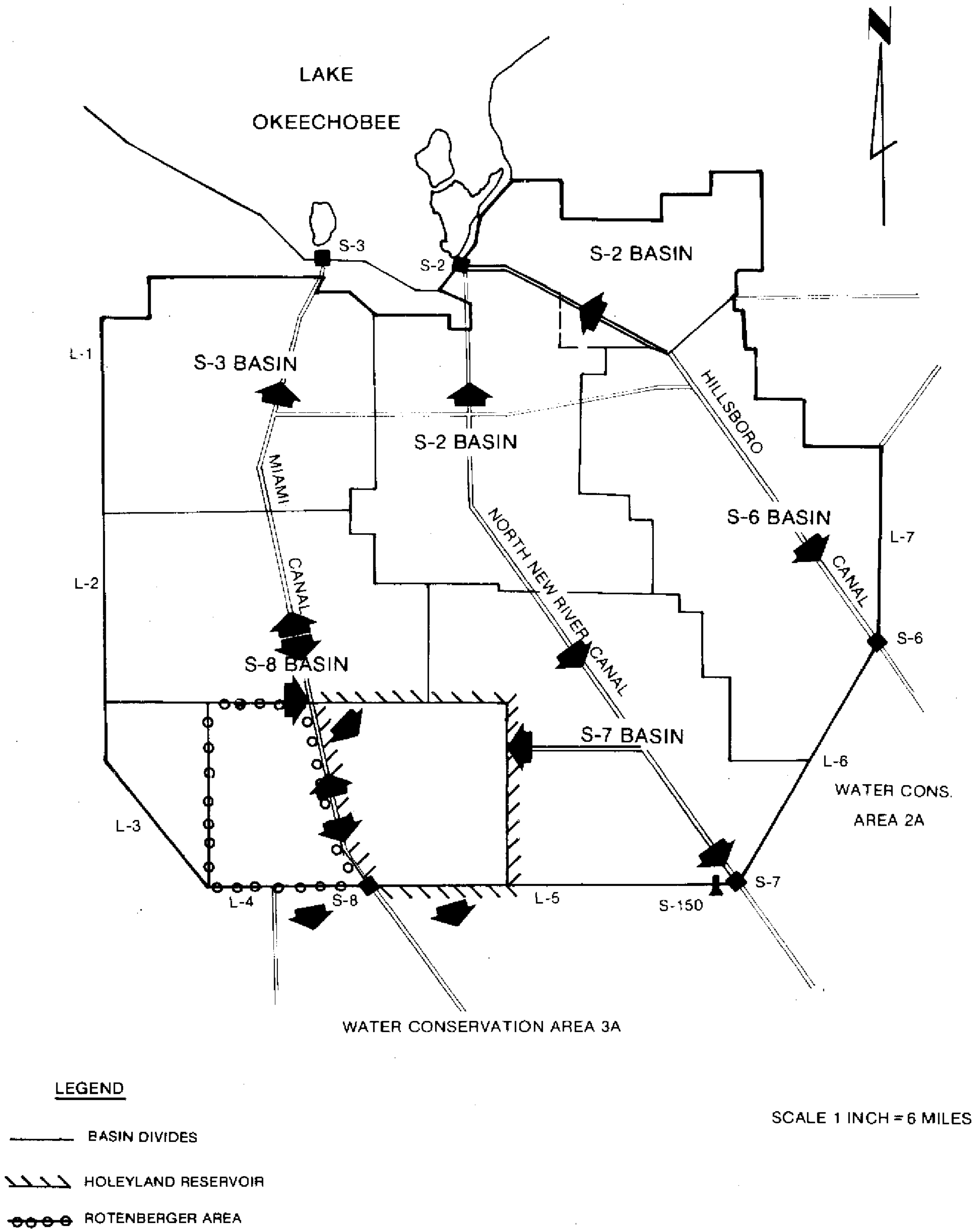


Figure 8 LONG RANGE PLAN, SEVERE RUNOFF CONDITIONS

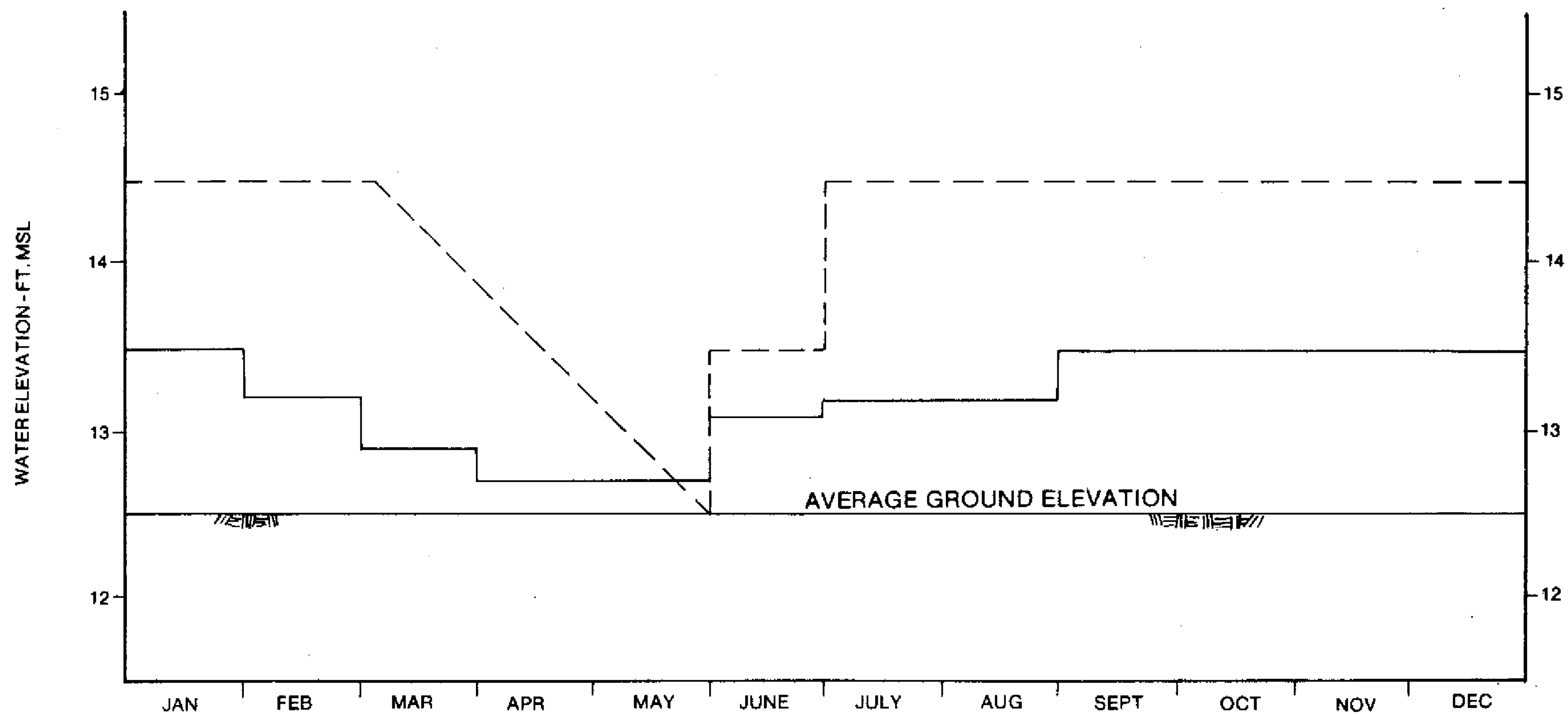


Figure 9 · WATER REGULATION SCHEDULES FOR THE ROTENBERGER AREA

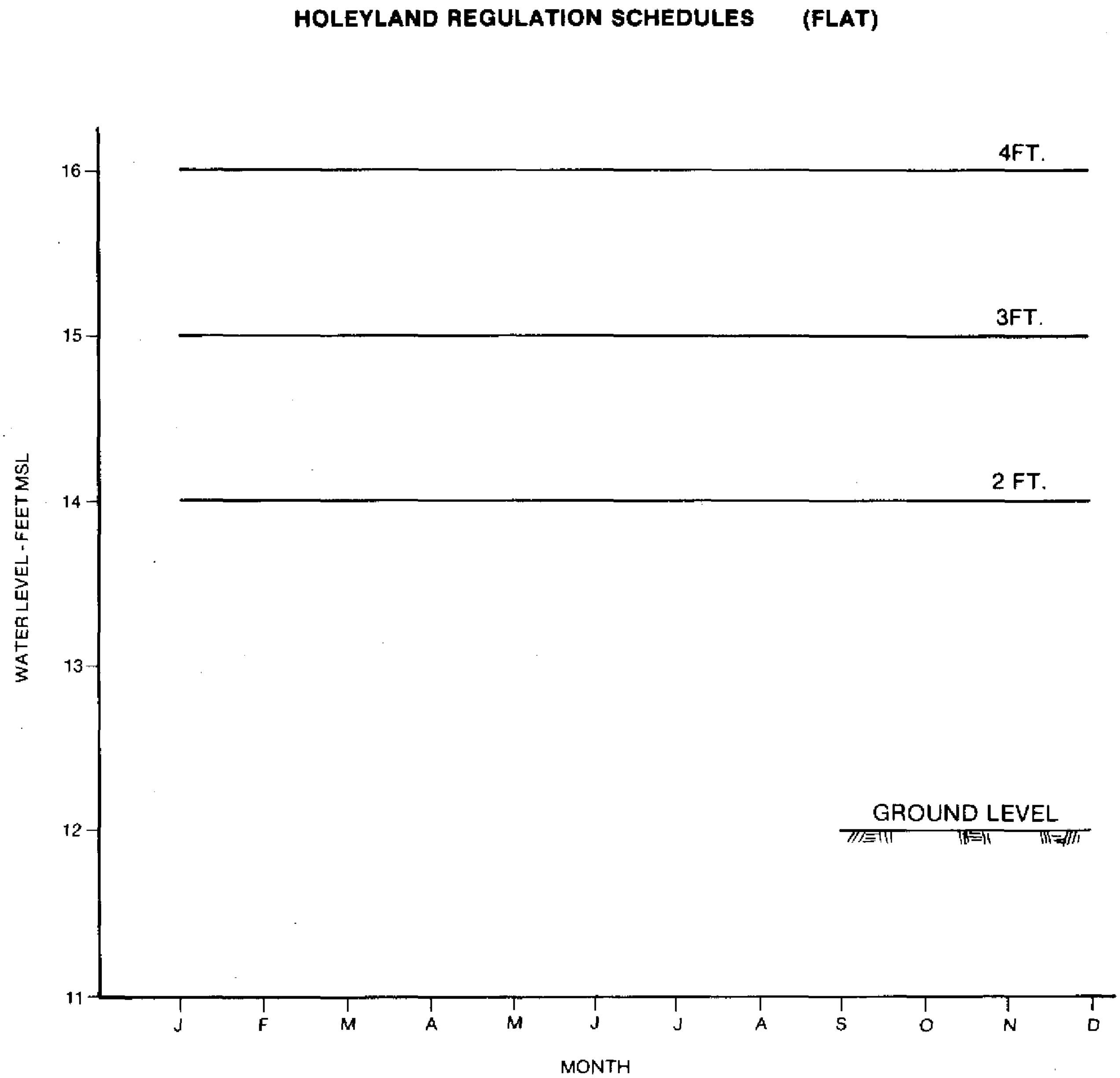


Figure 10 WATER REGULATION SCHEDULES FOR HOLEYLAND RESERVOIR

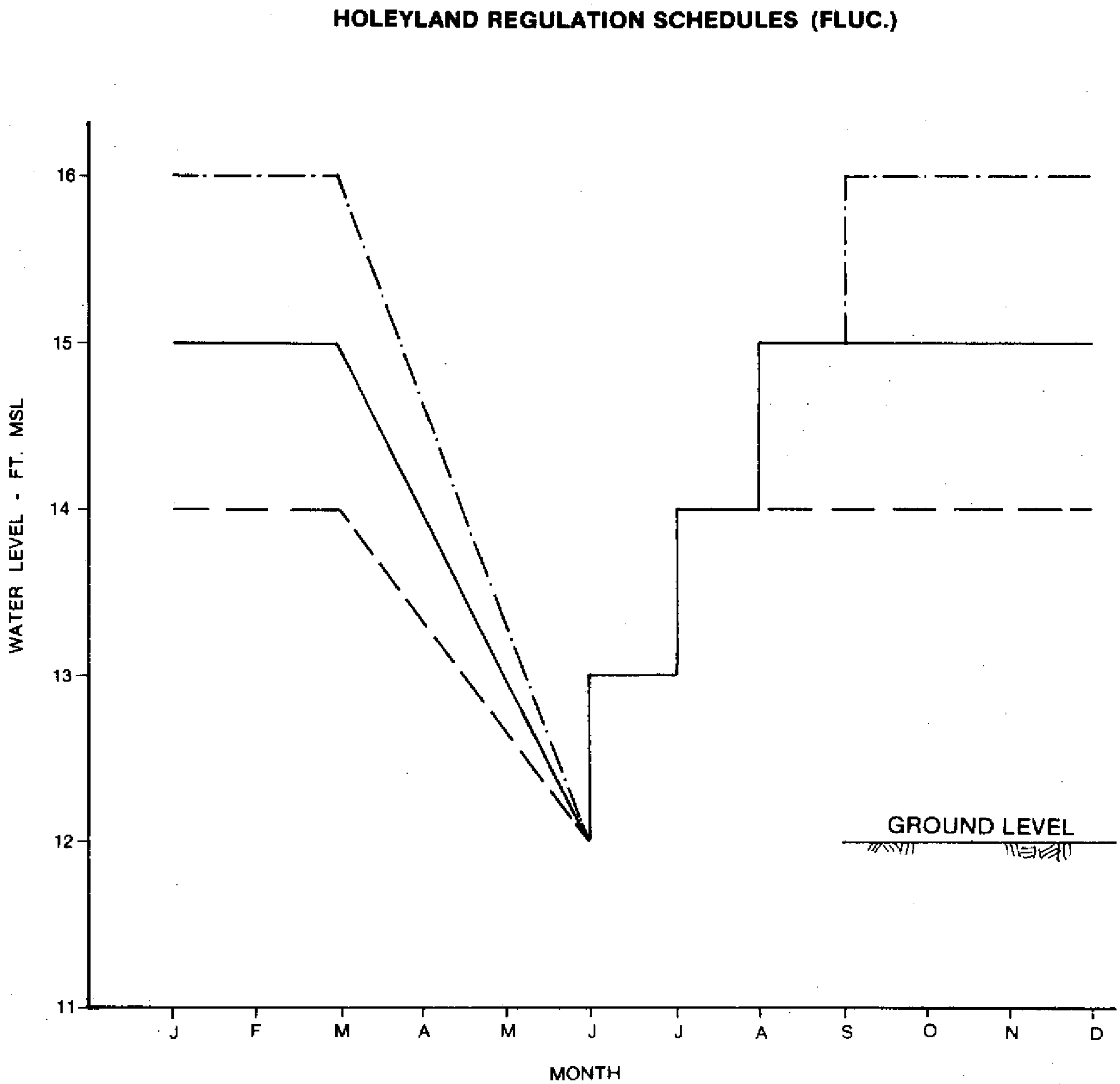


Figure 11 WATER REGULATION SCHEDULES FOR HOLEYLAND RESERVOIR

Rotenberger area

Two water regulation schedules were analyzed. One was based on a 0-12 inch maximum water depth with no water supply releases from the area, the other on a 0-24 inch maximum water depth to provide recycling water for local demand.

The projected water levels in the Rotenberger tract under the 0-1 ft. schedule varies between 12.0 ft msl to 13.5 ft msl under most cases. If there was additional inflow from Hendry County, this could be managed at the intake structure to maintain a desired water level in the Rotenberger tract. The results of this study also indicate that the different regulation schedules used in the Holeyland area do not affect the stage in the Rotenberger area. The projected water levels under the last two scenarios (in which one area included the Indian Reservation north to Manley Ditch) are almost the same under the proposed system. The water levels fluctuated between 12.0 and 14.6 ft msl under the simulated conditions, with the exception of the wet conditions similar to 1968 and 1969. A limited amount of additional supplemental water may be required for muck fire prevention during the month of April (6,000 AF for 1967, 1971, and 1981 rainfall conditons). The average amount of supplemental water required under the 0-12 inch schedules are 2400, 4400, and 8000 AF for February, March, and April. This difference may be due to the reduction in storage under this schedule.

Holeyland Area

The projected water levels in the Holeyland varied from near ground level to the top of the schedule under simulated conditions. The results also indicated that the proposed outlet structures would be capable of maintaining stages in the area without causing excessively high water levels. The water levels reach the top of the schedule most of the time under the flat schedule, and the area would not be as dry as under the fluctuated schedule. The results under the fluctuated schedule indicated that the top of the schedule would not be reached for the rainfall conditions similar to the years 1964, 1967, 1972, and 1981.

2) Water quality benefits of the Holeyland marsh

Recent work in Water Conservation Areas 2A and 3A, conducted by the District's Environmental Sciences Division, has shown the effectiveness of the Everglades marsh in the uptake of nutrients resulting from agricultural surface water runoff. In particular, at least seven years of data have been collected in WCA 2A, which has been receiving discharges of nutrient enriched agricultural runoff for more than 22 years. Results of this work indicate that nutrients impacted the marsh for a distance of approximately 2.5-3.0 miles south of the discharge structures to WCA 2A. Beyond this point, nutrients and associated parameters returned to natural background levels. Similar results were observed in the northern part of WCA 3A based on studies conducted during the summer of 1982. Projected annual nutrient loadings into the Holeyland and zones of impact were then calculated based on the following:

(a) Calculated annual inflows into the Holeyland based on hydrologic routings described earlier.
(b) Average annual flow-weighted nutrient concentrations from the Miami and North New River Canals.
(c) Nutrient uptake profiles in WCA 2A mentioned above.
(d) Estimates of nutrient impacts on WCA 2A vegetation based on aerial photography and nutrient uptake profiles.

Predicted areas of nutrient enrichment in the Holeyland are illustrated in Figure 12. The distributions of the enrichment zones were based on the assumptions that sheetflow will occur during most pumping periods and that water will be evenly distributed from the point of pumping. The actual zone of nutrient impact will depend to some degree on the alignment of interior canals. Predicted areas of highest impact are also the areas which are currently the most disturbed from an environmental standpoint. Also, the dense sawgrass area in the southern half of the Holeyland would be the area least impacted from poor quality water being pumped into the area. Nutrient concentrations in the water flowing out of the Holeyland into WCA 3A should be similar to background concentrations in WCA 2A.

3) Impacts on flora and fauna

Existing plant communities in Holeyland

The existing vegetation in the Holeyland can be separated into four major plant communities (Figure 12).

The most highly disturbed area (approximately 2000 acres) occurs adjacent to the levees in the NE corner of the Holey Land. Much of this area was devoid of emergent vegetation when an aerial survey was made in January 1983. Fallen decomposing trunks of pig weed (*Amaranthus hybridus*) were common, and widely scattered shoots of cattail (*Typha* sp.) were emerging between them. Extensive pockets of exposed bedrock in this area apparently resulted from peat fires.

A 3000 acre shrub area dominated by saltbush (*Baccharis* sp.) borders the west and south levees. Stands of large red maple (*Acer rubrum*) and wax myrtle (*Myrica cerifera*) are scattered among the saltbush. Numerous trails from track vehicles crisscross this area. Water hyacinths (*Eichhornia crassipes*) were observed in the depressions left by the tracks.

Sawgrass (*Cladium jamaicense*) still predominates in most of the interior marsh of the Holeyland. The sawgrass interior can be divided into a northern sector characterized by a greater degree of disturbance and a southern sector which appears less disturbed. In the northern area of approximately 15,500 acres, the sawgrass stand is less dense than in the southern area, and is intermixed with herbaceous species (such as dog fennel (*Eupatorium* sp.)) characteristic

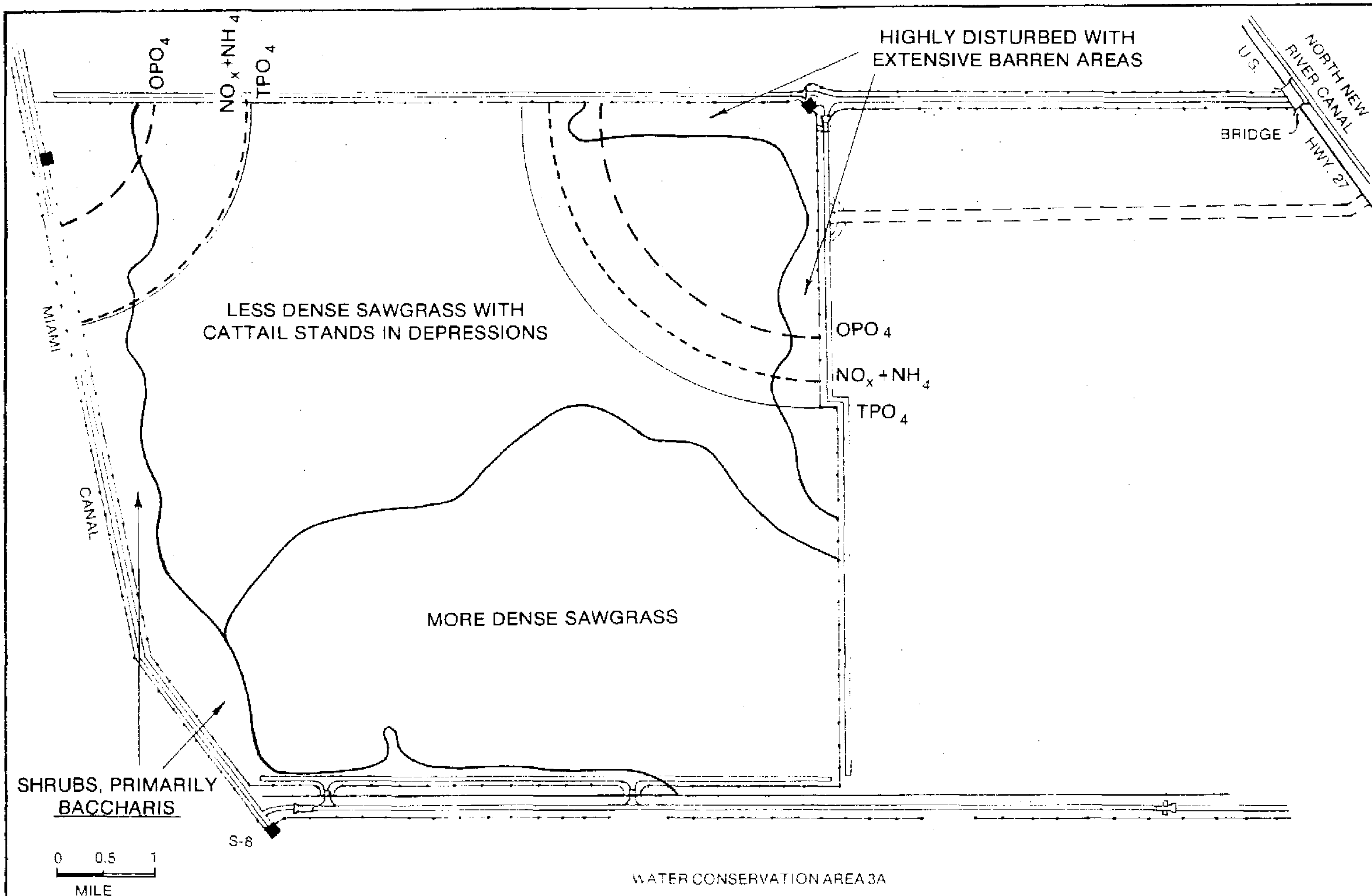


Figure 12 HOLEYLAND GENERALIZED MAP OF EXISTING VEGETATION WITH PREDICTED AREAS OF NUTRIENT ENRICHMENT.

of drained areas. Cattail stands grow in depressions which are scattered over the interior of the less dense sawgrass area. A matrix of trails from track vehicles also covers this area.

The southern portion of the interior sawgrass stand is characterized by a more dense growth of sawgrass with few other species present. This area (approximately 11,000 acres) apparently has been less affected by the impacts of drainage and fire.

Analyses of Different Water Schedules (two, three, and four foot schedules) for Holeyland

All of the computer runs of three and four foot schedules, either variable ascending or flat, indicate the same general environmental effect in the Holeyland. Some of the predictable environmental effects are as follows:

(a) A shift toward a bladderwort/white water lily slough-oriented aquatic system encroaching within the existing sawgrass community.

(b) Sawgrass will be maintained and will probably compensate for increased inundation by tussock formation as found in the deeper portions of WCA2A.

(c) Periphyton species changes and increases in biomass of periphyton.

(d) Sufficient drying periods to prevent a buildup of deep layers of unconsolidated organic materials (1967, 1971, 1974, 1975, 1981).

(e) A water level conducive to wading bird feeding in the January thru April time frame in most years.

(f) At times, good to excellent sport and pan fishing will occur as a result of the Holeyland retaining some water during the spring months. During the 19 year period of the routings, each of the three and four foot schedules contains five events when water is retained on the marsh through one or more consecutive dry periods. The three and four foot flat schedules, as well as the four foot variable schedule, each indicate one long wet period of 33 consecutive months within the time period analyzed, and will offer rather spectacular fishing. The three foot variable schedule does not indicate the 33 month inundated period, but does indicate five periods of 20 month flooding.

(g) Alligators may be common in the Holeyland under any of the three and four foot schedules, but nesting and reproduction will be extremely limited due to the rapidity with which the waters rise during the June through September nesting season.

(h) A loss of woody vegetation can be anticipated. Flooding on an annual basis to depths of three and four feet will eventually drown the trees. Most of the woody vegetation is not growing on elevated sites (tree islands) as it is in the Water Conservation Area system.

(i) Hyacinths will grow in the open areas nearest the pump stations. Hyacinths will not do well outside of the zone of nutrient enrichment.

(j) period of inundation and depth of water which will act adversely on the woody vegetation will offer favorable conditions for a large population of apple snails (Pomacea). These two factors together will act as an enhancement to the Everglade Kite, which will use the Holeyland as a feeding area on an annual basis, and as a nesting area during the time period the trees are water-stressed.

(k) There will be no huntable deer herd in the Holeyland.

(l) There will be an increase in cattails in the enriched zone affected by the pumps.

Analyses of the computer runs for the two foot schedules led to the following conclusions:

(a) Bladderwort/white water lily will exist, but will not dominate anywhere other than present ponds.

(b) Sawgrass will be maintained in its present condition.

(c) Periphyton species changes and increases in periphyton biomass will also take place with the two-foot schedules, as these are functions of water chemistry.

(d) Sufficient drying periods will occur to prevent buildup of deep layers of unconsolidated organic materials (1965, 1967, 1968, 1971, 1973, 1974, 1975, 1976, 1981).

(e) Declining water levels conducive to wading bird feeding will occur in the December thru March time frame in most years.

(f) Fishing will not be as good as under the three and four foot schedules. There are only two periods during the 20 year period of projection which indicate a holdover of the sport fish population to age class II. Sport fishing will be fair on an annual basis for yearling bass.

(g) Alligators may be fairly common in the Holeyland under the two foot water schedules, but nesting occurs during the time of the two-foot rise in water level, thus only very limited reproduction can be anticipated.

(h) The woody vegetation presently in the Holeyland will probably be maintained.

(i) Hyacinths will grow on an annual basis but will not do well outside the pumped zone of enrichment.

(j) Water depths and duration of flooding are not conducive to Pomacea snail production nor Everglade kite use.

(k) There will be no huntable deer herd in the Holeyland.

(l) There will be an increase in cattails in the enriched zone affected by the pumps.

Rotenberger Area Impacts

At the request of District staff, the Florida Game and Freshwater Fish Commission provided a general assessment of the impacts of the District's proposal for the Rotenberger area, which is provided below. The complete transmittal is included in the Appendix, along with a detailed historical tabulation of game harvest levels for the Rotenberger area, Holeyland, Brown's Farm, and Everglades wildlife management areas.

"Relatively little is known about Rotenberger topographic relief and no previous Everglades habitat restoration projects have been undertaken. We can not, therefore, project future wildlife populations and wildlife harvest as a result of more water. However, we expect that deer populations and deer harvest will be lower under a 0- to 1-foot schedule than under the hydrologic conditions of recent years, and perhaps significantly so.

"Most deer on the Rotenberger WMA occur in the northern one-half of the area. If the lands between the Manley Ditch and the Rotenberger Township were excluded from the restoration project and subsequently developed for economic purposes, the deer herd would be severely reduced, and this impact would be most unwelcome.

"The 0- to 1-foot schedule you propose should be favorable to the development of wet prairie communities that provide valuable waterfowl winter habitat, and waterfowl populations should increase. Wetter conditions should also provide more snipe and other shorebird habitat. Numerous wading birds, including the endangered wood stork, will be afforded favorable feeding conditions due to the increased hydroperiod. Longer hydroperiods should also benefit marsh nesting wildlife species such as gallinules, waterfowl, rails, bitterns, alligators, and various passerine birds by providing more attractive and predictable nesting conditions.

"Practically any reasonable schedule should encourage the development of woody vegetation on the higher portions of the area through reduction of destructive fires. Hopefully, some of the tree islands that have been burned out of the area will be reestablished. Reestablishing tree islands will increase vegetation diversity and provide improved habitat for a wide range of Everglades wildlife.

"The district's 0- to 1-foot schedule is acceptable as an interim schedule for the restoration of Everglades habitat on the Rotenberger WMA. However, depending on vegetation and wildlife community response to this schedule, schedule alteration (including possible increases) may be appropriate, even obligatory, in the future. Consequently, structural features should accommodate higher regulation schedules and water levels which may result from abnormally heavy precipitation.

"An important point we want very much to stress is that restoration of Everglades habitat in the Rotenberger was a prime consideration at the time of acquisition and we are aware of no change in that intent. While your letter emphasized the impacts of water on game and game harvests, it is important to stress that a diversity of Everglades wildlife, in general, will benefit from restoration effofts. While some species will decline, others will increase and, hopefully, a proper balance can be struck. That is why it is important to retain flexibility on the matter of water schedules."

c. Analysis of impacts on regional water management system

1) <u>Irrigation Recycling</u>

Neither of the plans analyzed have the capability to meet all the irrigation water requirements of the Miami and the North New River Canal basins. Simulated results show that different plans can normally supply between 58,000 and 113,000 AF per year of the local requirement, depending upon the schedule chosen. An additional foot of water storage in the Holeyland area increased the recycling water available for irrigation by 21,000 to 25,000 AF/year under the flat schedule, and approximately 17,500 to 21,200 AF/year under the fluctuated schedule. The flat schedule would provide more water than the fluctuated schedule (8,700 AF/year under a 2 foot maximum, and 16,500 AF/year under a 4 foot maximum). This difference occurred primarily during the wet season when more water was projected to be available under the flat schedule (see Table 4). The recycling water from the

TABLE 4. SUMMARY OF AVERAGE ANNUAL TOTAL FOR IRRIGATION RELEASES S-8, S-7, AND GRAVITY SHEET FLOW TO WCA 3A UNDER PROPOSED SCENARIOS, UNIT IN AF

Scenario	Irrigation Releases Wet Season	Irrigation Releases Dry Season	Irrigation Releases Total	Flow to WCA 3A by S-8	Flow to WCA 3A by S-7	Gravity Flow to WCA 3A
Holeyland 2 ft flat	27,076	39,807	66,883	141,451	116,513	102,208
Holeyland 3 ft flat	30,851	61,465	92,316	127,535	98,157	100,141
Holeyland 4 ft flat	33,523	79,740	113,263	120,459	94,750	79,570
Holeyland 2 ft fluctuated	20,272	37,867	58,139	149,080	127,407	93,156
Holeyland 3 ft fluctuated	21,000	58,344	79,344	139,601	115,619	85,672
Holeyland 4 ft fluctuated	21,917	74,891	96,808	131,375	114,355	69,609
Holeyland-Rotenberger 2 ft fluctuated	18,769	45,822	64,591	113,541	107,469	117,083
Holeyland-Rotenberger 2 ft fluctuated[1]	18,879	50,054	68,933	102,425	108,541	113,101
Historical[2]	76,460[3]	146,975[3]	222,435[3]	202,792	136,029	0

[1]Area includes Manley Ditch
[2]Prior to L.O.-T.O.P.; backpumping to Lake Okeechobee through S-2 and S-3 in effect
[3]Releases from Lake Okeechobee

Rotenberger area under the 2 foot schedule was projected to be 6,500 AF/year for the area bounded by the Deerfence Canal extension, and 10,800 AF/year for the area including the Manley Ditch.

2. Flow to Water Conservation Areas

Table 4 also presents the summary of flow to WCA 3A and WCA 2A via pump stations S-8 and S-7, and gravity sheetflow to the northwest corner of WCA 3A. In general, the reduction of pumpage by S-8 and S-7, shown in the table, results from increasing water storage in the Holeyland area under the proposed plans.

The pumpage at S-8 and S-7 is smaller under the flat schedule than under the fluctuated schedule. A substantial decrease in pumpage at S-7 and S-8 would result under the last two scenarios, due to increasing water storage in the Rotenberger area. Gravity sheet flow did not follow the same pattern, decreasing under the fluctuated schedule as compared to the flat schedule, and increasing under the last two scenarios.

3. Impacts on Regional Water Supply Capabilities

The water storage and operational changes brought about by the Holeyland plans will increase the overall urban and agricultural water supply capabilities and decrease the frequency and severity of supply shortfalls when compared to the Interim Action Plan. The resulting expected decrease in drought damages is a significant benefit of the Holeyland Plans. This section of the report provides an assessment of the impacts that the Holeyland plans will have on the frequency and severity of expected shortages and presents estimates of the drought damage reductions this would entail.

It is important to note that in this analysis the Holeyland reservoir is treated as an integral part of the C&SFFCP. Thus, while the Holeyland reservoir will be providing water directly to the Everlgades Agricultural Area, the net system impact will be to increase the supply capabilities of other storage areas. This additional supply capability may be used to benefit agricultural or urban interests in either the Lake Okeechobee or Lower East Coast areas depending on the needs and priorities established at the time of need.

The first step in this process is to analyze the adequacy or inadequacy of system supply capabilities under the Interim Action Plan. The chief indicator used to measure this capability was the minimum total available water storage for Lake Okeechobee and the Water Conservation Areas for each of the hydrologic years (November to October) from 1964 to 1981.This is defined as the estimated total water available for release from Lake Okeechobee and the three Water

Conservation Areas. The quantities calculated represent storage above stages of 9.2 ft NGVD for Lake Okeechobee and 10.0, 7.0, and 6.0 ft NGVD for WCA 1, WCA 2, and WCA 3, respectively.

These data, presented in Table 5, show that in three and possibly four of the eighteen years the system supply capabilities would be in serious question. Under conditions of low storage, such as those estimated for 1964-1965 and 1980-1981, the declaration of a water shortage and the requiring of use reductions would be an appropriate management strategy in order to avoid even more serious damages later should the system storage become fully depleted. For purposes of further analysis, a minimum storage level of 400,000 acre feet will be used to divide situations requiring water use cutbacks from those which do not. Thus, the lowest three years under the Interim Action Plan are considered those under which a water shortage declaration would take place.

A system indicator which tends to confirm the interpretations made of the system storage levels is the stage in Lake Okeechobee. In the three worst years, the minimum stage in the lake was below 10.5 feet. In the fourth year, it was close but slightly above 10.5 feet. In the other years, it was above 11 feet.

The next step is to estimate the additional supplies which would be available as a result of the Holeyland storage areas. To do this, storage differences were calculated for the days on which minimum storage occurred as presented in Table 5. These data are presented in Table 6. The storage differences refer only to Lake Okeechobee and the three Water Conservation Areas because the Holeyland is not a major factor in system storage at low points since it will be the first priority source of irrigation water for the Everglades Agricultural Area.

Storage differences are presented as an average for both the three years when minimum storage was the lowest and for the full eighteen years covered in the analysis. This was because, while the performance of the Holeyland plans under low water conditions was of primary concern, an examination of the data indicated that the measured performance of the Holeyland plans in the years of concern depended more on the situation as the year began than on what took place during the year of low water conditions.

The data indicate that all the Holeyland plans provide significant additional storage. The pattern also emerges that the higher and the steadier the schedule, the greater the contribution.

TABLE 5 - MINIMUM AVAILABLE WATER IN SYSTEM STORAGE UNDER THE INTERIM ACTION PLAN[1] (IN RANK ORDER)

YEAR	DATE OF MINIMUM STORAGE	MINIMUM STORAGE (ACRE FEET)
1968-1969	6/4/69	3,008,000
1979-1980	7/15/80	2,728,000
1969-1970	5/23/70	2,707,000
1978-1979	7/10/79	2,120,000
1965-1966	5/21/66	1,739,000
1966-1967	6/2/67	1,713,000
1971-1972	4/28/72	1,483,000
1967-1968	5/7/68	1,310,000
1977-1978	6/18/78	1,225,000
1974-1975	5/11/75	1,000,000
1975-1976	4/30/76	872,000
1970-1971	6/6/71	720,000
1963-1964	4/24/64	636,000
1976-1977	5/3/77	623,000
1972-1973	6/6/73	438,000
1964-1965	6/6/65	283,000
1980-1981	7/17/81	125,000
1973-1974	5/31/74	-20,000[2]

[1]Represents the estimated total water available for release from Lake Okeechobee and the three Water Conservation Areas. The quantities calculated represnt storage above stages of 9.2 ft NGVD for Lake Okeechobee and 10.0 ft, 7.0 ft, and 6.0 ft NGVD for WCA 1, WCA 2, and WCA 3, respectively.

[2]At this time there had also been an accumulated total of 73,500 acre feet of demands not met.

TABLE 6 - ADDITIONAL STORAGE AVAILABLE
AS A RESULT OF THE HOLEYLAND PLANS

HOLEYLAND PLAN	ADDITIONAL SYSTEM STORAGE (ACRE FEET) AVERAGE FOR EIGHTEEN YEARS	AVERAGE FOR LOWEST THREE YEARS
3 feet flat	288,000	228,000
4 feet flat	332,000	297,000
3 feet fluct.	241,000	157,000
4 feet fluct.	290,000	210,000
2 feet fluct.	173,000	87,000
2 feet fluct. (to Manley Ditch)	187,000	93,000

The value of additional water supplies in years when water use is restricted has been estimated by the District at $250 per acre foot for situations in which the cutback levels are mild and properly managed[1]. This value is associated with impacts such as the slowing of growth of sugarcane and pasture, the changing of lawn watering schedules to inconvenient hours and the forced reduction of domestic inside water use. This same value has also been selected for use in this analysis.

For each Holeyland plan, dollar benefit estimates for the additional water supplies were next formulated using the estimated reductions in demands not met plus the additional storage for that plan for each of the three years when additional storage would be of benefit. Any amount of the additional storage which would raise total system storage above 400,000 acre feet was not credited since it was thought that this would extend the storage above that needed to avoid a water shortage declaration. The total credited additional storage for the three years was multiplied by the estimated $250 per acre foot value and divided by eighteen to put the analysis on an annual basis. These estimated annual water supply benefits are presented in Table 7 along with a present value sum of this annual benefit over a period of twenty years. This latter value is especially useful if it is desired to compare the water supply benefits of the Holeyland plans to their costs. The twenty year period was selected to correspond with average expected life of Holeyland capital improvements. A discount rate of ten percent per annum was used in estimating the present value of future benefits.

4) Water deliveries to Everglades National Park

As can be seen in Table 8, the average monthly discharges to the ENP, estimated by the simulation model, do not appreciably change with the management alternatives evaluated, but they are between 10 to 23% higher than historical. The interim action plan alternative will result in higher annual discharges to the Park than any of the Holeyland alternatives, but the higher discharges will occur during the wet season months (June-November).

5) Water quality impacts on ENP

The general water quality impacts on the ENP of any of the Holeyland alternatives can be estimated by examining the water quality changes that occurred at the S-12 structures during the recent period that the Interim Action Plan was in effect. The potential concern is that the water quality at

[1]South Florida Water Management District, An Analysis of Water Supply Backpumping for the Lower East Coast Planning Area, February, 1982, pp.50

TABLE 7 - ESTIMATED AGRICULTURAL AND MUNICIPAL WATER SUPPLY BENEFITS OF THE HOLEYLAND PLANS

HOLEYLAND PLAN	ANNUAL EXPECTED VALUE OF BENEFITS	20 YEAR PRESENT VALUE OF EXPECTED BENEFITS
3 feet flat	$ 9,698,000	$ 82,569,000
4 feet flat	10,516,000	89,533,000
3 feet fluct.	7,548,000	64,264,000
4 feet fluct.	9,058,000	77,120,000
2 feet fluct.	4,646,000	39,556,000
2 feet fluct. (to Manley Ditch)	4,905,000	41,761,000

TABLE 8. MONTHLY AVERAGE DISCHARGES TO ENP (Ac-Ft)

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Interim Action	37,718	28,311	29,607	18,924	21,717	36,120	59,317	71,858	95,819	115,137	97,068	53,675	665,271
Holeyland 4' Flat Plan	35,438	26,015	27,011	16,472	18,819	30,322	48,374	58,484	83,161	108,091	89,882	51,512	593,581
Holeyland 2' & Rotenberger 2' Fluctuation Schedules including Manley Ditch	35,372	26,007	28,456	17,604	19,801	31,984	50,136	59,640	84,292	108,817	90,372	52,134	604,615
Historical	25,052	24,608	30,104	23,562	17,409	35,525	56,981	65,952	76,684	80,714	64,767	39,749	541,108

the S-12 structures will deteriorate due to the diverting of the poor quality runoff from the S-2 and S-3 drainage basin south into WCA 3A. In this analysis the worst case situation is evaluated since water quality at S-12D during the 2 year IAP is compared directly to data at the same station during a similar 2 year period. This comparison does not take into account any of the considerable mitigation effect that the Holeyland may have on water quality from the EAA as discussed elsewhere in this report. Also, S-12D is directly connected hydraulically to S-8 via the Miami Canal and L-67A, resulting in the minimum opportunity for water quality improvements between the EAA and the ENP.

The results of comparing water quality values measured at S-12D before and during the IAP support the following findings and conclusions.

(a) The nutrient concentrations at S-12D are very similar to background concentrations measured in the interiors of WCA 2A and WCA 3A.

(b) The two year IAP did not appear to have any significant effect on nutrient concentrations at S-12D.

(c) The concentrations of six trace metals appeared unaffected by the IAP. The concentrations of copper and lead may have slightly increased during the IAP, however, only limited comparison data were available prior to the IAP and no metals consistently exceeded either the ENP or State of Florida water quality standards.

(d) Residues of chlorinated hydrocarbons such as aldrin/dieldrin, chlordane, DDT and heptachlor are detected in the sediments at S-8, WCA 3A, and L-67A near S-12D. Although all of these compounds were previously used by the agricultural industry in the EAA, all are now either banned or restricted for use in control of termites. Since these compounds are highly persistent, the residues in the sediments undoubtedly represent the impacts of prior widespread use.

    Aldrin, chlordane, and heptachlor have been detected in the water of L-67A in January and April of 1980. However, no residues have been detected there since July 1980 and none were detected at five other locations in WCA 3A in December 1980.

III. RECOMMENDATIONS

A. General Management Strategy

The implementation of management actions in the Lake Okeechobee region is a very ambitious endeavor; therefore, it is proposed that a phased approach over a number of years be used.

Phase I is composed of five major activities:

...Continuation of the Interim Action Plan for five years.

...Acceleration of implementation of BMP programs in the Taylor Creek/Nubbin Slough basin through existing cooperative programs.

...Continuation of the District's regulatory program to include water quality limitations for any new construction of drainage systems in all areas tributary to Lake Okeechobee. Regulation of existing systems will be implemented if necessary.

...Continuation and completion of the Kissimmee River Survey Review.

...Continuation of the District water quality monitoring program for Lake Okeechobee and its tributaries.

The District will continue to support and augment the current BMP implementation efforts in the Taylor Creek/Nubbin Slough basin. A twenty month implementation period has been allotted for the completion of this element of Phase I. Additionally, we will continue our cooperation and coordination with the Corps of Engineers and other agencies involved in the Kissimmee River Restudy.

Throughout the District, this agency presently regulates existing and new agricultural and urban surface water management systems. It is proposed to broaden the regulatory activity to include water quality requirements for new agricultural construction in areas tributary to Lake Okeechobee. This approach will aid in preventing an increase in nutrient loadings to the lake from the surrounding areas. New construction would include modifications of existing systems due to more intensive land use or development of raw land, for agricultural and urban purposes. Regulation of existing systems would be implemented as required. Finally, Phase I includes continuation of the District's existing water quality monitoring program for Lake Okeechobee and the basins tributary to it.

The framework of this proposal provides an opportunity for the agricultural community and the agencies involved to come to a concensus as to the effectiveness of BMPs in terms of reduction of nutrient loads and the impacts of BMPs on agricultural production.

This first phase voluntary approach for existing operations is recommended because of the current uncertainty regarding the effectiveness of BMPs. Additionally, experience over time will allow the District to develop criteria which would be used effectively in a modified regulatory program, if such is deemed necessary for existing systems.

The conclusion of Phase I will mark a major milestone and a "fork in the road." At that time, progress toward implementation of management actions will be assessed to determine what steps will be necessary in Phase 2. Among the issues to be considered under Phase 2 are the following:

1. How effective have the management actions already taken been in improving water quality?

2. Are other water quality trends emerging?

3. How much further reduction in nutrient loading is necessary from all tributaries to the lake?

Figure 13 outlines the sequence of tasks which will take, in all, several years to accomplish. Phase I will conclude in mid-1988 and implementation of Phase II will commence at that point.

B. Everglades Agricultural Area (S-2 and S-3)

Both the Interim Action Plan (IAP) and the alternative of Holeyland water storage and recycling will meet the desired load reductions for total nitrogen and total phosphorous for the S-2 and S-3 pump stations. In terms of cost, the IAP does not have any additional capital expenditures associated with it, only a shifting of some of the operation and maintenance costs away from S-2 and S-3 to the southerly pump stations (S-6, S-7 and S-8). The Holeyland/Rotenberger Plan has an estimated construction cost of approximately $8.7 million, based on the District proceeding "on its own" to build the projects. The primary consideration in the staff's earlier recommendations to proceed with the Holeyland/Rotenberger Plan rather than make the IAP permanent was the difference in regional water supply storage. This difference is highlighted in Tables 5 and 6 on pages 34 and 35. The various Holeyland/Rotenberger water level schedules analyzed indicate that an additional 93,000-297,000 AF of water would be available for use during the three most critical periods (late spring/early summer of 1965, 1974 and 1981), as compared to the IAP.

Water supply and other aspects of the proposed Plan have undergone extensive review and scrutiny between November 1982 and the present, with no clear consensus on how the Plan should proceed. Differences of opinion still exist regarding the boundary configuration/land exchange proposals, and acceptable water level schedules and management objectives in the Holeyland and Rotenberger areas (refer to Figure 14 for land exchange proposals). However, there is a consensus that restoration of the Holeyland and Rotenberger areas is a valid state and regional goal. Further, the Holeyland/Rotenberger restoration issue is much broader than the issue of meeting water quality limitations for the S-2 and S-3 pump stations, since it is intricately related to long-term management strategies for the Water Conservation Areas and regional water supply storage. Based on these considerations, it is therefore recommended that the Holeyland/Rotenberger Plan be deleted from further consideration under the Lake Okeechobee T.O.P. process. Instead, it is proposed that the District apply for a five-year operating permit for all 14 structures currently under the T.O.P., utilizing the IAP to meet the load reductions

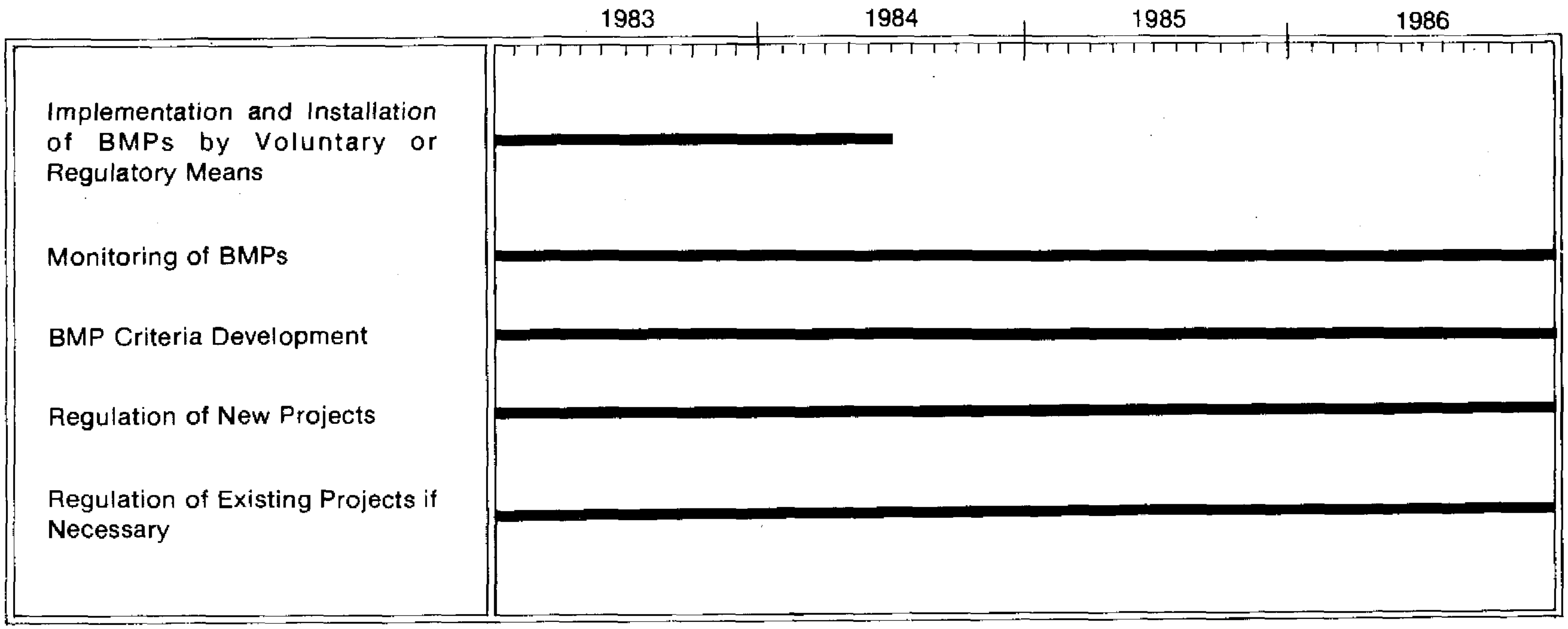


Figure 13 WATER QUALITY MANAGEMENT STRATEGY FOR LAKE OKEECHOBEE IMPLEMENTATION SCHEDULE FOR TAYLOR CREEK/NUBBIN SLOUGH BASIN

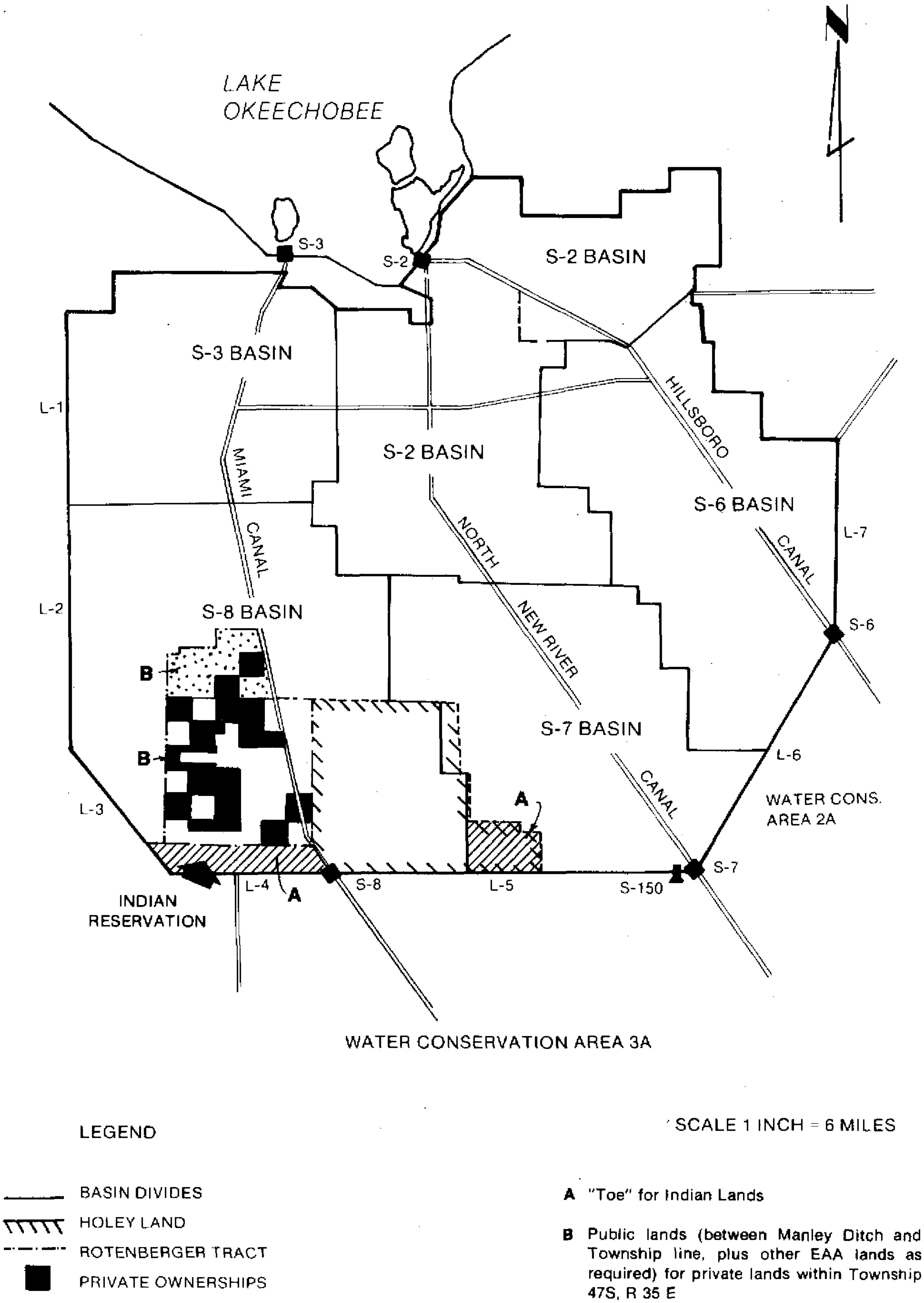


Figure 14 PROPOSED LAND EXCHANGES

for the S-2 and S-3 pump stations. The Holeyland/Rotenberger Plan would be handled as a separate issue outside of the Lake Okeechobee T.O.P. process. This strategy would be reexamined prior to the expiration date of the five-year operating permit.

C. Taylor Creek/Nubbin Slough (S-191)

Many programs are in existence which are providing financial support needed for the implementation of Best Management Practices (BMPs) as well as the data to analyze and evaluate the effectiveness of these practices in terms of reducing nutrient loads. Some of these programs are funded by the federal government through the local Agricultural Stabilization and Conservation Service (ASCS) offices, with Soil Conservation Service (SCS) providing technical support.

The Taylor Creek/Nubbin Slough Basin Project was funded through the Rural Clean Waters Program (RCWP) which is being administered through the local ASCS Okeechobee office. Only 33 watersheds in the nation were selected for funding through this program. Over one million dollars have been allocated by the federal government for the implementation and evaluation of BMPs in this watershed. The ASCS, the SCS, and the District are partners in this program, with the ASCS assuming the leadership role. The District has been involved with this program from its inception and is responsible for the monitoring program which will document the effectiveness of the BMPs implemented through funding support offered by the RCWP. Recently initiated, the program has a life of approximately 10 years.

Other programs are in existence; for example, the Upland Retention/Detention Demonstration Project which was initiated by the Coordinating Council on the Restoration of the Kissimmee River and Taylor Creek/Nubbin Slough. It involves the installation of BMPs at five sites located throughout the Lower Kissimmee River Valley and Taylor Creek/Nubbin Slough. This program has been administered and implemented jointly by the Council and the District. It is recommended that the District assume total responsibility as soon as practicable for this program. Another existing and on-going program in this area is the Taylor Creek Headwaters Program, also initiated by the Coordinating Council and inherited by the District in the spring of 1981.

The District has been and is currently assuming leadership and partnership roles in all of the programs. The experience with the design and implementation of the BMPs, the data collected before and after installation of the BMPs, and the communication between the District and the farmers in the area are invaluable opportunities to develop and implement a feasible plan to reduce nutrient loadings to Lake Okeechobee.

Other state programs are emerging to provide coordinated technical and some financial assistance towards the implementation of BMPs. The Department of Environmental Regulation, in support of the Agricultural Nonpoint Source Element of the State Water Quality Management Plan, has developed a state strategy for the implementation of BMPs. This program proposes a non-regulatory program administered statewide by the DER and implemented using the authority and resources of County Soil and Water Conservation Districts, in cooperation with the ASCS, SCS, and the Florida Department of Agriculture and Consumer Services. The Institute of Food and Agricultural Sciences is proposed as the agency to provide research assistance in evaluating the effectiveness of BMPs as to their impact on the quality of receiving waters and their impact on agricultural production. The District proposes that increased funding for cost sharing assistance be requested, particularly through the new activities of the Florida Department of Agriculture and Consumer Services. District staff have been working with FDACS staff to develop a cooperative approach for installation of BMPs into new construction activities.

APPENDIX

RECEIVED
JAN 31 1983
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

FLORIDA GAME AND FRESH WATER FISH COMMISSION

FARRIS BRYANT BUILDING
620 South Meridian Street
Tallahassee, Florida 32301

January 21, 1983

Mr. John R. Maloy
Executive Director
South Florida Water Management
District
Post Office Box V
3301 Gun Club Road
West Palm Beach, FL 33402

Dear Mr. Maloy:

We have your 10 January 1983 letter requesting harvest records from wildlife management areas (WMA) near the EAA and projected harvest levels for the Rotenberger WMA assuming a 0- to 1-foot variable schedule. Enclosed are tables showing harvest levels of three game species on the Rotenberger, Holey Land, Brown's Farm and Everglades WMAs. This information should be self-explanatory.

Your second request for projected harvest levels on the Rotenberger WMA is more difficult to provide. Relatively little is known about Rotenberger topographic relief and no previous Everglades habitat restoration projects have been undertaken. We can not, therefore, project future wildlife populations and wildlife harvest as a result of more water. However, we expect that deer populations and deer harvest will be lower under a 0- to 1-foot schedule than under the hydrologic conditions of recent years, and perhaps significantly so.

Most deer on the Rotenberger WMA occur in the northern one-half of the area. If the lands between the Manley Ditch and the Rotenberger Township were excluded from the restoration project and subsequently developed for economic purposes, the deer herd would be severely reduced, and this impact would be most unwelcomed.

Orig: ✓Mr. Reel
XC: Exec. Office, Rhoads, Dineen

The 0- to 1-foot schedule you propose should be favorable to the development of wet prairie communities that provide valuable waterfowl winter habitat, and waterfowl populations should increase. Wetter conditions should also provide more snipe and other shorebird habitat. Numerous wading birds, including the endangered wood stork, will be afforded favorable feeding conditions due to the increased hydroperiod. Longer hydroperiods should also benefit marsh nesting wildlife species such as gallinules, waterfowl, rails, bitterns, alligators and various passerine birds by providing more attractive and predictable nesting conditions.

Practically any reasonable schedule should encourage the development of woody vegetation on the higher portions of the area through reduction of destructive fires. Hopefully, some of the tree islands that have been burned out of the area will be reestablished. Reestablishing tree islands will increase vegetation diversity and provide improved habitat for a wide range of Everglades wildlife.

The district's 0- to 1-foot schedule is acceptable as an interim schedule for the restoration of Everglades habitat on the Rotenberger WMA. However, depending on vegetation and wildlife community response to this schedule, schedule alteration (including possible increases) may be appropriate, even obligatory, in the future. Consequently, structural features should accommodate higher regulation schedules and water levels which may result from abnormally heavy precipitation.

An important point we want very much to stress is that restoration of Everglades habitat in the Rotenberger was a prime consideration at the time of acquisition and we are aware of no change in that intent. While your letter emphasized the impacts of water on game and game harvests, it is important to stress that a diversity of Everglades wildlife, in general, will benefit from restoration efforts. While some species will decline, others will increase and, hopefully, a proper balance can be struck. That is why it is important to retain flexibility on the matter of water schedules.

If you have any questions regarding this information, please do not hesitate to call or write.

Sincerely,

Bob Brantly

Colonel Robert M. Brantly
Executive Director

W745jg5/17-18
WLD 8-5-2 (Rotenberger)
Enclosures
cc: Mr. Fred Stanberry
Major O. G. Kelley
Mr. Brad Hartman
Mr. Jim Schortemeyer
Mr. Bob Ellis

The number of deer, hogs and ducks harvested per year on the Everglades Wildlife Management Area[1] from 1967 to 1982.

Year	Number Harvested			
	Deer		Hogs	Ducks
1967-68*	319		38	5,775
1968-69	123		13	1,642
1969-70	480		20	8,836
1970-71*	Season Closed		Season Closed	Season Closed
1971-72	650E	298C	ND	5,300
1972-73	610E	183C	ND	1,650
1973-74	820E	617C	55	123
1974-75	610E	246C	12	ND
1975-76	700E	288C	3	ND
1976-77	809E	535C	2	ND
1977-78	486E	237C	Closed	ND
1978-79	383T		16	ND
1979-80*	262T		1	750
1980-81*	58T		17	ND
1981-82[1]	585T		78	ND
1982-83*	830T		0	ND

E = Estimated
C = Actually Checked
* = Special Regulations and Quotas in Force
1 = Includes Conservation Areas 2 and 3
T = Total Harvest - Mandatory Check Stations

W745dr5/1

The number of deer, hogs and ducks harvested per year on the Rotenberger Wildlife Management Area from 1967 to 1982.

Year	Number Harvested			
	Deer		Hogs	Ducks
1967-78	ND		ND	ND
1968-69	ND		ND	ND
1969-70	ND		ND	ND
1970-71	Season Closed		Season Closed	ND
1971-72	200E	93C	ND	ND
1972-73	300E	195C	ND	ND
1973-74	390E	196C	2	ND
1974-75	425E	351C	2	ND
1975-76	250E	163C	ND	ND
1976-77	187E	117C	ND	ND
1977-78	221E	127C	ND	ND
1978-79*	103E	82C	4	ND
1979-80*	241E	217C	6	ND
1980-81*	124E	99C	ND	ND
1981-82*	372T			ND
1982-83*	261T			2

E = Estimated
C = Actually Checked
* = Special Regulations or Quotas in Force
ND = No data
T = Total Harvest - Mandatory Check Stations

W745dr5/3

The number of deer, hogs and ducks harvested per year on the Holey Land Wildlife Management Area from 1967 to 1982.

Year	Number Harvested: Deer		Hogs		Ducks
1967-68	ND		ND		ND
1968-69	ND		ND		ND
1969-70	ND		ND		ND
1970-71	Season Closed		Season Closed		ND
1971-72	10E	4C	ND		ND
1972-73	30E	20C	ND		ND
1973-74	60E	46C	ND		ND
1974-75	55E	42C	ND		ND
1975-76	200E	124C	ND		ND
1976-77	191E	113C	ND		ND
1977-78	144E	74C	ND		ND
1978-79	77T		5		ND
1979-80	50T		7		ND
1980-81*	24T		14		ND
1981-82*	24T		4E	3C	ND
1982-83*	54T		17		ND

E = Estimated
C = Actually Checked
* = Special Regulations and Quotas in Force
ND = No data
T = Total Harvest - Mandatory Check Stations

W745dr5/2

The number of deer, hogs and ducks harvested per year on the Brown's Farm Wildlife Management Area from 1967 to 1982.

Year	Number Harvested		
	Deer	Hogs	Ducks
1967-78*	ND	ND	ND
1968-79*	ND	ND	ND
1969-70*	ND	ND	ND
1970-71	69	ND	ND
1971-72	40	ND	ND
1972-73	42E 28C	1	ND
1973-74	115E 60C	ND	ND
1974-75	97E 77C	11	ND
1975-76	51E 43C	4	ND
1976-77	85E 61C	2	ND
1977-78	81E 57C	21E 12C	ND
1978-79	77E 54C	12E 11C	ND
1979-80	33E 27C	16E 13C	ND
1980-81	22T	21	ND
1981-82	24T	4E 3 C	ND
1982-83	23T	9	ND

E = Estimated
C = Actually Checked
* = Not yet a WMA
ND = No data
T = Total Harvest

W745dr5/5