TECHNICAL MEMORANDUM

AN ATLAS OF THE UPPER KISSIMMEE SURFACE WATER MANAGEMENT BASINS

by

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February 1992

DRE 309

Water Resources Engineering Division
Department of Research and Evaluation
South Florida Water Management District

AN ATLAS OF UPPER KISSIMMEE RIVER SURFACE WATER MANAGEMENT BASINS

EXECUTIVE SUMMARY

This atlas contains information about the surface water management basins in the Upper Kissimmee River watershed (UKRW). Sections of the following four counties in Central Florida comprise the UKRW:

Orange County (northern part of the UKRW)
Lake County (a small section of northwestern UKRW)
Osceola County (eastern and northwestern part of the UKRW, approximately 50 percent of the UKRW total area)
Polk County (central and southwestern part of UKRW)

The South Florida Water Management District (District) and the U.S. Army Corps of Engineers (COE) have primary authority over water management in these basins. Other agencies involved in water management exist within the UKRW. The District has sponsored publication of this atlas so that up-to-date, nontechnical descriptions of the surface water management basins in the Upper Kissimmee River watershed are available to District personnel, to local governments in Osceola County, Polk County, Orange County, and Lake County, and to other interested persons.

The surface water management basins of the UKRW were first studied in the mid 1950s by the COE in their General Design Memoranda (GDM) for the Central and Southern Florida Project (Project) for flood control and other purposes. Based on the hydrology of the basins, the COE designed and constructed a conveyance system consisting mainly of canals and control structures to provide flood protection for southern and central Florida. Mean sea level (m.s.l.) datum was used by the COE in its designs, NGVD is used in this atlas. For practical purposes, elevations from m.s.l. and NGVD are the same in this area. The Project is dynamic to meet the changing needs of the involved area. New structures are being constructed and existing ones modified to improve the system. Most of the works under the Project are now under the management of the District.

By text, maps, and tables of information, the following 18 basins are described in this atlas: Alligator Lake, Lake Gentry, S-63A, Canoe Creek, Lake Cypress, Lake Myrtle, Lake Hart, Boggy Creek, East Lake Tohopekaliga, Shingle Creek, Lake Tohopekaliga, Reedy Creek, Horse Creek, Lake Pierce, Lake Hatchineha, Lake Marian, Lake Weohyakapka, and Lake Kissimmee. The total area of the Upper Kissimmee River watershed is 1,596 square miles.

The Project canals in the UKRW serve a variety of functions. The canals together with the lakes form the chain that conveys the water from the entire Upper Kissimmee River watershed to Lake Kissimmee. This basin represents a major contribution to Lake Okeechobee through the Kissimmee River (C-38). The primary function of all the canals is to provide flood protection for the basins in which they are located. Secondary uses of the canals are to enable regulation of connected lakes for environmental and recreational purposes, and as well as to provide land drainage from the adjacent areas.

The Project control structures in the UKRW regulate the flow of water in the canals and in the lakes. Their primary use is to discharge excess water from the lakes during flooding, to provide environmentally desirable fluctuations, and to maintain minimum water levels in the canals and lakes to prevent overdrainage.

A bibliography is included in this atlas listing publications concerning hydrology, hydraulics, water use, water quality and land use in the Upper Kissimmee River watershed. For the reader unfamiliar with some of the concepts and terms used in these descriptions, the appendices contain a discussion of some basic hydraulic and hydrologic concepts, and a glossary of terms.

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ABSTRACT

An atlas of the surface water management basins in the Upper Kissimmee River watershed (UKRW) covering part of Osceola, Polk, Orange and Lake counties in Central Florida, is presented. The UKRW yields a major contribution to Lake Okeechobee and consists of 18 basins. These basins are described together with their canals and control structures. Description and discussion of the water works within the UKRW are limited to those constructed for the Central and Southern Flood Control District (Project). Information with regard to operation and management of the system is also provided.

ACKNOWLEDGMENTS

The author is thankful to many people who contributed to the completion of this publication: to Jorge Marban, Jim Lane, Ron Mierau, and Shawn Sculley for their suggestions and comments; to Nettie Winograd for preparing the text for publication; to Joan Stockum for developing the land use map; to Bob Macartney for drawing the DOT map; to Grace Colon and Jane Walters for the Lake Regulation Schedule graphs and figure titles; to Charles Gove for providing some of the references used in this publication. Special thanks are due to Madhav Pandey for creating the location and basin maps supporting this atlas.

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AN ATLAS OF UPPER KISSIMMEE RIVER SURFACE WATER MANAGEMENT BASINS

INTRODUCTION

This atlas contains information about the surface water management basins in the Upper Kissimmee River watershed (UKRW). Sections of the following four counties in Central Florida make up the UKRW:

Orange County (northern part of the UKRW)
Lake County (a small section of northwestern UKRW)
Osceola County (eastern and northwestern part of the UKRW approximately 50 percent of the UKRW total area)
Polk County (central and southwestern part of UKRW)

The South Florida Water Management District (District) and the U.S. Army Corps of Engineers (COE) have primary authority over water management in these basins. However, other agencies also are involved in water management within the UKRW.

There are several drainage districts located in this region; the most important are:

1. Reedy Creek Improvement District which includes Walt Disney World. This district, within the Reedy Creek basin occupies a major part of the northwestern area of the UKRW in southwestern Orange County and northwestern Osceola County. This is the most heavily populated and intensely developed area of the entire Kissimmee River watershed, which also includes the southern half of the city of Orlando. This district operates and maintains a system of canals and control structures for water management purposes.

2. The Valencia Water Control District, located in the Shingle Creek basin area, consists of a 7.2 square-mile tract in southwestern Orange County; its primary water quality management strategy involves the Blue Stone Tract. This is a two-square mile parcel where a cypress strand is used to receive water prior to entering Shingle Creek.

3. The Haines City Drainage District, established in 1925, is located in Polk County within the Lake Hatchineha basin at the western boundary of the UKRW.

Major cities of the UKRW include Kissimmee and St. Cloud. Kissimmee is the hub of the cattle industry in central Florida, and is in the Lake Tohopekaliga basin. The city of Kissimmee does not have surface water management regulations. St. Cloud, located in the East Lake Tohopekaliga basin, is just south of East Lake Tohopekaliga. Both Kissimmee and St. Cloud are located in Osceola County.

The District has sponsored publication of this atlas so that up-to-date, non-technical descriptions of the surface water management basins in the UKRW are available to District personnel, to local governments in the counties of Osceola, Polk, Orange and Lake, and to other interested persons. By text, maps, figures, and tables, the basins are described and located within the UKRW. The canals and control

structures within each basin are managed by the District and the COE. They are described in detail in this atlas.

The surface water management basins of the UKRW were first delineated in the mid-1950s by the COE in their General Design Memoranda (GDM) for the Central and Southern Florida Project (Project) for flood control and other purposes. Presented in the GDM were the COE's hydrologic analysis of each basin and an assessment of the flood risk for a storm of specified duration and intensity. Based on the hydrology of the basins, the COE designed and constructed a conveyance system consisting mainly of canals and control structures to provide flood protection for each basin. Designs of these works were presented in the GDM and in the Detailed Design Memoranda for the Project. Most of the hydraulic works constructed under the Project are now under the management of the District.

The Project has evolved to meet the needs caused by population growth, land use development, and increased water demands. A current land use map is included in this publication (refer to pocket of flyleaf). Some parts of the original Project were never constructed, other parts were rebuilt or modified, and, as the need arose, new structures were designed and constructed to improve the system. In some instances, the basins themselves have been redefined. This atlas includes the new boundary between Alligator Lake basin and Lake Myrtle basin. This boundary was redefined based on the location of S-58, which regulates part of the flow from Alligator Lake basin to Lake Myrtle basin.

This atlas describes the 18 surface water management basins that form the UKRW, and the Project works associated with each. The UKRW in the counties of Osceola, Polk, Orange and Lake covers an area of 1,596 square miles .

The lakes are an important feature of the UKRW. The eastern chain of lakes may flow either north from Alligator Lake to Lake Mary Jane or south to Lake Gentry. The chain of lakes flowing north consists of Alligator Lake, Lake Lizzie, Coon Lake, Trout Lake, Lake Joel, Lake Myrtle, and Lake Mary Jane, which connects to Lake Hart. The chain flowing south consists of Alligator Lake and Lake Gentry, which connects to Cypress Lake. The western chain begins with Lake Hart, continues with Ajay Lake, East Lake Tohopekaliga and Lake Tohopekaliga, discharging into Cypress Lake. From Cypress Lake the chain continues with Lake Hatchineha and, finally, Lake Kissimmee. These last three lakes and their tributaries were previously known as the Middle Kissimmee River basin. The Department of Transportation (DOT) map prepared by the District shows all the pertinent features in the UKRW (refer to pocket of flyleaf). All the major lakes in this basin are shallow, with mean depths varying from 6 to 13 feet.

A considerable number of lakes in this watershed are identified as priority water bodies in the Surface Water Improvement and Management (SWIM) Plan. Some of them, such as Lake Tohopekaliga, East Lake Tohopekaliga and Lake Weohyakapka, are considered of high priority in the SWIM Plan development process.

Since 1971, extreme drawdowns have been used to improve aquatic habitat in some of the UKRW lakes. Basic results included consolidation of bottom sediments and expansion of rooted aquatic vegetation communities. Following flooding, fish food organisms increased tremendously. Three extreme drawdowns have been conducted in Lake Tohopekaliga, one in 1971, one in 1979, and one in 1987.

Extreme drawdowns took place in Lake Kissimmee in 1977 and in East Lake Tohopekaliga in 1990.

Although the basin descriptions are not technical, the reader unfamiliar with the hydrology within the UKRW and with basic water resources engineering may find some words and concepts unfamiliar. When this happens, the reader is referred to the appendices. Appendix 1, which contains definitions of **BASIC CONCEPTS,** discusses the important concepts the reader should be familiar with to understand basin descriptions. Appendix 2 is a glossary of terms, abbreviations and acronyms used in these descriptions.

Using the Basin Description

Surface water management basins (referred to as drainage basins) in the UKRW are identified by the major lake, creek, or Project water control structure. For example, Lake Kissimmee represents the final confluence of the entire UKRW. The basin is named Lake Kissimmee basin and has the largest drainage area. Reedy Creek is the longest creek and has the second largest drainage area. The drainage basin is named Reedy Creek basin. S-63A is a control structure located on the Canoe Creek canal (C-34), and further regulates stages in that canal before discharging into Cypress Lake. The S-63A basin is, in this case, the only example of a basin named for a water control structure.

The drainage basins in the UKRW are shown in the DOT map (placed in pocket of the flyleaf). The map shows the basin boundaries, lakes, creeks, canals, and water control structures relative to local roads and landmarks, and should be referred to precisely locate basin boundaries and District and Project works within the UKRW. A color map is included showing current land use within UKRW and District boundaries.

The **Basin Description** provides general information about each of the 18 basins, including drainage area, relative location, and other hydrologic characteristics of its water bodies,. When applicable, a complete description of the canals and control structures is included under **District Canals and Structures**. **Comments on Historic Operation** provides information about the regulation schedules of the major lakes and their tributaries that form this system. These are: Alligator Lake (S-58 and S-60), Lake Gentry (S-63), Lake Myrtle (S-57), Lake Hart (S-62), East Lake Tohopekaliga (S-59), Lake Tohopekaliga (S-61), and Lake Kissimmee (S-65). Figures showing these regulation schedules are provided. Lake Rosalie is partially regulated by G-103 and Lake Marian is partially regulated by G-113.

Table A contains information about the control structures within the UKRW, and provides a physical description of each structure, i.e., type of structure, location, regulation schedule, pertinent dimensions and elevations, and the recorded maximum daily mean stages and discharges. Where a structure has been designed to pass a specific discharge under specified conditions of upstream and downstream water levels, the information is included as the design discharge, design headwater stage, and design tailwater stage, respectively. The specified discharge is commonly the flood discharge obtained from the **Design Storm** (included in **Basic Concepts**).

Table A. Control Structures in the Upper Kissimmee River Watershed

Structure (Completion)	Location	Regulation Schedule	Type	Design*			Recorded Maximum Daily Mean		
				HW Stage (ft msl)	TW Stage (ft msl)	Discharge (cfs)	HW Stage (ft msl)	TW Stage (ft msl)	Discharge (cfs)
S-58 (Oct 1969)	C-32C, L. Myrtle Basin	Alligator Lake (North)	Culvert 2-54 in x 70 ft CMP Invert elev = 54.5 ft	64.8 62.9	63.0 61.3	160 105	66.05 (Aug 27, 1978)	63.06 (Dec 2, 1987)	N/A
S-60 (Dec 1966)	Alligator-Gentry Canal (C-33) Alligator L. Basin	Alligator Lake (South)	Gated Spillway, RC 1 gate 9.1 ft high x 12.8 ft wide Net crest lgth = 12.0 ft Crest elev = 55.0 ft msl	64.2 62.3	63.3 61.7	450 450	64.54 (Mar 14, 1988)	62.90 (Mar 15, 1988)	399 (Apr 8, 1987)
S-57 (Sept 1969)	C-30, L. Myrtle Basin	Lake Myrtle	Culvert 2-54 in x 80 ft CMP Invert elev = 52.5 ft msl	62.8 60.7	61.6 60.2	170 110	63.64 (Oct 8, 1969)	63.09 (Dec 2, 1987)	172 (Aug 23, 1989)
S-62 (Oct 1969)	C-29, L. Hart Basin	Lake Hart	Gated Spillway, RC 1 gate 6.8 ft high x 14.8 ft Net crest lgth = 14.0 ft Crest elev = 55.3 ft msl	61.3 59.6	60.1 58.8	640 410	69.63 (Apr 29, 1980)	59.36 (Feb 18, 1983)	528 (Jun 21, 1982),
S-59 (Apr 1963)	St. Cloud Canal (C-31), East L. Tohopekaliga Basin	East Lake Tohopekaliga	Gated Spillway, RC 1 gate 8.9 ft high x 18.0 ft wide Net crest lgth = 18.0 ft Crest elev = 49.1 ft msl	57.5 55.8	56.9 55.3	820 590	58.82 (Mar 5, 1966)	57.59 (Feb 17, 1983)	1,097 (Apr 15, 1987)
S-61** (Oct 1963)	South Port Canal, (-35), L. Tohopekaliga Basin	Lake Tohopekaliga	Gated Spillway, RC 1 gate 18.1 ft high x 27.8 ft wide Net crest lgth = 27 ft Crest elev = 36.9 ft msl	54.7 53.1	54.3 52.8	2,300 1,570	56.09 (Mar 4, 1966)	53.71 (Feb 22, 1983)	2,383 (Jan 12, 1986)
S-63 (May 1967)	Canoe Creek Canal (C-34), L. Gentry Basin		Gated Spillway, RC 1 gate 8.1 ft high x 15.8 ft wide Net crest lgth = 15 ft Crest elev = 54.0 ft msl	62.8 60.5	57.5 57.7	715 715	63.44 (July 31, 1967)	57.36 (Aug 20, 1975)	824 (Mar 22, 1988)

in = inches
ft = feet
cfs = cubic feet per second
lgth = length
HW = head water
TW = tailwater
CMP = corrugated metal pipe
RC = reinforced concrete
ft msl = feet relative to mean sea level (ft NGVD)

*The first values for HW Stage, TW Stage, and Discharge (Design) refer to *peak stage* (or upper limit); the second for the same variables refer to *lower profile* (or lower limit). Peak stage is based on lake operation for design flood which allows 2.0 feet of storage above historic average levels. *Lower profile* is based on no rise in lake levels from historic average. Actual operation will probably be closeto *lower profile* for the design flood.

**S-61 and S-65 have lock structures.

***Maximum releases ranging from 3,000 cfs to 11,000 cfs can be handled by S-65, depending on inflow between S-65 and S-65A in such a way that flow at S-65A does not exceed 11,000 cfs.

Table A. Control Structures in the Upper Kissimmee River Watershed

Structure (Completion)	Location	Regulation Schedule	Type	Design*			Recorded Maximum Daily Mean		
				HW Stage (ft msl)	TW Stage (ft msl)	Discharge (cfs)	HW Stage (ft msl)	TW Stage (ft msl)	Discharge (cfs)
S-63A (May 1967)	Canoe Creek Canal (C-34), S-63A Basin	None	Gated Spillway, RC 2 gates 7.7 ft high x 15.8 ft wide Net crest lgth = 30.0 ft Crest elev = 49.4 ft msl	57.0 57.0	53.8 53.2	870 2,000	57.54 (Jul 21, 1983)	53.24 (Feb 22, 1983)	1,519 (Mar 31, 1987)
S-65** (Aug 1964)	Kissimmee River (C-38), L. Kissimmee Basin	Lake Kissimmee	Gated Spillway, RC 3 gates 14.2 ft high x 27.8 ft wide Net crest lgth = 81.0 ft Crest elev = 39.3 ft msl	52.1 51.0	46.4 46.4	3,000 3,000 ***	54.07 (Oct 8, 1969)	51.44 (Oct 10, 1969)	12,100 (Feb 24, 1988)

in = inches
ft = feet
cfs = cubic feet per second
lgth = length
HW = head water
TW = tailwater
CMP = corrugated metal pipe
RC = reinforced concrete
ft msl = feet relative to mean sea level (ft NGVD)

*The first values for HW Stage, TW Stage, and Discharge (Design) refer to *peak stage* (or upper limit); the second for the same variables refer to *lower profile* (or lower limit). Peak stage is based on lake operation for design flood which allows 2.0 feet of storage above historic average levels. *Lower profile* is based on no rise in lake levels from historic average. Actual operation will probably be closeto *lower profile* for the design flood.

**S-61 and S-65 have lock structures.

***Maximum releases ranging from 3,000 cfs to 11,000 cfs can be handled by S-65, depending on inflow between S-65 and S-65A in such a way that flow at S-65A does not exceed 11,000 cfs.

ALLIGATOR LAKE BASIN

Description of the Basin

The Alligator Lake basin, located in Osceola County, has an area of 46.8 square miles (Figure 1A), and is in the central-eastern part of the UKRW (Figure 1B). The surface water features of this basin include the chain of lakes formed by Alligator Lake, Lake Lizzie, Coon Lake and Trout Lake; Live Oak Lake, Sardine Lake, and Buck Lake *are* tributaries of Alligator Lake; Lake Center, *a* tributary of Coon Lake; Bay Lake, *a* tributary of Lake Lizzie, as well as a series of short connecting channels. These nine lakes represent 22.5 percent of the total area of the basin.

Alligator Lake has an area of 5.3 square miles at a stage of 63.5 feet NGVD, and is the uppermost lake in the UKRW. It receives surface inflow from several tributary lakes: Buck Lake and Live Oak Lake through Sardine Lake. The lake also receives runoff from its direct watershed and, at times, from the Lake Lizzie area. Outflow from Alligator Lake can go either north through Lake Lizzie, Coon Lake, Trout Lake, Lake Joel, Lake Myrtle, Lake Mary Jane, Lake Hart and Ajay Lake, to East Lake Tohopekaliga, or south through Lake Gentry. In both cases, the water will end up in Cypress Lake. Because of the limited capacity of the lakes north of Alligator Lake, major discharges occur primarily south to Lake Gentry.

An extensive forested wetland, which still remains relatively undisturbed, exists on the southwest shore of Alligator Lake near its outlet.

District Canals and Structures

Water from Alligator Lake can be released either north or south. Most of the water from Alligator Lake is discharged to the south into Lake Gentry through the Alligator-Gentry Canal (C-33). This canal is 2.6 miles long, of which the first 1.1 miles are in the Alligator Lake basin. These 1.1 miles extend from the outlet of Alligator Lake to S-60. Its design flood water surface varies from 64.6 feet NGVD to 64.2 feet NGVD (upper limit), and from 63.0 feet NGVD.to 62.3 feet NGVD (lower limit) in Alligator Lake and upstream of S-60, respectively. Its design slope is 2.32 feet per mile and its design bottom width is 5 feet.

S-60 is a reinforced concrete, fixed-crest gated spillway with discharge controlled by a stem-operated vertical lift gate. The gate is currently controlled manually in accordance with seasonal operational criteria. The structure is located on C-33 about 1,500 feet upstream of State Road 534 and 3,700 feet downstream of Alligator Lake. The purposes of this structure are: (1) to maintain optimum upstream water control stages in C-33 and in Alligator Lake, (2) to convey the design flood (30 percent of the SPF) without exceeding the upstream flood design stage, and to restrict downstream flood stages and channel velocities to nondamaging levels, and (3) to pass sufficient discharge during low-flow periods to maintain downstream stages when water is available. The water level which will bypass this structure is 71.0 feet NGVD.

Outflow from Alligator Lake drains north to Lake Lizzie by means of C-32G, and runs northeast crossing U.S. Highway 441. The length of C-32G from the shoreline of Alligator Lake to Lake Lizzie is 1,050 feet. C-32G maintains a constant design floodwater stage between 64.8 feet NGVD (upper limit) and 62.9 feet NGVD (lower limit). Its ground-surface slope is nearly flat, and its design bottom width is 5 feet.

Lake Lizzie and Coon Lake are connected by C-32F, which is 0.6 miles long. Its design floodwater surface elevation is 64.8 and 62.9 feet NGVD (upper and lower limits respectively). Its design slope is nearly flat, and its design bottom width is 5 feet.

C-32D connecting Coon Lake to Trout Lake is 0.3 miles in length. Its design floodwater surface elevation is 64.8 feet NGVD (upper limit), and 62.9 feet NGVD (lower limit). Its design slope is nearly flat and its design bottom width is 5 feet.

C-32C connects Trout Lake to Lake Joel which lies within the Myrtle Lake basin. The canal is 2.1 miles in length, with a design bottom width of 5 feet. Its design floodwater surface elevation varies from 64.8 feet NGVD to 63.0 feet NGVD (upper limit), and 62.9 feet NGVD to 61.0 feet NGVD (lower limit).

S-58 which controls Alligator Lake is located on C-32C, 3,700 feet (0.7 miles) downstream of Trout Lake. This structure is a double-barreled, corrugated metal pipe culvert, controlled by stem-operated vertical lift gates. The gates are controlled manually in accordance with the seasonal operational criteria. The purposes of this structure are: (1) To maintain optimum upstream water control stages in C-32 and in Alligator Lake, Lake Lizzie, Coon Lake, Lake Center, and Trout Lake; (2) to pass the design flood (30 percent of the SPF) without exceeding the upstream flood design stage,-restricting downstream flood stages and channel velocities to nondamaging levels; (3) to prevent overtopping of the structure by breaking waves from Trout Lake during the design storm and windy tide, and (4) to pass sufficient discharge during low-flow periods to maintain downstream stages. The water level which will bypass this structure is 70.0 feet NGVD.

Comments on Historic Operation

S-58 is operated in accordance with the Lake Alligator regulation schedule. This schedule represents the desirable water level throughout the year, and ranges between 62.0 and 64.0 feet NGVD. Flood operation is followed if the water-surface elevation is above the prescribed level. Low-water operation is followed if the water-surface elevation is below the prescribed level. The operation also depends on hydraulic and structural limitations of the structure.

S-60 is operated in accordance with the Alligator Lake regulation schedule, which ranges between 62.0 and 64.0 feet NGVD, and indicates the desirable water level throughout the year. Flood operation is followed if the water-surface elevation is above the prescribed level. Low-water operation is followed if the water-surface elevation is below the prescribed level. The operation also depends on hydraulic and structural limitations of the structure.

Flood Control Operations: S-58 controls the discharge north from Alligator Lake, and S-60 controls the discharge south from Alligator Lake. Consequently, discharges from both S-58 and S-60 must be considered to establish release schedules. When the water level in Alligator Lake is within 0.5 feet above the prescribed level, a release schedule, based on forecasted inflow, is established to return the lake to that level within 15 days. When the lake stage is over 0.5 feet from the prescribed level, maximum releases subject to hydraulic and structural limitations are made.

Low-Water Operation: Whenever the lake level is below the prescribed level, minimum releases from S-60 are made to satisfy downstream demands. No releases are made from S-58 when the lake level is below the prescribed level.

Structural Limitations: The maximum water level drop across the S-60 is 7 feet, and the headwater elevation cannot exceed 68.0 feet NGVD. The maximum water level drop across S-58 is 2 feet; the headwater elevation cannot exceed 64.0 feet NGVD.

Hydraulic Limitations: The gate opening for S-60 is controlled in accordance with the "Maximum Allowable Gate Opening Curve" to prevent damage from high velocities. Before large discharges are made, the gate has to be opened gradually to allow tailwater stages to rise.-

S-60 and C-33 were completed in December 1966 for the purpose of providing some regulatory control; however, it was not until the completion of S-58 in October 1969 that full control was possible. The current regulation schedule is shown in Figure 1C.

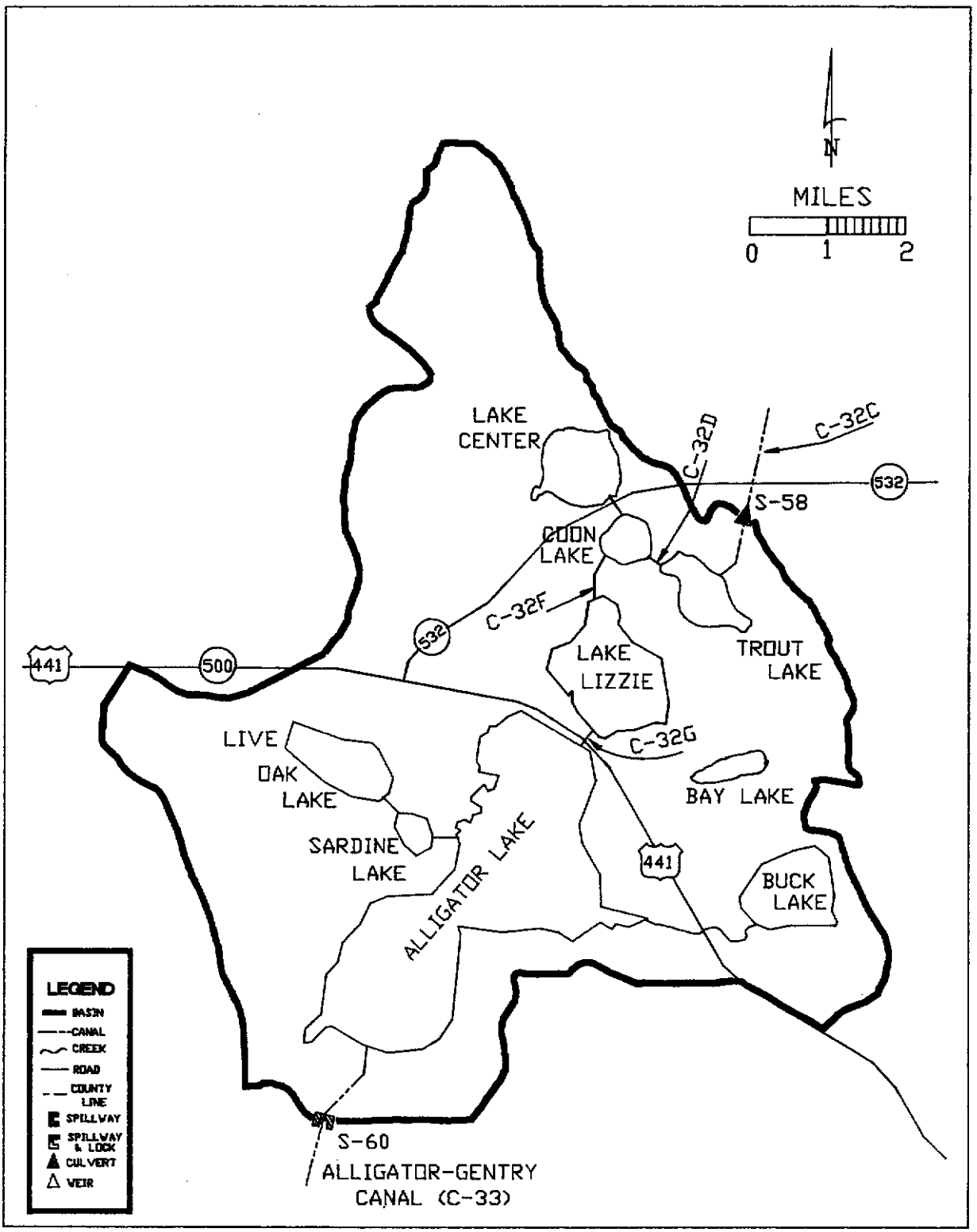


FIGURE 1A. Alligator Lake Basin (29,985 acres).

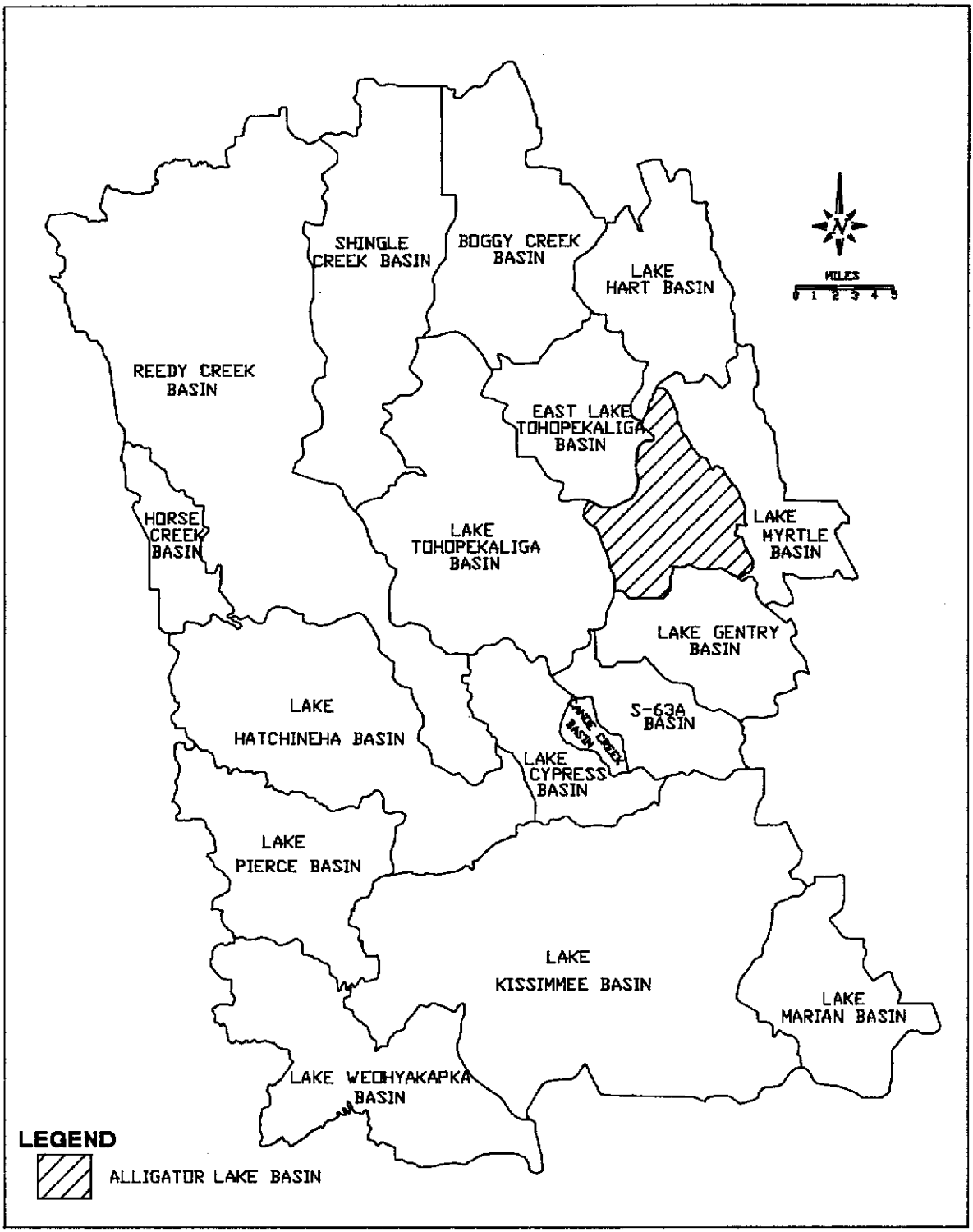
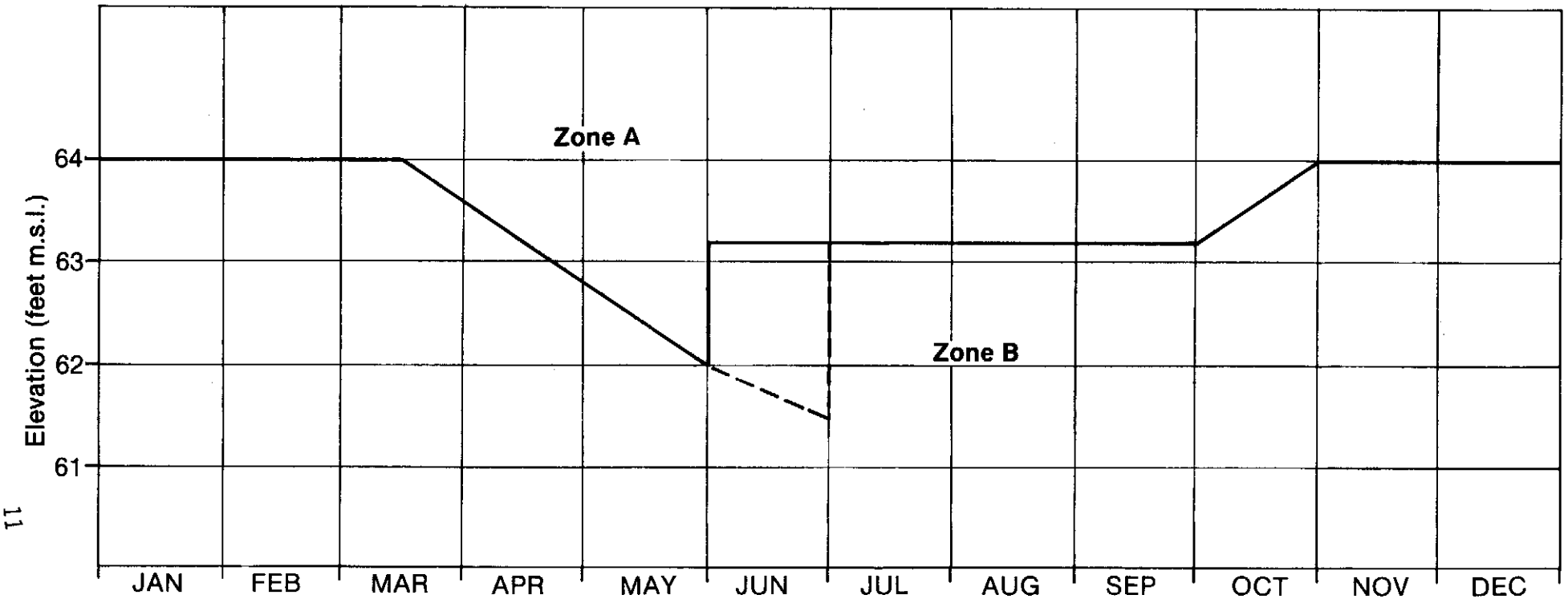


FIGURE 1B. Relative Location of Alligator Lake Basin within the UKRW.



Zone	Releases S-58 & S-60
A	At design capacity (610 cfs) except when the lake is within 0.5 feet of desired stage. Forecasts will then be made and releases started to bring the lake back to schedule within 15 days.
B	To maintain minimum flows.

Note: — — — Use this schedule one year in three.

FIGURE 1C. Alligator Lake Regulation Schedule.

LAKE GENTRY BASIN

Description of the Basin

The Lake Gentry basin, located in Osceola County, has an area of 51.7 square miles (Figure 2A). This basin is in the central-eastern part of the UKRW (Figure 2B). Lake Gentry has an approximate area of 2.8 square miles at a stage of 61.8 feet NGVD.

Most of the water from Alligator Lake discharges into Lake Gentry through C-33 and S-60. Brick Lake (1.2 square miles) and Pearl Lake (80 acres), which are northeast of Lake Gentry, drain southward through the Big Bend Swamp.

District Canals and Structures

The section of C-33 (Alligator-Gentry Canal) from S-60 to Lake Gentry is in the Lake Gentry basin. This reach of C-33 is 1.8 miles long. Its design floodwater surface level varies from 63.3 feet NGVD to 63.0 feet NGVD (upper limit), and from 61.7 feet NGVD to 61.0 feet NGVD (lower limit) downstream of S-60. Its design slope is nearly flat, and its design bottom width varies from 10 to 20 feet.

S-63, which is the outlet of Lake Gentry, is on the Canoe Creek Canal (C-34). Water levels in C-34, downstream of S-63, are further stepped down by S-63A before discharging into Lake Cypress.

S-63 is a reinforced concrete, gated spillway controlled by a stem operated, vertical lift gate. This gate is operated according to seasonal operation criteria. The structure is located 0.6 miles east of State Road 523 and 0.3 miles from Lake Gentry. The purposes of this structure are: (1) To maintain optimum upstream water control stages in C-34 and in Lake Gentry, (2) to pass the design flood (30 percent of the SPF) without exceeding the upstream flood design stage, and to restrict downstream flood stages and channel velocities to non-damaging levels, and (3) to pass sufficient discharge during low-flow periods to maintain downstream stages. The water level which will bypass this structure is 68.5 feet NGVD.

Comments on Historic Operation

S-63 is operated in accordance with Lake Gentry's regulation schedule, which ranges between 59.5 and 61.5 feet NGVD, and indicates the desirable water level throughout the year. Flood operation is followed if the water-surface elevation is above the prescribed level. Low-water operation is followed if the water-surface elevation is below the prescribed level. The operation depends also on hydraulic and structural limitations of the structure.

Flood Control Operation: When the water level in Lake Gentry is is less than 0.5 feet above the prescribed level, a release schedule, based on the forecasted inflow, is established to return the lake to that level within 15 days. When the lake stage is 0.5 feet above the prescribed level, maximum releases subject to hydraulic and structural limitations are made.

Low-Water Operation: Whenever the lake level is below the prescribed level, minimum releases are made to satisfy downstream demands.

Structural Limitations: The maximum water level drop across the structure is 11 feet, if the upstream water surface elevation is below 64.0 feet NGVD, or 10 feet, if the upstream water surface elevation is over 62.8 feet NGVD. The headwater elevation cannot exceed 67.0 feet NGVD.

Hydraulic Limitations: To prevent damage from high channel velocities, the gate opening is in accordance with the "Maximum Allowable Gate Opening Curve". The gate also has to be opened gradually to allow tailwater stages to rise before large discharges are made.

S-63 is the structure that regulates Lake Gentry. This structure is located at the south end of the lake on the Canoe Creek Canal (C-34). Water levels in C-34, downstream of S-63, are further stepped down by S-63A before discharging into Lake Cypress. After completion of S-63, S-63A, and C-34, regulation of Lake Gentry began in May 1967. The current regulation schedule is shown in Figure 2C .

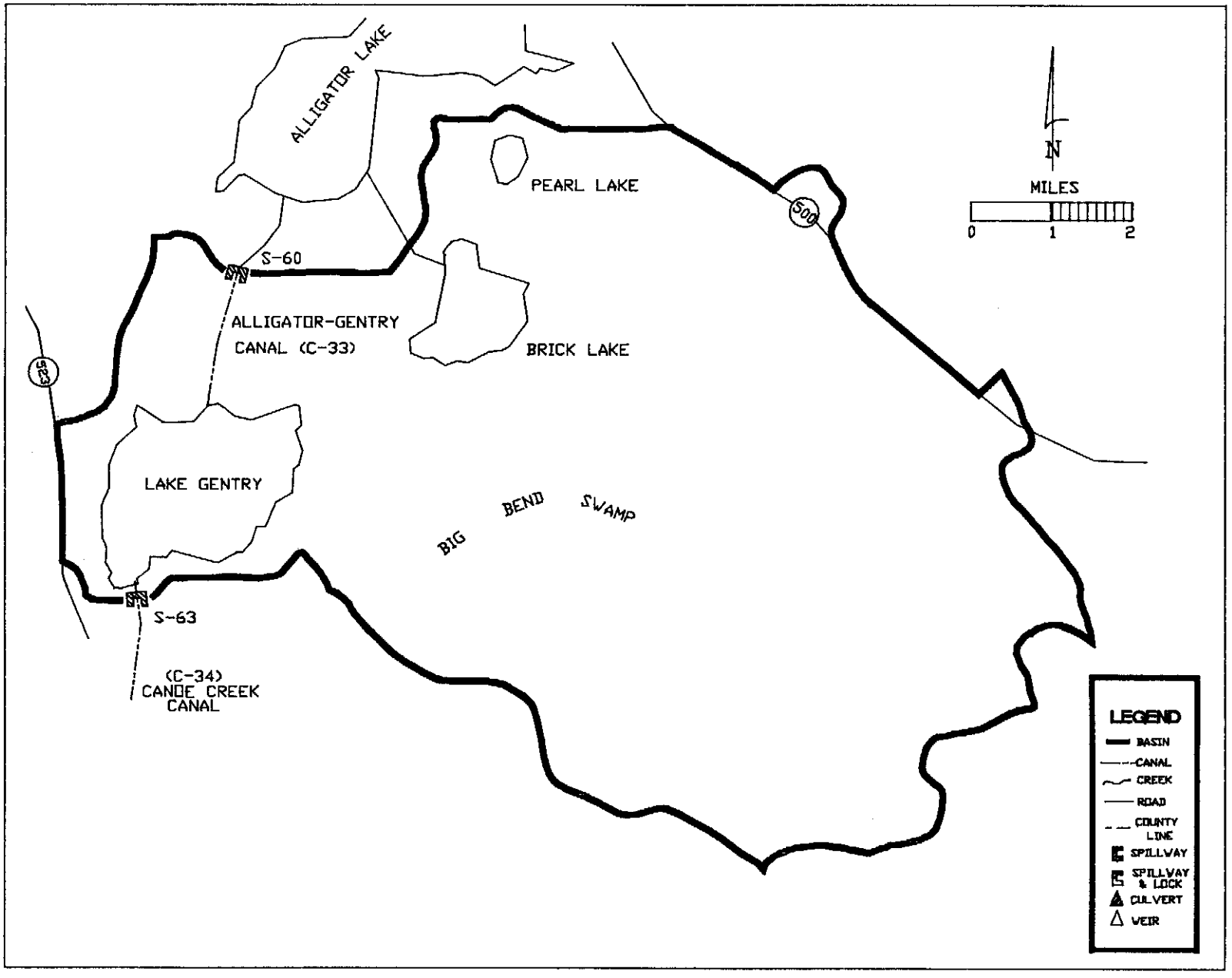


FIGURE 2A. Lake Gentry Basin (33,115 acres).

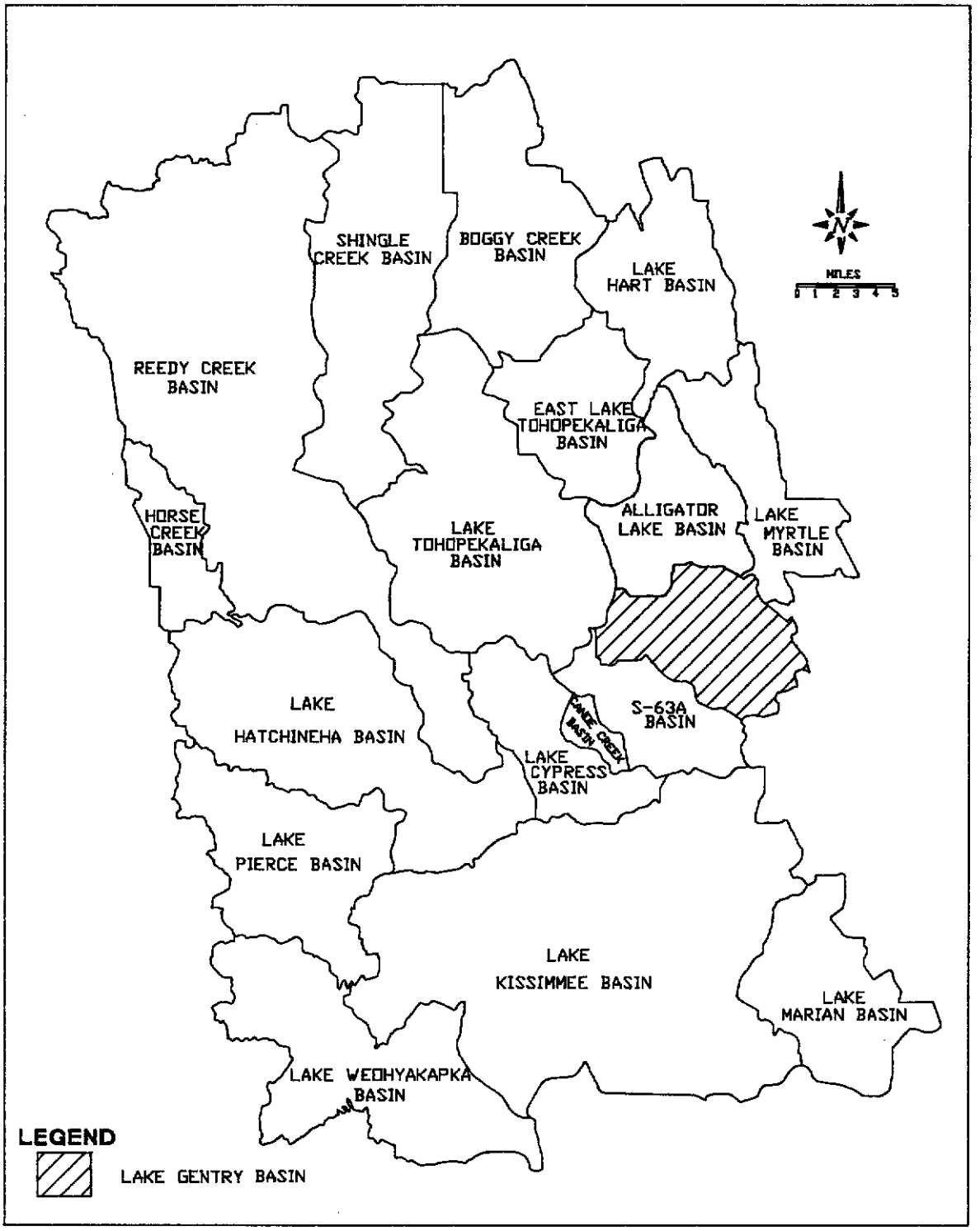
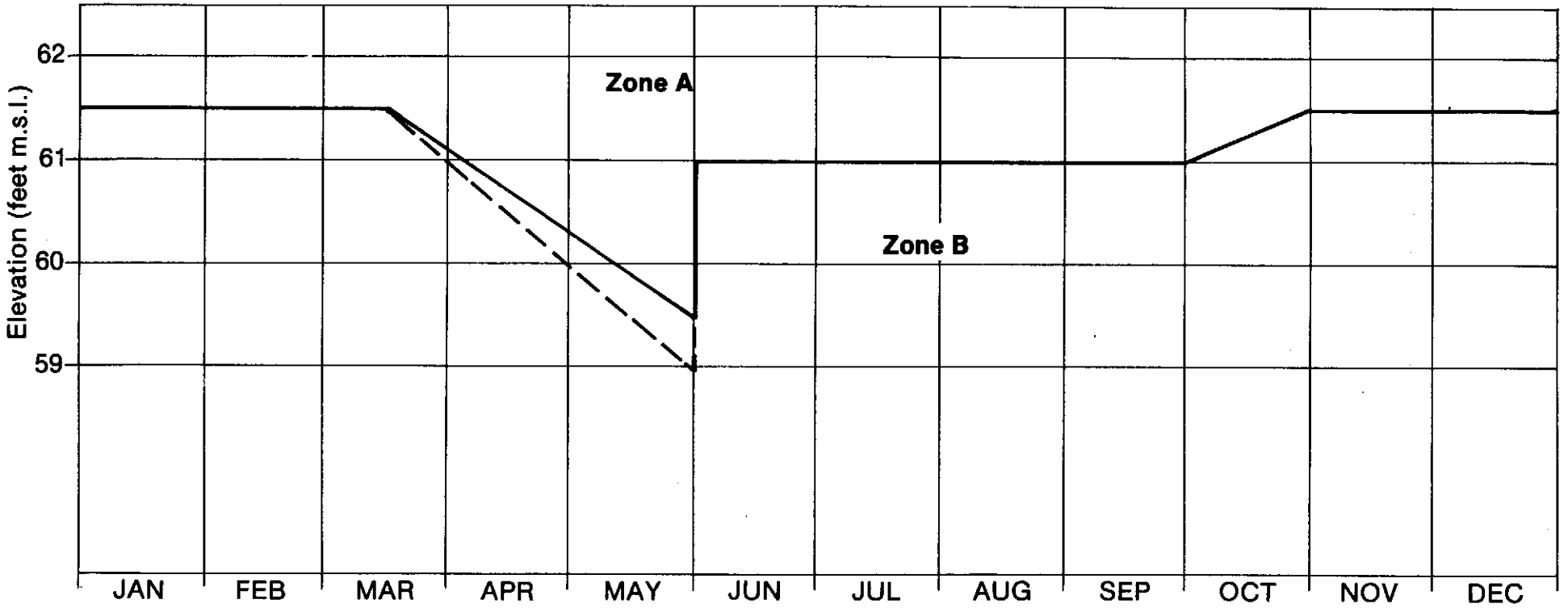


FIGURE 2B. Relative Location of Lake Gentry Basin within the UKRW.



Zone	Releases S-63
A	At design capacity (715 cfs) except when the lake is within 0.5 feet of desired stage. Forecasts will then be made and releases started to bring the lake back to schedule within 15 days.
B	To maintain minimum flows.

Note: — — — Use this schedule one year in three.

FIGURE 2C. Lake Gentry Regulation Schedule.

S-63A BASIN

Description of the Basin

The S-63A basin has an area of 35.3 square miles (Figure 3A), and is located in Osceola County. Its relative location within the UKRW is shown in Figure 3B. This basin is upstream of Canoe Creek basin, and contains 3.4 miles of Canoe Creek Canal (C-34) connecting Lake Gentry with Cypress Lake. The portion of C-34 which is part of this basin extends from S-63 (outlet of Lake Gentry) to S-63A (that is half way between Lake Gentry and Cypress Lake).

District Canals and Structures

Approximately 2.8 miles of Canoe Creek Canal (C-34) extending from S-63 to S-63A are within the S-63A basin. This canal connects Lake Gentry to Cypress Lake. Its design floodwater-surface elevation varies from 57.5 feet NGVD to 57.0 feet NGVD downstream of S-63 and upstream of S-63A, respectively. In this section, C-34 has a ground design slope of 1.74 feet per mile, and design bottom widths of 20, 40, and 60 feet.

S-63A is a reinforced concrete, fixed-crest, gated spillway with discharge controlled by two stem-operated vertical lift gates. The two gates are automatically controlled in accordance with the seasonal operation criteria. The structure is located on the Canoe Creek Canal (C-34), approximately 500 feet upstream of State Road 523 and 2.8 miles upstream from Lake Cypress. The purposes of this structure are: (1) To maintain optimum upstream water control stages in C-34, (2) to convey the design flood without exceeding the upstream flood design stage, (3) to restrict downstream flood stages and channel velocities to nondamaging levels, and (4) to pass sufficient discharge during low-flow periods to maintain downstream stages.

Comments on Historic Operation

S-63A is operated, subject to hydraulic and structural constraints, to maintain an optimum headwater elevation of 56.5 feet NGVD, insofar as possible, using automatic control.

Flood Control Operation: When the headwater elevation rises to 57.25 feet NGVD, the gates will open at 6 inches per minute; when the headwater elevation rises or falls to 56.5 feet NGVD, the gates will become stationary; and when the headwater elevation falls 56.19 feet NGVD, the gates will close at six inches per minute.

Low-Water Operation: Minimum releases to satisfy requirements will be made during low-water periods. These requirements will be met from Lake Gentry, and eventually without any control changes in S-63A.

Structural Limitations: The maximum water level drop across the structure is 11 feet, if the upstream water elevation is below 58.0 feet NGVD, or 10 feet if the upstream water elevation is over 58.0 feet NGVD. The headwater elevation cannot be higher than 62.0 feet NGVD.

Hydraulic Limitations: The gate opening is limited in accordance with the "Maximum Allowable Gate Opening Curve" for either automatic or manual operation in order to avoid damage from high velocity discharges.

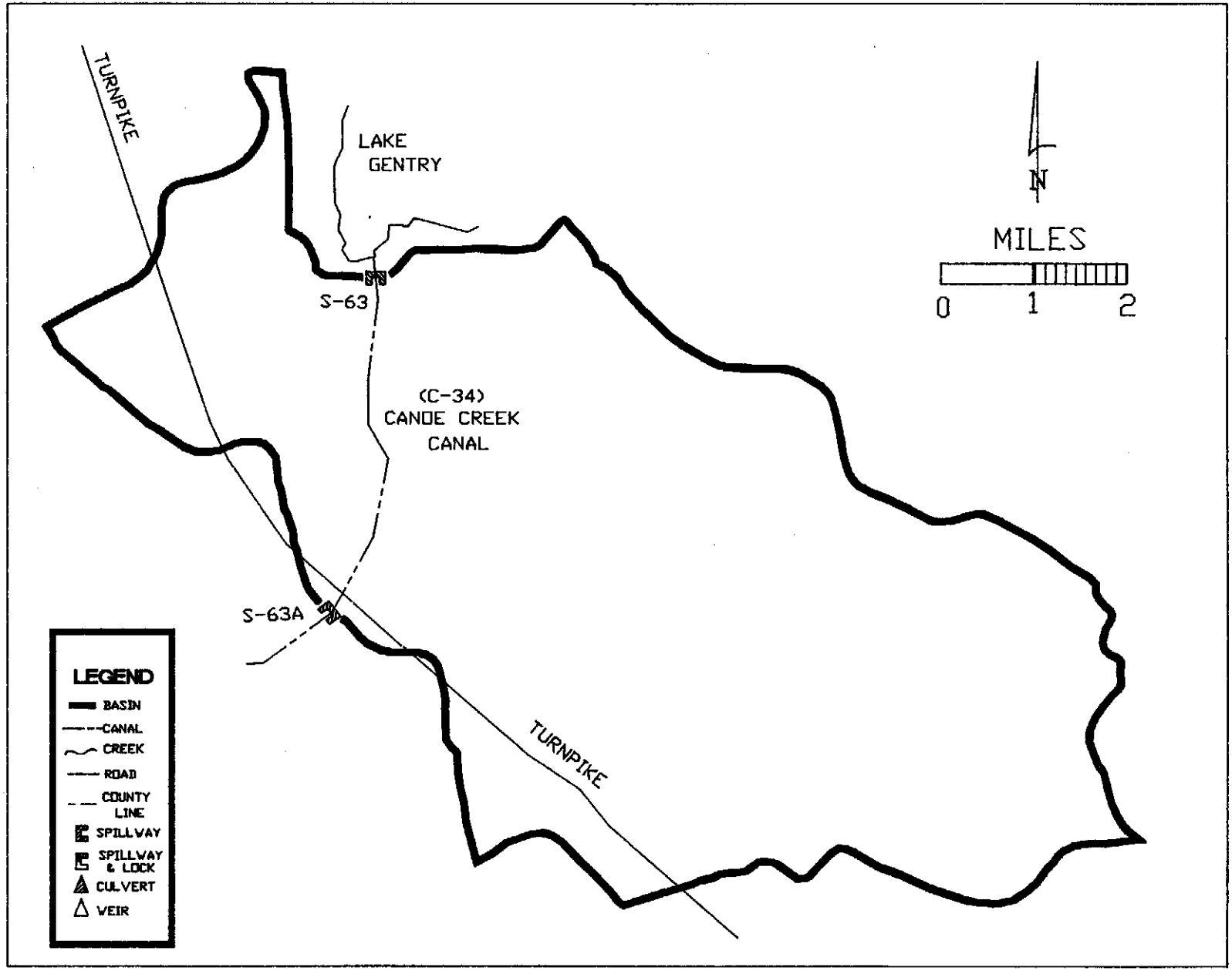


FIGURE 3A. S-63A Basin (22,570 acres).

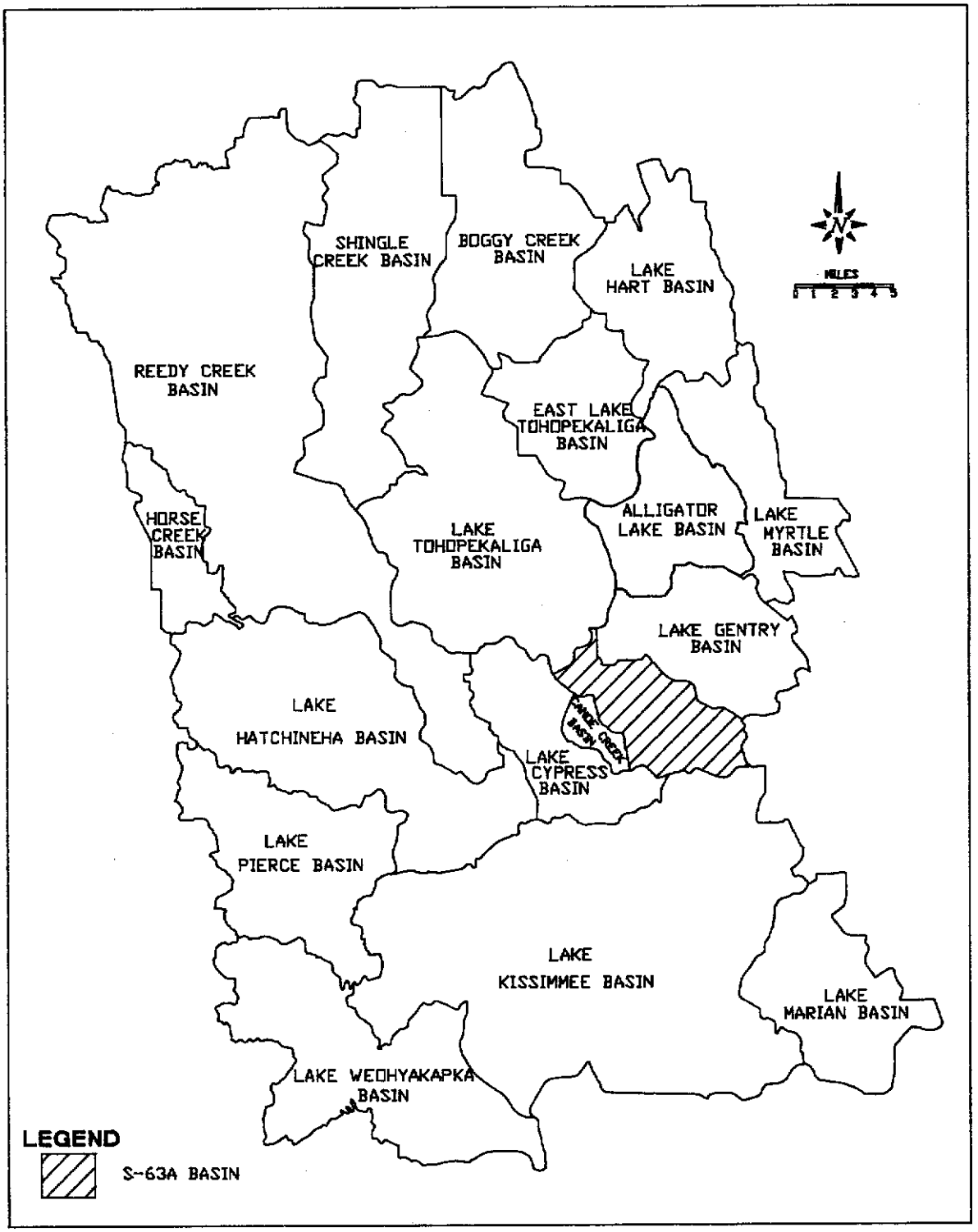


FIGURE 3B. Relative Location of S-63A Basin within the UKRW.

CANOE CREEK BASIN

Description of the Basin

The Canoe Creek basin has an area of 6.9 square miles (Figure 4A), and is located in Osceola County. This basin is in the central part of the UKRW (Figure 4B).

Canoe Creek Canal (C-34) is 6.4 miles long and conveys water from Lake Gentry to Cypress Lake. This basin contains the last 2.9 miles of Canoe Creek Canal, running toward the west from S63-A to the inlet of Cypress Lake.

District Canals and Structures

The last 2.9 miles of Canoe Creek Canal (C-34) are in the Canoe Creek basin. Its design floodwater surface elevation varies from 53.8 feet NGVD to 53.3 feet NGVD (upper limit), and from 53.2 feet NGVD to 51.5 feet NGVD (lower limit) downstream of S-63A and in Cypress Lake. Its ground-surface slope is nearly flat, and the design bottom widths are 60 and 70 feet, with the transition located 1.4 miles downstream from S-63A.

S-63A is located 2.8 miles upstream from Lake Cypress and maintains optimum upstream water control stages in C-34. Its design characteristics are described in the section corresponding to the S-63A basin.

This basin does not contain any water control structures.

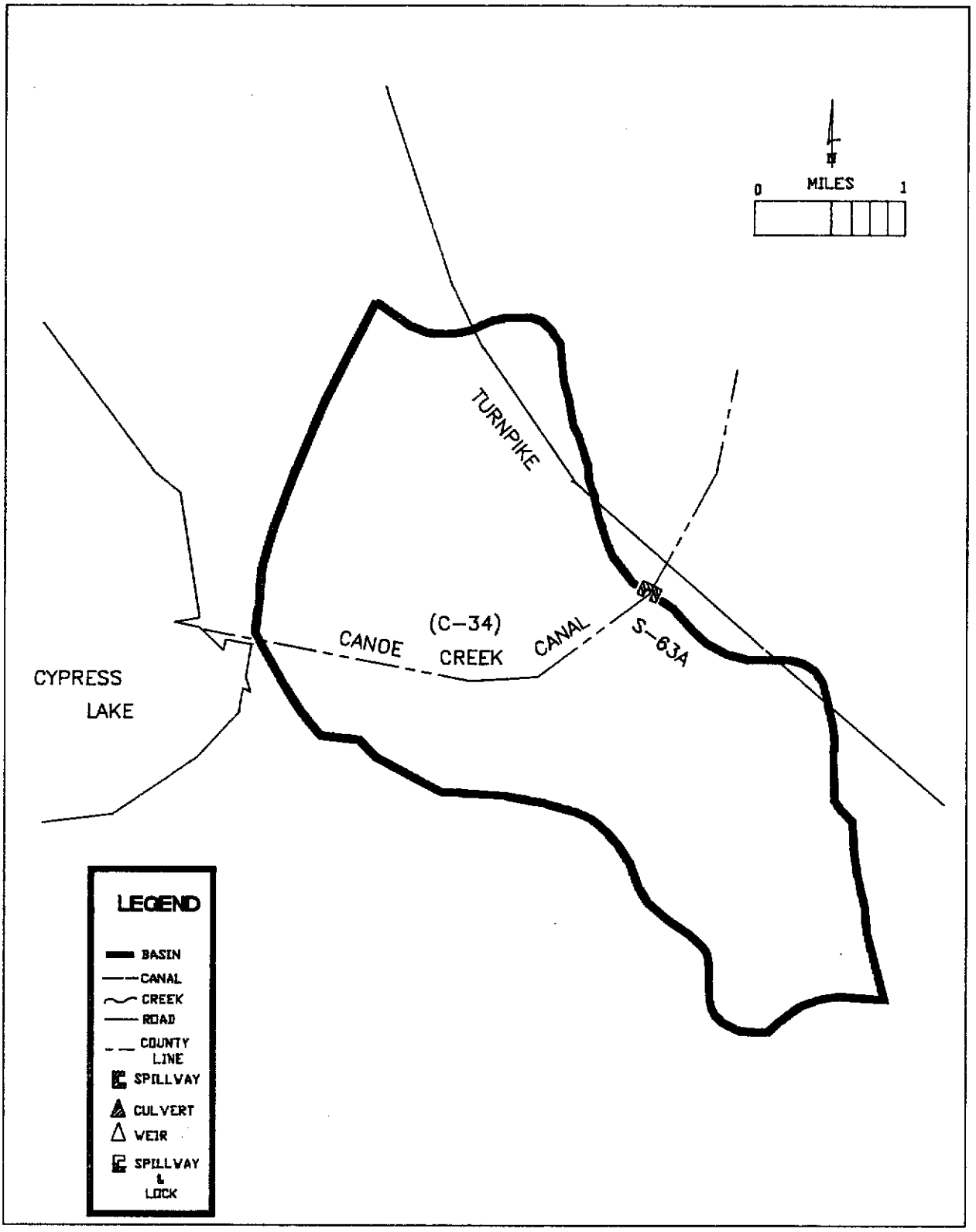


FIGURE 4A. Canoe Creek Basin (4,440 acres).

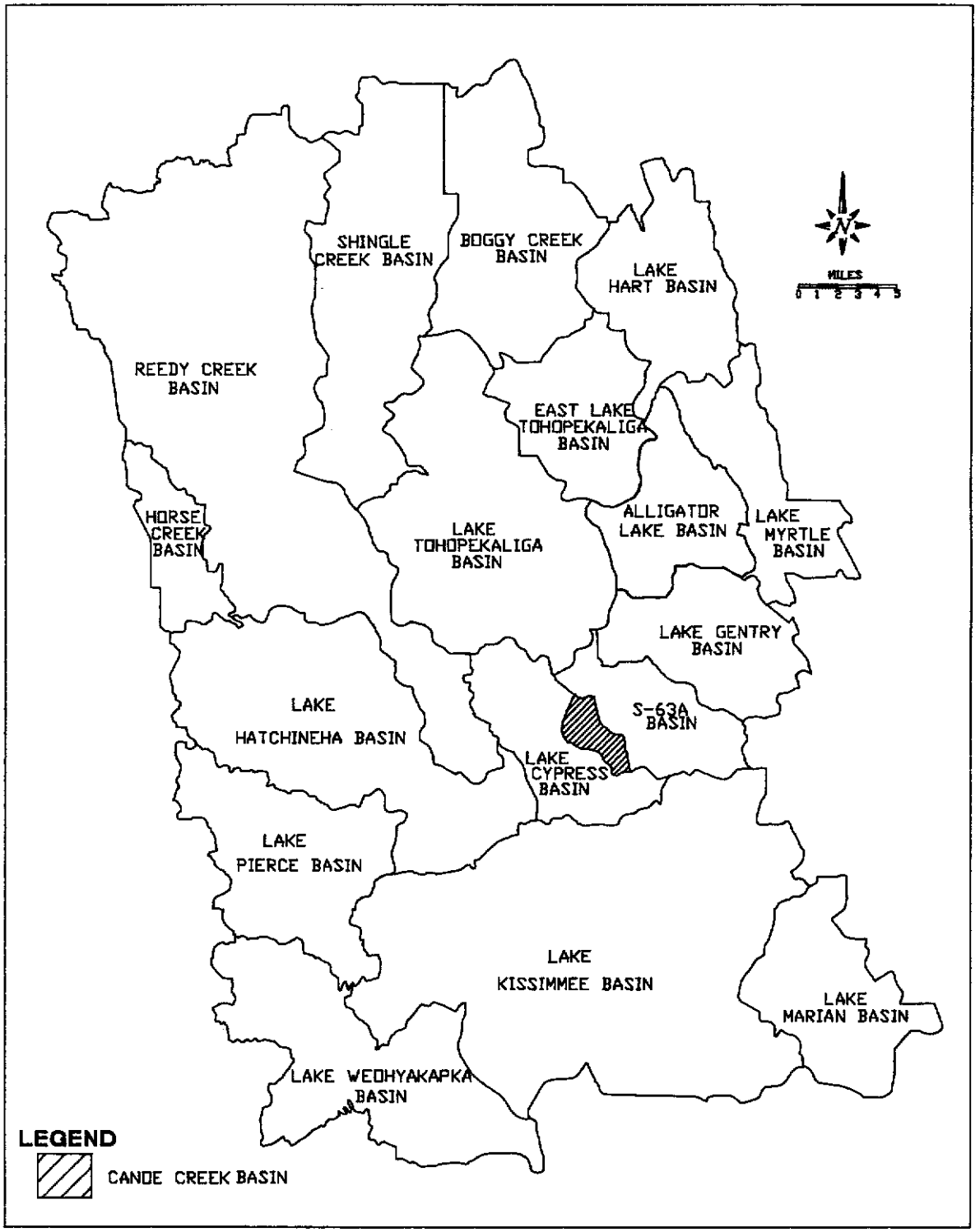


FIGURE 4B. Relative Location of Canoe Creek Basin within the UKRW.

LAKE CYPRESS BASIN

Description of the Basin

The Lake Cypress basin has an area of 42.4 square miles (Figure 5A), located in Osceola County; a small area of the basin, west of Lake Cypress, is located in Polk County. This is one of the basins occupying the central part of the UKRW (Figure 5B).

Lake Cypress has an area of 6.4 square miles at a stage of 52.0 feet NGVD. Flows from Lake Gentry and from Lake Tohopekaliga converge at Lake Cypress through Canoe Creek canal and South Port Canal (C-34 and C-35, respectively). Lake Cypress receives approximately 30 percent of the flow from Reedy Creek.

District Canals and Structures

The South Port Canal (C-35), 4.5 miles long, connecting Lake Tohopekaliga with Lake Cypress, is in the Lake Cypress basin. Its design water-surface elevation varies from 54.7 feet NGVD in Lake Tohopekaliga, to 53.6 feet NGVD in Lake Cypress. Its design slope is 1.37 feet per mile. C-35 has design bottom widths of 27 and 20 feet; its transition is approximately 600 feet from the outlet of Lake Tohopekaliga, just downstream of S-61.

S-61 regulates Lake Tohopekaliga. Its characteristics are described in the Lake Tohopekaliga basin. Lake Cypress, together with Lake Hatchineha and Lake Kissimmee, is regulated by S-65. This structure is located at the outlet of Lake Kissimmee in the Kissimmee River (C-38), and is described in the section covering Lake Kissimmee basin

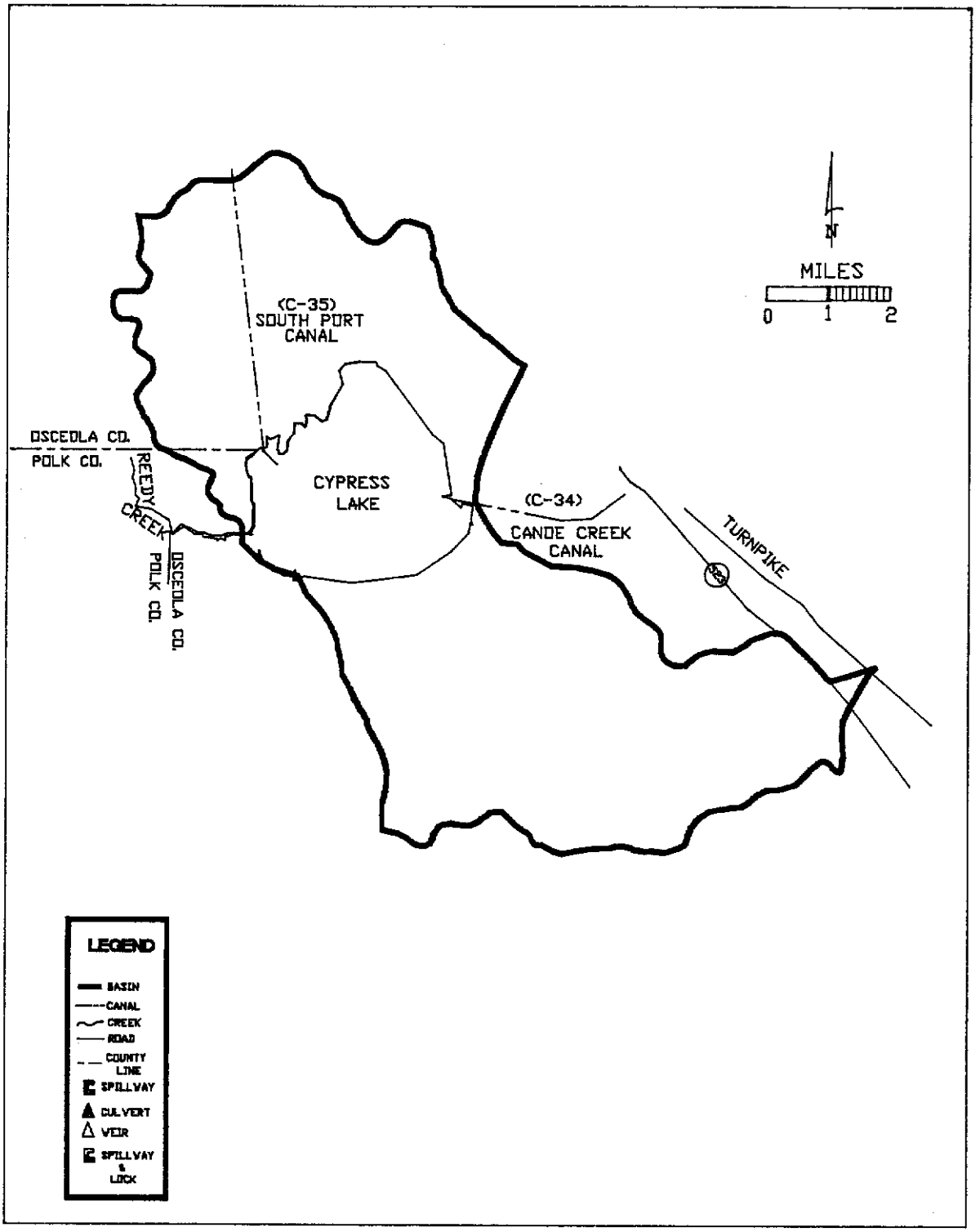


FIGURE 5A. Lake Cypress Basin (27,170 acres).

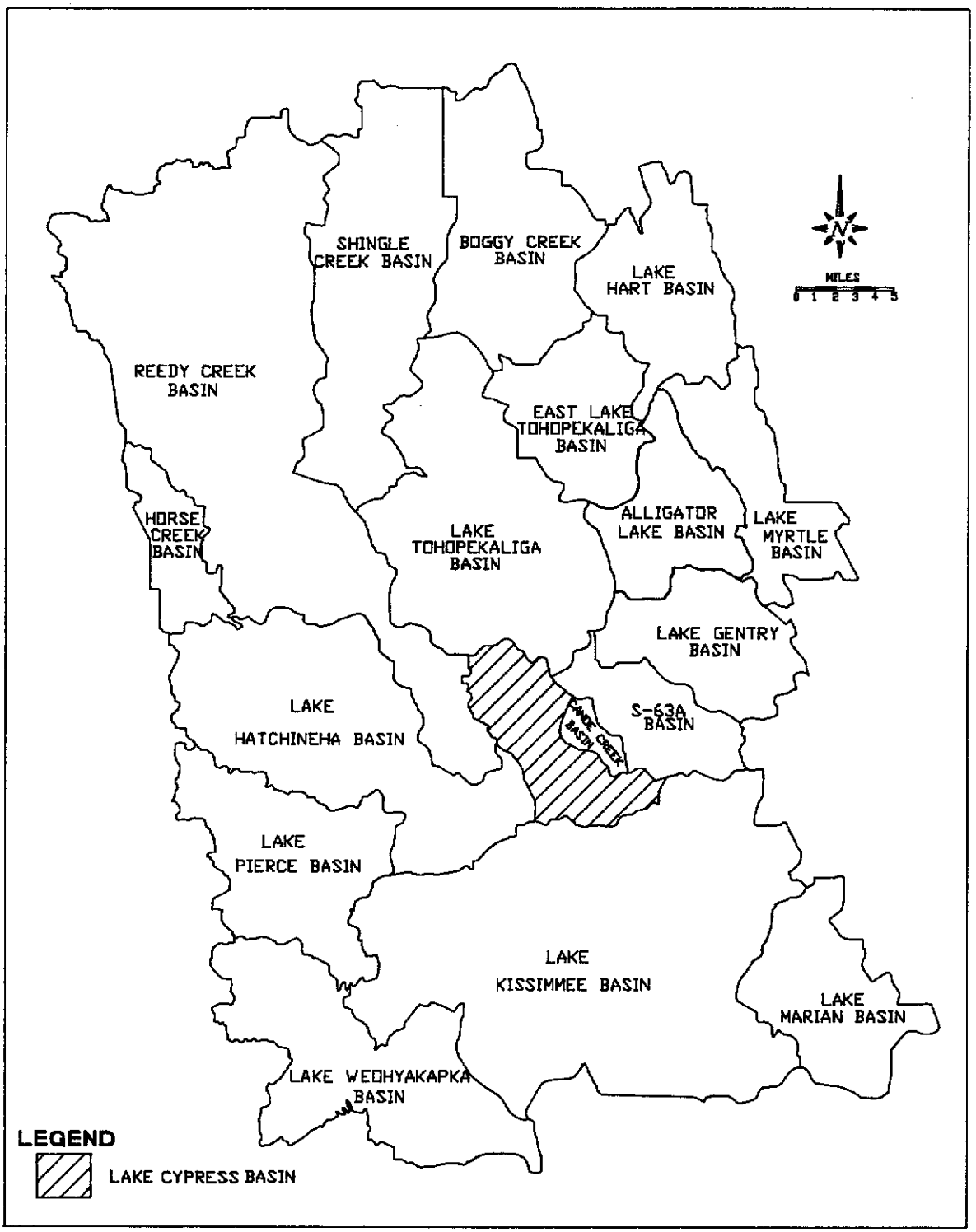


FIGURE 5B. Relative Location of Lake Cypress Basin within the UKRW.

LAKE MYRTLE BASIN

Description of the Basin

The Lake Myrtle basin has an area of 47.5 square miles (Figure 6A). Except for a small area of this basin located in the northeast corner of Orange County, the greater portion is located in Osceola County. Its relative location within the UKRW is shown in Figure 6B. On occasion, Lake Myrtle basin receives water from Alligator Lake basin (through Lake Lizzie). These releases from Alligator Lake basin to Lake Myrtle basin occur when large discharges cannot be handled through C-33 to Lake Gentry. A 1985 COE study indicated that during a 1 in 10 year flood, water will flow from Lake Myrtle basin to Alligator Lake. This study indicates that the peak will occur in Lake Myrtle at stage 65.3 feet NGVD.

Lake Joel, which receives water from Trout Lake (Alligator Lake basin) through S-58, has an area of 220 acres and is upstream of Lake Myrtle. In addition to these lakes, another chain formed by Cat Lake, Lake Conlin, and Lake Preston discharges into Lake Myrtle. Lake Myrtle, which is the last lake in this basin, is nearly one square mile at a stage of 61.0 feet NGVD and discharges into Lake Mary Jane (Lake Hart basin) by means of C-30. These five major lakes (in the basin) account for 10.5 percent of the total area of the basin.

District Canals and Structures

C-32B which connects Lake Joel to Lake Myrtle 0.4 miles long. Its design floodwater surface elevation is 62.9 feet NGVD and 60.9 feet NGVD (upper and lower limits, respectively). Its design slope is nearly flat and its design bottom width is 5 feet.

Also, 1.4 miles of C-30, extending from the outlet of Lake Myrtle to S-57, are within this basin. C-30 connects Lake Myrtle (Lake Myrtle basin) with Lake Mary Jane (Lake Hart basin). In this section of C-30, its design floodwater surface elevation is 62.8 feet NGVD (upper limit) and 60.8 feet NGVD (lower limit). Its ground-surface slope is nearly flat, and its design bottom width is 5 feet.

S-57 is located on C-30, 1.2 miles downstream from Lake Myrtle. This structure is a double-barreled corrugated metal pipe culvert, with discharge controlled by stem operated vertical gates. The two gates are controlled manually according with the seasonal operational criteria. The purposes of this structure are: (1) To maintain optimum upstream water control stages in C-30 and in Lake Myrtle, Lake Preston and Lake Joel; (2) to pass the design flood (30 percent of the SPF) without exceeding the upstream flood design stage; (3) to restrict downstream flood stages and channel velocities to nondamaging levels; (4) to prevent overtopping of the structure by waves, from Lake Myrtle, breaking against the structure during the design storm and wind tide; and (5) to pass sufficient discharge during low flow periods to maintain downstream stages. The water level which will bypass this structure is 69.0 feet NGVD.

Comments on Historic Operation

S-57 is operated in accordance with the Lake Myrtle regulation schedule. This schedule, which ranges between 60.0 and 62.0 feet NGVD represents the desirable water level throughout the year. The flood operation procedure is followed if the water-surface elevation is above the prescribed level. Low-water operation

procedure is followed if the water-elevation is below the prescribed level. The operation depends also on hydraulic and structural limitations of the structure.

Flood Control Operation: When the water level in Lake Alligator is within 0.5 feet of the present level, a release schedule, based on forecasted inflow, is established to return the lake to that level within 15 days. When the lake stage is over 0.5 feet from the prescribed level, maximum releases are made, subject to hydraulic and structural limitations.

Low-Water Operation: Whenever the lake level is below the prescribed level, releases are not allowed.

Structural Limitations: The maximum water level drop across the structure is 2.2 feet.

S-57, located in C-30 connecting Lake Myrtle to Lake Mary Jane (Lake Hart basin), regulates Lake Myrtle, Lake Preston, and Lake Joel. Regulation began in September 1969 upon completion of C-30 and S-57. The current schedule is shown in Figure 6C.

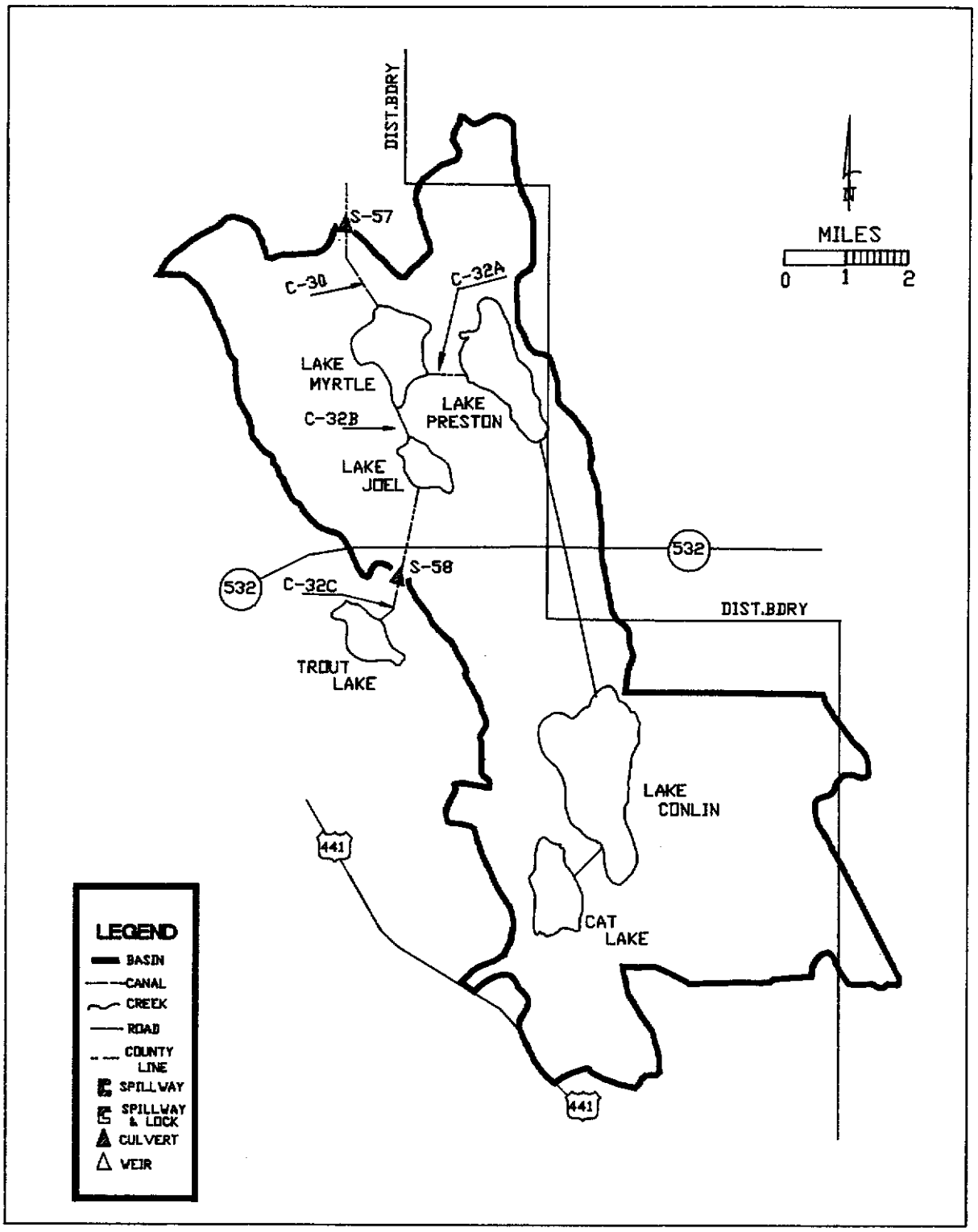


FIGURE 6A. Lake Myrtle Basin (30,435 acres).

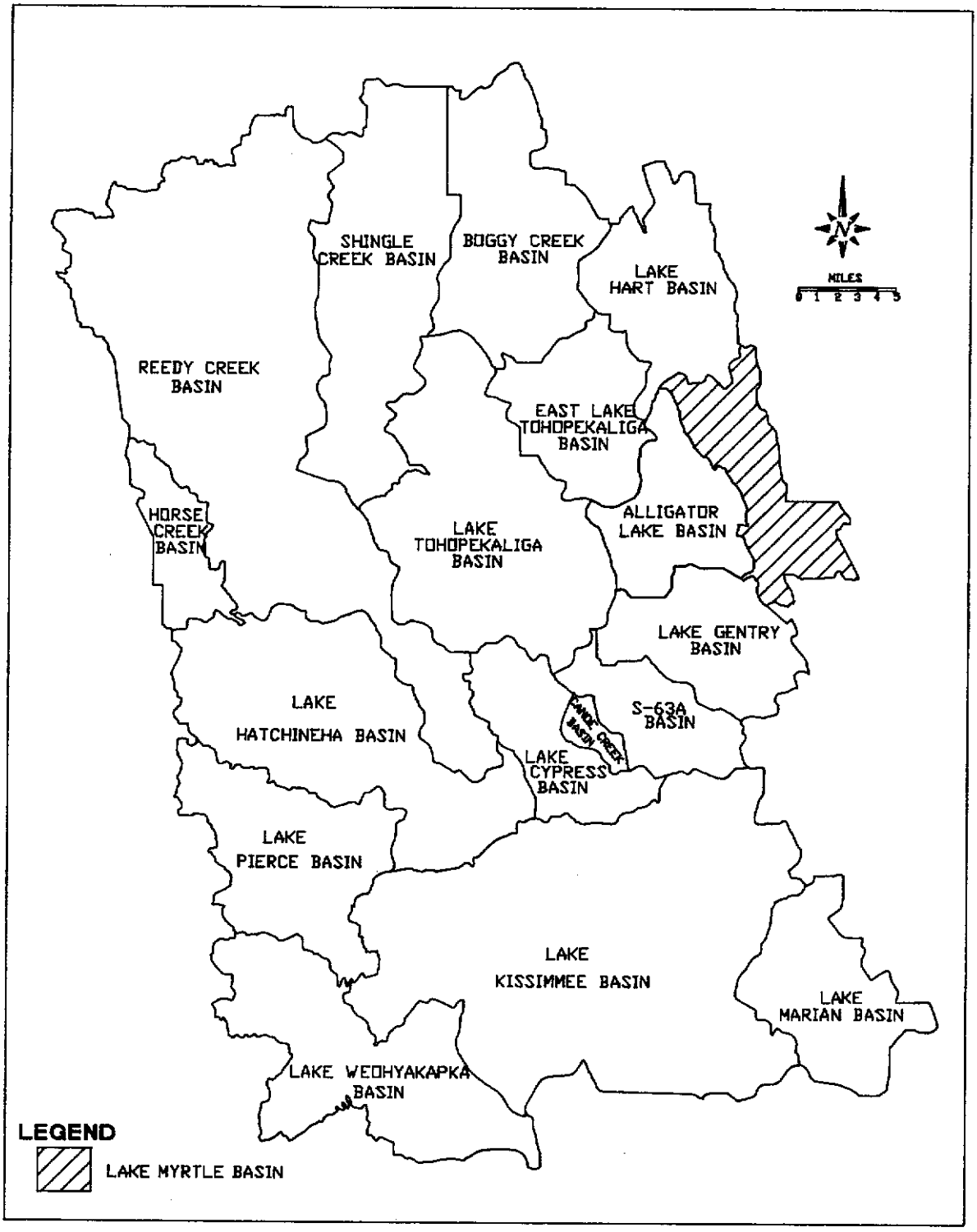
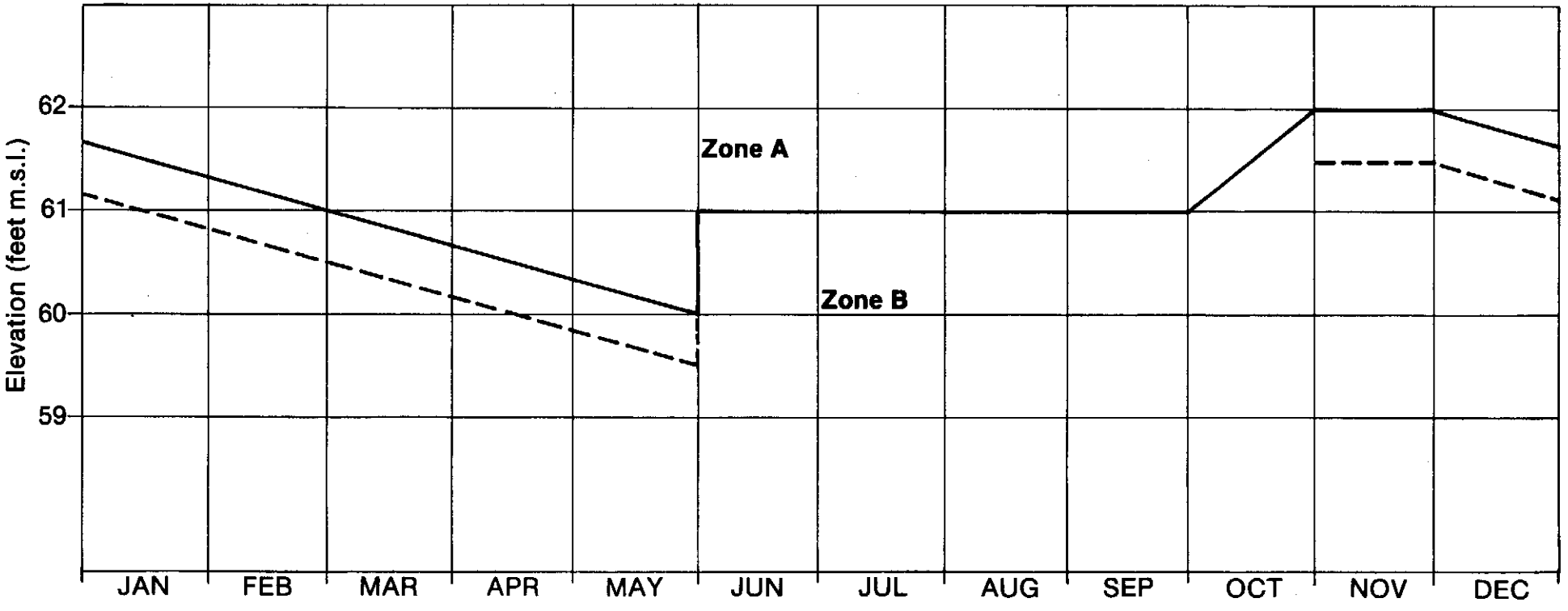


FIGURE 6B. Relative Location of Lake Myrtle Basin within the UKRW.



Zone	Releases S-57
A	At design capacity (170 cfs) except when the lake is within 0.5 feet of desired stage. Forecasts will then be made and releases started to bring the lake back down to schedule within 15 days.
B	To maintain minimum flows.

Notes:

1. ——— Use this schedule if 1 November stage is 61.5 feet or above.
2. — — — Use this schedule if 1 November stage is below 61.5 feet.
3. Regulation to be such that drawdown to 59.5 feet occurs at least twice but not more than three times in any six-year period.
4. Between 1 June and 30 September the stage may be raised to 61.0 feet as water is available.

FIGURE 6C. Lake Myrtle Regulation Schedule.

LAKE HART BASIN

Description of the Basin

The Lake Hart basin covers 60.1 square miles (Figure 7A), of which 55.2 square miles are in Orange County and 4.9 square miles in Osceola County. This basin occupies the northeastern corner of the UKRW, except for 16.9 percent of the area which is outside the District boundary (Figure 7B).

C-29 serves as a connection between Lake Hart and Lake Mary Jane, which are 2.9 and 1.8 square miles in area at stages of 59.0 and 60.0 feet NGVD, while C-29A connects Ajay Lake (150 acres) with Lake Hart. In addition, Barton Lake (330 acres), located to the west of Lake Hart, is connected to that lake by means of a short channel. A chain formed by Lake Nona-Red Lake-Buck Lake (620, 230 and 135 acres, respectively) is also connected to Lake Hart through Myrtle Bay. Ajay Lake, the last lake in this basin, connects to East Lake Tohopekaliga (Fells Cove) by means of C-29B. Lakes in this basin accounts for 11.7 percent of the total area.

District Canals and Structures

Approximately one mile of C-30 connecting Lake Myrtle with Lake Mary Jane is in the Lake Hart basin which extends from S-57 to Lake Mary Jane. C-29 (between Lake Mary Jane and Lake Hart) and C-29A (connecting Lake Hart with Ajay Lake), plus a small section of C-29B (downstream from Ajay Lake), are also in this basin.

The last 1.1 miles of C-30, downstream of S-57, have a design floodwater surface elevation of 61.6 feet NGVD (upper limit) and varies from 60.1 feet NGVD to 59.9 feet NGVD (lower limit) downstream of S-57 and in Lake Mary Jane. Its ground-surface slope is nearly flat and its bottom width is 5 feet.

C-29 is 1.1 miles long, but most of its length is within the inundated area of Lake Mary Jane and Lake Hart. Nearly 2,000 feet of this canal separates both lakes at normal elevations. Its design floodwater surface varies from 61.7 feet NGVD to 61.4 feet NGVD (upper limit), and from 59.8 feet NGVD to 59.7 feet NGVD (lower limit) in Lake Mary Jane and in Lake Hart, respectively. Its ground-surface slope is nearly flat, and its bottom width is 5 feet.

C-29A is 1.5 miles in length and connects Lake Hart with Ajay Lake. Its design floodwater surface varies from 61.4 feet NGVD to 58.8 feet NGVD (upper limit), and from 59.7 feet NGVD to 57.1 feet NGVD (lower limit) in Lake Hart and in Lake Ajay respectively. Its ground-surface slope is 2.16 feet per mile, and its bottom width is 10 feet.

The design characteristics of the small section C-29B located in Lake Hart basin are described in **District Canals and Structures, East Lake Tohopekaliga Basin.**

S-62 is located on C-29A at the outlet of Lake Hart. This structure is a reinforced concrete, gated spillway controlled by a cable operated, vertical lift gate. Operation of the gate is manually controlled in accordance with seasonal operational criteria. The purposes of this structure are: (1) to maintain optimum upstream water control stages in C-29, in Lake Hart and in Lake Mary Jane, (2) to pass the design flood (30 percent of the SPF) without exceeding the upstream flood design stage, and to restrict downstream flood stages and channel velocities to nondamaging levels, (3)

to prevent overtopping of the structure by breaking waves from Lake Hart during the design storm and wind tide, and (4) to pass sufficient discharge during low-flow periods to maintain downstream stages. The water level which will bypass this structure is 68.6 feet NGVD.

Comments on Historic Operation

S-62 is operated in accordance with the Lake Hart regulation schedule, which ranges between 59.5 and 61.0 feet NGVD, indicating the desirable water level throughout the year. Flood operation is followed if the water-surface elevation is above the prescribed level. Low-water operation is followed if the water-surface elevation is below the prescribed level. The operation depends also on hydraulic and structural limitations of the structure.

Flood Control Operation: When the water level in Lake Hart and Lake Mary Jane is less than 0.5 feet above of the prescribed level, a release schedule, based on the forecasted inflow, is established to return the lake to that level within 15 days. When the lake stage is over 0.5 feet from the prescribed level, maximum releases subject to hydraulic and structural limitations are made.

Low-Water Operation: Whenever the lake level is below the prescribed level, minimum releases are made to satisfy downstream.

Structural Limitations: The maximum head on the structure is 7.2 feet.

Hydraulic Limitations: The gate opening is limited in accordance with the "Maximum Allowable Gate Opening Curve". To prevent damage from high velocities, the gate also has to be opened gradually to allow tailwater stages to rise before large discharges are released.

Lake Hart and Lake Mary Jane are regulated by S-62 located in C-29A, which discharges into Ajay Lake. Regulation began in May 1970 after completion of S-62 and C-29 in October 1969. The current regulation schedule is shown in Figure 7C.

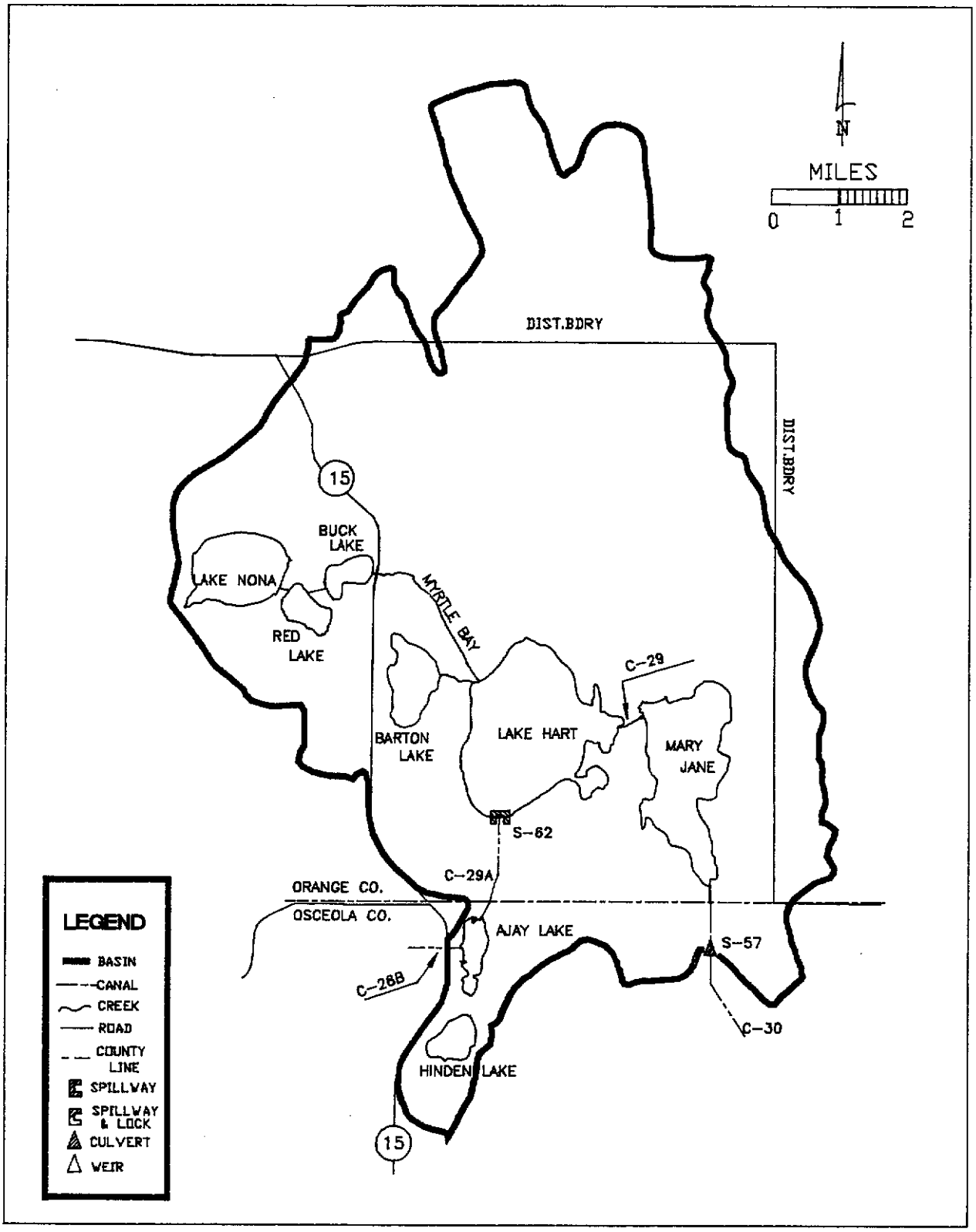


FIGURE 7A. Lake Hart Basin (38,530 acres).

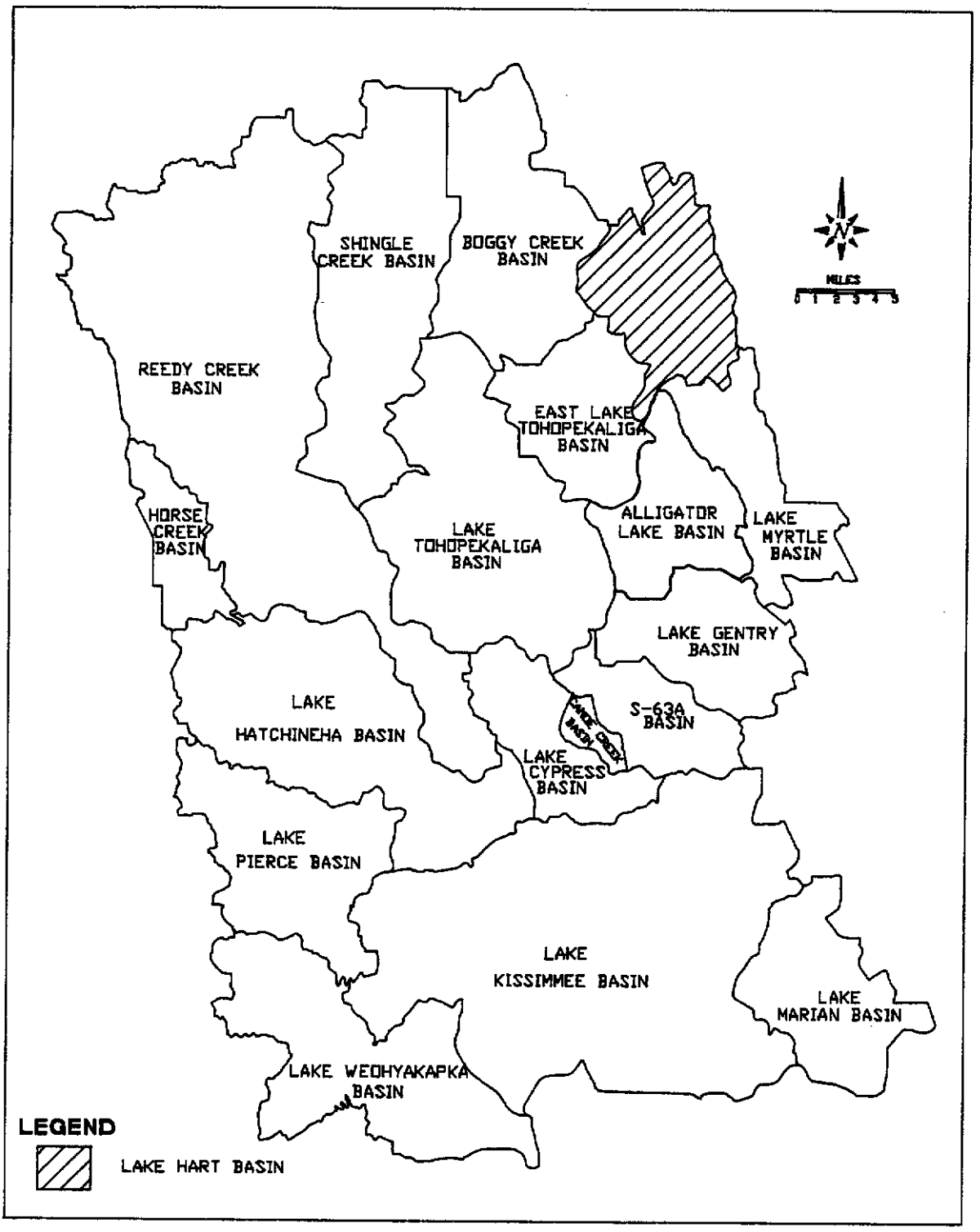
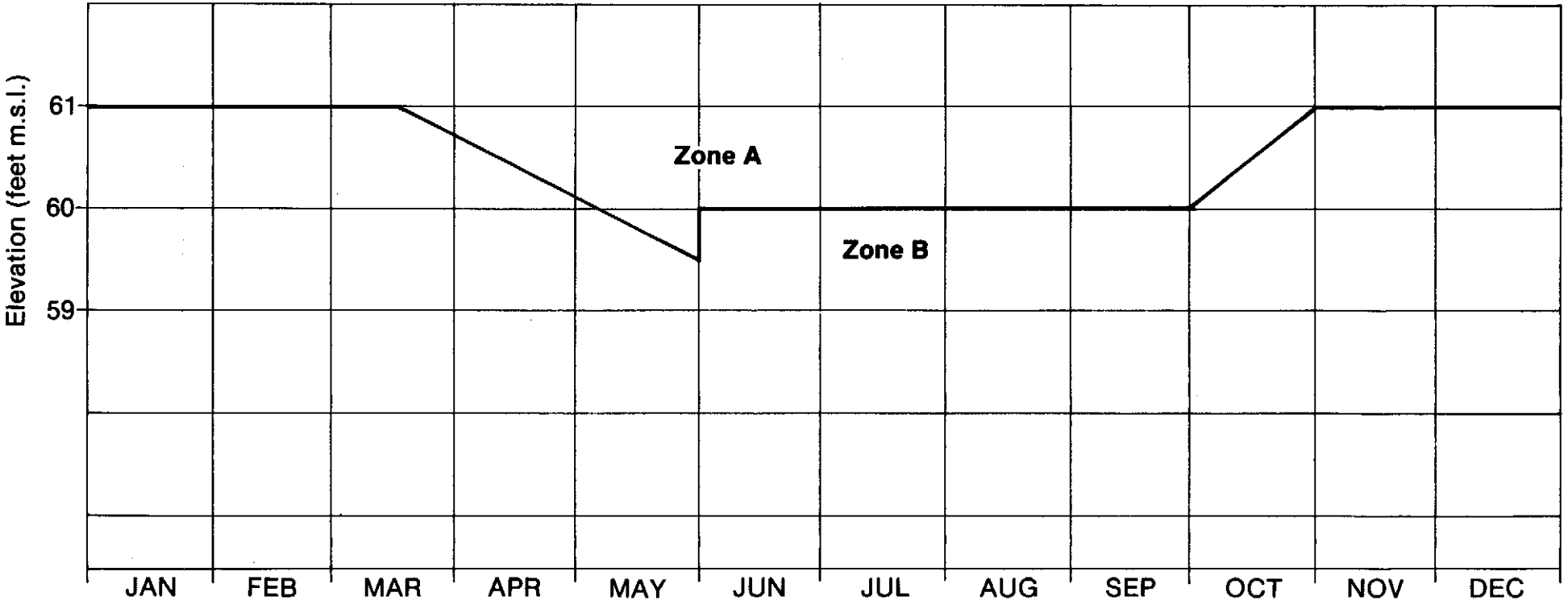


FIGURE 7B. Relative Location of Lake Hart Basin within the UKRW.



Zone	Releases S-62
A	At design capacity (640 cfs) except when the lake is within 0.5 feet of desired stage. Forecasts will then be made and releases started to bring the lake back to schedule within 15 days.
B	To maintain minimum flows.

FIGURE 7C. Lake Hart Regulation Schedule.

BOGGY CREEK BASIN

Description of the Basin

The Boggy Creek basin has a drainage area of 86.8 square miles (Figure 8A), and is located in central-western Orange County, east of Florida's Turnpike. Its drainage area extends southward from the center of the city of Orlando to the boundary between Osceola and Orange counties, and has the largest inflow to East Lake Tohopekaliga. The relative location of the Boggy Creek basin within UKRW is shown in Figure 8B. Twenty-four named lakes whose areas vary from 8 acres (Lake Farrar) to 1.7 square miles (Lake Conway) are located in Boggy Creek basin, and many of these are in the northern part of the basin. Of the 24 lakes only three , Mud (240 acres) located one mile east of the Boggy Creek swamp, Gatlin (65 acres) located just upstream of Lake Conway, and Warren (130 acres) located 4,000 feet east of Lake Conway, are not landlocked at normal stages.

The main water-course of Boggy Creek, also known as the east branch, is 12 miles long. Its headwaters originate in the southern lobe of Lake Conway, where a canal on the east side of the lake flows east to Lake Warren (Mare Prairie). This upper portion of the basin is within the general urban area of Orlando, and is characterized by numerous small lakes surrounded by gently rolling land. From here, the creek follows a channelized course southward passing under the Beeline Expressway, flowing through the Orlando International Airport property, and passing under Boggy Creek Road. Downstream of this point the creek is no longer channelized. This lower portion of the basin has a number of depressions and swamps, many of which are connected to the main stream by natural sloughs or small drainage ditches. The largest of these is known as the Boggy Creek Swamp, which covers nearly two square miles acting as a natural retention area of runoff from the basin. Upon leaving the swamp, the creek is well-defined to its outlet, located on the northwestern shore of East Lake Tohopekaliga.

The west branch of Boggy Creek, which is channelized in certain sections, extends from Lake Jessamine (306 acres) to Boggy Creek swamp. Due to Orange County's obstruction of the culverts under Oak Ridge Road on the west branch, there is no flow under normal as well as frequent flood events from the area north of Oak Ridge Road. Therefore, during moderate and severe flood events, the flow travels north over Oak Ridge Road into Lake Jessamine, causing the lake to drain into Lake Conway, flowing into the east branch of Boggy Creek. Lake Jessamine's water surface elevation is 5 feet higher than that of Lake Conway.

Boggy Creek traverses both lands remaining in agricultural use (16 percent of the basin) and lands which have undergone heavy urban development *which includes* the Orlando International Airport (43 percent of the basin). Boggy Creek swamp, together with other wetlands, lakes, and ponds, accounts for 18 percent of the basin. The remainder of the basin, which has no control structures, consists of forest uplands and recreational lands.

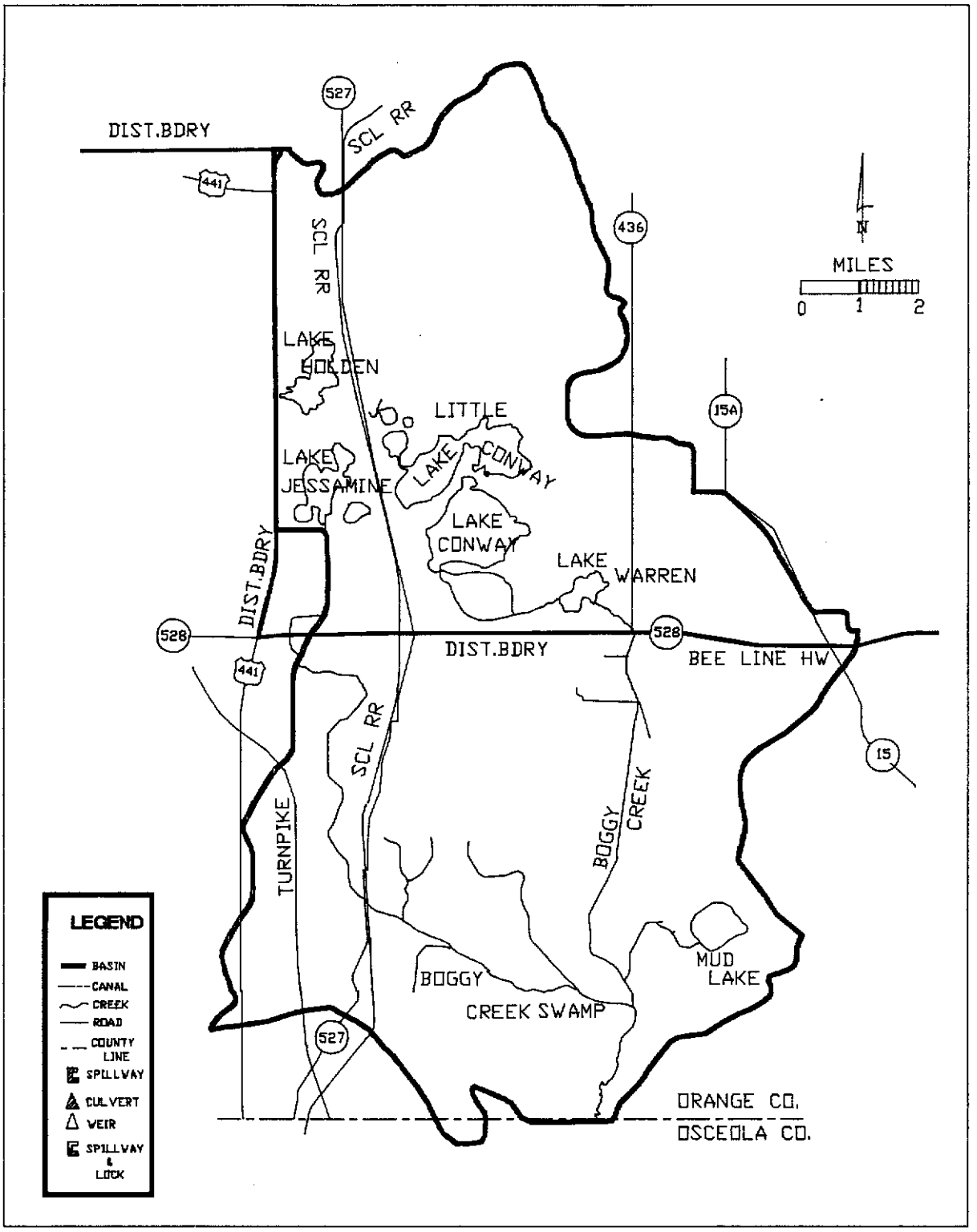


FIGURE 8A. Boggy Creek Basin (55,600 acres).

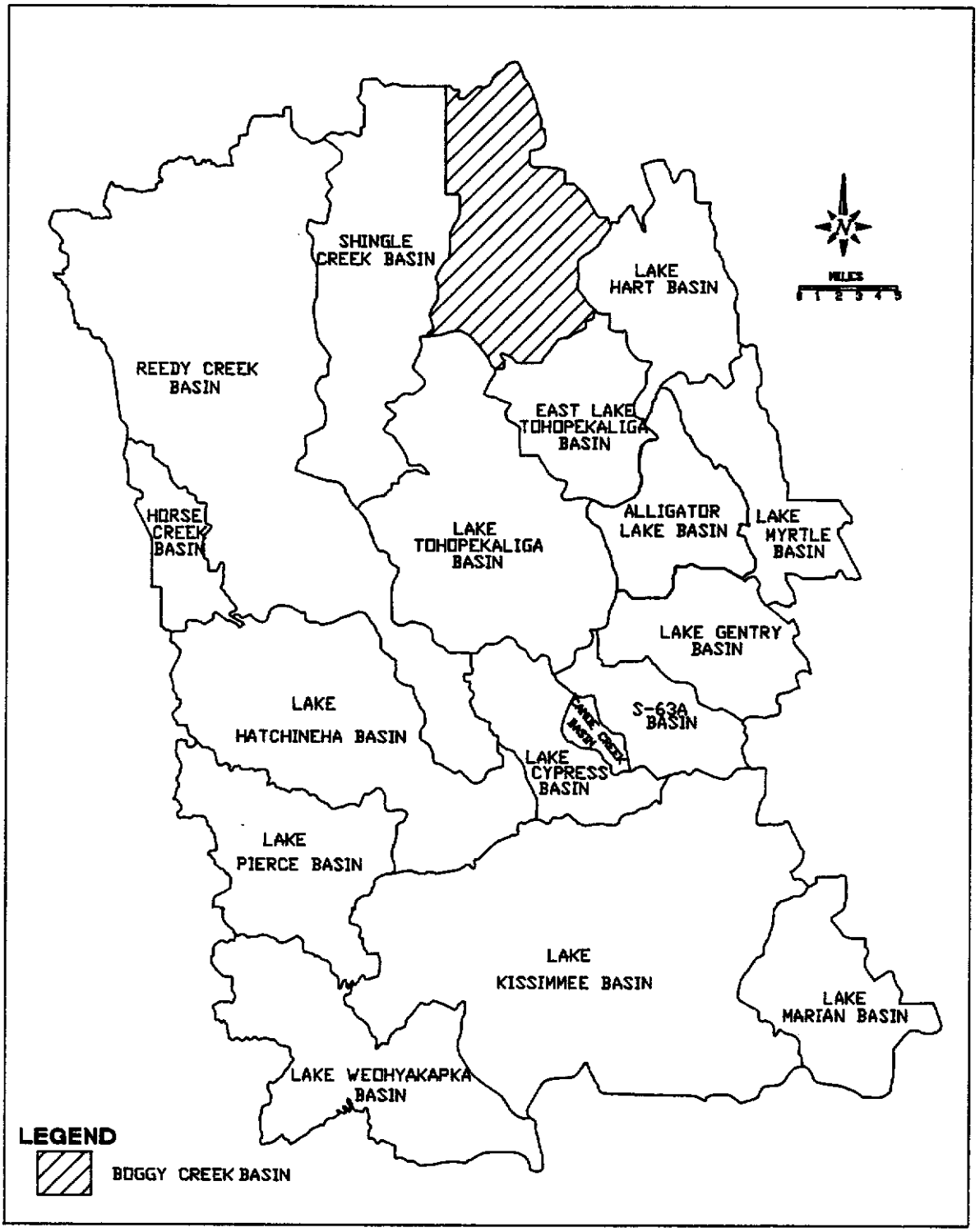


FIGURE 8B. Relative Location of Boggy Creek Basin within the UKRW.

EAST LAKE TOHOPEKALIGA BASIN

Description of the Basin

The East Lake Tohopekaliga basin has an area of 50.8 square miles (Figure 9A), of which approximately 7.6 square miles belong to Orange County and 43.2 square miles to Osceola County. Its relative location within UKRW is shown in Figure 9B. East Lake Tohopekaliga is 19.9 square miles in area at a stage of 56.3 feet NGVD. Lake Runnymede has an approximate area of 300 acres, and is located about 1,500 feet southeast of East Lake Tohopekaliga. Runnymede Canal connects Lake Runnymede with East Lake Tohopekaliga.

Boggy Creek discharges into the northwestern shore of East Lake Tohopekaliga. Lake Hart basin also discharges into this lake at Fells Cove through the C-29B from Ajay Lake. Boggy Creek and Lake Hart basins contribute most of the surface flow to East Lake Tohopekaliga. Two other basins, (Lake Myrtle and Alligator Lake) are indirect contributors to East Lake Tohopekaliga. Flows released from East Lake Tohopekaliga to Lake Tohopekaliga are conveyed by the St. Cloud Canal (C-31) through S-59.

District Canals and Structures

Most of the 1.1 miles of C-29B connecting Ajay Lake with Fells Cove (East Lake Tohopekaliga) are in the East Lake Tohopekaliga basin. Its design flood water surface elevation varies from 58.8 feet NGVD to 58.2 feet NGVD. (upper limit) and from 57.1 feet NGVD to 56.5 feet NGVD (lower limit) in Ajay Lake and in Fells Cove, respectively. Its ground-surface slope is nearly flat; its bottom width is 10 feet.

S-59 is the outlet of East Lake Tohopekaliga. This structure is a reinforced concrete-gated spillway controlled by a cable operated, vertical lift gate. The gate is currently controlled manually in accordance with seasonal operational criteria. In January 1979, a fixed weir at 51.0 feet NGVD. was installed downstream of S-59 to increase tailwater elevation. The purposes of S-59 are: (1) to maintain optimum upstream water control stages in C-31 and in East Lake Tohopekaliga, (2) to convey the design flood (30 percent of the SPF) without exceeding the upstream flood design stage, (3) to restrict downstream flood stages and channel velocities to non-damaging levels, (4) to prevent overtopping of the structure from East Lake Tohopekaliga during the design storm and wind tide, and (5) to pass sufficient discharge during low-flow periods to maintain downstream stages. The water level which will bypass this structure is 65.0 feet NGVD.

Comments on Historic Operation

S-59 is operated in accordance with the East Lake Tohopekaliga regulation schedule, which ranges between 55.0 and 58.0 feet NGVD and indicates the desirable water level throughout the year. Flood operation is followed if the water-surface elevation is above the prescribed level. Low-water operation is followed if the water-surface elevation is below the prescribed level. The operation also depends upon the hydraulic and structural limitations of the structure.

Flood Control Operation: When the water level in East Lake Tohopekaliga is within 0.5 feet of the prescribed level, a release schedule, based on the forecasted inflow, is established to return the lake to that level within 15 days. When the lake stage is

over 0.5 feet from the prescribed level, maximum releases subject to hydraulic and structural limitations are made.

Low-Water Operation: Whenever the lake level is below the prescribed level, minimum releases may be made to satisfy downstream demands.

Structural Limitations: The maximum water level drop across the structure is 8.0 feet if the upstream water surface elevation is below 62.8 feet NGVD. The water level drop will not exceed 8.0 feet if the upstream water surface elevation is higher than 62.8 feet NGVD.

Hydraulic Limitations: To prevent damage from high velocities, the gate opening is limited in accordance with the "Maximum Allowable Gate Opening Curve." The gate also has to be opened gradually to allow tailwater stages to rise before large discharges are released.

East Lake Tohopekaliga and its small tributary Ajay Lake (Lake Hart basin) (see or refer to Lake Hart basin) are regulated by S-59, located in the St. Cloud Canal (C-31). Contingent upon the completion of construction of S-59 and C-31 in April 1963, and completion of Lake Tohopekaliga's outlet works, in late 1963, regulation did not begin until 1964. This regulation schedule was modified in 1967 and was used until 1981, when the existing schedule was introduced. The current regulation schedule is shown in Figure 9C.

Water quality studies conducted since 1980 in the UKRW lakes showed that phosphorus and nitrogen concentration, as well as chlorophylla levels in East Lake Tohopekaliga, have been the lowest for all major lakes. The vegetated zone of this lake comprises 30 percent of the total surface area at a regulation stage of 58.0 feet NGVD. Restricted water level fluctuations had contributed to the deterioration of aquatic habitat in East Lake Tohopekaliga. A low water berm had developed along the shoreline at an approximate elevation of 55.0 feet NGVD. Organic sediments had been continually deposited in this area, and had not been exposed to long-term drying and compaction for at least 22 years. An extreme drawdown would help reverse plant succession, allowing physical removal of heavy organic bands within the littoral zone. The Florida Game and Fresh Water Fish Commission implemented the extreme drawdown for East Lake Tohopekaliga, which was executed during the spring of 1990 to reestablish native aquatic vegetation and improve lake habitat.

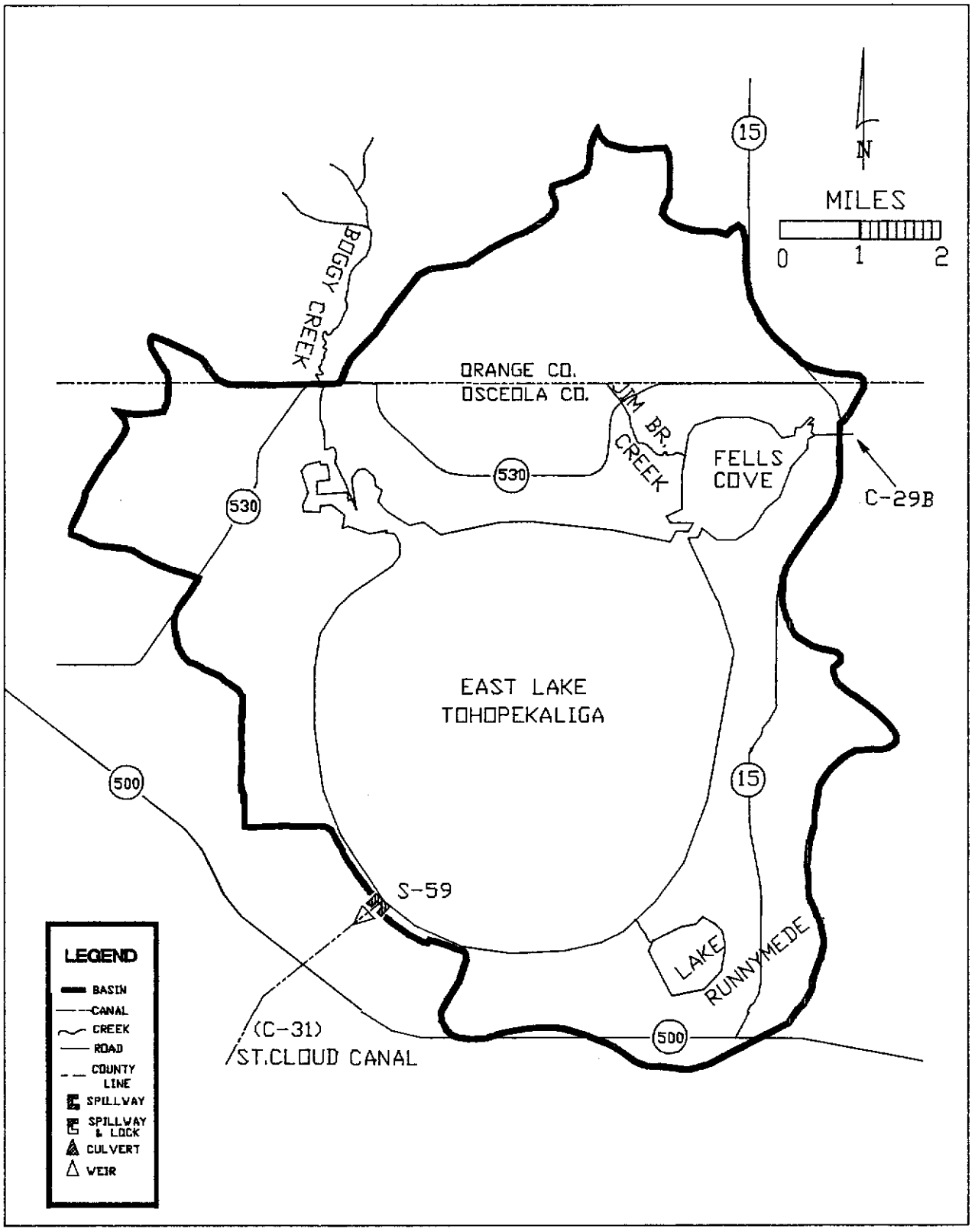


FIGURE 9A. East Lake Tohopekaliga Basin (32,540 acres).

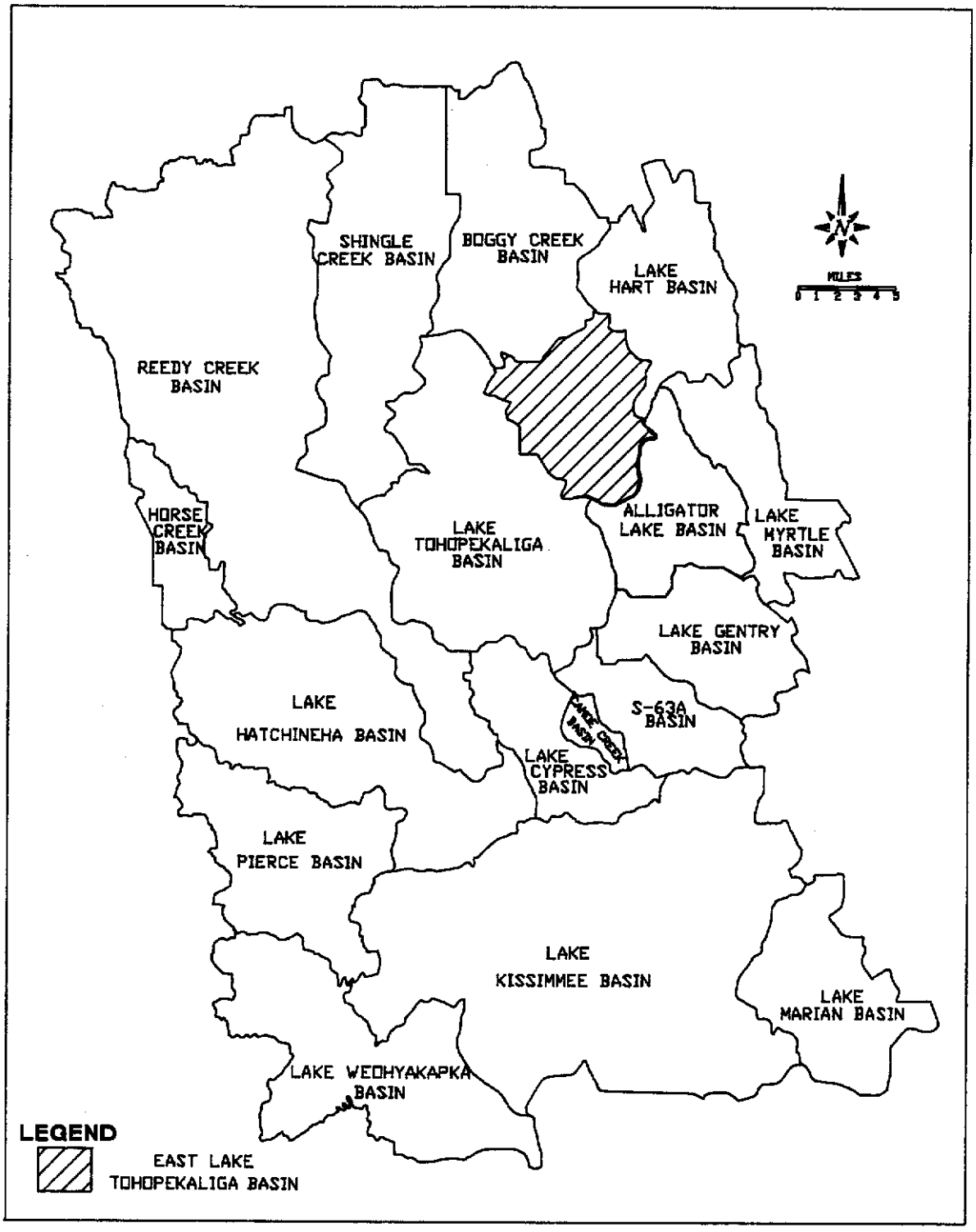
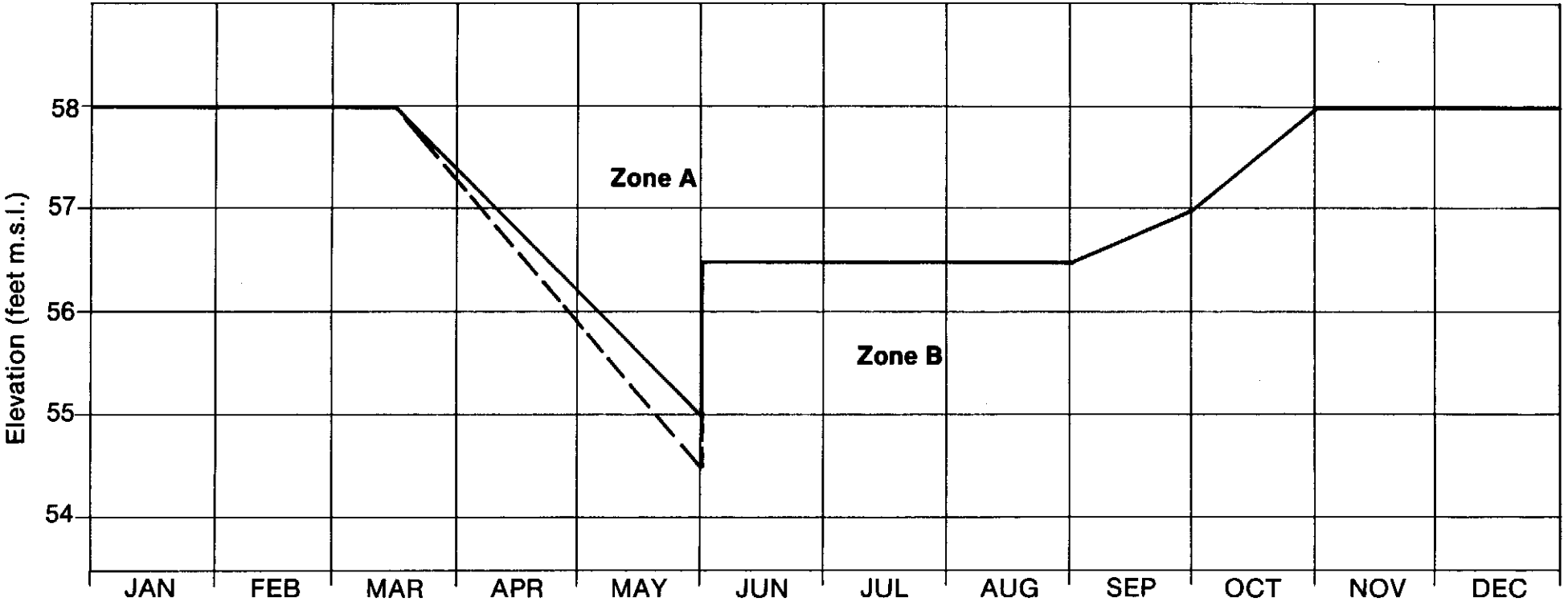


FIGURE 9B. Relative Location of East Lake Tohopekaliga Basin within the UKRW.



Zone	Releases S-59
A	At design capacity (820 cfs) except when the lake is within 0.5 feet of desired stage. Forecasts will then be made and releases started to bring the lake back to schedule within 15 days.
B	To maintain minimum flows.

Note: — — — Use this schedule one year in three.

FIGURE 9C. East Lake Tohopekaliga Regulation Schedule.

SHINGLE CREEK BASIN

Description of the Basin

The Shingle Creek basin has an area of 111.4 square miles (Figure 10A), of which 29.4 square miles are contained in Orange County and 82 square miles in Osceola County. This basin occupies the northcentral part of the Upper Kissimmee River basin, bounded by Reedy Creek basin to the west and Boggy Creek basin to the east (Figure 10B).

Inflow from Shingle Creek frequently is a major component of the total inflow to Lake Tohopekaliga. It may exceed 50 percent during the fall and winter months. Shingle Creek itself begins at the Westside Manor pumping station (east of Turkey Lake) and receives water from Clear Lake. In its headwaters, this creek receives water from a populated area west of Orlando. The inflow then proceeds southward for 24 miles to its outlet on the northwestern shore of Lake Tohopekaliga. The northern one-third of the basin, in south Orlando, has been subjected to major residential development. The part of Shingle Creek that is within this area has been channelized.

The southern one-third of the basin, south of the Orange County and Osceola County line, consists of limited wetland areas with citrus and pasture land usage.

There are 22 named lakes in this basin with surface areas ranging from 10 acres to 1.7 square miles (Big Sand Lake). Many of them are located in the north and northwestern sections of the basin. Most of these lakes are landlocked at normal stages, although several lakes are directly connected to Shingle Creek. In this latter category are included Lake Mann, Clear Lake, Lake Cain, Turkey Lake, Rattlesnake Lake and Lake Catherine. Also included in the Shingle Creek drainage area is that portion of Reedy Creek swamp, east of the Disney Outfall Canal levee, from which surface flow now discharges to Shingle Creek through its tributary the Brown's Farm Canal.

When the outflow from the Reedy Creek Improvement District exceeds 800 to 900 cfs, water will flow east to Shingle Creek.

A plan of improvement for providing flood control and water management in the Shingle Creek basin between Clear Lake and Lake Tohopekaliga has already been authorized by the COE. The areas of greatest concern are that portion of the basin north of the Florida Turnpike, the south Orlando area, and the development areas along the creek immediately south of the city of Kissimmee. The network of canals and ditches in the upper part of this basin, which extends north of Sand Lake Road, offers less than 1 in 10 year flood protection throughout most of the basin. Flooding in the south Orlando area would be caused by insufficient downstream conveyance of a fast peaking storm runoff from this highly urbanized area. Most of the flood damage would occur to residential areas between the Florida Turnpike and the Old Winter Garden Road. The middle basin area from the Florida Turnpike south to the Old Tampa Highway at Kissimmee has experienced almost no development within the historic floodplain. Flood levels up to and beyond the 1 in 10 year frequency will not cause damage to residential properties; however, some damage could occur to pastures and groves in this area. Shingle Creek has been identified in the past as a major source of pollution which was accelerating the eutrophication of Lake Tohopekaliga. Any proposed project in this area should, therefore, seek to address this problem.

The major sewage treatment facilities previously discharging into Shingle Creek were converted to a no discharge disposal method during 1987; however, discharges from the intensively developed urban areas of the upper basin remain a major concern. The lower basin has experienced development between the Old Tampa Highway and SR-531. This development consists of residential homes and a large retirement housing complex. The existing creek channel can handle 1 in 10 year flood protection to this area. It is expected that extensive flood damage due to storms which exceed that frequency may occur.

Shingle Creek Swamp covers approximately 4.7 square miles west of Shingle Creek in southern Orange Counts (Figure 10A). The swamp receives much of the storm water runoff from areas south and southwest of the city of Orlando, as well as storm water runoff from the Valencia Water Control District. Except for its connection with Single Creek, which runs along the eastern portion of the swamp, Shingle Creek Swamp is largely isolated. The northeastern corner of the swamp area has been divided by two powerline easements and service roads. The importance of the swamp is in water management, flood attenuation, and water quality improvement. The COE proposed project could cause environmental problems by restricting the water flow into the eastern portion of the swamp. For this reason, some modifications will have to be made to the COE plan to restore more overland flow to the eastern portion of the swamp. Valencia Water Control District has already begun to remove canal berms to increase overland flow to that portion of the swamp.

This basin does not contain any water control structures.

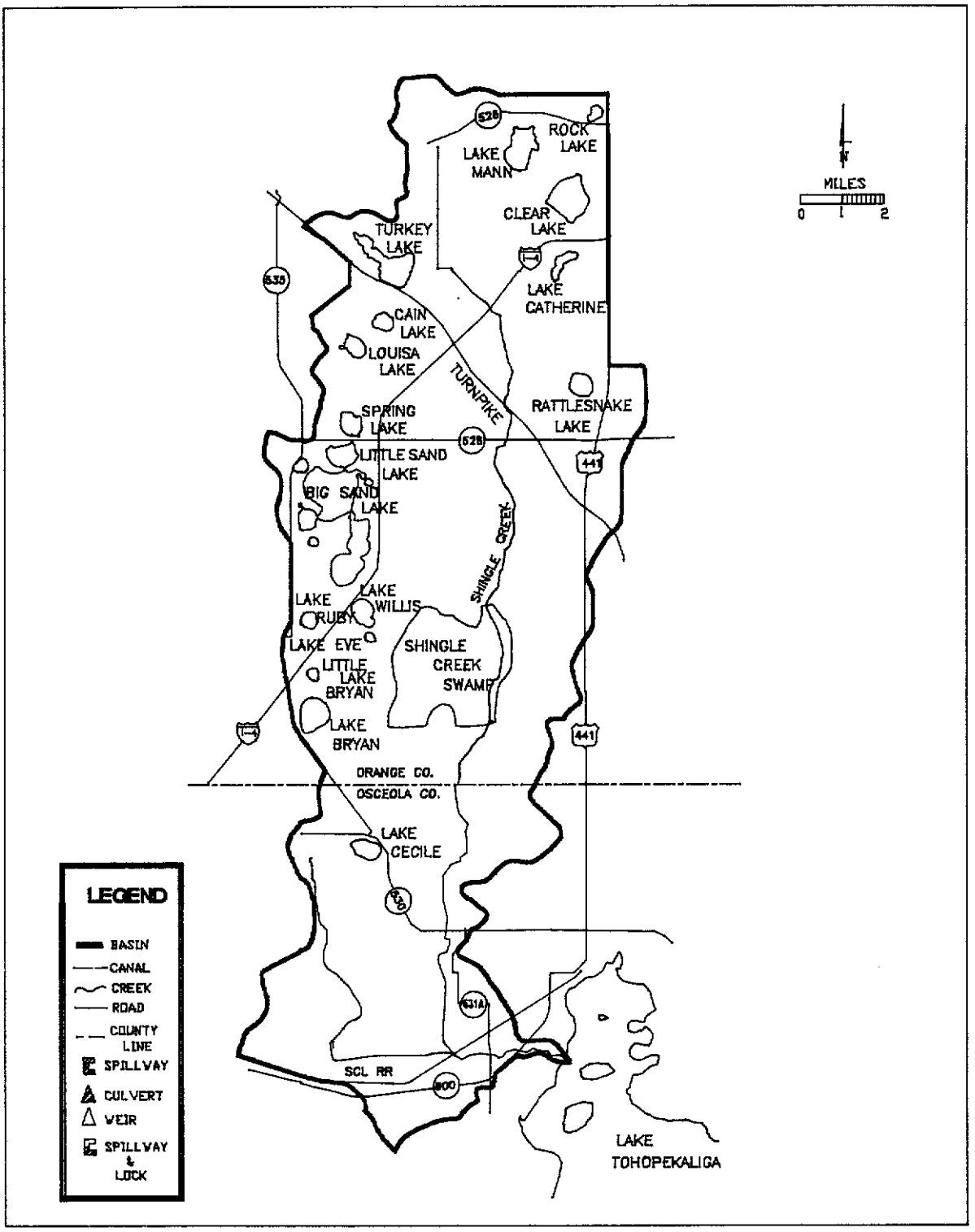


FIGURE 10A. Shingle Creek Basin (71,310 acres).

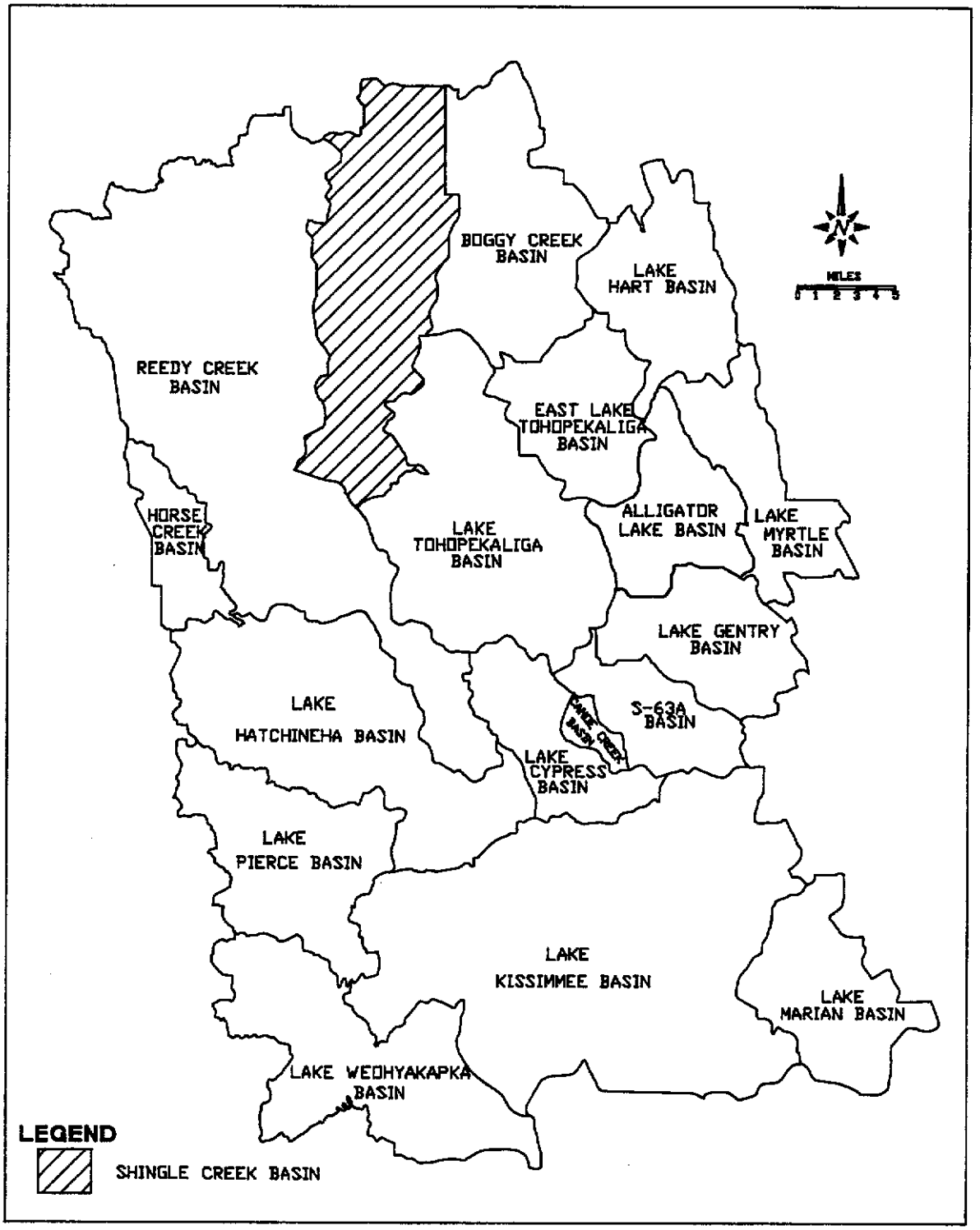


FIGURE 10B. Relative Location of Shingle Creek Basin within the UKRW.

LAKE TOHOPEKALIGA BASIN

Description of the Basin

The Lake Tohopekaliga basin has an area of 131.4 square miles (Figure 11A). Most of this basin is located in Osceola County except for the northernmost part which is in Orange County. This basin occupies the central part of the UKRW (Figure11B). The southernmost point of Lake Tohopekaliga is the outlet of this basin discharging into Cypress Lake through C-35.

Lake Tohopekaliga, which has an area of 30.2 square miles at a normal stage of 53.7 feet NGVD, receives inflows from two major sources: Shingle Creek and St. Cloud Canal (C-31) from East Lake Tohopekaliga. Lake Tohopekaliga is a shallow lake having a mean depth of 7.0 feet at the maximum regulation stage of 55.0 feet NGVD. This lake alone represents approximately 23 percent of the entire area of the basin. Fish Lake, a 220-acre lake located west of the St. Cloud Canal (C-31) and northeast of Lake Tohopekaliga, discharges into Lake Tohopekaliga through an excavated canal. Although it does not contribute flow to Lake Tohopekaliga, Brown Lake, a 140-acre lake located to the southwest of Lake Tohopekaliga, is also part of this basin. Discharges from Lake Tohopekaliga are conveyed by the South Port Canal (C-35) to Lake Cypress through S-61.

District Canals and Structures

The St. Cloud Canal (C-31) connecting East Lake Tohopekaliga to Lake Tohopekaliga is 3.9 miles long. S-59, which controls East Lake Tohopekaliga, is located on C-31, 1,100 feet downstream of this lake. Its design water surface elevation varies from 57.7 feet NGVD in East Lake Tohopekaliga to 54.8 feet NGVD in Lake Tohopekaliga. C-31 has a ground-surface slope of 0.84 feet per mile, and a bottom width of 20 feet.

S-61 controls Lake Tohopekaliga on the South Port Canal (C-35) at the outlet of Lake Tohopekaliga on its southern shore. This structure is a reinforced concrete-gated spillway controlled by a cable operated vertical lift gate. Operation of the spillway gate is manually controlled in accordance with seasonal operational criteria. This structure also includes a reinforced concrete lock with two pairs of sector gates. The purposes of S-61 are: (1) To maintain optimum upstream water control stages in Lake Tohopekaliga, (2) to pass the design flood without exceeding the upstream flood design stage, and to restrict downstream flood stages and channel velocities to nondamaging levels, (3) to prevent overtopping of the structure by wind tide from Lake Tohopekaliga, and (4) to pass sufficient discharge during low-flow periods to maintain downstream stages. The water level which will bypass this structure is 62.0 feet NGVD.

The lock structure is 30 feet wide by 90 feet long with the invert elevation at 43.0 feet NGVD. The lock has hydraulically operated sector gates which allows passage of vessels with a draft of less than 6 feet between the Kissimmee River (C-38) and Lake Tohopekaliga.

Comments on Historic Operation

S-61 is operated according with the Lake Tohopekaliga regulation schedule. This schedule ranges between elevations 52.0 and 55.0 feet NGVD and represents

the desirable water level throughout the year. If the level is above the prescribed level, flood operation is required. If the level is below the prescribed level, low-water operation is required. The operation is also dependent on hydraulic and structural limitations of the structure.

Flood Control Operation: When the water level in Lake Tohopekaliga is less than 0.5 feet above the prescribed level, a release schedule based on forecasted inflow is established to return the lake to that level within 15 days. When the lake stage is over 0.5 feet above the prescribed level, maximum releases subject to hydraulic and structural limitations are made.

Low-Water Operation: Whenever the lake level is below the prescribed level, minimum releases are made to satisfy downstream demands.

Structural Limitations: The maximum water level drop across the structure is 10 feet, if the upstream water elevation is below 55.0 feet NGVD; 6.0 feet if the upstream water elevation is between 55.0 and 59.9 feet MGVD; and less than 6.0 feet if the upstream water elevation is above 60.0 feet NGVD.

Hydraulic Limitations: The gate opening is limited in accordance with the "Maximum Allowable Gate Opening Curve," to prevent damage from high velocities. The gate also has to be opened gradually to allow tailwater stages to rise before large discharges are released.

The schedule of lock operation is based on the River and Harbor Act of August 8, 1917, established by the COE.

Construction of S-61 and C-35 was completed in October 1963 and regulation of Lake Tohopekaliga began in early 1964. Because of environmental considerations, the regulation schedules for East Lake Tohopekaliga, Lake Tohopekaliga, Cypress Lake, Lake Hatchineha, and Lake Kissimmee were modified in 1971 and in 1979. The current regulation schedule is shown in Figure 11C.

Preliminary investigations conducted on Lake Tohopekaliga in 1968-69 indicated that desirable aquatic habitat was deteriorating. Major factors contributing to this deterioration were water level stabilization and pollution associated with watershed development, compounded by rapid population growth. To completely eliminate these problems, alternate methods of maintaining desirable aquatic habitat was explored. An extreme drawdown of Lake Tohopekaliga was recommended in 1969 as an experimental management effort to reduce, moderate, or reverse symptoms of habitat degradation. The extreme drawdown would cause a temporary negative impact on residents, merchants, and recreational users of the lake, but long-term benefits to the lake would far outweigh any short-term inconvenience. By early 1970 a basic program had been developed, and was accepted by the community and controlling governmental agencies.

The drawdown consisted of a 7-foot vertical drop in water level from high regulation stage of 55.0 feet NGVD to a drawdown stage of 48.0 feet NGVD. The lake elevation remained low for six months, from March to September 1971, with approximately 50 percent of the lake bottom exposed. As a result of the drought, refilling to low regulation stage of 52.0 feet NGVD was delayed until March 1972. A high regulation stage of 55.0 feet NGVD was achieved in March 1973. Beneficial changes occurred as a result of the drawdown yielding a significant improvement in fish population. Two years after the 1971 Lake Tohopekaliga extreme drawdown,

fish population in the vegetated areas of the lake more than doubled the pre-drawdown population.

Subsequent extreme drawdowns were achieved in 1979 and 1987. During the 1987 extreme drawdown of Lake Tohopekaliga, muck removal operations were first implemented. Aquatic habitat was restored and improved along 12 miles of shoreline during the three-month low water period. Over 215,000 cubic yards of organic debris were scraped from 217 acres of prime sport fish spawning, feeding, and rearing habitat. Fish population surveys completed in the spring of 1988 indicated that there *was* a 400 percent increase in the number of harvestable bass found off the scraped areas when compared to adjacent sites that were not scraped .

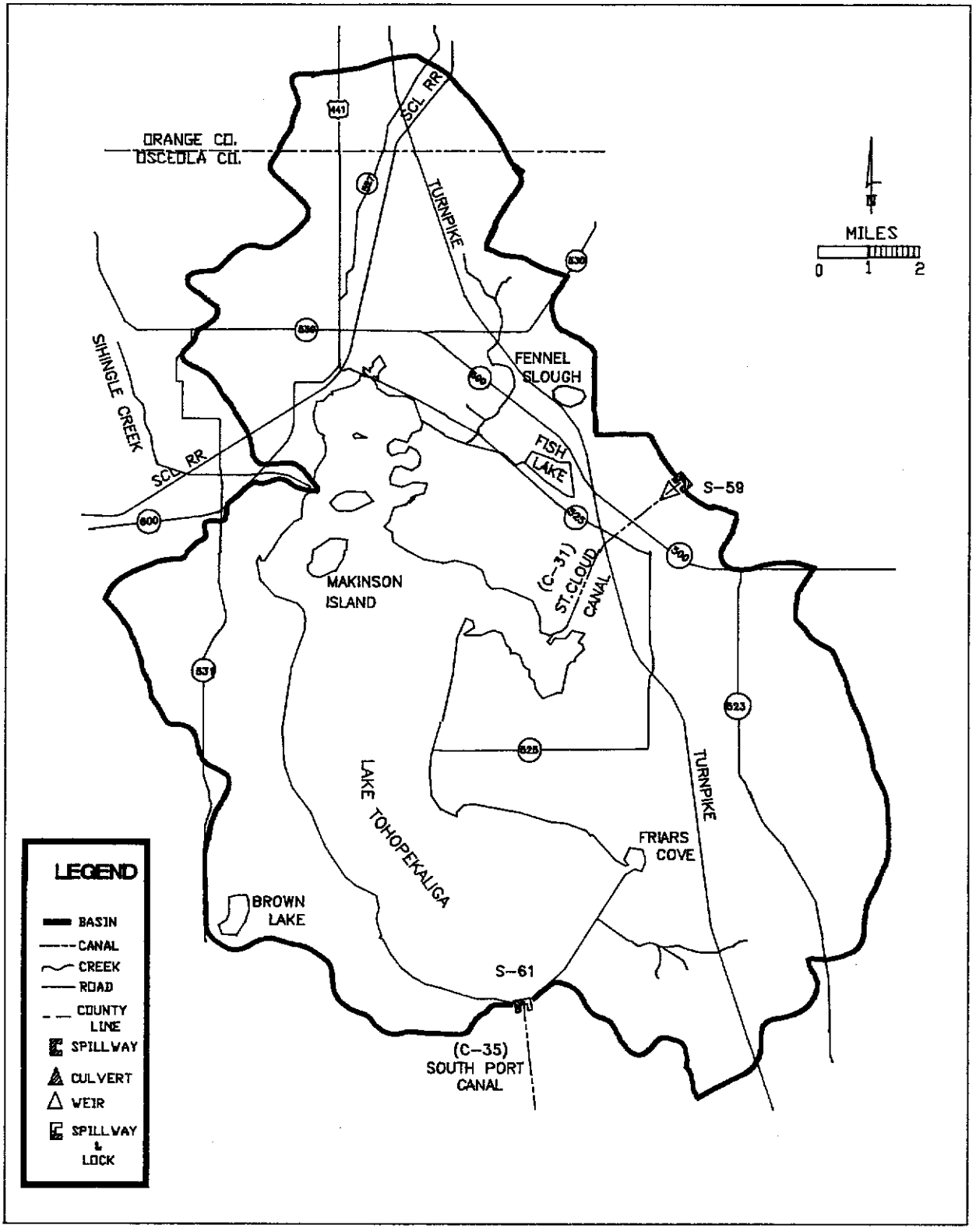


FIGURE 11A. Lake Tohopekaliga Basin (84,130 acres).

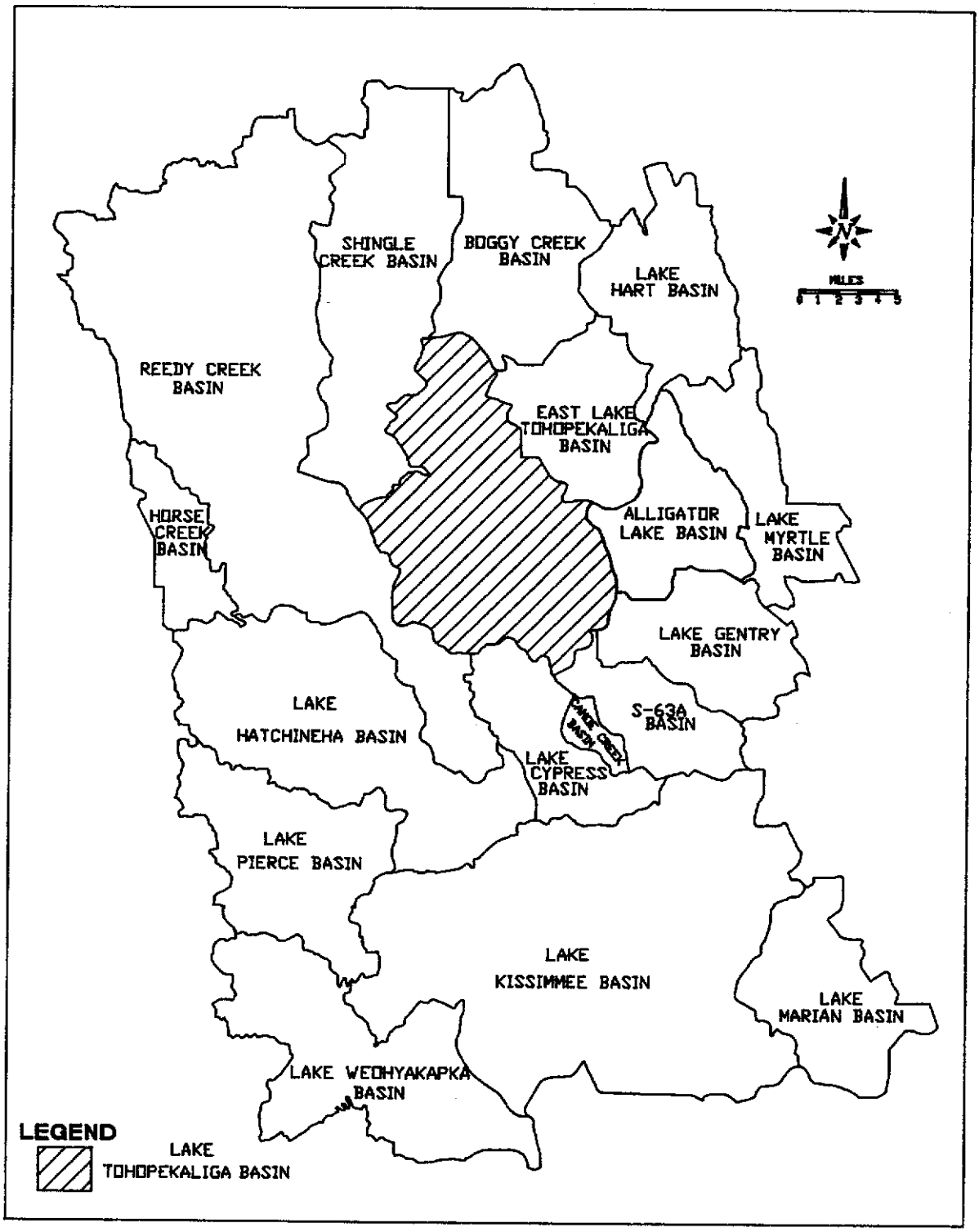
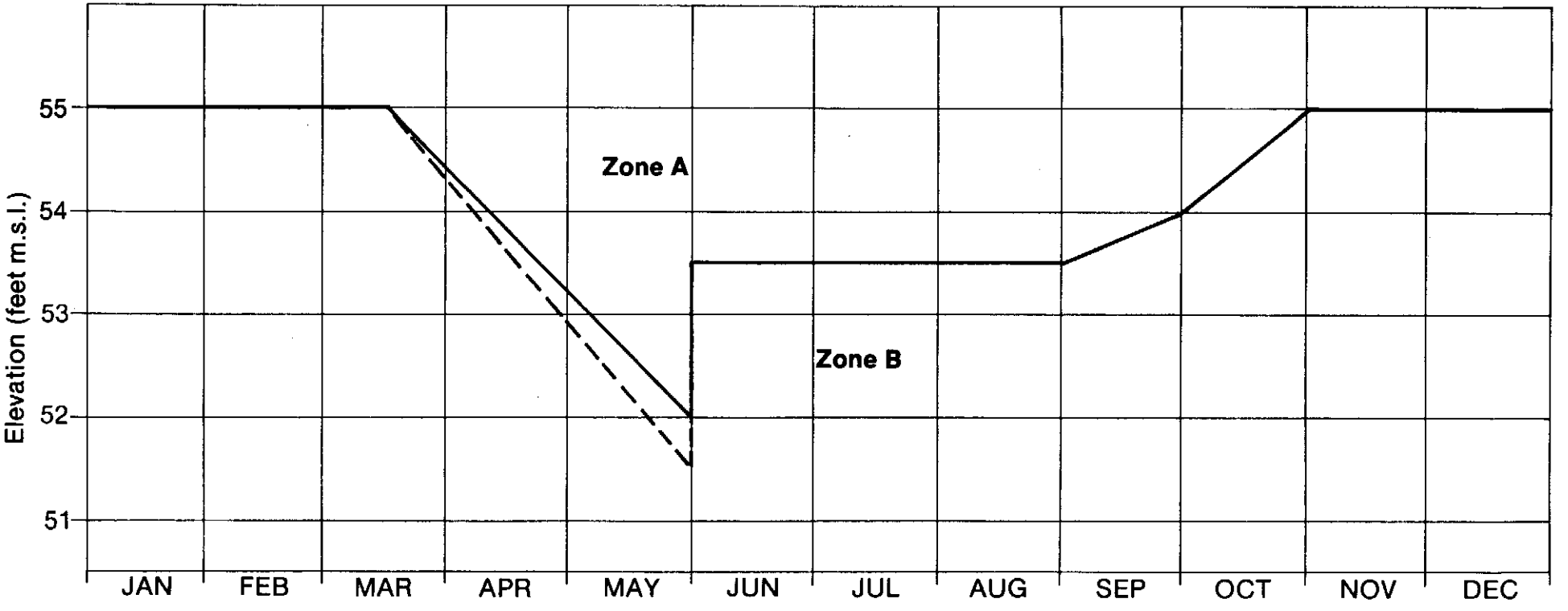


FIGURE 11B. Relative Location of Lake Tohopekaliga Basin within the UKRW.



Zone	Releases S-61
A	At design capacity (2300 cfs) except when the lake is within 0.5 feet of desired stage. Forecasts will then be made and releases started to bring the lake back to schedule within 15 days.
B	To maintain minimum flows.

Note: — — — Use this schedule one year in three.

FIGURE 11C. Lake Tohopekaliga Regulation Schedule.

REEDY CREEK BASIN

Description of the Basin

The Reedy Creek basin has an area of 269.0 square miles (Figure 12A), of which 25.1 square miles are in Lake County, 26.6 square miles in Polk County, 105.7 square miles in Orange County, and 111.6 square miles in Osceola County. This basin occupies the northwest corner of the Upper Kissimmee River basin, and its entire north area has a significant number of relatively small lakes. The Reedy Creek basin's relative location within UKRW is shown in Figure 12B.

Walt Disney World located in the Reedy Creek Improvement District is bordered on the north, west, and south by Reedy Creek and the northwest portion of Bay Lake. Reedy Creek runs southeast for 29 miles before splitting into two branches near Cypress Lake. One branch enters Cypress Lake and the other one, known as the Dead River, enters Lake Hatchineha. Historically 70 percent of the flow has gone to Lake Hatchineha. Reedy Creek forms Lake Russell, which has an area of 725 acres, and is located 7 miles upstream of Cypress Lake.

During extreme rainfall events, water from Reedy Creek north of Highway 600 can flow to Shingle Creek through the Reedy Creek swamp.

The portion of Reedy Creek basin operated by the District does not contain any water control structures; however, there are several structures within this basin that are operated by Walt Disney World.

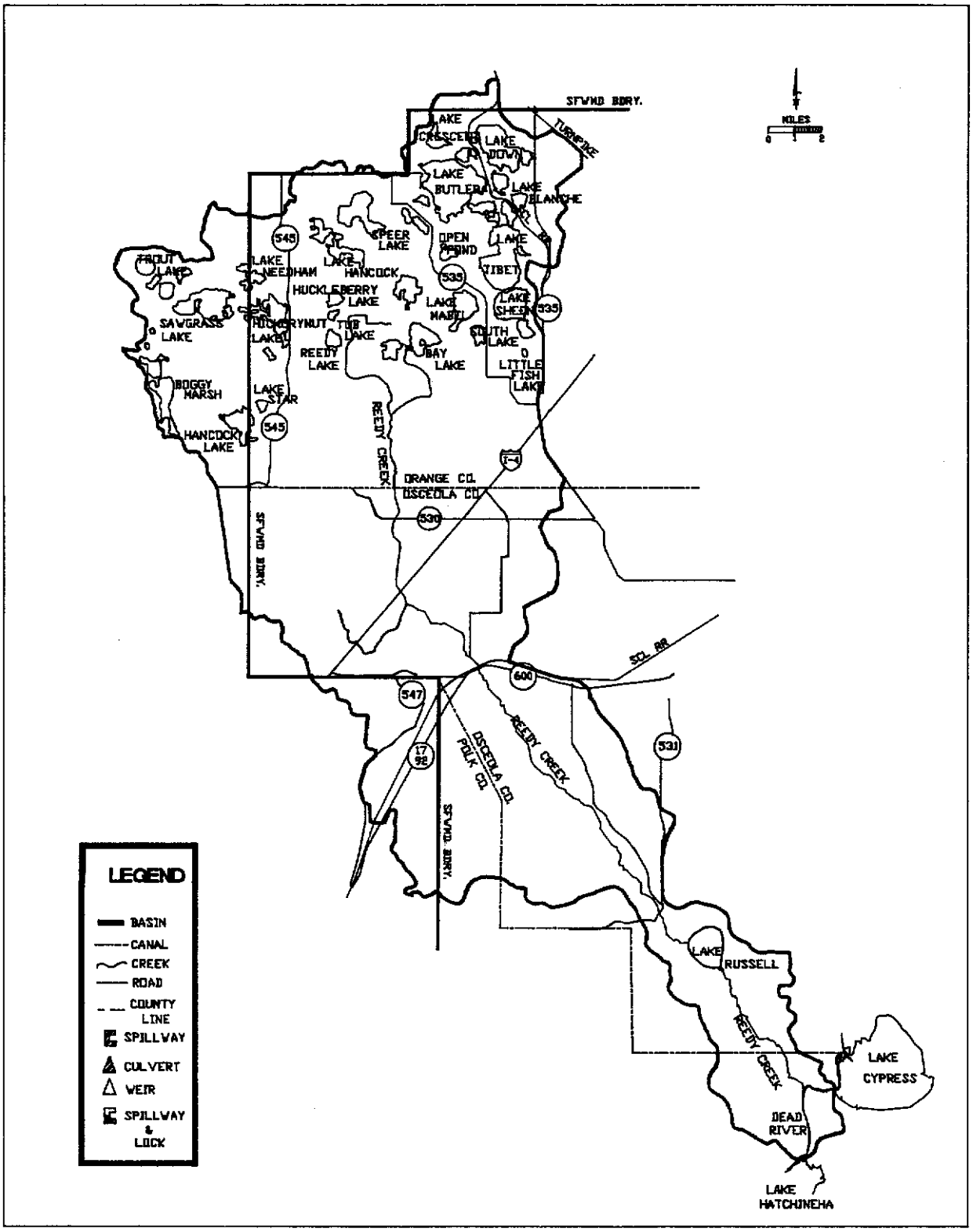


FIGURE 12A. Reedy Creek Basin (172,200 acres).

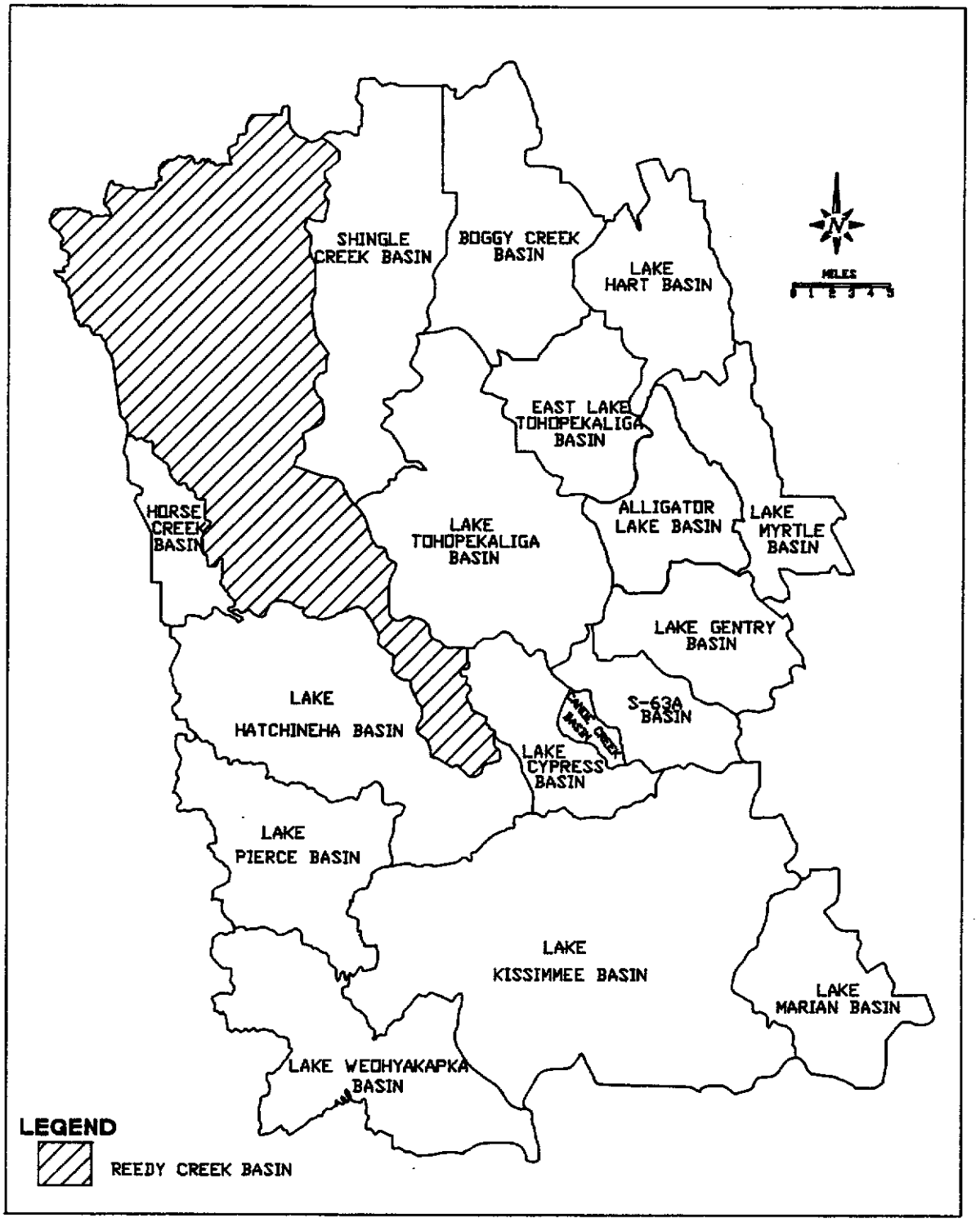


FIGURE 12B. Relative Location of Reedy Creek Basin within the UKRW.

HORSE CREEK BASIN

Description of the Basin

Horse Creek basin, which is in the western part of UKRW (Figure 13A) has an area of 26.5 square miles (Figure 13B). Only 11 percent of this area, located in Osceola County, is within the District's boundary line. Over 88 percent is in Polk County, and a small part of the basin is in Lake County.

This basin does not contain any water control structures.

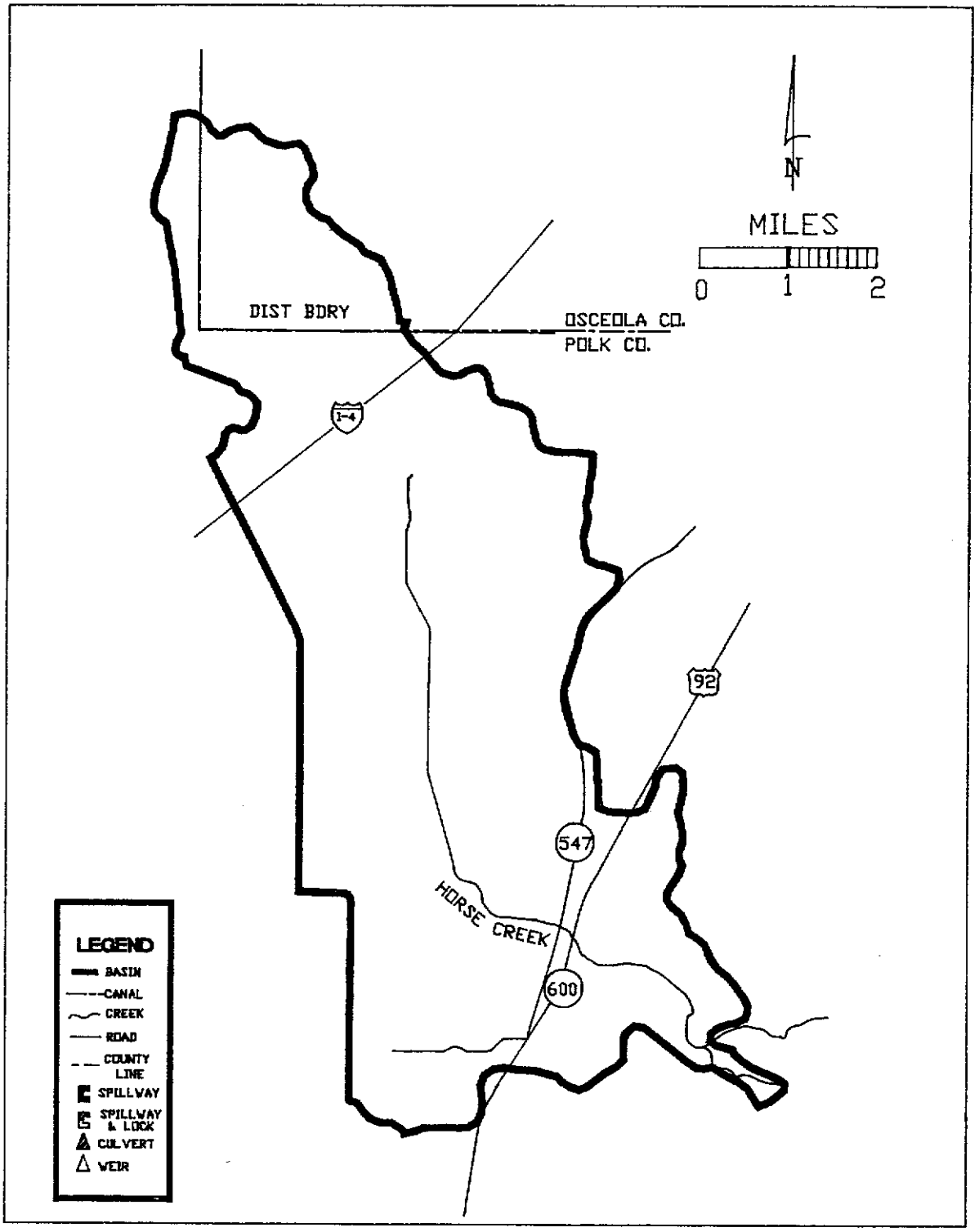


FIGURE 13A. Horse Creek Basin (16,960 acres).

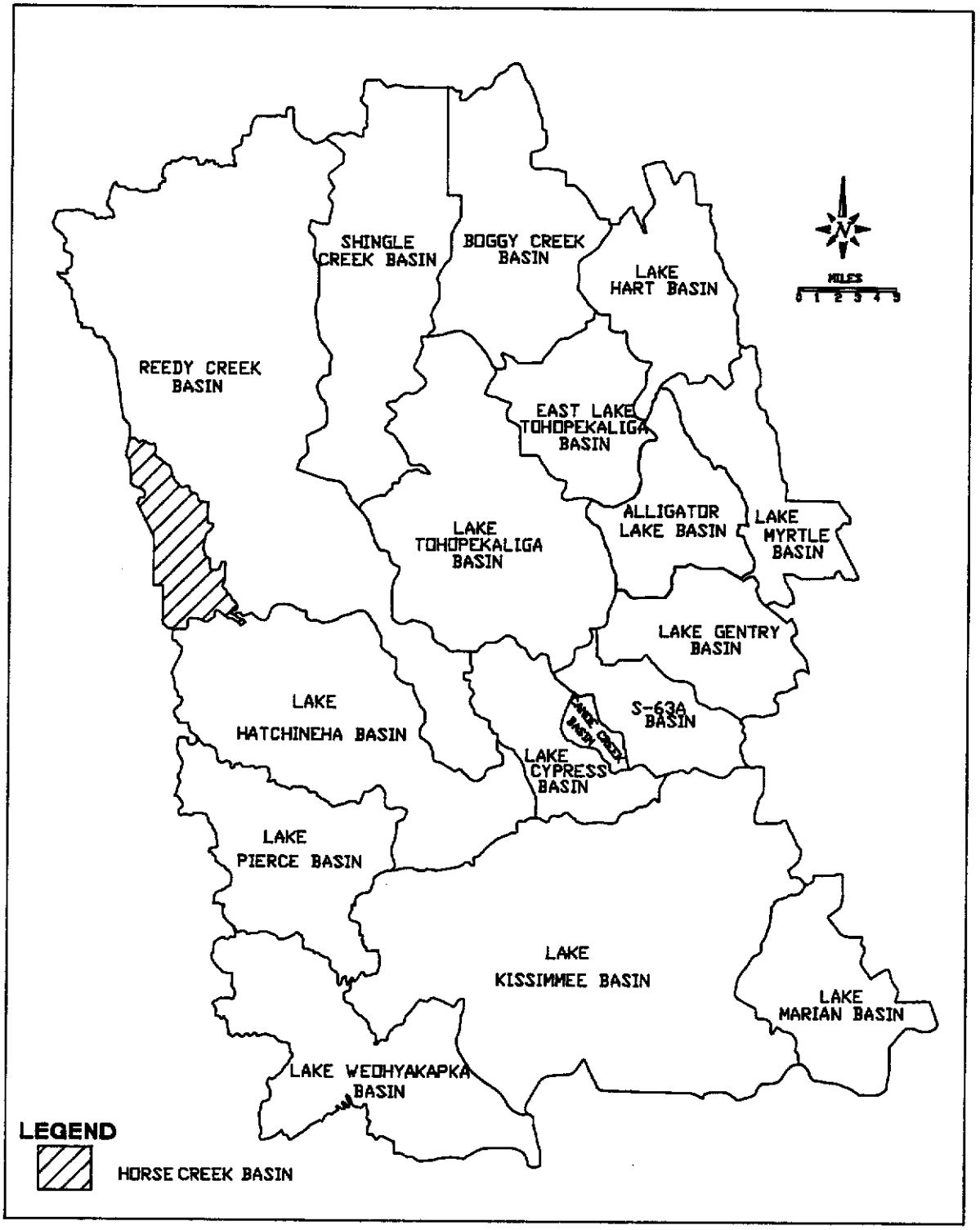


FIGURE 13B. Relative Location of Horse Creek Basin within the UKRW.

LAKE PIERCE BASIN

Description of the Basin

The Lake Pierce basin has an area of 75.9 square miles in area (Figure 14A), and is located in Polk County. This basin is located in the southwest portion of the UKRW (Figure 14B). Water from Lake Pierce, which has an approximate area of 6.1 square miles (at a stage of 76.0 feet NGVD), flows into Lake Hatchineha through Catfish Creek.

Saddlebag Lake, Thomas Lake, Parks Lake, Cypress Lake, Little Gum Lake and Big Gum Lake, which range from 25 to 170 acres in area, are in the southeast part of this basin.

This basin does not contain any water control structures.

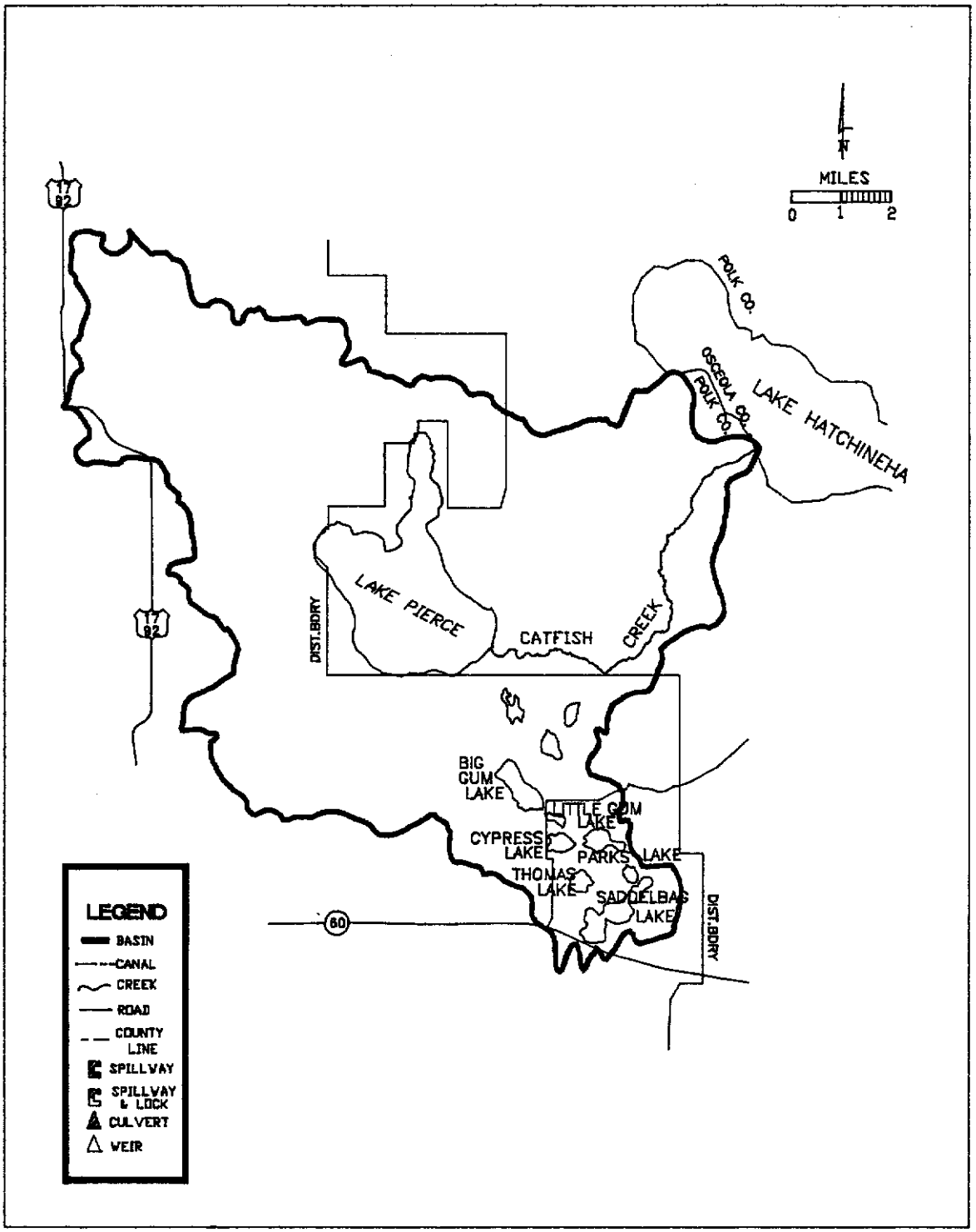


FIGURE 14A. Lake Pierce Basin (48,610 acres).

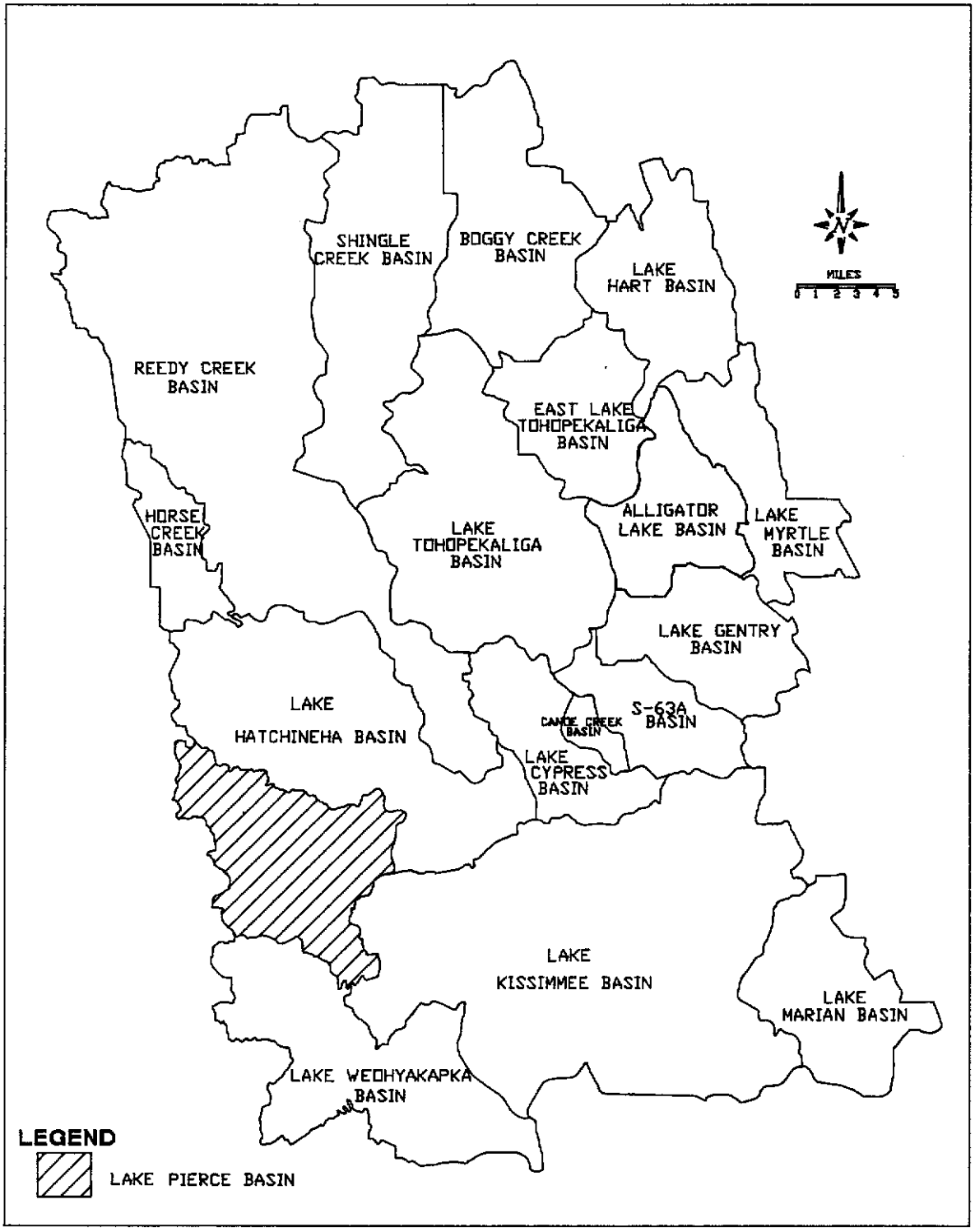


FIGURE 14B. Relative Location of Lake Pierce Basin within the UKRW.

LAKE HATCHINEHA BASIN

Description of the Basin

The Lake Hatchineha basin has an area of 128.5 square miles (Figure 15A), of which 33.3 square miles are located in Osceola County and 95.2 square miles in Polk County. This basin occupies the central-western portion of the UKRW (Figure 15B).

Lake Hatchineha is approximately 14.8 square miles at a stage of 51.8 feet NGVD, and most of its perimeter defines the boundary between Osceola County and Polk County. A considerable amount of the western part of this basin drains to Lake Marion which is approximately 5.4 square miles in area at 67.0 feet NGVD. Water from Lake Marion to Lake Hatchineha is conveyed by Lake Marion Creek. Snell Creek joins Lake Marion Creek just downstream of Lake Marion.

District Canals and Structures

Cypress-Hatchineha Canal (C-36) and part of Hatchineha-Kissimmee Canal (C-37) are in the Lake Hatchineha basin.

C-36 is 3.1 miles long connecting Cypress Lake to Lake Hatchineha. Its design floodwater surface varies from 53.6 feet NGVD to 53.3 feet NGVD (upper limit), and from 52.3 feet NGVD to 52.0 feet NGVD (lower limit) in Cypress Lake and in Lake Hatchineha, respectively. Its design slope is nearly flat, and its design bottom width is 20 feet.

Approximately half of C-37, which connects Lake Hatchineha to Lake Kissimmee, is within this basin. C-37 is 4.4 miles in length and has a design bottom width of 40 feet. Its design floodwater surface varies from 53.3 feet NGVD to 52.6 feet NGVD (upper limit), and from 52.0 feet NGVD to 51.5 feet NGVD (lower limit) in Lake Hatchineha and in Lake Kissimmee respectively. Its design slope is nearly flat.

S-65, located at the outlet of Lake Kissimmee on the Kissimmee River (C-38), regulates Lake Hatchineha together with Cypress Lake and Lake Kissimmee.

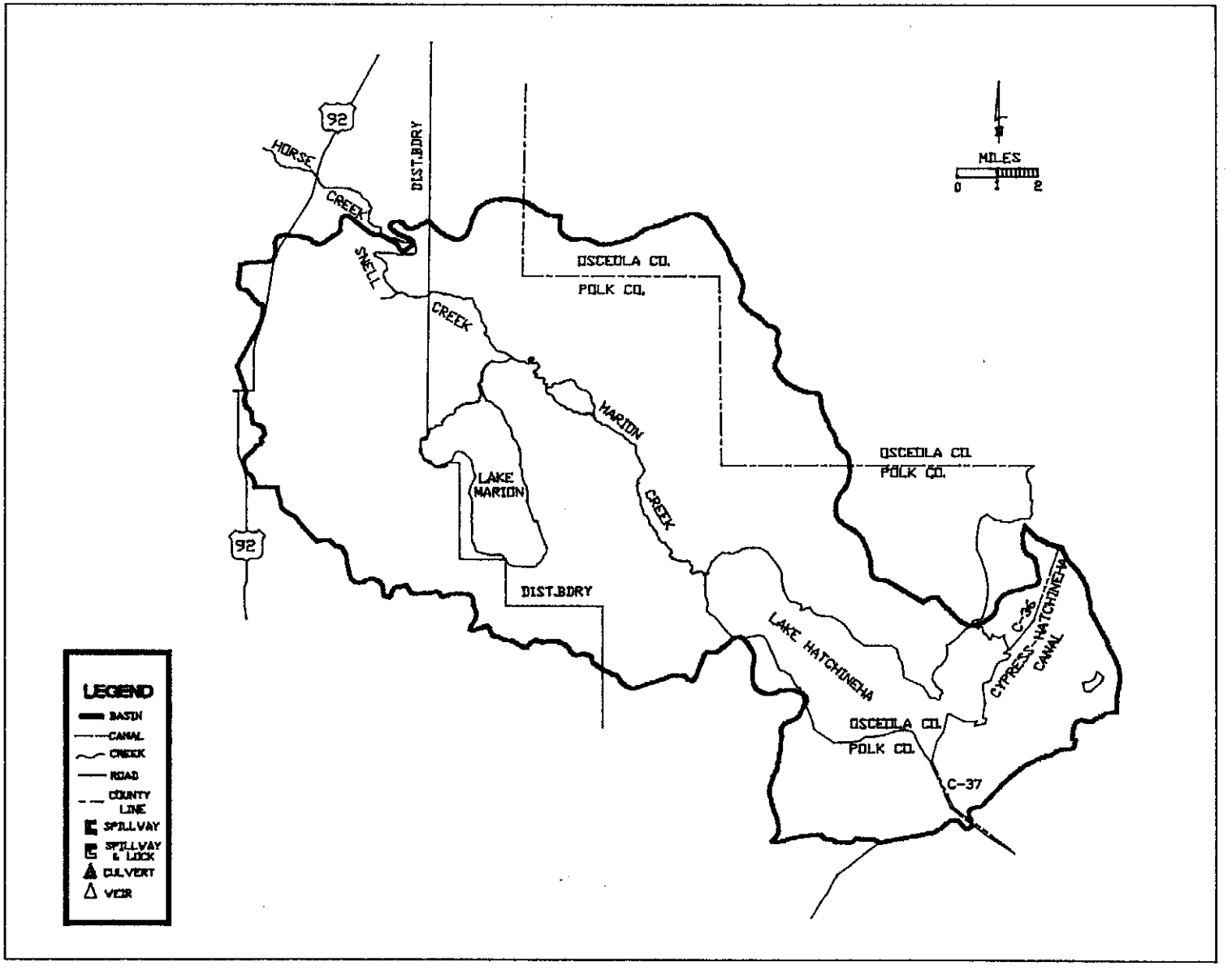


FIGURE 15A. Lake Hatchineha Basin (82,250 acres).

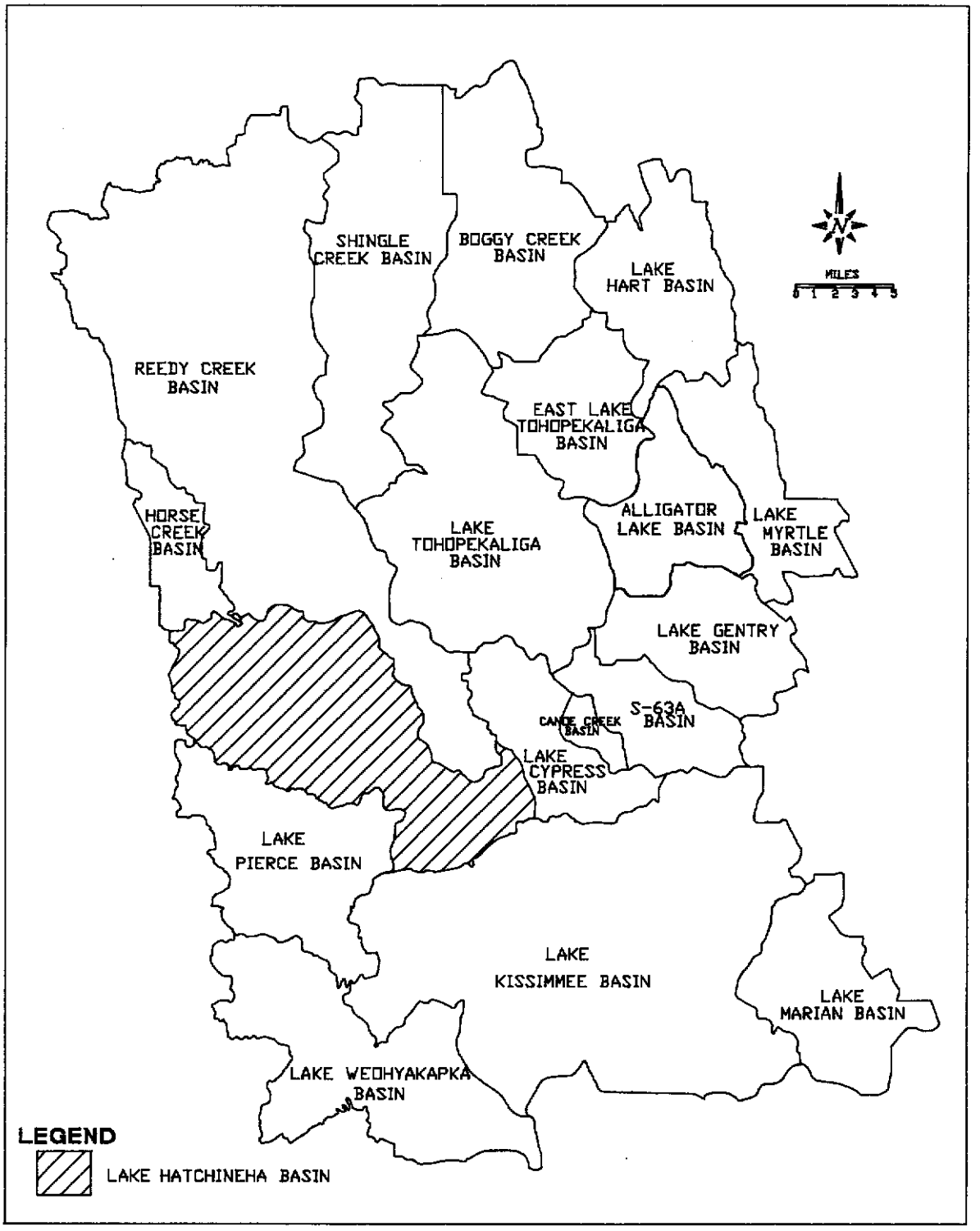


FIGURE 15B. Relative Location of Lake Hatchineha Basin within the UKRW.

LAKE MARIAN BASIN

Description of the Basin

Lake Marian basin, located in Osceola County, has an area of 57.9 square miles (Figure 16A) and occupies the southeast corner of the UKRW (Figure 16B). Lake Marian has a surface area of 7.9 square miles at a stage of 59.1 feet NGVD.

Lake Marian is connected to Lake Jackson by a channel less than 2 miles long. G-113 is located in this channel, 3,000 feet from the outlet of Lake Marian. This structure is a triple-barreled corrugated metal pipe culvert, 72 inches in diameter, which controls the discharge from Lake Marian to Lake Jackson. By means of the Jackson Canal, water from Lake Jackson discharges into Lake Kissimmee. This culvert is under an unimproved dirt road running southwest approximately 2.8 miles from its intersection with Canoe Creek Road (523).

Comments on Historic Operation

The principal outlet for Lake Marian has historically been Fodderstack Slough which connects with Jackson Canal. When water surface elevation at Lake Marian reaches 59.0 feet NGVD, water begins to flow into Lake Kissimmee through Fodderstack Slough.

The structure prevents overdraining Lake Marian and maintains optimum lake stages between 58.0 and 60.5 feet NGVD. When water surface elevation upstream of G-113 exceed 59.0 feet NGVD, water begins flowing to Lake Jackson. The stop logs on G-113 are set at an elevation of 59.0 feet NGVD under normal conditions. The number of boards in the risers are adjusted to regulate the lake stage within the optimum range.

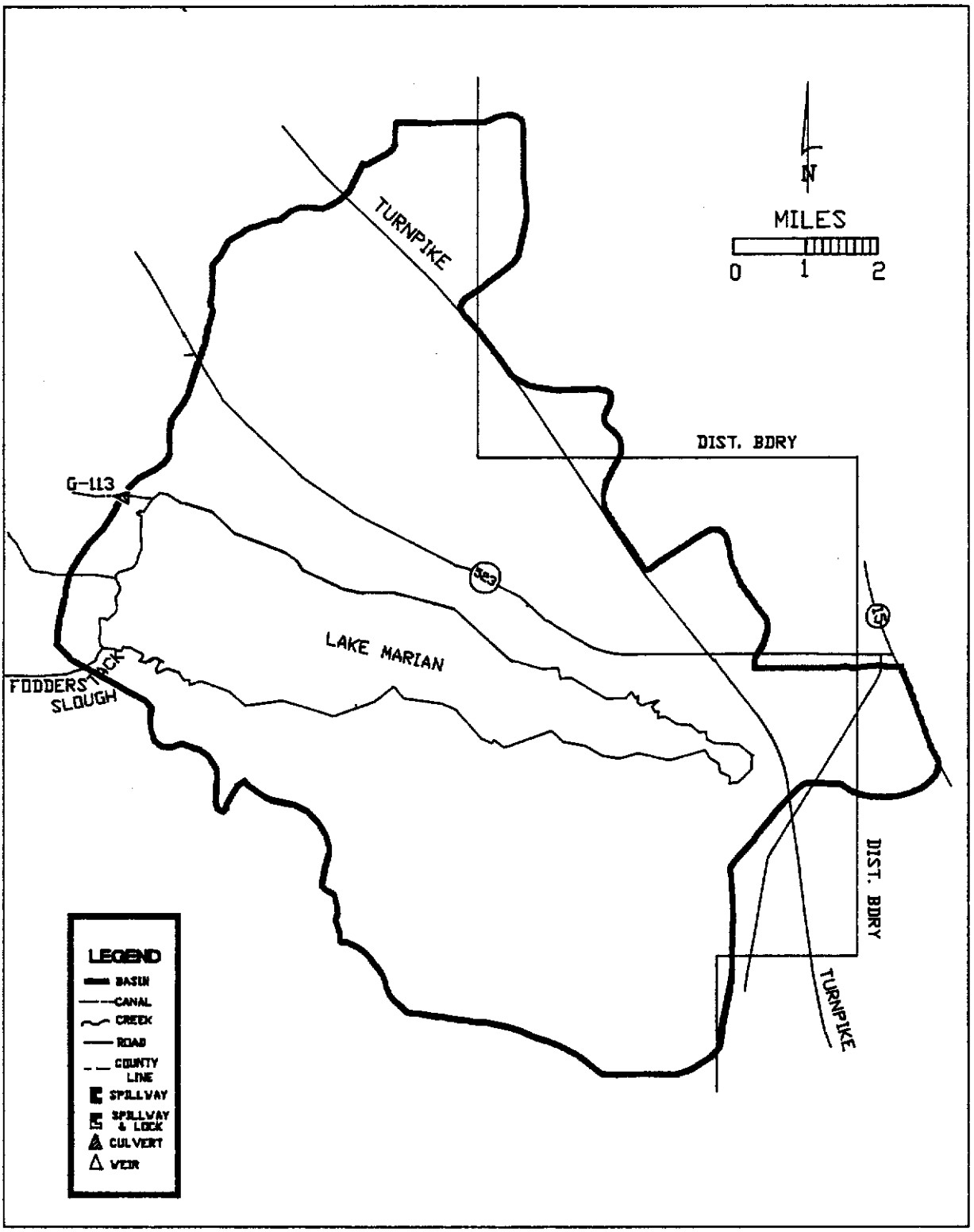


FIGURE 16A. Lake Marian Basin (37,040 acres).

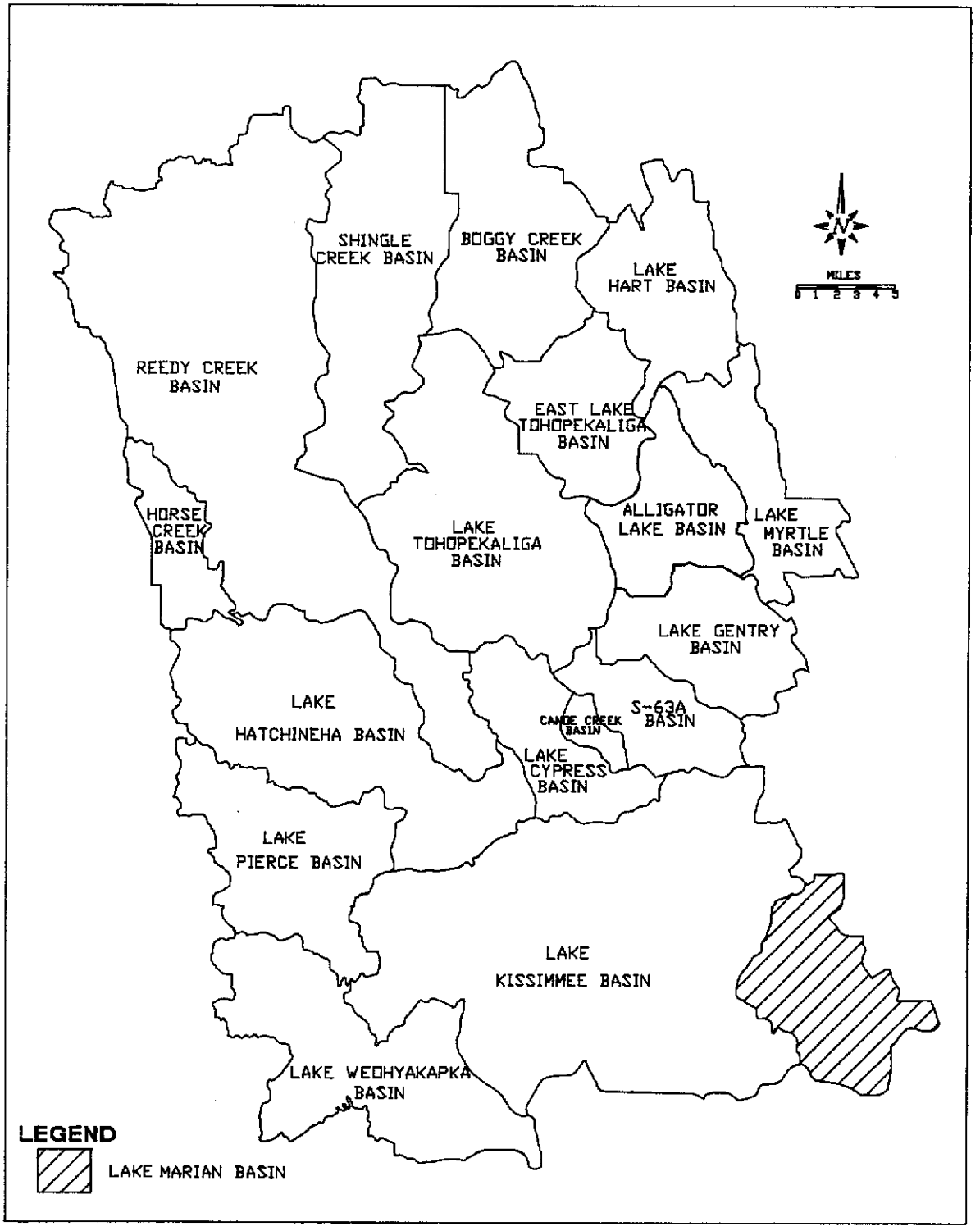


FIGURE 16B. Relative Location of Lake Marian Basin within the UKRW.

LAKE WEOHYAKAPKA BASIN

Description of the Basin

The Lake Weohyakapka basin, located in Polk County, has an area of 97.8 square miles (Figure 17A). This basin occupies the southwest corner of the UKRW (Figure 17B). Approximately 50 percent of Lake Weohyakapka basin (western section) is outside of the District's boundary line. Lake Weohyakapka is 11.9 square miles in area at a stage of 60.0 feet NGVD, and is connected to Lake Rosalie by Weohyakapka Creek, which is 4.5 miles long. Lake Wales, Lake Easy, Lake Leonore and Lake Moody which average 320 acres in size, are located along the western boundary of this basin.

When the stage at Lake Weohyakapka is above 63.5 feet NGVD, water may also flow through Blue Jordan Swamp to Lake Arbuckle, located outside of the UKRW.

This basin does not contain any water control structures.

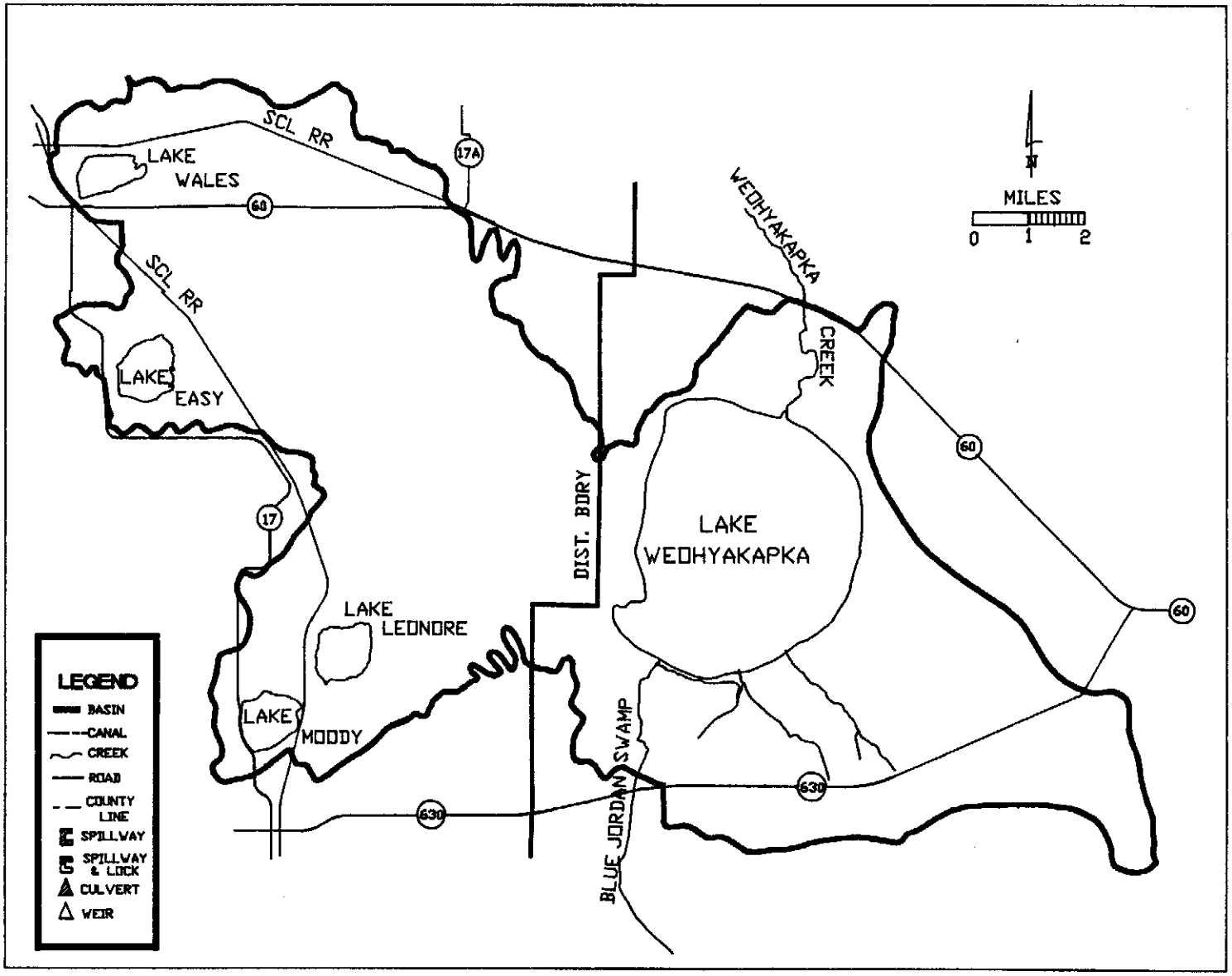


FIGURE 17A. Lake Weohyakapka Basin (62,600 acres).

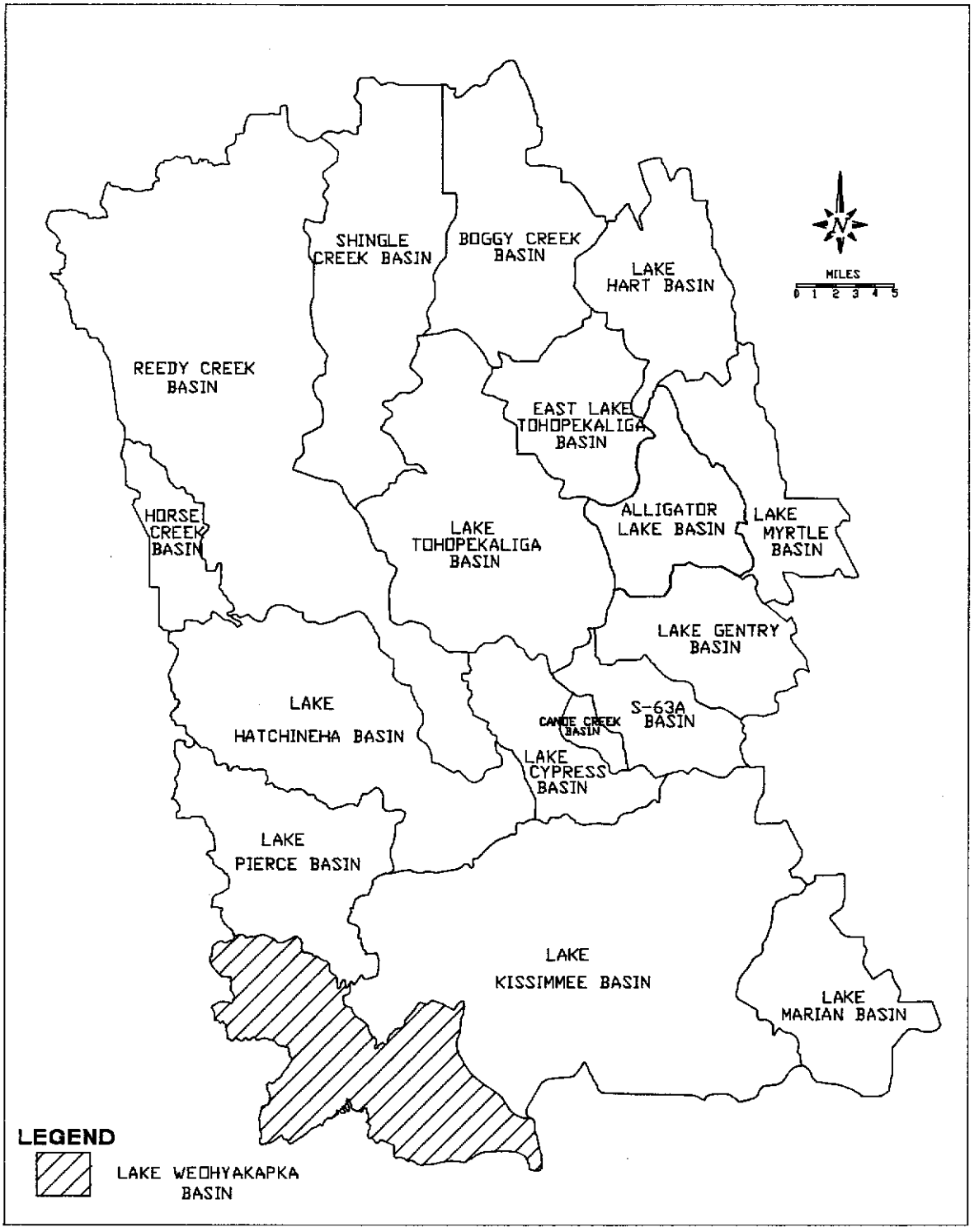


FIGURE 17B. Relative Location of Lake Weohyakapka Basin within the UKRW.

LAKE KISSIMMEE BASIN

Description of the Basin

The Lake Kissimmee basin has an area of 269.1 square miles (Figure 18A), of which 175 square miles is located in Osceola County and 94.1 square miles in Polk County. This basin occupies a considerable portion of the southern area of the UKRW (Figure 18B). The west side of Lake Kissimmee forms the boundary between Osceola County and Polk County.

Four major lakes are in this basin: Lake Kissimmee (55.5 square miles at a stage of 50.8 feet NGVD); Lake Jackson (1.6 square miles at 51.0 feet NGVD) located in Osceola County; Lake Rosalie (9.1 square miles at 53.5 feet NGVD); and Tiger Lake (4.8 square miles at 51.0 feet NGVD) located in Polk County. Lake Jackson receives water from Lake Marian basin by G-113. Jackson Canal conveys water from Lake Jackson and Lake Marian to Lake Kissimmee. Lake Rosalie discharges into Tiger Lake by means of Rosalie Creek, and Tiger Lake discharges into Lake Kissimmee through Tiger Creek. Also, Lake Rosalie is connected directly to Lake Kissimmee by Zipprer Canal located in Kissimmee Park. Lake Kissimmee is the largest lake of the UKRW. The S-65 structure located at the outlet of Lake Kissimmee represents the discharge outlet point for surface flows leaving the entire UKRW.

District Canals and Structures

The downstream half of C-37 connecting Lake Hatchineha to Lake Kissimmee is in the Lake Kissimmee basin. The characteristics of C-37 are described in the section on Lake Hatchineha basin.

G-103, located at the northern end of the lake on the Zipprer Canal, regulates Lake Rosalie. The structure is a steel sheet pile weir with flashboard control and controls, in part, the level of Lake Rosalie. The natural outlet of Lake Rosalie, however, is Rosalie Creek, at the south end of the lake, which discharges into Tiger Lake.

S-65 regulates Cypress Lake, Lake Hatchineha and Lake Kissimmee. This structure is on the Kissimmee River (C-38) at the outlet of Lake Kissimmee. The structure is a reinforced concrete, three-gated spillway controlled by three cable-operated, vertical lift gates. The spillway is manually controlled in accordance with seasonal operational criteria. This structure also contains a reinforced concrete lock with two pairs of sector gates. The purposes of S-65 are: (1) to maintain optimum upstream water control stages in Lake Kissimmee, (2) to pass the design flood (30 percent of the SPF) without exceeding the upstream flood design stage, and to restrict downstream flood stages and channel velocities to nondamaging levels, (3) to prevent overtopping of the structure by wave action from Lake Kissimmee during the design storm and wind tide, and (4) to pass sufficient discharge during low-flow periods to maintain downstream stages. The lock structure is 30 feet wide by 90 feet long with downstream invert elevation at 38.0 feet NGVD and upstream invert elevation at 40.5 feet NGVD.

Comments on Historic Operation

G-103 is operated whenever Lake Rosalie is above schedule (54.0 to 54.5 feet NGVD). Required discharges are calculated to bring the lake to regulation schedule within two weeks by appropriate manipulation of the flashboards and uncontrolled flows in Rosalie Creek. The water level which will bypass the structure is 57.0 feet NGVD.

S-65 is operated in accordance with the Lake Kissimmee regulation schedule, which ranges between 49.0 and 52.5 feet NGVD, and indicates the desirable water level throughout the year. Flood operation is followed if the water surface elevation is above the prescribed level. Low-water operation is followed if the water-surface elevation is below the prescribed level. The operation depends also on hydraulic and structural limitations of the structure.

Flood Control Operation: When the water level in Lake Kissimmee is less than 0.5 feet above the prescribed level, a release schedule based on forecasted inflow is established to return the lake to that level within 15 days. When the lake stage is over 0.5 feet from the prescribed level, maximum releases are made, subject to hydraulic and structural limitations. Maximum releases range from 3,000 cfs to 11,000 cfs, and depending on inflow between S-65 and S-65A, the flow at S-65A is regulated in such a way that it does not exceed 11,000 cfs. S-65A is located on the Kissimmee River (C-38) nearly 10.6 miles downstream of S-65.

Low-Water Operation: Whenever the lake level is below the prescribed level, minimum releases are made to satisfy downstream navigation demands.

Structural Limitations: The maximum water level drop across the structure is 10 feet.

Hydraulic Limitations: The gate opening is limited in accordance with the "Maximum Allowable Gate Opening Curve," to prevent damage from high velocities. The gate also has to be opened gradually to allow tailwater stages to rise before large discharges are released.

The schedule of lock operation is based on the River and Harbor Act of August 8, 1917, established by the COE.

Lake Hatchineha and Cypress Lake, together with Lake Kissimmee, are regulated by S-65 located at the outlet of Lake Kissimmee. The original GDM called for Lake Hatchineha and Cypress Lake to be regulated together, and independent of Lake Kissimmee by a structure in C-37 located between Lake Hatchineha and Lake Kissimmee. Water elevations in Hatchineha and Cypress *lakes* were to be one foot higher than that for Lake Kissimmee; however, it was determined feasible to combine the regulation schedules of all three lakes, whereby the upper level of the Kissimmee regulation schedule would be raised by 0.5 feet, and the Hatchineha and Cypress lakes' upper level of their regulation schedules would be lowered by 0.5 feet. Regulation began in August 1964 once construction of S-65 was completed. The current regulation schedule is shown in Figure 18C.

The extreme drawdown of Lake Kissimmee was completed in October 1977. Its main purpose was to restore and maintain quality aquatic habitat in the lake to stimulate sport fish populations. All major sport fish species were positively affected by this drawdown. Bottom sediments were consolidated and coverage of vegetation communities was improved. The effects of the drawdown were further

documented by fish population studies and creel survey which were continued through 1982. Rainfall patterns and lake stages recorded throughout this four-year study (1979-1982) were erratic. In late summer of 1979, two tropical disturbances affected the Kissimmee River Valley and nearly 20 inches of rainfall was recorded in the city of Kissimmee. Lakes in the UKRW exceeded their high regulation stages and remained high during the winter. In the summer of 1980, normal rainfall did not occur; unusually dry weather continued throughout 1980 and 1981. The District determined that this deficit rainfall period had produced a drought with a frequency of 1 in 200 years. Water stages in Lake Kissimmee dropped steadily throughout 1980, and the lake levels fluctuated barely 1 foot during the drought.

Public concern over the drought focused attention on the practice of overdraining the lakes in the UKRW by June 1 of each year in anticipation of the rainy season. Regulation schedules dictate discharges throughout the normal rainy season (June-August). By premature overdraining for the rainy season and possible hurricanes, water is removed from Lake Kissimmee and seldom recovered in late summer when the lake stages are scheduled to rise. In fact, from 1970 through 1982, Lake Kissimmee had reached a high regulation stage (52.5 feet NGVD) only three times. Prior data from 1943 to 1960 indicated that Lake Kissimmee reached an elevation of 52.5 feet NGVD in 9 of 18 years.

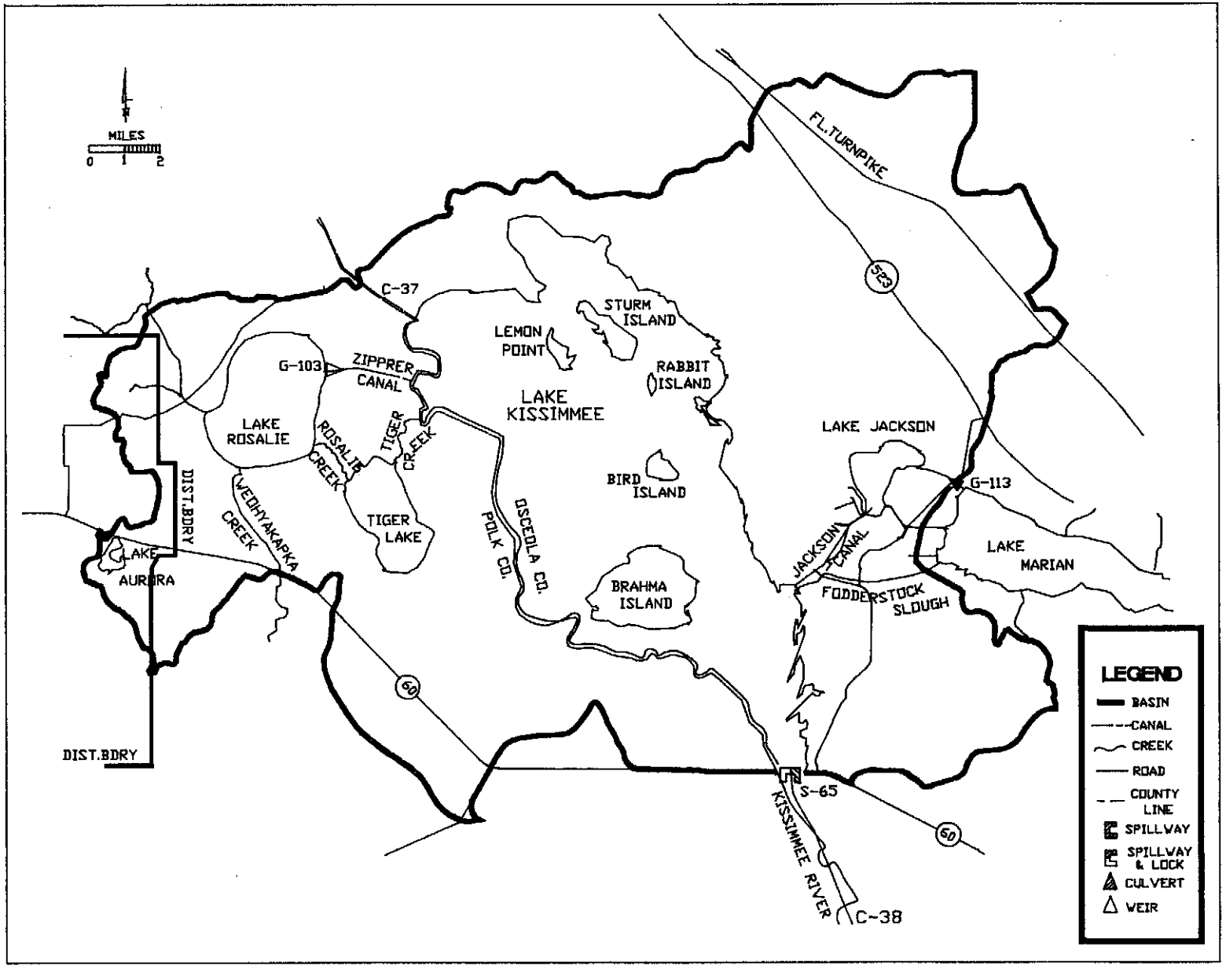


FIGURE 18A. Lake Kissimmee Basin (172,300 acres).

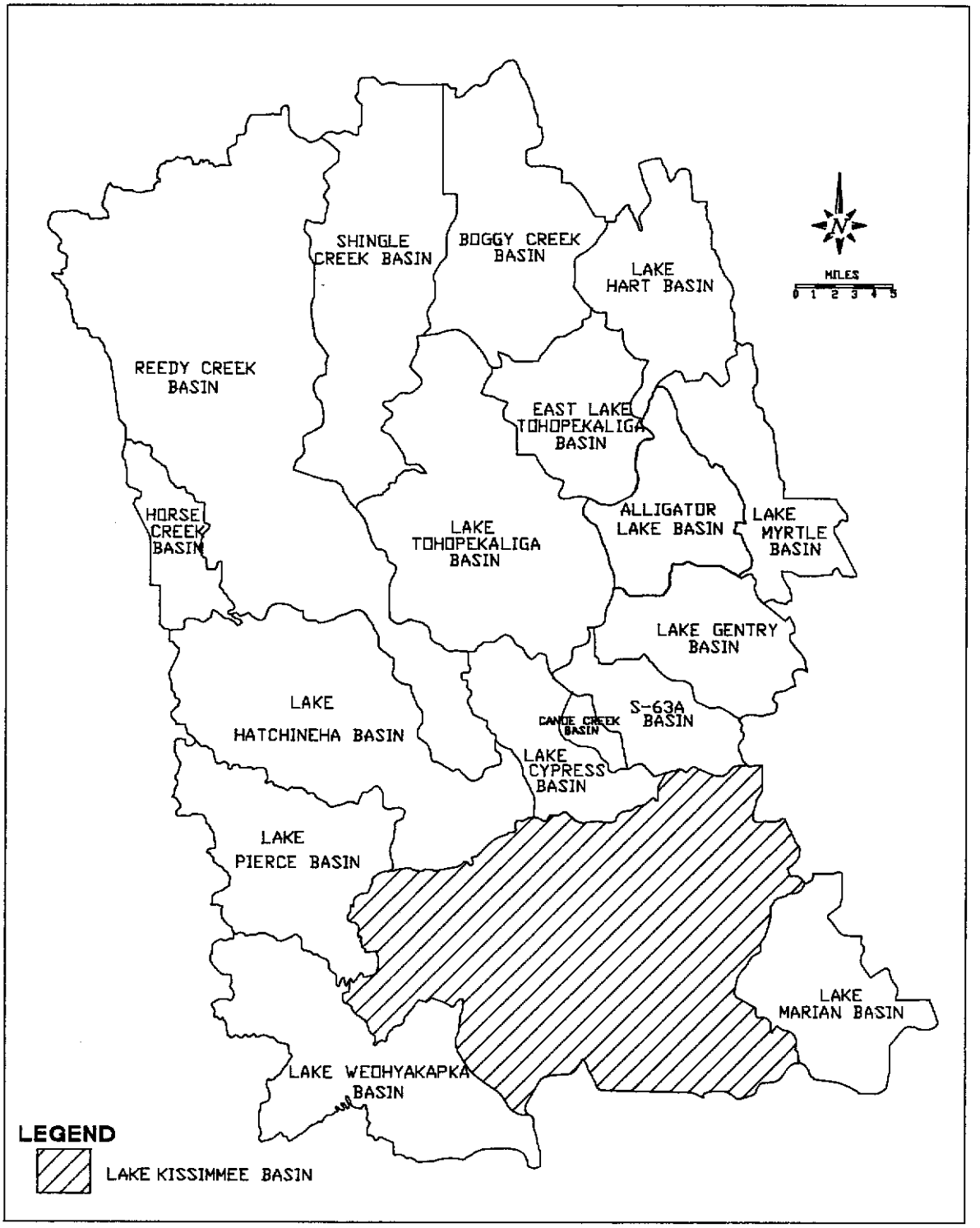
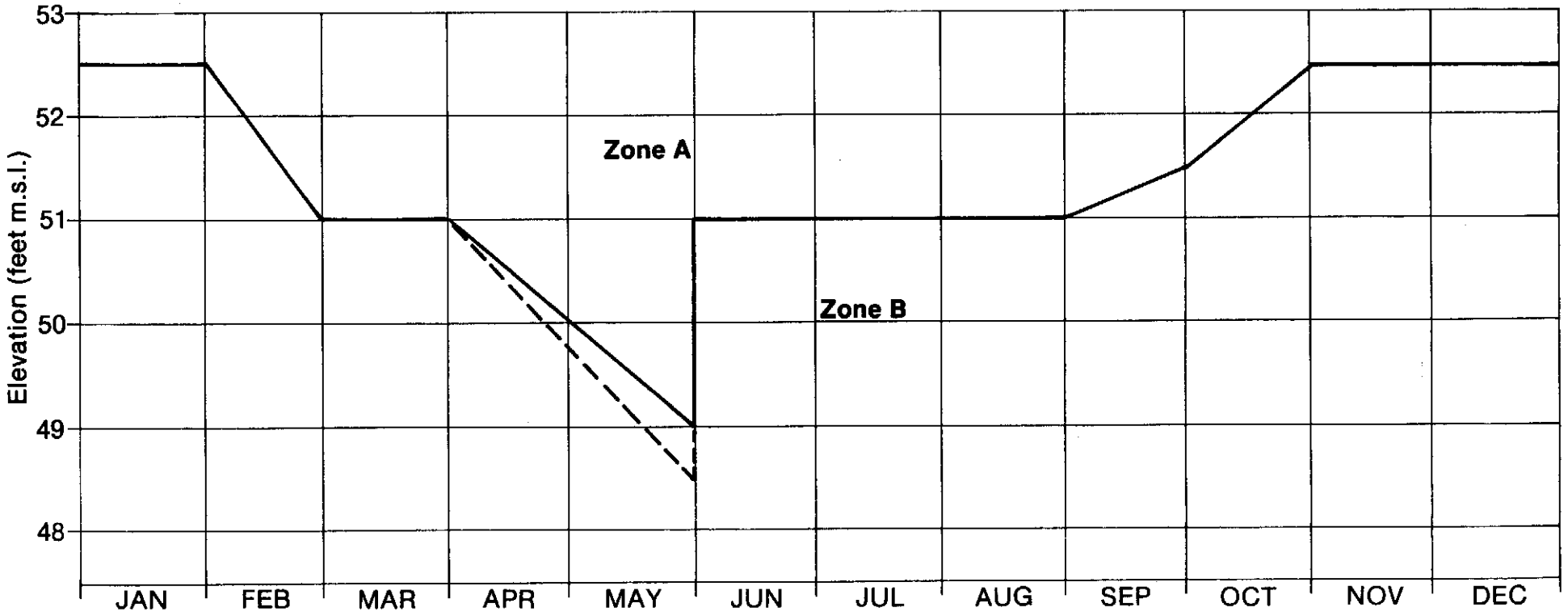


FIGURE 18B. Relative Location of Lake Kissimmee Basin within the UKRW.



Zone	Releases S-65
A	3,000 cfs, up to design capacity (11,000 cfs) without exceeding design conditions downstream. When the lake is within 0.5 feet of desired stage, forecasts will then be made and releases started to bring the lake back to schedule within 15 days.
B	To maintain minimum flows.

Note: — — — Use this schedule one year in three.

FIGURE 18C. Lake Kissimmee Regulation Schedule.

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APPENDIX 1 - BASIC CONCEPTS

Runoff and Drainage - All the water moving in the landlocked portion of the hydrological cycle derives either directly or indirectly from precipitation, also known as rainfall. Several things can happen to rain after it falls to earth. At the beginning of a rainfall event, part of it forms the surface retention. Surface retention consists mainly of two hydrologic processes, which are interception and depression storage, and in minor proportion, evaporation during the storm (or rainfall itself). This part of the rainfall is stored on the vegetal cover as interception and, as rain continues, in surface puddles as depression storage. These components are commonly unified as initial abstractions. After this, most of the water reaching the ground surface will tend to infiltrate through the soil. As the soil becomes saturated, infiltration rate tends to decrease,and at the same time, evapotranspiration begins playing its role. The process of ET, evapotranspiration, consists of evaporation and transpiration. Evaporation is briefly defined, in this case, as the process by which water is changed into a gas and returned to the atmosphere. Transpiration is the process by which water vapor escapes from a living plant, principally the leaves, and enters the atmosphere. In field conditions it is practically impossible to differentiate between evaporation and transpiration if the ground surface is covered by vegetation. The two processes are commonly linked together and referred to as evapotranspiration.

Once infiltrating water has passed through the surface layers, it percolates downward under the influence of gravity until it reaches the saturation zone at the phreatic surface or "water table". This zone is also known as groundwater. Many soils in South Florida are sandy and underlying rock strata. Flow of water is easily accomplished through these permeable soils. When the water table level is higher than the local surface water levels, water will enter the surface water from groundwater. When the water table is lower than the local surface water level, flow is from surface water to groundwater. Usually groundwater supplements stream flow during periods of low rainfall, and surface water recharges groundwater storage during periods of high rainfall. Although subsurface flow from groundwater to surface water is important to the long term supply of water to a canal or stream (it is sometimes referred to as "base flow"), it does not make significant contributions, if at all, to streamflow during storm events of high rainfall.

In general, part of the storm rainfall retained on or above the ground surface is surface retention, which with the infiltration and evapotranspiration losses are subtracted from input rainfall resulting in the rainfall excess. This "effective" part of the original rainfall is the one capable of yielding surface runoff after routing to the basin outlet.

For the purposes of this atlas, the term drainage is used to refer to the total surface and subsurface flows entering a lake and/or canal, or a creek from their drainage basin. It is important to keep in mind that during a rain event (especially one severe enough to cause flooding), it is surface runoff that is the important contributor to this flow, and, at times, between rain events, subsurface flow from groundwater to surface water is most important.

Runoff from a drainage area is a function of several factors: how much rain has fallen and how often it has occurred, the depth to the water table, and how the land in the drainage area is utilized. The amount of recent rain, and the depth to the water table impose how much water there is in the soil. The degree to which the soil

is saturated, in turn, determines how much of the falling rain may infiltrate the soil, and thus, how much of the rain will run off to local streams.

Land use has a large influence on the amount of surface runoff entering local streams, which will convey the water to the lakes, canals or creeks. Much of the surface area in an urban development (i.e. roofs, roads, and parking lots) is considered to be impervious to water. Almost all the rain falling on impervious areas becomes surface runoff. Some water may be detained and will evaporate, but the percentage of rainfall that enters local stream by surface runoff in an urban development is usually considerable high. As a result, urban developments are subject to high stream flows during rain events, and consequently they need to be provided with drainage systems to avoid or minimize flooding damage.

A vegetated area can intercept and retain a significant part of the rainfall and, consequently, surface runoff will diminish. This intercepted water has an additional opportunity to evaporate or seep into the ground. Commonly, a small percentage of the rain falling on a vegetated area will enter local streams, and subsequently will produce surface runoff. For this reason, stream flows in vegetated areas are moderated compared to urban developments.

Drainage Basin - A drainage basin can be defined as a certain area that due to its topographic characteristics is able to convey the runoff produced by rainfall on it to a final location, commonly known as the outlet of the basin. If rain falls over a large area, some of the runoff from that storm will likely enter one stream, and some of it will enter other streams. It is said that those streams "drain different basins, or that they are in "different drainage basins." Thus, a drainage basin of a stream is all the land that contributes runoff to the stream or its tributaries. The boundary between drainage basins is represented by the lines of highest elevation or "divide" in a topographic map, from which water is able to establish two or more flow patterns. Usually a large drainage basin or watershed, such as in this case, the Upper Kissimmee River watershed, is divided into basins, such as the Cypress Lake basin. This creates more accurate calculations because different factors affecting each basin can be taken into consideration. Also, by subdividing a large area (watershed or basin) into basins, hydrologic results can be obtained at intermediate points of the entire basin, which, in this case, are represented at each subbasin.

Water Surface Elevation - A water surface elevation in a canal or a lake is the vertical distance from the surface of the water to some reference elevation or "datum." The GDM reports from the COE use the elevations relative to the mean sea level (m.s.l.). In the District, elevations are relative to the National Geodetic Vertical Datum (NGVD). For practical purposes m.s.l. coincides with NGVD. Water surface elevations may also be referred to as "stages."

Important water surface elevations for a control structure are the headwater (upstream) stage, and the tailwater (downstream) stage (see **Control Structures**). The difference between these stages will affect the flow through or over the structure. In general, flow increases as the difference in elevation increases.

Water surface elevations elsewhere in the canal reach are also important. Obviously, if the stage exceeds the top elevation of the canal, flooding will occur. Not as obvious is the fact that the stage in the canal may influence the water table elevation of the local groundwater (see **Runoff and Drainage**).

Water elevations or stages in the lakes are of crucial importance. These are regulated by means of the control structures strategically located on the canals or at the outlets of the lakes. This elevations should match as much as possible the values given in the regulation schedule. For most of the lake, this regulation schedule can be change onc.,e every three years to improve environmental conditions of the lakes.

Control Structures - The structures referred to in this atlas are hydraulic works (i.e. spillways, culverts, and weirs) located in the canals to control water surface elevation (stage divide) or amount of flow (stage divide or water supply structure).

Hydraulic Analysis - The hydraulic profile of a canal is represented by a number of water surface elevations taken along its length. The water surface elevations are a function of the amount and location of the inflow to the canal, the size and shape of the canal, the roughness of the material forming the canal, and the longitudinal slope of the canal. Given the especial characteristics of the area, the slopes of the canals are nearly flat. This condition characterized the so-called subcritical flow, which is defined by regimes having low velocities and high flow depths. This regime is controlled by downstream conditions, and the downstream water surface elevation in the canal (often determined by a control structure or a lake) becomes another factor affecting the hydraulic profile of the canal. Canals are design to convey a certain discharge without overtopping their banks. Designing a canal and its structures consists of selecting values for the factors described above for which none of the water surface elevations of the resulting hydraulic profile exceed the elevation of the banks of the canal for the design discharge. An additional elevation or "free-board" has to be added to the hydraulic profile to count as a safety requirement. Since the design discharge is given and to a large extent, the slope of the canal is determined by the topography of the area, it is the size and shape of the canal and the downstream water surface elevation that are varied to obtain an appropriate design. Because the factors that determine the water surface elevations are either known or can be reasonably estimated, it is possible to calculate the hydraulic profile of a proposed canal. In this way, an appropriate design can be selected. Also, computation of the hydraulic profile can be used to determine the flood protection provided by a canal constructed without regard to a specific design storm, or for a canal whose design specifications have been modified. For instance, increasing the cross-sectional area of a canal will, in general, allow the canal to pass a given discharge at stages lower than before enlargement. This can also be interpreted as an additional flood protection of the canal, that is, the canal can now pass the runoff from a storm more severe than the design storm.

Design Storm - The design storm for a basin is the most severe storm for which the canals, structures and/or lakes in the basin are able to handle the runoff yielded by that storm without flooding occurring in the basin. Frequently, a basin is described as having "flood protection" up to a certain design storm.

Any storm is described by the frequency with which it may occur. On a long term average, a storm of a given intensity may occur, for example, once in every ten years (i.e., the storm has a 10 percent chance of occurring in any given year). This is written as 1-10 year, and is read as one in ten years. It must be understood that a storm of a given intensity can occur at any time regardless of the frequency assigned to it.

The U. S. Army Corps of Engineers (COE) specifies a Standard Project Storm (SPS) for South Florida. The rainfall amounts for the SPS are those for a 1-100 year

storm increased by 25 percent. The storm is assumed to occur during the hurricane, or wet season, when water tables are high and soils are wet. These conditions will maximize the runoff from the storm. The SPS is intended to be reasonably characteristic of large storms that have or could occur in the Project area. The runoff from the SPS is designated the Standard Project Flood (SPF). The capacity of a canal and its structures may be given as a percentage of the SPF (e.g., 40 percent SPF). The storm that would generate this amount of runoff is given by its frequency (e.g., 1-10 years). Note that it is implicitly assumed that these storms occur for antecedent weather conditions that will maximize the runoff from the storm in the basin of interest.

A severe storm of a certain frequency may not generate the same amount of runoff in different basins of the same size even when antecedent weather conditions or water table elevations for the basins are similar. Land use in the basins will affect the relative amounts of surface runoff to be expected from the basins (see **Runoff and Drainage**). Urban areas will often have more surface runoff than will more vegetated areas.

The amount of runoff to be expected per unit area for design storms at various recurrence intervals, antecedent conditions, and land use can be found in the COE General Design Memorandums for the Project. The runoff calculated to occur for a given set of storm frequency, antecedent conditions, and land use is the design discharge.

APPENDIX 2 - GLOSSARY

Designations Given to District Works

C-XXX The letter C followed by a number, or a number and a letter, designates a Central and Southern Florida Flood Control Project canal. Some canals have also a proper name. For example, C-31 reads as "Canal 31", also known as the St. Cloud Canal. C-32G reads as "Canal 32G", in which G represents an specific section of the Canal 32 connecting Alligator Lake to Lake Lizzie.

S-XXX The letter S followed by a number designates a Central and Southern Florida Flood Control Project structure (see **Control Structures**, under **Basic Concepts**). For example, S-59 read as "Control Structure 59". S structures were built by the U.S. Army Corps of Engineers.

G-XXX The letter G followed by a number designates a South Florida Water Management District control structure (see **Control Structures** under **Basic Concepts**). For example, G-113 reads as "Control Structure 113. G structures were built by the District.

Terms

District

This refers to the South Florida Water Management District (formerly the Central and South Florida Flood Control District), the agency which operates and maintains the Project.

General Design Memorandum (GDM)

This is a document prepared by the U.S. Army Corps of Engineers that reports all work done preliminary to preparation of the final design of a project. In the GDM for the Central and Southern Florida Project for flood control and other purposes:

-the basins are delineated.

-a design storm is specified (commonly 10-year-return period, max. 5-day-duration) and the resulting runoff estimated for each basin.

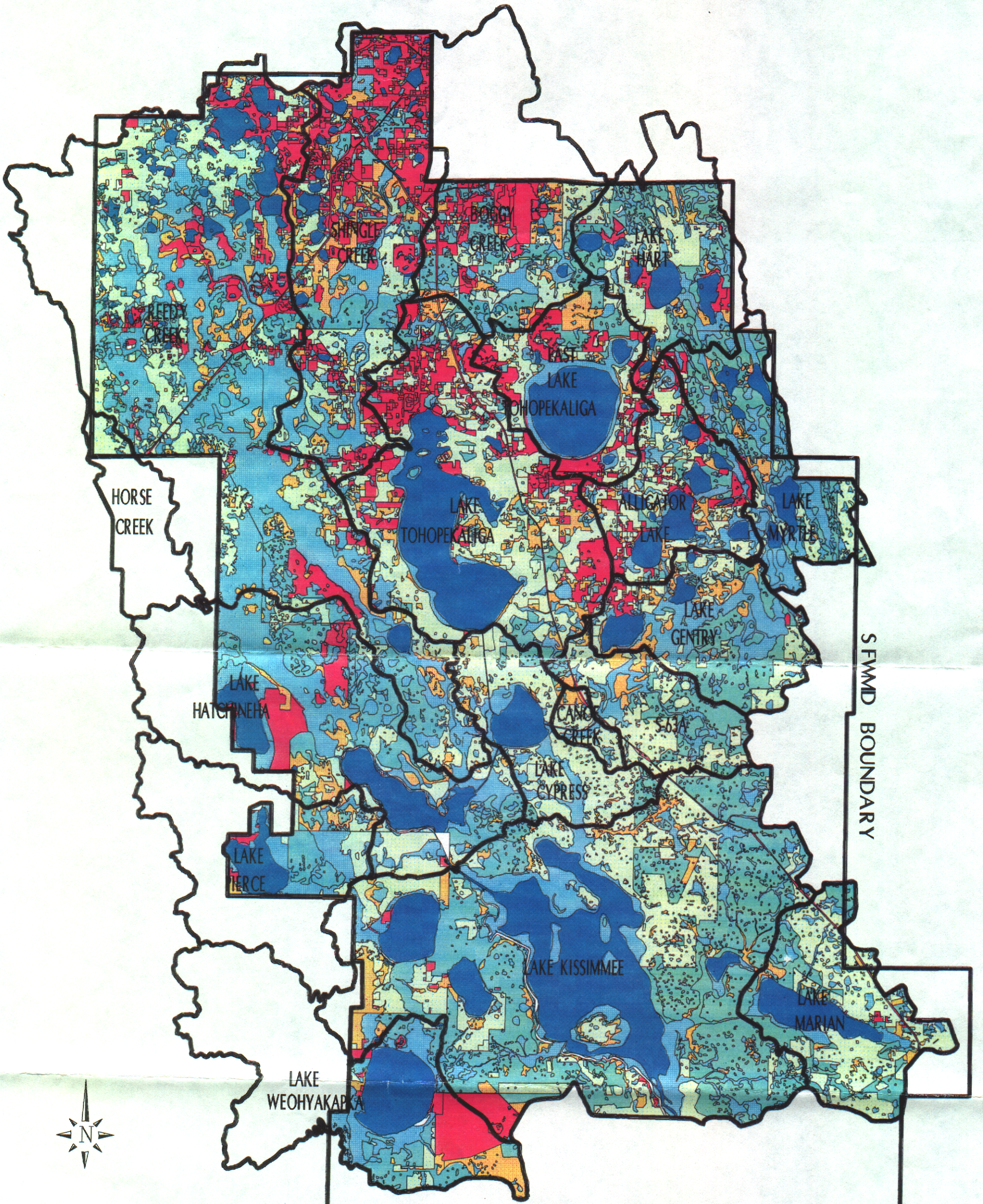
-the flood protection to be afforded at each basin is identified.

-the size of canals, and the size and number of control structures is determined.

Detail Design Memorandum (DDM)

This is a document prepared by the U.S. Army Corps of Engineers that contains all final design work regarding canals and structures.

1-XXX Year

This designates the recurrence interval or return period for a design storm (see **Design Storm**, under **Basic Concepts**). For example, "1-100 year storm" reads as one in one in one-hundred year storm.

LANDUSE (1986-88) IN THE UPPER KISSIMMEE RIVER WATERSHED