Minimum and Guidance Levels for King Lake in Pasco County, Florida

March 17, 2008

Ecologic Evaluation Section
Resource Projects Department

Southwest Florida
Water Management District

Minimum and Guidance Levels for King Lake in Pasco County, Florida

March 17, 2008

Ecologic Evaluation Section
Resource Projects Department
Southwest Florida Water Management District
Brooksville, Florida 34604-6899

Cover: King Lake shoreline during a low-water period in 2001 (District files).

Table of Contents

Minimum and Guidance Levels for King Lake

State law (Section 373.042, Florida Statutes; hereafter F.S.) directs the Department of Environmental Protection or the water management districts to establish minimum flows and levels for lakes, wetlands, rivers and aquifers. As currently defined by statute, the minimum flow for a given watercourse "shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area", and the minimum level of an aquifer or surface water body is "the level of groundwater in the aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources of the area". Minimum flows and levels are established and used by the Southwest Florida Water Management District for water resource planning, as one of the criteria used for evaluating water use permit applications, and for the design, construction and use of surface water management systems.

Development of a minimum flow or level does not in itself protect a water body from significant harm; however, resource protection, recovery and regulatory compliance can be supported once the flow or level standards are established. State law governing implementation of minimum flows and levels (Chapter 373.0421, F.S.) requires development of a recovery or prevention strategy for water bodies if the " existing flow or level in a water body is below, or is projected to fall within 20 years below, the applicable minimum flow or level". Recovery or prevention strategies are developed to: "(a) achieve recovery to the established minimum flow or level as soon as practicable; or (b) prevent the existing flow or level from falling below the established minimum flow or level." Periodic re-evaluation and as necessary, revision of established minimum flows and levels are also required by state law.

Minimum flows and levels are to be established based upon the best available information with consideration given to "…changes and structural alterations to watersheds, surface waters and aquifers, and the effects such changes or alterations have had, and the constraints such changes or alterations have placed on the hydrology of the affected watershed, surface water, or aquifer…", with the caveat that these considerations shall not allow significant harm caused by withdrawals (Section 373.0421, F.S.). The Florida Water Resources Implementation Rule (Chapter 62-40.473, Florida Administrative Code; hereafter F.A.C.) provides additional guidance for the establishment of minimum flows and levels, requiring that "consideration shall be given to the protection of water resources, natural seasonal fluctuations in water flows, and environmental values associated with coastal, estuarine, aquatic and wetland ecology, including: a) recreation in and on the water; b) fish and wildlife habitats and the passage of fish; c) estuarine resources; d) transfer of detrital material; e) maintenance of freshwater storage and supply; f) aesthetic and scenic attributes; g) filtration and absorption of nutrients and other pollutants; h) sediment loads; i) water quality; and j) navigation." The Water Resource Implementation Rule also indicates that "minimum flows and levels should be expressed as multiple flows or levels defining a minimum hydrologic regime, to the extent practical and necessary to establish the limit beyond which further withdrawals would be significantly harmful to the water resources or the ecology of the area".

The Southwest Florida Water Management District has developed specific methodologies for establishing minimum flows or levels for lakes, wetlands, rivers and aquifers, subjected the methodologies to independent, scientific peer-review, and incorporated the methods into its Water Level and Rates of Flow Rule (Chapter 40D-8, F.A.C). For lakes, methodologies have been developed for establishing Minimum Levels for systems with fringing cypress-dominated wetlands greater than 0.5 acre in size, and for those without fringing cypress wetlands. Lakes with fringing cypress wetlands where water levels currently rise to an elevation expected to fully maintain the integrity of the wetlands are classified as Category 1 Lakes. Lakes with fringing cypress wetlands that have been structurally altered such that lake water levels do not rise to levels expected to fully maintain the integrity of the wetlands are classified as Category 2 Lakes. Lakes without at least 0.5 acre of fringing cypress wetlands are classified as Category 3 Lakes. Chapter 40D-8, F.A.C. also provides for the establishment of Guidance Levels, which serve as advisory information for the District, lakeshore residents and local governments, or to aid in the management or control of adjustable water level structures. Information regarding the development of adopted methods for establishing Minimum and Guidance lake levels is provided in Southwest Florida Water Management District (1999a, b), Leeper *et al.* (2001) and Leeper (2006). Peer-review findings regarding the lake level methods are available in Bedient *et al.* (1999), Dierberg and Wagner (2001) and Wagner and Dierberg (2006).

Two Minimum Levels and three Guidance Levels have typically been established for lakes, and upon adoption by the District Governing Board, incorporated into Chapter 40D-8, F.A.C. The levels, which are expressed as elevations in feet above the National Geodetic Vertical Datum of 1929 (NGVD), are described below.

- The Ten Year Flood Guidance Level is provided as an advisory guideline for lakeshore development. It is the level of flooding expected on a frequency of not less than the ten-year recurring interval, or on a frequency of not greater than a ten percent probability of occurrence in any given year.

- The High Guidance Level is provided as an advisory guideline for construction of lakeshore development, water dependent structures, and operation of water management structures. The High Guidance Level is the elevation that a lake's water levels are expected to equal or exceed ten percent of the time on a long-term basis.

- The High Minimum Lake Level is the elevation that a lake's water levels are required to equal or exceed ten percent of the time on a long-term basis.

- The Minimum Lake Level is the elevation that a lake's water levels are required to equal or exceed fifty percent of the time on a long-term basis.

- The Low Guidance Level is provided as an advisory guideline for water dependent structures, information for lakeshore residents and operation of water management structures. The Low Guidance Level is the elevation that a lake's

water levels are expected to equal or exceed ninety percent of the time on a long-term basis.

In October 2007, the District Governing Board approved rule amendments pertaining to the elimination of Ten Year Flood Guidance Levels and references to the levels from Chapter 40D-8, F.A.C. Work related to the development of ten-year flood levels and other flood-recurrence levels is currently conducted through the District Watershed Management Program, and information pertaining to flood levels is included in watershed management plans that result from program activities.

In accordance with Chapter 40D-8, F.A.C., proposed Minimum and Guidance Levels were developed for King Lake, a Category 1 Lake located in Pasco County, Florida (Southwest Florida Water Management District 2007a). The levels were established using best available information, including data that were obtained specifically for the purpose of minimum levels development. Following a public input process, the District Governing Board approved adoption of the proposed levels on December 18, 2007 and the levels (Table 1) were subsequently incorporated into Chapter 40D-8, F.A.C. The data and analyses used for development of the adopted levels are described in the remainder of this report.

Table 1. Minimum and Guidance Levels for King Lake.

Minimum and Guidance Levels	Elevation (feet above NGVD)
High Guidance Level	73.1
High Minimum Lake Level	72.4
Minimum Lake Level	70.8
Low Guidance Level	69.7

Data and Analyses Supporting Development of Minimum and Guidance Levels for King Lake

Lake Setting and Description

King Lake is located in south-central Pasco County, Florida (Sections 12 and 13, Township 26 South, Range 18 East; and Sections 7 and 18, Township 26 South, Range 19 East) in the Hillsborough River Basin of the Southwest Florida Water Management District (Figure 1). White (1970) classified the region of central or mid-peninsular Florida containing King Lake as the Northern Gulf Coastal Lowlands. Brooks (1981) categorized the area surrounding the lake as the Land O Lakes subdivision of the Tampa Plain division of the Ocala Uplift District, and described the region as a plain with numerous small lakes imbedded in moderately thick silty-sand deposits lying above the Tampa Limestone formation. As part of the Florida Department of Environmental Protection's Lake Bioassessment/ Regionalization Initiative, the area has been identified as the Land-O-Lakes Region (Griffith *et al.* 1997). and described as an area of neutral to slightly alkaline, low to moderate nutrient, clear-water lakes interspersed in sandy uplands (Griffith *et al.* 1997).

Wetland areas occur through the basin (see Figure 2), dominated by *Taxodium* sp., with abundant *Typha* sp., *Saggitaria* sp., *Pontederia cordata* and *Hydrocotyle* sp. Common submersed species include *Chara* sp. and *Hydrilla verticillata.* Uplands in the immediate lake basin are used primarily for low-density residential development, with some citrus production. Historical photography (Figures 2-9) of the lake vicinity indicates that by the 1940s, land alterations for agricultural purposed were already occurring within the immediate lake watershed. Significant dredging of the lake basin, particularly at the southern end near the current lake outlet was evident by the 1970s. The District maintains a water-level gauging station on the south shore of the lake (Figure 2). There are no public boat ramps located on the lakeshore; public access to the lake is limited to government-owned right of ways.

King Lake lies within the Lake Hannah Outlet drainage basin in the Hillsborough River watershed (U.S. Geological Survey Hydrologic Unit Classification System), and has a drainage area of approximately 1.7 square miles (Foose 1981). The lake is situated near the upstream end of Thirteen Mile Run, a lake/wetland conveyance system which ultimately drains to Cypress Creek. Surface water inputs to the lake include direct precipitation on the lake surface, runoff from immediately adjacent upland areas, and inflow from the wetland/pond areas to the north and east of the lake (Figure 10). There are no surface withdrawals from the lake permitted by the District. Ten currently permitted groundwater withdrawal sites are, however, located within one mile of the lake shoreline (Figure 11). The sites are permitted for a total daily average withdrawal of 225,300 gallons per day.

A canal system with a 41-ft long, 36-inch diameter corrugated metal pipe located under Hale Road provides conveyance from the south end of the King Lake to Bell Lake (Figure 10). Currently, King Lake may drain to the south by discharging over a metal plate/weir mounted to the north end of the culvert when the lake surface exceeds 71.61 feet above NGVD (Southwest Florida Water Management District 2006). Documents on file at the District indicate that the outlet conveyance system has been modified several times during the past twenty years. A survey data sheet from 1984 (Southwest Florida Water Management District 1996) indicates that at that time a 33-foot long, 36-inch diameter culvert with an invert of 71.03 feet above NGVD provided conveyance from the King Lake outlet canal to the canal leading to Bell Lake. An engineer's field notes from September 1987 (see Sua 2003b) indicated there was a weir with an invert of 72.01 feet located inside the upstream end of the culvert. Sometime between 1987 and 1999 it appears that the currently existing 41-foot long, 36-inch diameter reinforced concrete pipe replaced the previously existing pipe. The existing culvert was modified in September 1999 by the addition of a metal plate/weir across the upstream end of the culvert, which resulted in an invert elevation of 72.50 feet above NGVD. In September 2003, the District (Sua 2003a) directed Pasco County Government to modify the structure to re-establish the lake outlet invert at 72.01 feet above NGVD as soon as it was practicable, and to construct a new water-control structure with the same invert upstream of the existing culvert. Construction of the this new structure has yet to be initiated due to issues associated with obtaining an easement for the structure site (personal communication, R. Maciuszek, Pasco County Stormwater Department).

King Lake is listed as a 122-acre lake in the "Gazetteer of Florida Lakes" (Florida Board of Conservation 1969, Shafer *et al.* 1986). The 1943 U.S. Geological Survey 1:24,000 Lutz quadrangle 7.5 minute topographic map does not include a water surface elevation for the lake, but the 1974 (and 1987 photorevised) versions of the map show the lake surface at an elevation of 72 feet above NGVD (see Figure 12 for an image from the most recent Untied States Geological Survey topographic map of the lake area). A topographic map of the lake basin generated in support of minimum levels development (Figure 13) indicates that the lake extends over 155 acres when it is staged at 72 feet above NGVD.

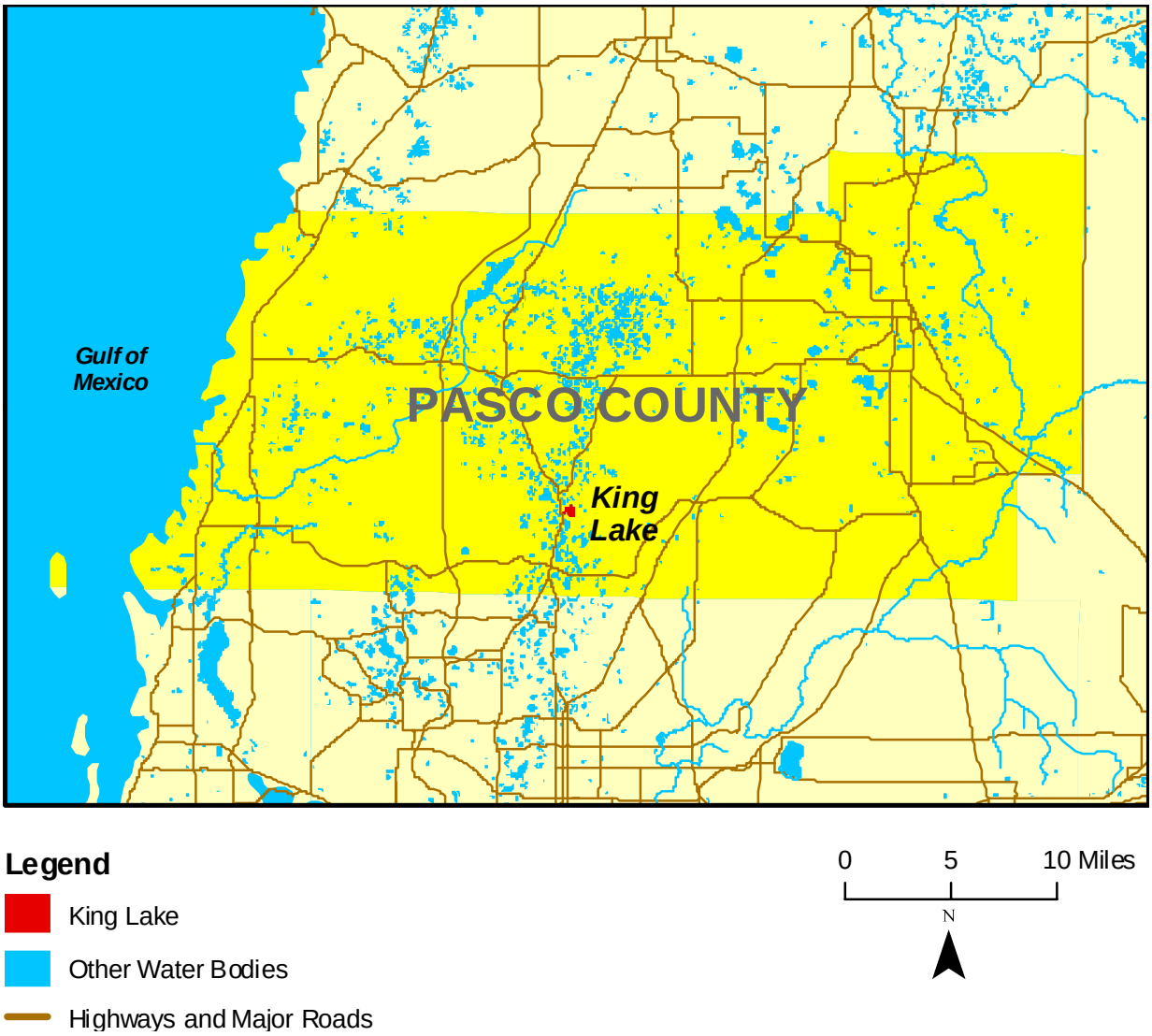


Figure 1. Location of King Lake, other regional water bodies, and highways/ major roads in and around Pasco County, Florida (image sources: Southwest Florida Water Management District 2003a,c,d and United States Geological Survey 2004b).

Figure 2. Aerial photograph of King Lake in 2007, showing the location of the District water level gauge, wetland sites where hydrologic indicators of normal pool were measured and the names of selected roads in the lake vicinity (photographic image source: EarthData International 2007).

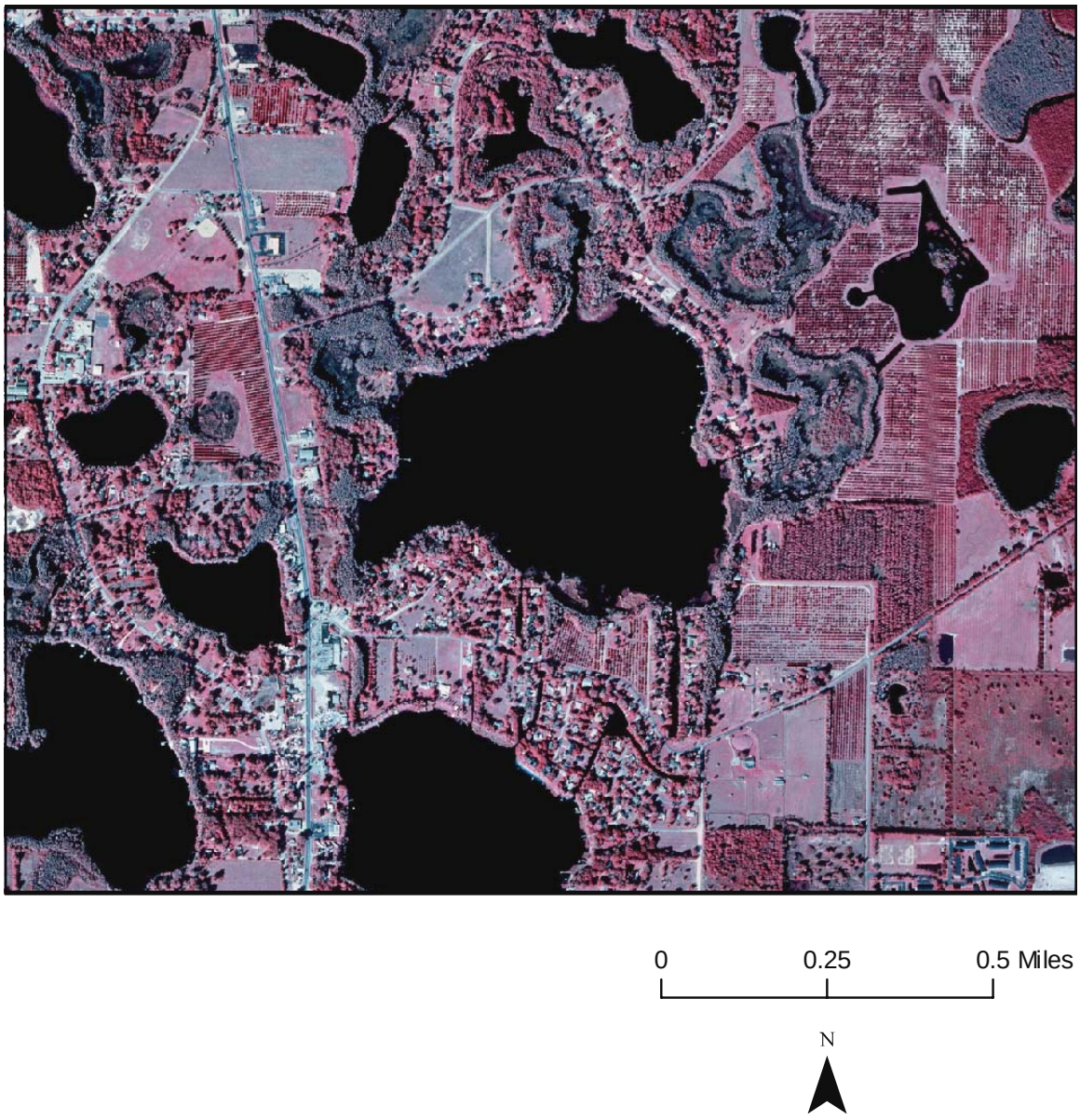


Figure 3. Aerial infrared photograph of King Lake in 1999 (image source: Southwest Florida Water Management District 2002a).

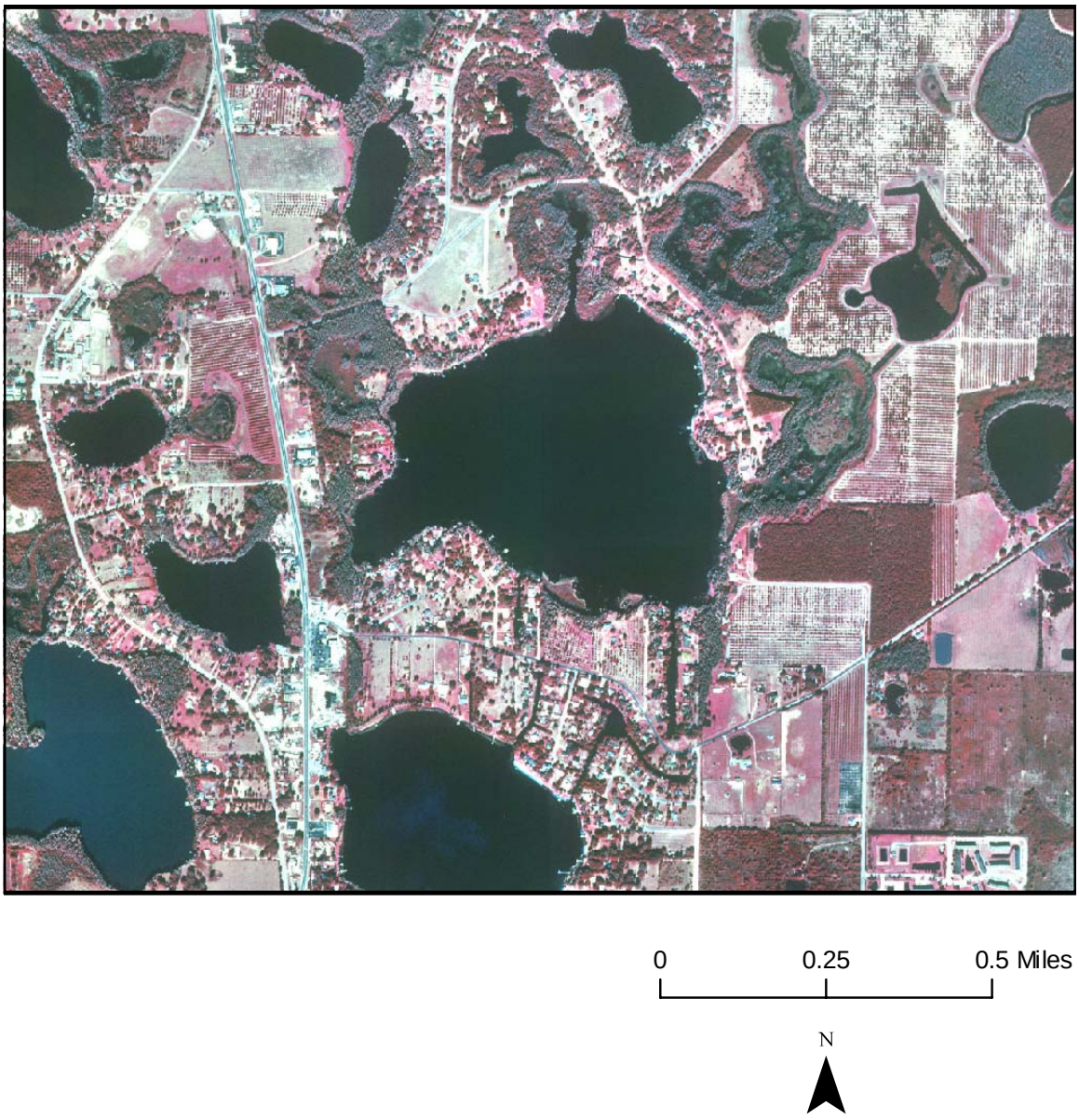


Figure 4. Aerial infrared photograph of King Lake in 1994 (image source: Southwest Florida Water Management District, date unknown).

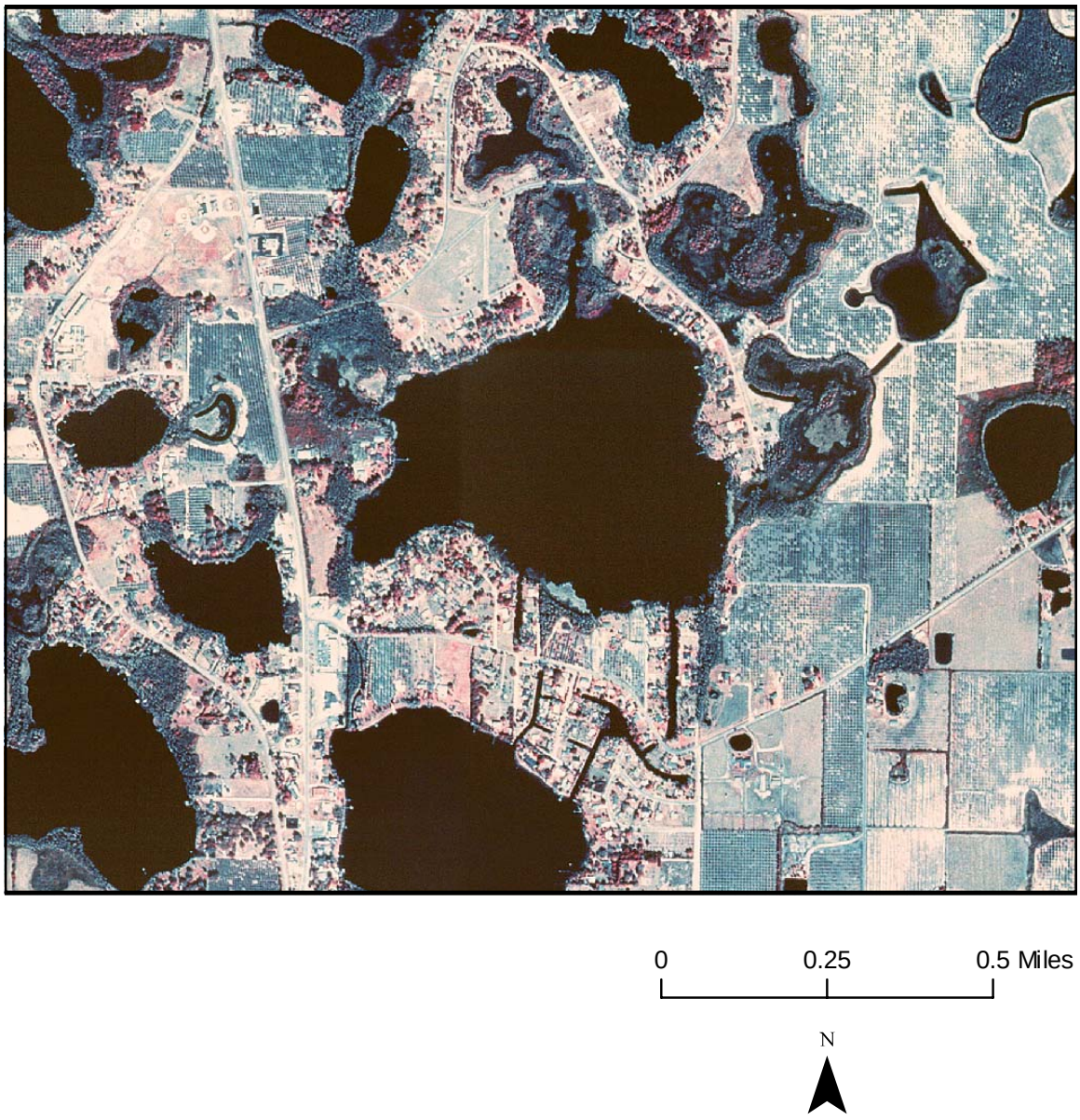


Figure 5. Aerial infrared photograph of King Lake in 1984 (image source: United States Geological Survey 2004a).

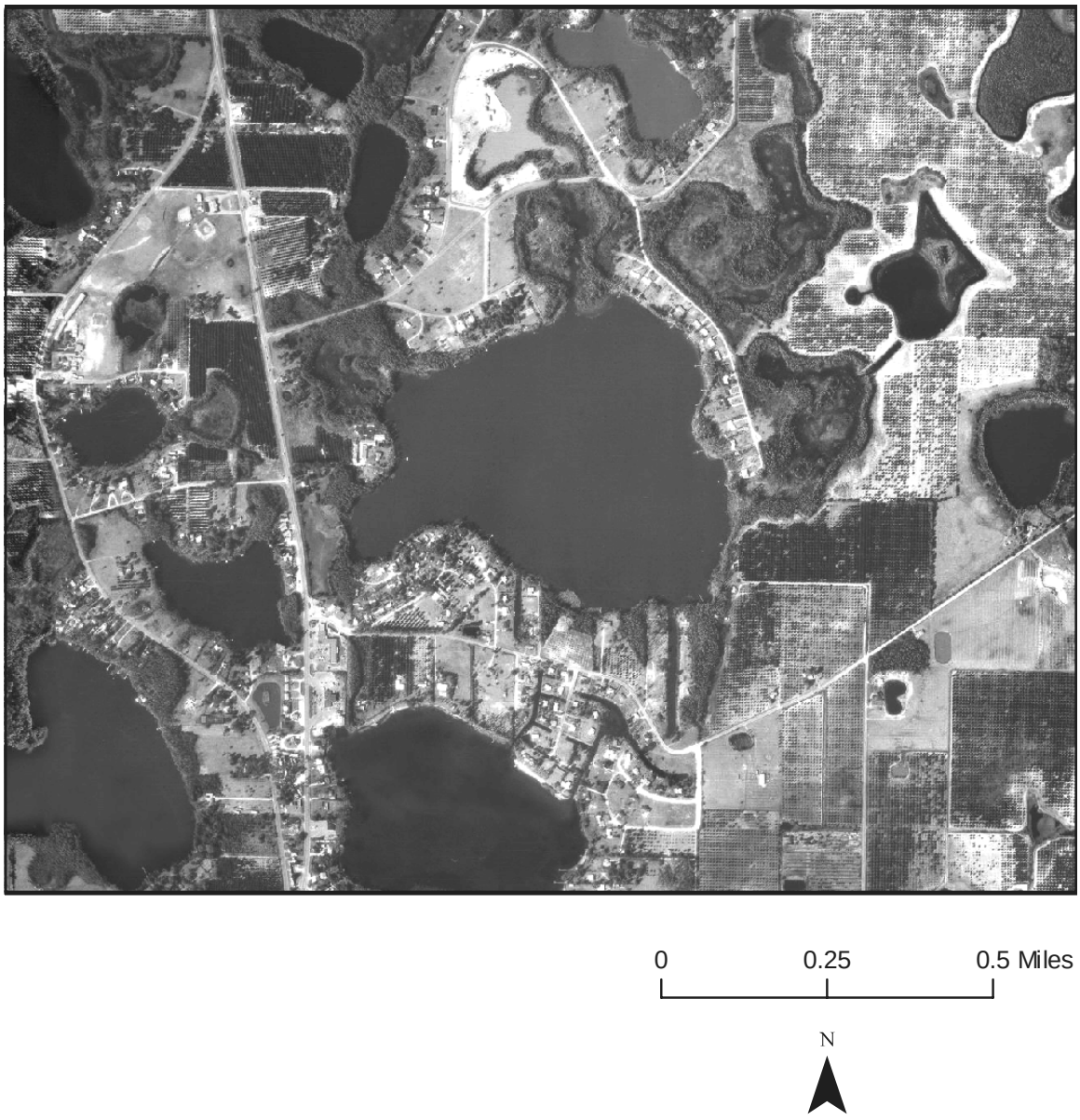


Figure 6. Aerial photograph of King Lake in 1973 (image source: Woolpert, Inc. 2005a).

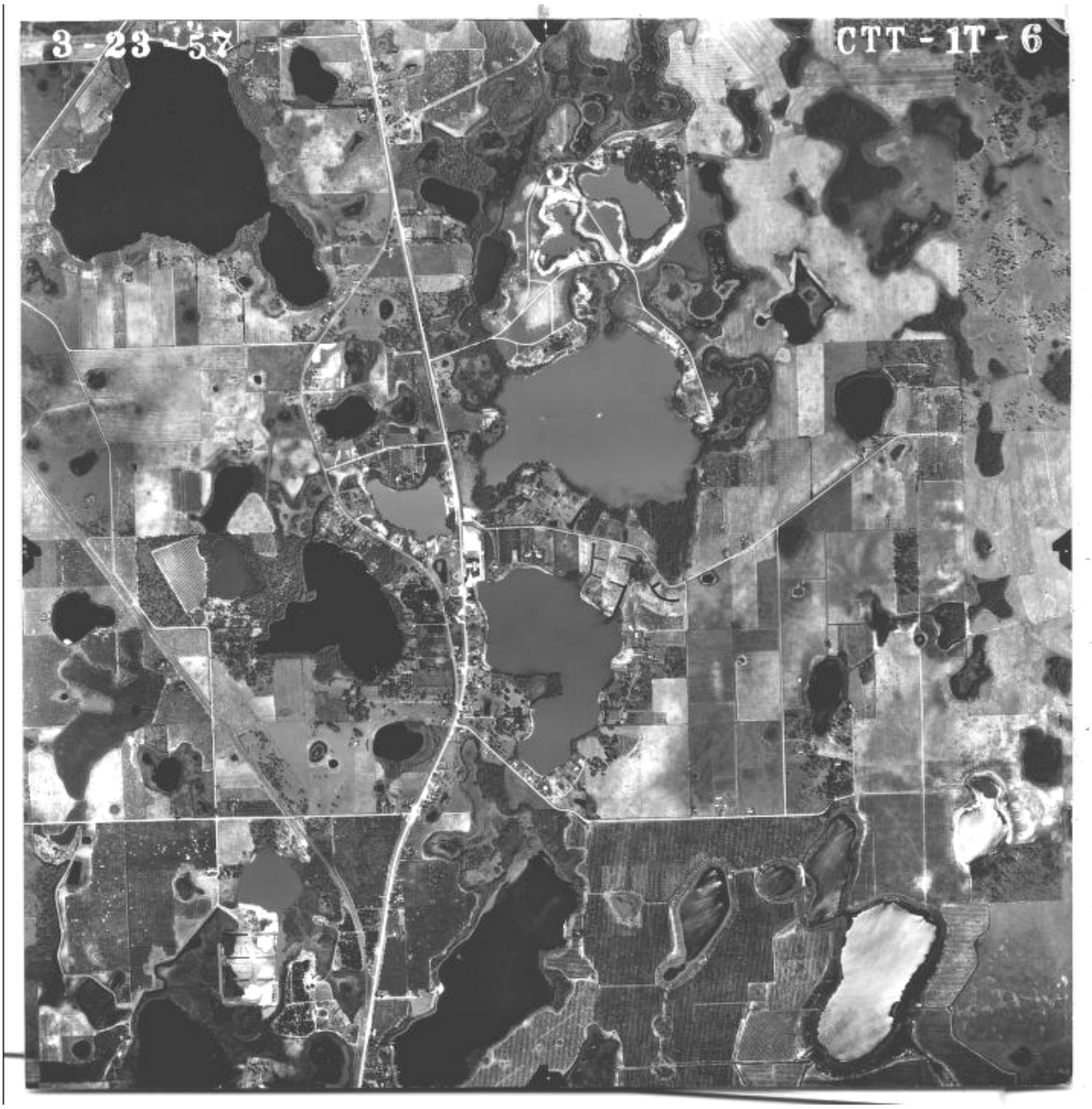


Figure 7. Aerial photograph of King Lake in 1957 (United States Department of Agriculture 1957b).

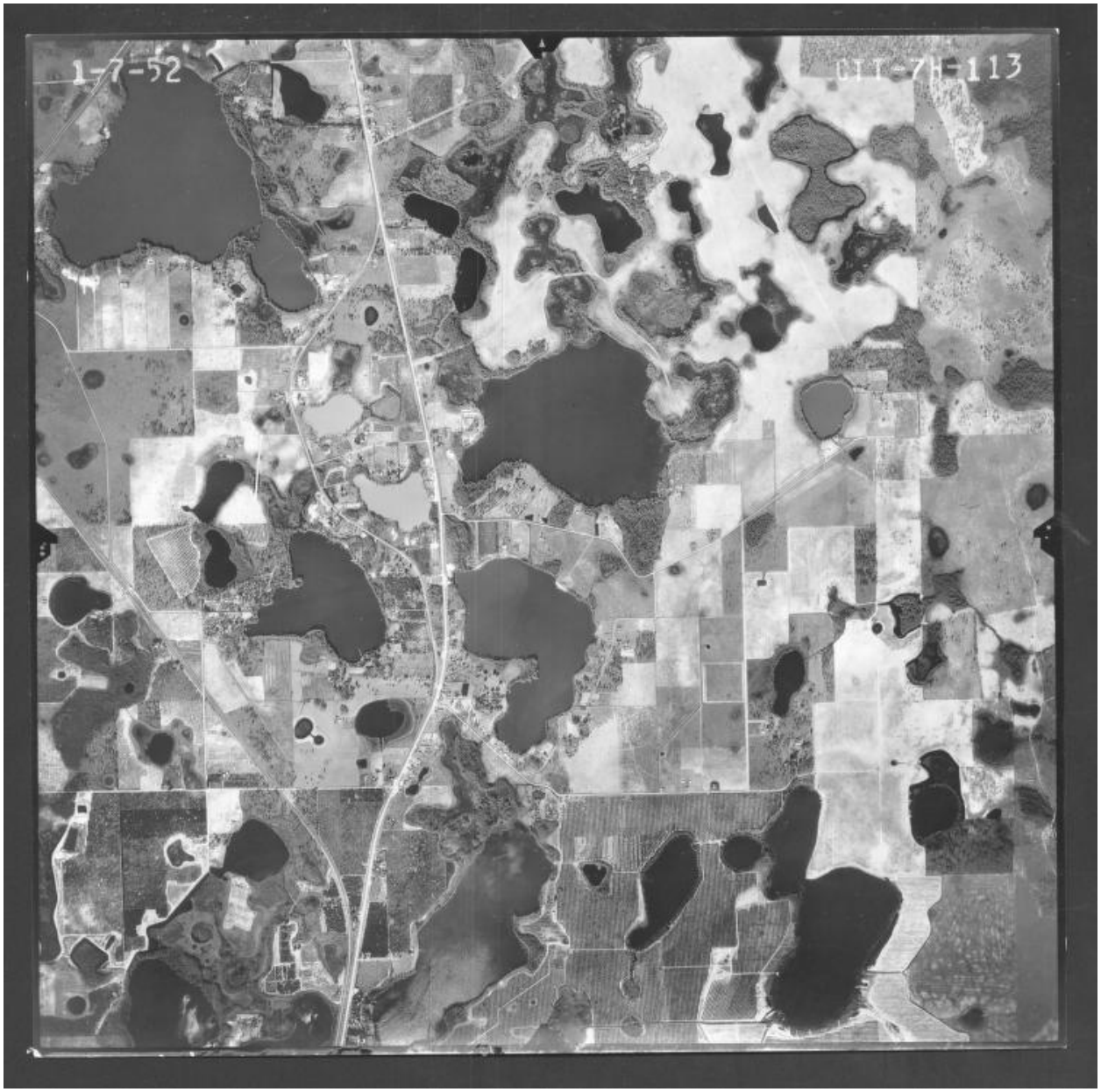


Figure 8. Aerial photograph of King Lake in 1952 (United States Department of Agriculture 1952b).

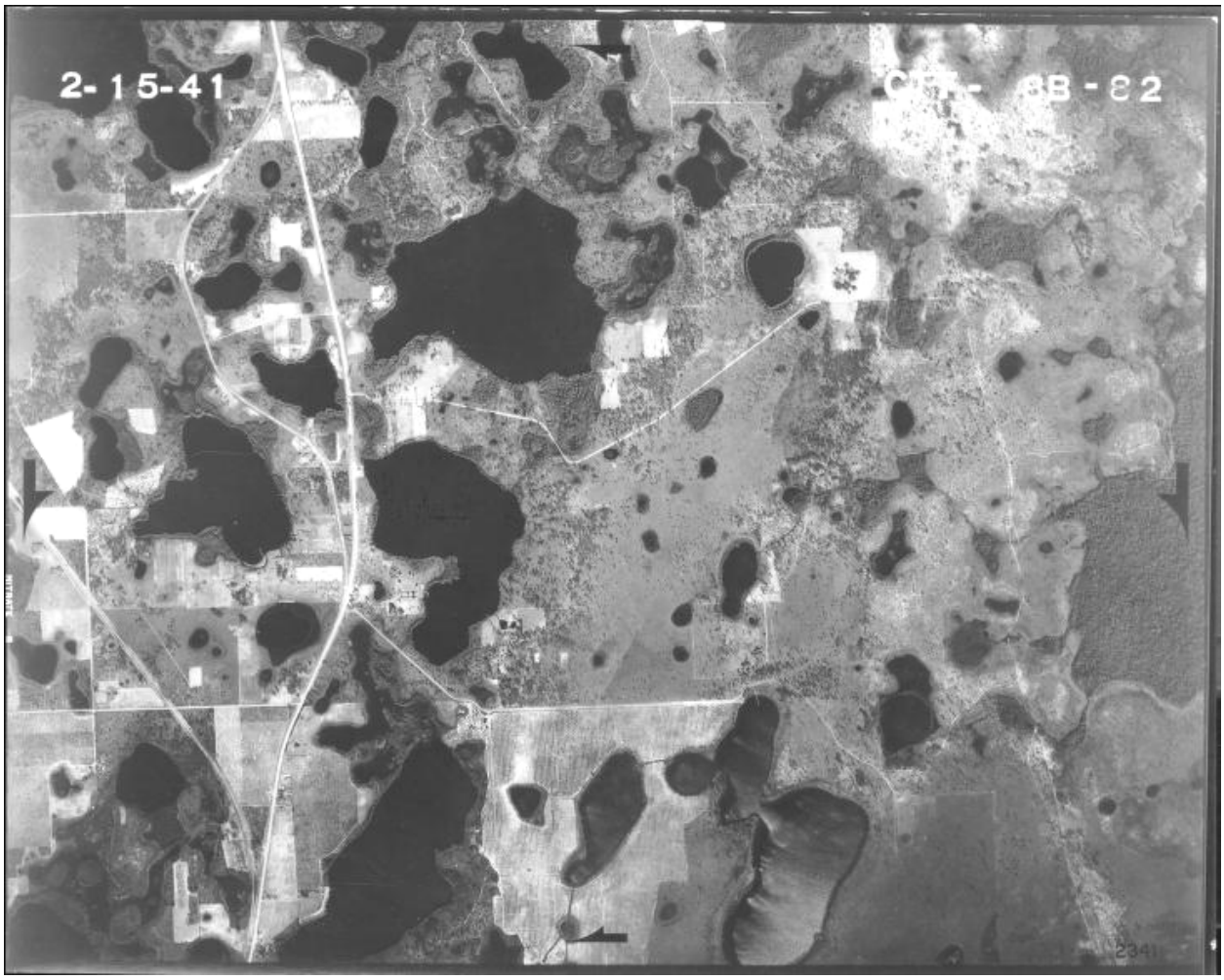


Figure 9. Aerial photograph of King Lake in 1941 (United States Department of Agriculture 1941b).

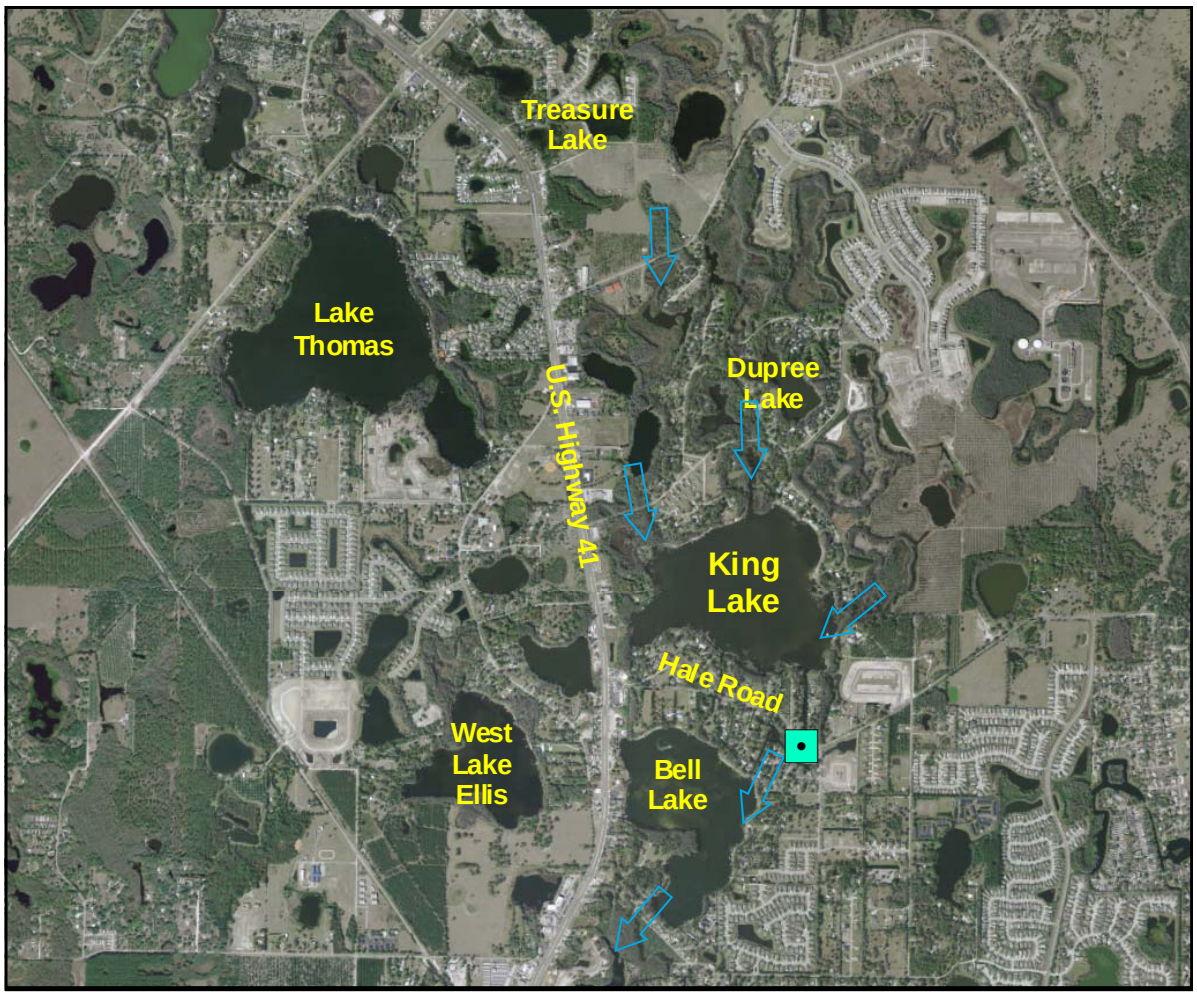


Figure 10. Aerial photograph of the King Lake area in 2007 (photographic image source: EarthData international 2007), showing locations of surface-flow paths and direction of flow into and out of the lake basin.

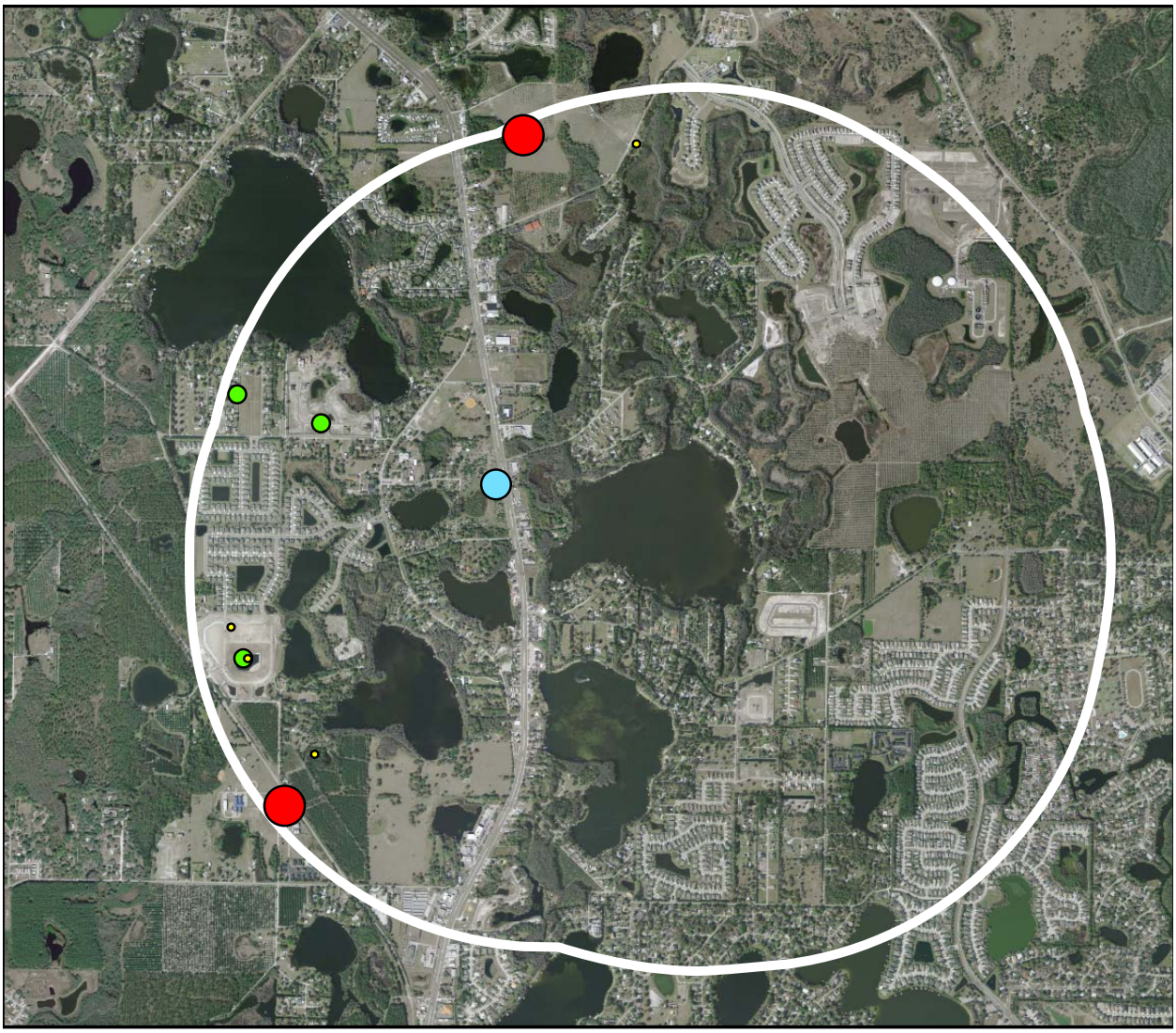


Figure 11. Permitted daily average quantities (gallons per day as of June 2007) for groundwater withdrawal points within one mile of the King Lake shoreline (as delineated by the white polygon surrounding the lake) (photographic image source: EarthData International 2007; permitted quantity data source: Southwest Florida Water Management District 2007b).

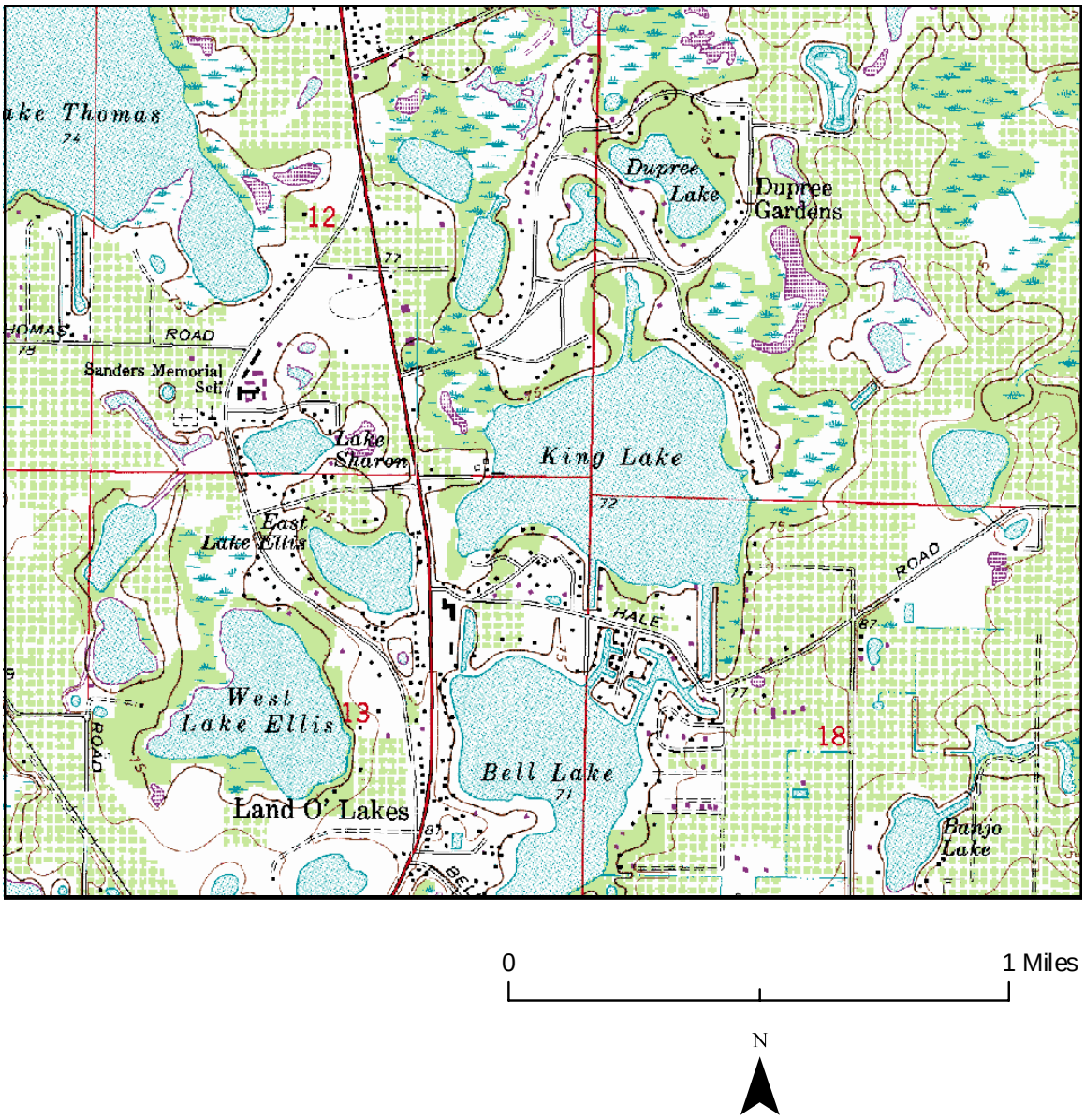
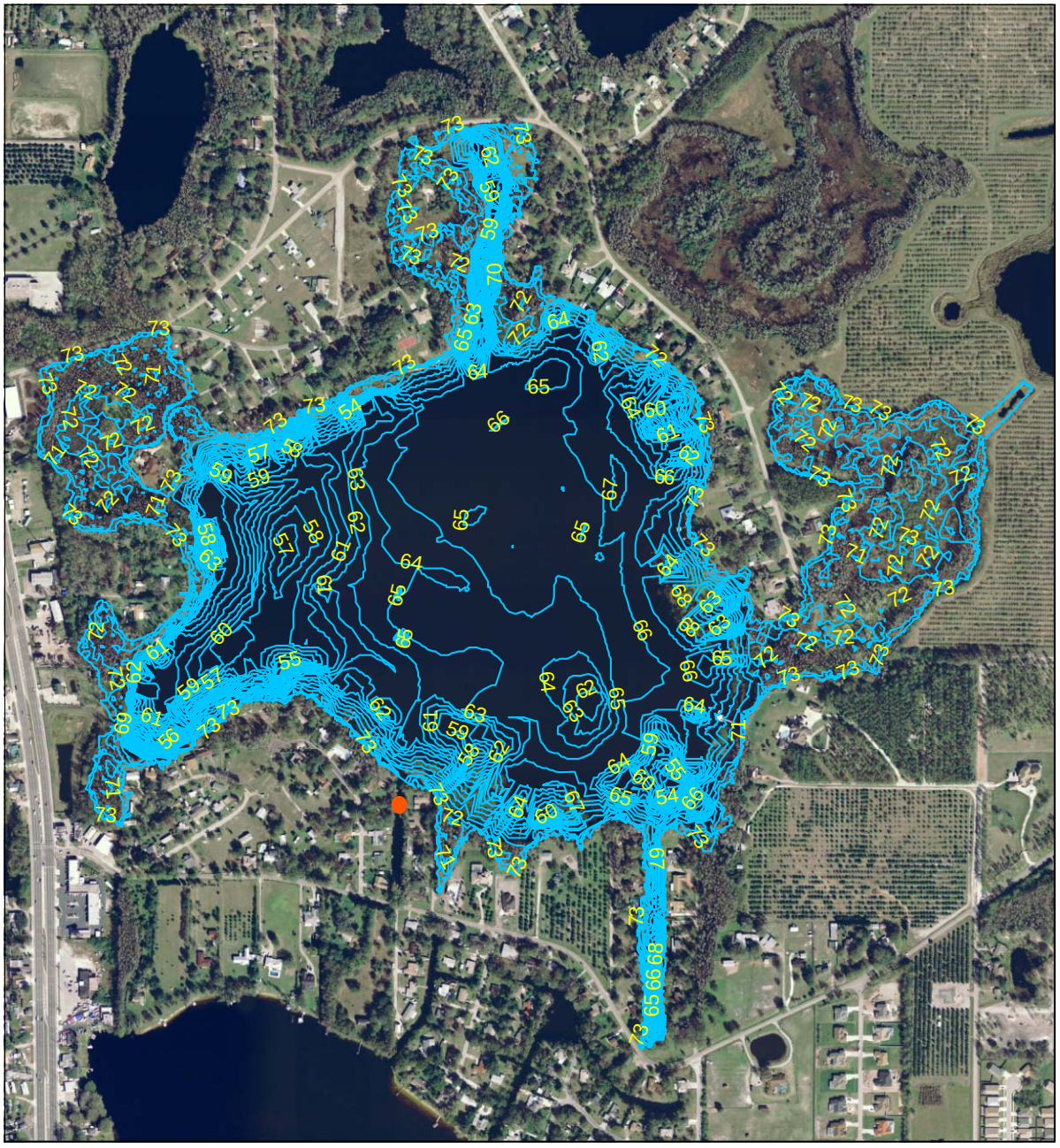


Figure 12. United States Geological Survey five-foot ground elevation contours (feet above NGVD 1929) in the vicinity of King Lake (image source: Southwest Florida Water Management District 2002b).



Map created using spot elevation data collected by D.C. Johnson Associates in May 2005, and LiDAR data collected by EarthData International, Inc.

0 0.1 0.2 0.3 Miles

N

Figure 13. One-foot ground elevation (feet above NGVD) contours within the King Lake basin. The orange dot indicates a canal area where spot elevation data were not available for mapping purposes (photographic image source: EarthData International 2007).

Previously Adopted Guidance Levels

The Southwest Florida Water Management District has a long history of water resource protection through the establishment of lake management levels. With the development of the Lake Levels Program in the mid-1970s, the District began establishing management levels based on hydrologic, biological, physical and cultural aspects of lake ecosystems. By 1996, management levels for nearly 400 lakes had been established.

In April 1985, the District adopted management levels (currently referred to as Guidance Levels) for King Lake and incorporated the levels into Chapter 40D-8, F.A.C. (Table 2). A Maximum Desirable Level of 73.00 feet above NGVD was also developed but was not adopted by rule. The levels were developed using a methodology that differs from the current District approach for establishing Minimum and Guidance Levels, and do not, therefore, necessarily correspond with levels developed using current methods. Following the December 2007 adoption of Minimum and Guidance Levels for King Lake that were developed using the current methods, the previously adopted Guidance Levels were removed from Chapter 40D-8., F.A.C.

Annually since 1991, a list of stressed lakes has been developed to support the District's consumptive water use permitting program. As described in the District's Consumptive Use of Water Rule (Chapter 40D-2, F.A.C.), "a stressed condition for a lake is defined to be chronic fluctuation below the normal range of lake level fluctuations". For lakes with adopted High, Low and Extreme Low Levels, chronic fluctuation below the Low Level is considered a stressed condition. For lakes without adopted levels, the evaluation of stressed condition is conducted on a case-by-case basis.

King Lake was not included on recent Stressed Lakes Lists (Gant 1999a, 2000, 2005, 2006, 2007), but was previously classified as a stressed lake (Gant 1999b, 2002, 2003, 2004b). Based on adoption of Minimum Levels for the lake in December 2007, King Lake will not be included in future Stressed Lakes List evaluations. Evaluation of water level fluctuations within the basin will instead be incorporated in annual determinations of compliance with adopted Minimum Levels.

Table 2. Previously adopted guidance Levels for King Lake.

Minimum and Guidance Levels	Elevation (feet above NGVD)
Ten Year Flood Guidance Level	73.66
High Level	73.50
Low Level	71.50
Extreme Low Level	69.50

Summary Data Used For Minimum and Guidance Levels Development

Minimum and Guidance Levels were developed for King Lake using the methodology for Category 1 lakes described in Chapter 40D-8, F.A.C. The levels and additional information are listed in Table 3, along with lake surface areas for each elevation. Detailed descriptions of the development and use of these data are summarized in subsequent sections of this report.

Table 3. Minimum and Guidance Levels, lake stage exceedance percentiles, Normal Pool, Control Point elevation, significant change standards and associated surface areas for King Lake.

	Elevation (feet above NGVD)	Lake Area (acres)
Lake Stage Exceedance Percentiles		
Historic P10	73.1	>177
Historic P50	71.6	136
Historic P90	69.7	118
Period of Record P10	72.6	171
Period of Record P50	71.6	136
Period of Record P90	69.6	117
Normal Pool and Control Point		
Normal Pool	72.6	171
Control Point	71.6	136
Significant Change Standards		
Cypress Standard	70.8	122
Dock-Use Standard*	72.9	175
Basin Connectivity Standard*	72.2	163
Wetland Offset Elevation*	70.8	122
Recreation/Ski Standard*	69.7	118
Aesthetic Standard*	69.7	118
Species Richness Standard*	69.2	116
Lake Mixing Standard*	NA	NA
Guidance and Minimum Levels		
High Guidance Level	73.1	>177
High Minimum Lake Level	72.4	168
Minimum Lake Level	70.8	122
Low Guidance Level	69.7	118

NA = Not available or not applicable.

* Developed for comparative purposes only; not used to establish Minimum Levels

Lake Stage Data and Exceedance Percentiles

Lake stage data, *i.e.,* surface water elevations for King Lake (District Universal Identification Number STA 455 456) are currently available from the District's Water Management Data Base from July 1976 through October 2007 (Figure 14, see Figure 2 for the location of the District water level gauge). The highest surface water elevation for the lake included in the database, 73.92 feet above NGVD, occurred on May 10, 1979 and September 15, 2004. The low of record, 66.89 feet above NGVD, was recorded on June 12, 2001.

For the purpose of minimum levels determination, lake stage data are categorized as "Historic" for periods when there were no measurable impacts due to water withdrawals, and impacts due to structural alterations were similar to existing conditions. In the context of minimum levels development, "structural alterations" means man's physical alteration of the control point, or highest stable point along the outlet conveyance system of a lake, to the degree that water level fluctuations are affected. Lake stage data are categorized as "Current" for periods when there were measurable, stable impacts due to water withdrawals, and impacts due to structural alterations were stable.

Based on water-use estimates and analysis of lake water levels and regional ground water fluctuations, all available lake-stage data for King Lake were classified as Historic data. Although the water level data record extends over 30 years, it was determined that Historic lake-stage exceedance percentiles would be better estimated using a longer data record. Historic lake-stage exceedance percentiles were, therefore, developed using a composite 60-year record of monthly mean lake surface elevations based on available stage records that were supplemented with modeled estimates. The 60-year period was considered sufficient for incorporating the range of lake-stage fluctuations that would be expected based on long-term climatic cycles that have been shown to be associated with changes in regional hydrology (Enfield et al. 2001, Basso and Schultz 2003, Kelly 2004).

Modeled monthly mean lake stage values for the composite data set were estimated using a linear fitting procedure known as the line or organic correlation (see Helsel and Hirsch 1992). The procedure was used to describe the relationship between available lake stage data for King Lake and regional rainfall, as measured at the St. Leo rainfall station (District Universal Identification Number RNF 306 306), a long-term rainfall gauging station located in Pasco County about 13.5 miles northeast of King Lake. Rainfall values used for the analysis consisted of weighted thirty-six month cumulative totals for the July 1976 through December 2005 period that were derived using a linear-decay series to weight monthly rainfall values for the thirty-six month periods. The line of organic correlation equation developed for the lake stage and rainfall data was used to estimate water surface elevation values for King Lake for the period from January 1946 through December 2005 (unpublished District data). A Historic, composite data set of monthly mean water surface elevations for King Lake was developed using available lake stage records from July 1976 though December 2005 and modeled water surface elevations for the period from January 1946 through June 1976 and for a few

more recent months when lake stage was not measured (Figure 15). The composite record includes periods when estimated monthly mean water surface elevations were higher than the values that have been measured at the lake gauging station. The highest value included in the composite data set, 76.66 feet above NGVD, was estimated for September 1960.

The Historic P10 elevation, the elevation the lake water surface equaled or exceeded ten percent of the time during the historic period, was 73.1 feet above NGVD. The Historic P50, the elevation the lake water surface equaled or exceeded fifty percent of the time during the historic period, was 71.6 feet above NGVD. The Historic P90, the lake water surface elevation equaled or exceeded ninety percent of the time during the historic period, was 69.7 feet above NGVD. The Historic P10 and P90 are respectively, 0.5 and 0.1 feet higher than the P10, and P90 values (72.6, and 69.7 feet) derived from the empirical data collected during the past 30 years. The Historic P50 is identical to the P50 value derived from the empirical data set.

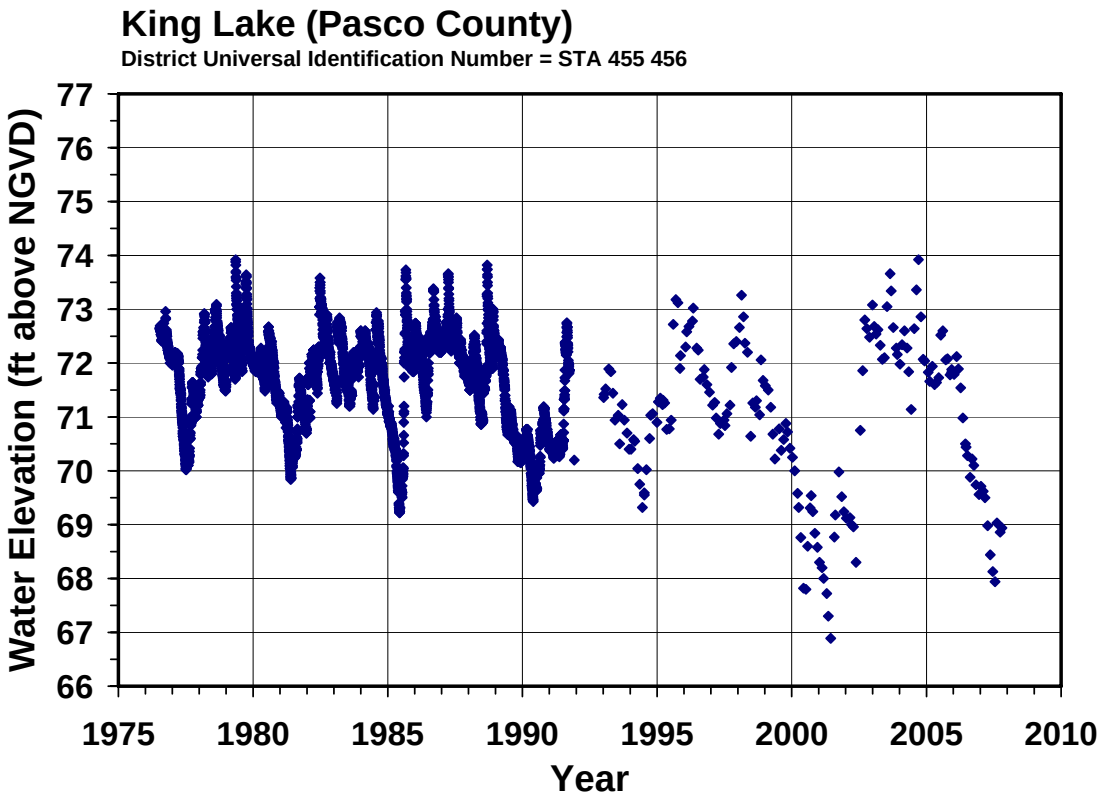


Figure 14. Measured water surface elevations for King Lake through October 2007.

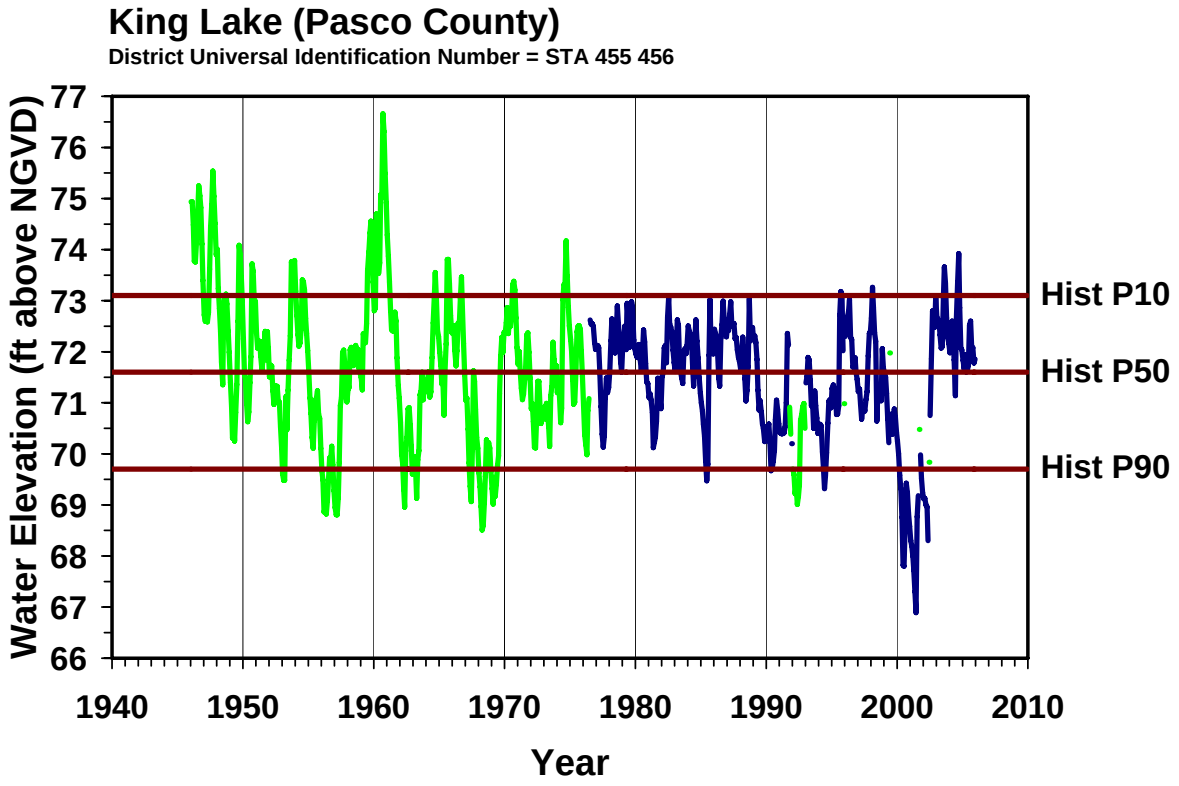


Figure 15. Composite monthly-mean surface water elevations and Historic lake-stage exceedance percentiles for King Lake, from January 1946 through December 2005. Composite data include values based on measured water surface elevations (blue) and modeled values (green). Historic exceedance percentiles include the Historic P10 (Hist P10), Historic P50 (Hist P50) and Historic P90 (Hist P90).

Normal Pool, Control Point Elevation and Determination of Structural Alteration Status

The Normal Pool elevation, a reference elevation used for development of minimum lake and wetland levels, is established using elevations of Hydrologic Indicators of sustained inundation, including biological and physical features. For development of Minimum Lake Levels, the Normal pool elevation is considered an approximation of the Historic P10. Based on elevations of *Taxodium* sp. buttress inflection points measured in July 2006 along the south, southwest and north shores of the lake, the Normal Pool elevation was established at 72.6 feet above NGVD (Figures 2 and 16, Table 4).

For development of minimum and guidance levels, lakes are classified as open or closed basin lakes. Open basin lakes are systems that are connected to, or are part of

an ordered surface water conveyance system, *i.e.*, they have outlets or inlets for conveyance of surface water. Closed basin lakes are those that are not part of an ordered conveyance system. Based on the outlet canal and culvert which allows King Lake to drain to Bell Lake, King Lake was classified as an open basin lake.

The Control Point elevation is the elevation of the highest stable point along the outlet profile of a surface water conveyance system (*e.g.,* a weir, canal or culvert) that is the principal control of water level fluctuations in the lake. A Control Point may be established at the invert or crest elevation associated with a water control structure at a lake outlet, or at a high, stable point in a lake-outlet canal, ditch or wetland area. The invert or crest elevation is the lowest point on the portion of a water control structure that provides for conveyance of water across or through the structure. The control point elevation for King Lake was established at 71.6 feet above NGVD, based on a recently completed survey of the lake outlet conveyance system (Southwest Florida Water Management District 2006). The control point was identified as the top of a metal plate/weir that is attached to the upstream end of a 41-ft long, 36-inch diameter reinforced concrete pipe that provides for conveyance under Hale Road from the King Lake outlet canal to a canal that connects to Bell Lake.

Structural alteration status is determined to support development of the High Guidance Level. In addition to identification of outlet conveyance system modifications, comparison of the Control point elevation with the Normal Pool is typically used to determine if a lake has been structurally altered. If the Control Point elevation is below the Normal Pool, the lake is classified as a structurally altered system. If the Control Point elevation is above the Normal Pool or the lake has no outlet, then the lake is not considered to be structurally altered. Based on the existence of the outlet ditch along the southeastern lakeshore, and given that the Normal Pool elevation (72.6 feet above NGVD) is higher than the Control point elevation (71.61 feet above NGVD), King Lake was classified as a structurally altered lake.

Table 4. Summary statistics for hydrologic indicator measurements (elevations of the buttress inflection points of lakeshore *Taxodium* sp.) used for establishing the Normal Pool Elevation for King Lake. Elevations were measured by District staff in July 2006.

Statistic	Statistic Value (N) or Elevation (feet above NGVD)
N	16
Median	72.6
Mean (SD)	72.6 (0.2)
Minimum	72.3
Maximum	72.8

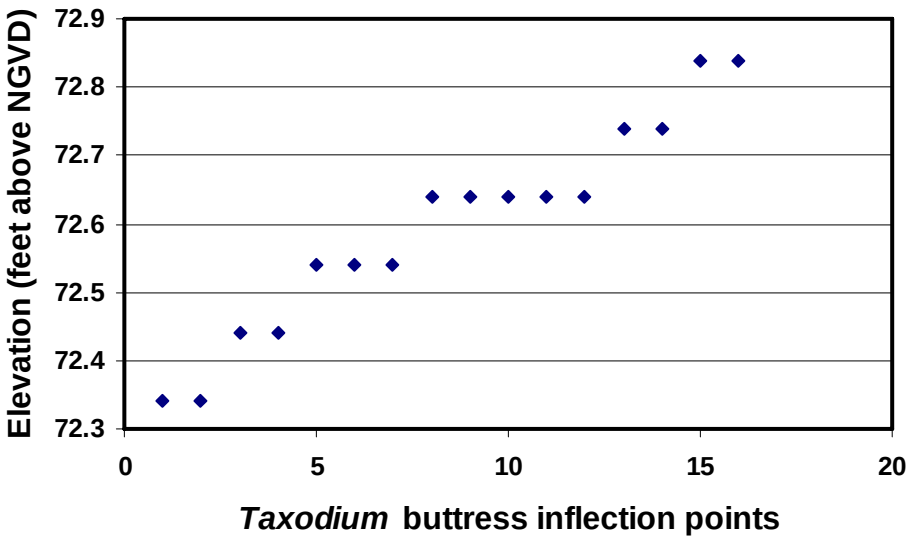


Figure 16. Elevations of *Taxodium* buttress inflection points used to establish the Normal Pool elevation for King Lake.

Guidance Levels

The Ten Year Flood Guidance Level has historically been provided as advisory information for lakeshore development and is the level of flooding expected on a frequency of not less than the ten-year recurring interval, or on a frequency of not greater than a ten percent probability of occurrence in any given year. For King Lake, a Ten Year Flood Guidance Level of 73.66 feet above NGVD was adopted into Chapter 40D-8, F.A.C. in April 1985. Recent work completed in support of the District's Watershed Management Program has yielded a new, provisional ten-year recurrence flood stage for King Lake. Results from the study, which involved floodplain analyses for the portion of the Cypress Creek basin in Pasco County, indicate a provisional ten-year flood level of 73.53 feet above the North American Vertical Datum of 1988 for King Lake (Parsons 2007). This provisional flood level corresponds to an elevation of 74.36 feet above NGVD, based on use of a 0.83 foot datum-conversion factor. It should be noted that the Watershed Management Plan that includes the provisional flood elevation for King Lake will be subjected to public review prior to finalization of project results.

In October 2007, the District Governing Board approved rule amendments to remove all adopted Ten Year Flood Guidance Levels from Chapter 40D-8, F.A.C. The intent of this action was not to discontinue development of regional and site-specific flood stage information, but rather to promote organizational efficiency by eliminating unnecessary rules. Flood stage levels continue to be developed under the District's Watershed Management Program, but ten year flood recurrence levels are not incorporated into Chapter 40D-8, F.A.C. In accordance with this policy, Chapter 40D-8, F.A.C. does not currently include a Ten Year Flood Guidance Level for King Lake.

The High Guidance Level is provided as an advisory guideline for construction of lakeshore development, water dependent structures, and operation of water management structures. The High Guidance Level is the expected Historic P10 of the lake, and is established using historic data if it is available, or is estimated using the Current P10, the control point and the normal pool elevation. Based on the availability of Historic data for King Lake, the High Guidance Level was established at the Historic P10 elevation, 73.1 feet above NGVD.

The Low Guidance Level is provided as an advisory guideline for water dependent structures, and as information for lakeshore residents and operation of water management structures. The Low Guidance Level is the elevation that a lake's water levels are expected to equal or exceed ninety percent of the time on a long-term basis, and is established using Historic or Current data and, in some cases, reference lake water regime statistics. Reference lake water regime statistics are used when adequate historic or current data are not available. These statistics represent differences between P10, P50 and P90 lake stage elevations for typical, regional lakes that exhibit little or no impacts associated with water withdrawals (*i.e.*, reference lakes). Reference lake water regime statistics include the RLWR50, RLWR90 and RLWR5090, which are, respectively, median differences between P10 and P50, P50 and P90, and P10 and P90 lake stage percentiles for a set of reference lakes. Based on the availability of Historic data for King Lake, the Low Guidance Level was established at the Historic P90 elevation, 69.7 feet above NGVD.

Lake Classification

Lakes are classified as Category 1, 2 or 3 for the purpose of Minimum Levels development. Systems with fringing cypress wetlands greater than 0.5 acres in size where water levels regularly rise to an elevation expected to fully maintain the integrity of the wetlands (*i.e.,* the Historic P50 is not more than 1.8 feet below the Normal Pool elevation) are classified as Category 1 Lakes. Lakes with fringing cypress wetlands greater than 0.5 acres in size that have been structurally altered such that the Historic P50 is more than 1.8 feet below the Normal Pool elevation are classified as Category 2 Lakes. Lakes without fringing cypress wetlands or with less than 0.5 acres of fringing cypress wetlands are classified as Category 3 Lakes. Based on the presence of lake-fringing cypress wetlands of 0.5 acre or more in size within the lake basin, and because the Historic P50 is less than 1.8 feet below the Normal Pool elevation, King Lake was classified as a Category 1 lake.

Significant Change Standards and Other Information for Consideration

Lake-specific significant change standards and other available information are developed for establishing Minimum Levels. The standards are used to identify thresholds for preventing significant harm to cultural and natural system values

associated with lake ecosystems, in accordance with guidance provided in the Florida Water Resources Implementation Rule (Chapter 62-40.473, F.A.C.). Other information taken into consideration for Minimum Levels development includes potential changes in the coverage of herbaceous wetland and submersed aquatic plants.

For Category 1 or 2 Lakes, a significant change standard is established 1.8 feet below the normal pool elevation. This standard identifies a desired median lake stage that if achieved, may be expected to preserve the ecological integrity of lake-fringing wetlands. Although not identified by name in the District's Minimum Flows and Levels rule, the elevation 1.8 feet below normal pool is typically referred to as the Cypress Standard in District documents pertaining to minimum levels development. For King Lake, the Cypress Standard was established at 70.8 feet above NGVD. Based on the Historic composite water level record, the standard was equaled or exceeded seventy-four percent of the time, *i.e*., the standard elevation corresponds to the Historic P74.

For Category 3 lakes, six significant change standards, including a Dock-Use Standard, a Basin Connectivity Standard, an Aesthetics Standard, a Recreation/Ski Standard, a Species Richness Standard, and a Lake Mixing Standard are developed. These standards identify desired median lake stages that if achieved, are intended to preserve various natural system and human-use lake values. Although King Lake is a Category 1 Lake, Category 3 Lake standards were developed for comparative purposes. These standards were not, however, used to establish the Minimum Levels.

The Dock-Use Standard is developed to provide for sufficient water depth at the end of existing docks to permit mooring of boats and prevent adverse impacts to bottom-dwelling plants and animals caused by boat operation. The standard is based on the elevation of lake sediments at the end of existing docks, a two-foot water depth for boat mooring, and use of Historic lake stage data or region-specific reference lake water regime statistics. The Dock-Use Standard forking Lake was established at 72.9 feet above NGVD, based on the sum of the elevation of sediments at the end of 90% of the 58 docks within the basin (69.0 feet above NGVD, Table 5), a two-foot water depth based on use of powerboats in the lake, and the 1.9 foot difference between the Historic P50 and Historic P90. Based on the Historic composite water level record, the Dock-Use Standard was equaled or exceeded thirteen percent of the time, *i.e*., the standard elevation corresponds to the Historic P13.

The Basin Connectivity Standard is developed to protect surface water connections between lake basins or among sub-basins within lake basins to allow for movement of aquatic biota, such as fish, and support recreational use of the lake. The standard is based on the elevation of lake sediments at a critical high spot between lake basins or lake sub-basins, identification of water depths sufficient for movement of biota and/or watercraft across the critical high spot, and use of Historic lake stage data or region-specific reference lake water regime statistics. The Basin Connectivity Standard was established at 72.2 feet above NGVD, based on the elevation (68.3 feet above NGVD) that ensures connectivity between the main lake basin and a small sub-basin along the eastern lakeshore, a two-foot water depth in the area of connectivity to allow for

movement of watercraft and biota between the main and sub-basin, and the difference between the Historic P50 and Historic P90 elevations (1.9 feet). Based on the Historic composite water level record, the Basin Connectivity Standard was equaled or exceeded thirty-two percent of the time, *i.e*., the standard elevation corresponds to the Historic P32.

The Aesthetics Standard is developed to protect aesthetic values associated with the inundation of lake basins. The standard is intended to limit potential change in aesthetic values associated with the median lake stage from diminishing beyond the values associated with the lake when it is staged at the Low Guidance Level. The Aesthetic Standard is established at the Low Guidance Level, which for King Lake occurs at an elevation of 69.7 feet above NGVD. Because the Low Guidance Level was established at the Historic P90 elevation, water levels equaled or exceeded the Aesthetics Standard ninety percent of the time during the Historic period defined by the Historic water level record.

The Recreation/Ski Standard is developed to identify the lowest elevation within the lake basin that will contain an area suitable for safe water skiing. The standard is based on the lowest elevation (the Ski Elevation) within the basin that can contain a 5-foot deep ski corridor delineated as a circular area with a radius of 418 feet, or a rectangular ski corridor 200 feet in width and 2,000 feet in length, and use of Historic lake stage data or region-specific reference lake water regime statistics. For King Lake, the Recreation-Ski Standard was established at 69.7 feet above NGVD, based on the sum of the Ski Elevation (67.8 ft above NGVD) and the 1.9-foot difference between the Historic P50 and Historic P90. Based on the Historic composite water level record, the Basin Connectivity Standard was equaled or exceeded ninety- percent of the time, *i.e*., the standard elevation corresponds to the Historic P90.

The Species Richness Standard is developed to prevent a decline in the number of bird species that may be expected to occur at or utilize a lake. Based on an empirical relationship between lake surface area and the number of birds expected to occur at a lake, the standard is established at the lowest elevation associated with less than a fifteen percent reduction in lake surface area relative to the lake area at the Historic P50 elevation. For King Lake, the Species Richness Standard was established at 69.2 feet above NGVD. The Species Richness Standard was equaled or exceeded ninety-five percent of the time during the Historic period; *i.e*., the standard elevation corresponds to the Historic P95.

The Lake Mixing Standard is developed to prevent significant changes in patterns of wind-driven mixing of the lake water column and sediment resuspension. The standard is established at the highest elevation at or below the Historic P50 elevation where the dynamic ratio (see Bachmann *et al.* 2000) shifts from a value of <0.8 to a value >0.8, or from a value >0.8 to a value of <0.8. Because the dynamic ratio does not shift across the 0.8 threshold as the stage of King Lake changes from approximately 73 feet above NGVD to dry conditions (Figure 17), a Mixing Standard was not developed for the lake.

Herbaceous Wetland Information is taken into consideration to determine the elevation at which changes in lake stage would result in substantial changes in potential wetland area within the lake basin (*i.e*., basin area with a water depth of four or less feet). Similarly, changes in lake stage associated with changes in lake area available for colonization by rooted submersed or floating-leaved macrophytes are also evaluated, based on water transparency values. Review of changes in potential herbaceous wetland area or area available for aquatic plant colonization in relation to change in lake stage did not indicate that of use of the significant change standards would be inappropriate for establishment of the Minimum Lake Level (Figure 18).

Because herbaceous wetlands are common within the King Lake basin, it was determined that an additional measure of wetland change should be considered for minimum levels development. Based on a recent review (Hancock 2006) of the development of minimum level methods for cypress-dominated wetlands, it was determined that up to an 0.8 foot decrease in the Historic P50 elevation would not likely be associated with significant changes in the herbaceous wetlands occurring within lake basins. A Wetland Offset elevation of 70.8 feet above NGVD was therefore established for King Lake by subtracting 0.8 feet from the Historic P50 elevation. The standard elevation was equaled or exceeded seventy-four percent of the time during the Historic period defined by the Historic composite data record, *i.e*., the standard elevation corresponds to the Historic P74.

Table 5. Summary statistics and elevations associated with docks in King Lake, based on measurements made by District staff in June 2006. Percentiles (P10, P50, P90) represent elevations exceeded by 10, 50 and 90 percent of the docks.

Summary Statistic	Statistic Value (N) or Elevation (feet above NGVD) of Sediments at Waterward End of Docks	Statistic Value (N) or Elevation (feet above NGVD) of Dock Platforms
N	58	57
Mean (Standard Deviation)	67.1 (2.2)	74.0 (0.5)
P10	69.0	74.5
P50 or Median	67.4	73.9
P90	65.5	73.3
Maximum	70.1	75.5
Minimum	58.3	72.1

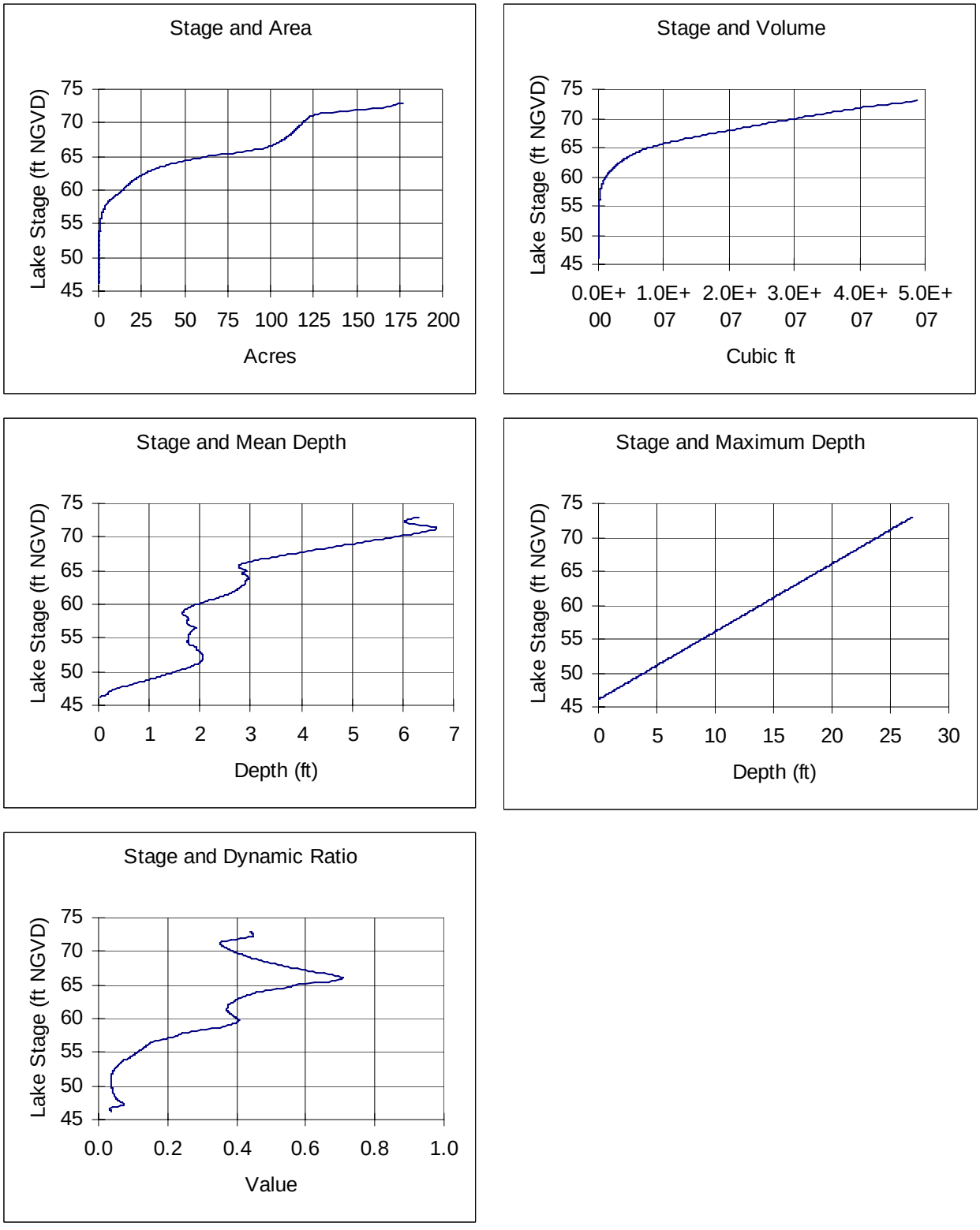


Figure 17. King Lake surface area, volume, mean depth, maximum depth and dynamic ratio (basin slope) as a function of lake stage (water surface elevation).

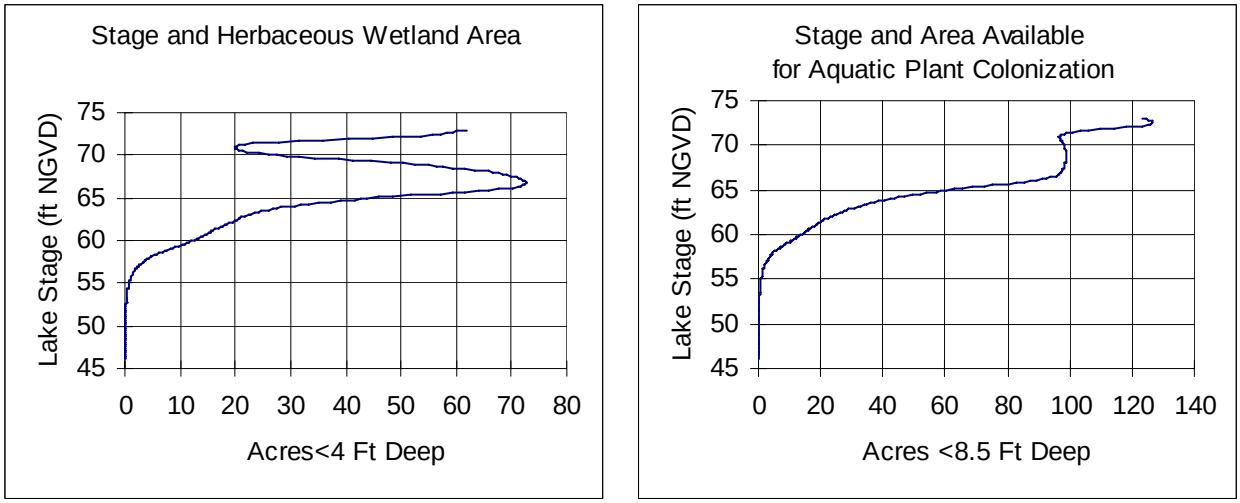


Figure 18. Potential herbaceous wetland area and area available for macrophyte colonization in King Lake as a function of lake stage (water surface elevation).

Minimum Levels

Minimum Lake Levels are developed using specific lake-category significant change standards and other available information or unique factors, including: potential changes in the coverage of herbaceous wetland vegetation and aquatic macrophytes; elevations associated with residential dwellings, roads or other structures; frequent submergence of dock platforms; faunal surveys; aerial photographs; typical uses of lakes (*e.g.,* recreation, aesthetics, navigation, irrigation); surrounding land-uses; socio-economic effects; and public health, safety and welfare matters. Minimum Levels development is also contingent upon lake classification*, i.e.,* whether a lake is classified as a Category 1, 2 or 3 lake.

The Minimum Lake Level is the elevation that a lake's water levels are required to equal or exceed fifty percent of the time on a long-term basis. For Category 1 lakes, the Minimum Level is established at the Cypress Standard, which is 1.8 feet below the Normal Pool. The Minimum Lake Level for King Lake was therefore established at 70.8 feet above NGVD.

The High Minimum Lake Level is the elevation that a lake's water levels are required to equal or exceed ten percent of the time on a long-term basis. For Category 1 lakes, the High Minimum Lake Level is established 0.4 feet below the Normal Pool elevation. The High Minimum Lake Level for King Lake was therefore established at 72.4 feet above NGVD.

Minimum and Guidance levels for King Lake are shown in Figure 19 along with monthly mean water surface elevations based on period of record water level measurements. Review of available data indicated that staging of the lake at the Minimum Levels would not flood any man-made features within the immediate lake basin (see Figure 20 for the approximate lake margins when the water surface is at the minimum levels). Based on recent field survey data (Southwest Florida Water Management District 2006), the High Minimum Lake Level is approximately 1.4 feet below the lowest residential home floor slab within the immediate lake basin, and about 0.6 feet below the centerline of the lowest paved road surrounding the lake (Table 6).

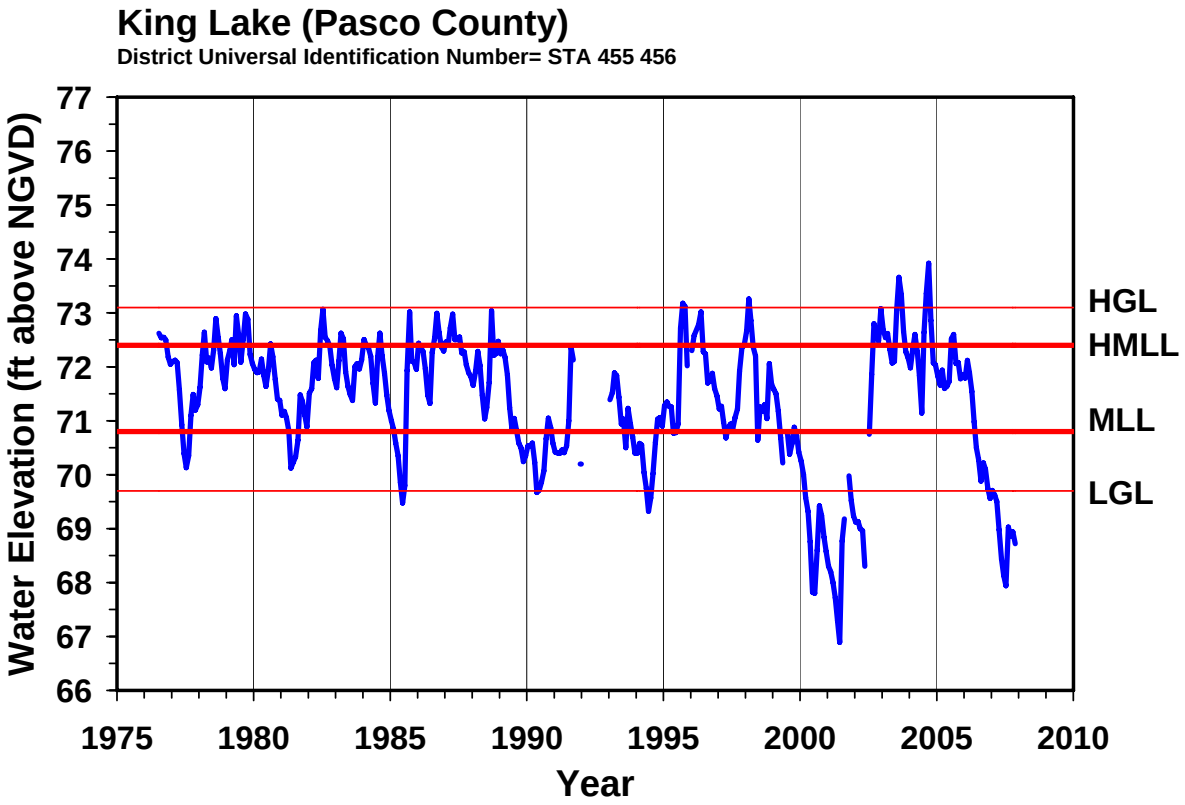


Figure 19. Mean monthly surface water elevation of King Lake through September 2007 (blue line) based on measured lake stage records, and adopted Guidance and Minimum Levels (red lines). Adopted levels include the High Guidance Level (HGL), High Minimum Lake Level (HMLL), Minimum Lake Level (MLL) and Low Guidance Level (LGL).

Table 6. Elevations of selected man-made features occurring at relatively low elevations within the immediate in the immediate King Lake basin.

Lake Basin Features	Elevation (feet above NGVD)
Finished floor of sunken living room in the lowest house adjacent to the lake	73.76
Finished garage floor of the lowest house adjacent to the lake	75.03
Finished floor of concrete patio of the lowest house adjacent to the lake	73.96
Centerline of lowest paved road (Tamney Lane) near the lake	73.04

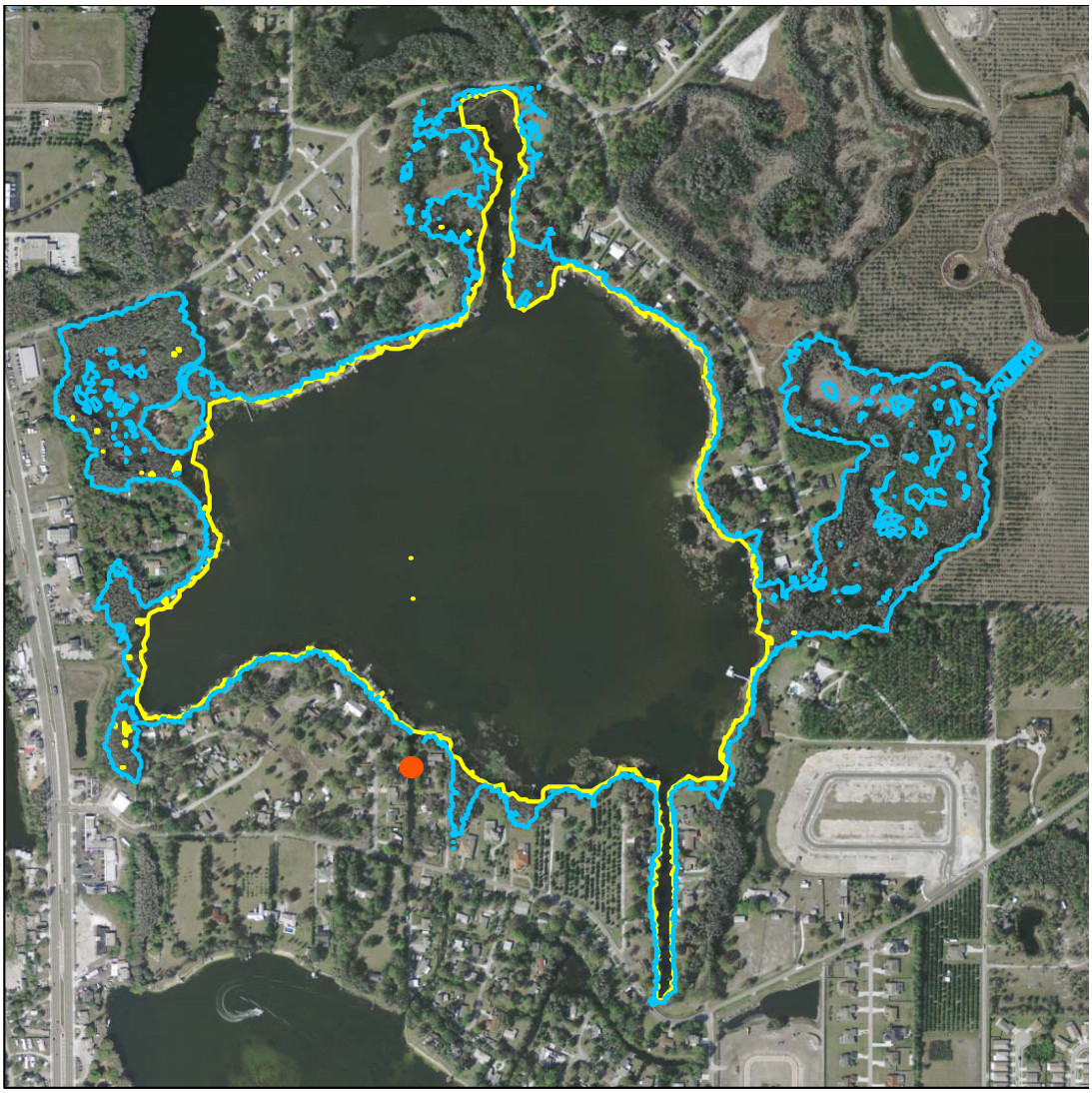


Figure 20. Approximate location of the Minimum Lake Level and High Minimum Lake Level for King Lake (photographic image source: Earhtdata International 2007). The orange dot indicates a canal area where elevation contours were truncated for mapping purposes.

Documents Cited and Reviewed for Development of Minimum and Guidance Levels for King Lake

Abbondondolo, D. 2006. E-mail to Doug Leeper, dated August 14, 2006. Subject: Latest King Lake plan. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

Arnold, D. 2007. E-mail to Doug Leeper, dated August 6, 2007. Subject: 10-yr peak stages. Southwest Florida Water Management District. Brooksville, Florida.

Bachmann, R. W., Hoyer, M. V., and Canfield, D. E., Jr. 2000. The potential for wave disturbance in shallow Florida lakes. Lake and Reservoir Management 16: 281-291.

Basso, R. 2004. Draft technical memorandum to Doug Leeper, dated November 9, 2004. Subject: Hydrogeologic setting of lakes within the northern Tampa Bay region. Southwest Florida Water Management District. Brooksville, Florida.

Basso, R. and Schultz, R. 2003. Long-term variation in rainfall and its effect on Peace River flow in west-central Florida. Southwest Florida Water Management District. Brooksville, Florida.

Bedient, P., Brinson, M., Dierberg, F., Gorelick, S., Jenkins, K., Ross, D., Wagner, K., and Stephenson, D. 1999. Report of the Scientific Peer Review Panel on the data, theories, and methodologies supporting the Minimum Flows and Levels Rule for northern Tampa Bay Area, Florida. Prepared for the Southwest Florida Water Management District, the Environmental Confederation of Southwest Florida, Hillsborough County, and Tampa Bay Water. Published by the Southwest Florida Water Management District. Brooksville, Florida.

Berryman & Henigar, Inc., SDI Environmental Services, Inc., Ormiston, B.G., HDR Engineering, Inc., Greeley and Hansen, Inc., Legette, Brashears, & Graham, Inc., and Reynolds, Smith, & Hills, Inc. 2001. Phase I mitigation plan, Volumes 1, 2 and 3. Prepared for Tampa Bay Water. Clearwater, Florida.

Brooks, H. K. 1981. Physiographic divisions of Florida: map and guide. Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Gainesville, Florida.

Caffrey, A.J., Hoyer, M.V., and Canfield, D.E., Jr. 2006. Factors affecting the maximum depth of colonization by submersed macrophytes in Florida lakes. Department of Fisheries and Aquatic Sciences. Gainesville, Florida. Prepared for the Southwest Florida Water Management District. Brooksville, Florida.

Comp, G.S. 1982. Technical memorandum-82-8, dated November 8, 1982, to R.G. Perry. Re: Cypress Creek Wellfield CUP #3650 lake level analysis. Southwest Florida Water Management District. Brooksville, Florida.

Craun, J. 2003. Fax transmittal to David Sua, dated August 27, 2003. Content: King Lake outlet structure. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

D.C. Johnson and Associates, Inc. 2006. Bathymetric survey – MFL06-Pasco-Polk surveyor's report. San Antonio, Florida.

Dierberg, F. E. and Wagner, K. J. 2001. A review of "A multiple-parameter approach for establishing minimum levels for Category 3 Lakes of the Southwest Florida Water Management District" June 2001 draft by D. Leeper, M. Kelly, A. Munson, and R. Gant. Prepared for the Southwest Florida Water Management District. Brooksville, Florida.

EarthData International. 2004a. LiDAR topographic data collected to support of Federal Emergency Management Agency Map Modernization for Pasco County, Florida. Available from the Mapping and GIS Section of the Southwest Florida Water Management District. Brooksville, Florida.

EarthData International. 2004b. 2004 digital orthophotographs natural color. Published by the United States Geological Survey. Reston, Virginia. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

EarthData International. 2007. 2007 one foot natural color ortho photographs – northern District. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Enfield, D.B., Mestas-Nunez, A.M., and Trimble, P.J. 2001. The Atlantic multidecadal oscillation and its relation to rainfall and river flow in the continental U.S. Geophysical Research Letters 28: 2077-2080.

Florida Board of Conservation. 1969. Florida lakes, part III: gazetteer. Division of Water Resources. Tallahassee, Florida.

Florida Lakewatch. 2004. Florida Lakewatch water chemistry summaries 2004, Volume 2. Department of Fisheries and Aquatic Sciences, Institute of Food and Agricultural Sciences, University of Florida. Gainesville, Florida.

Foose, D.W. 1981. Drainage areas of selected surface-water sites in Florida. Open-File Report 81-482. United States Department of the Interior, United States Geological Survey. Tallahassee, Florida.

Gant, R. 1999a. Memorandum to Mario Cabana, John Parker, Brian Starford and Scott Laidlow dated August 18, 1999. Subject: 1999 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 1999b. Memorandum to Mario Cabana, John Parker, Brian Starford and Scott Laidlow dated September 13, 1999. Subject: historical list of stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2000. Memorandum to Mario Cabana, John Parker, Brian Starford and Scott Laidlow dated August 18, 2000. Subject: 2000 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2002. Memorandum to Ralph Kerr, John Parker, Michael Balser and Scott Laidlow dated January 18, 2002. Subject: 2002 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2003. Memorandum to Ralph Kerr, John Parker, Michael Balser and Scott Laidlow dated January 30, 2003. Subject: 2003 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2004a. E-mail to D. Moore, dated October 11, 2004. Subject: King Lake @ Drexel – Pasco County. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2004b. Memorandum to Ralph Kerr, John Parker, Michael Balser and Scott Laidlow dated January 29, 2004. Subject: 2004 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2005. Memorandum to Ralph Kerr, John Parker, Michael Balser and Scott Laidlow dated January 31, 2005. Subject: 2005 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2006. Memorandum to Ralph Kerr, John Parker, Michael Balser and Scott Laidlow dated January 27, 2006. Subject: 2006 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gant, R. 2007. Memorandum to Ralph Kerr, John Parker, Michael Balser and Scott Laidlow dated January 23, 2007. Subject: 2007 stressed lakes. Southwest Florida Water Management District. Brooksville, Florida.

Gao. J. 2004. Lake stage fluctuation study in west-central Florida lakes using multiple regression models. Department of Civil and Environmental Engineering, University of South Florida. Tampa, Florida.

Gottschalk, P.M. 1998. Letter to Joellyn Miller, dated August 10, 1998. Re: Lake level/outfall structure. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

Gottschalk, P.M. 1999a. Letter to Mr. Marty Kelly, dated February 4, 1999. Re: Lake level/outfall structure. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

Gottschalk, P.M. 1999b. Letter to Martin H. Kelly, dated September 1, 1999. Re: Lake level/outfall structure King Lake (west), Pasco County. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

Griffith, G., Canfield, D., Jr., Horsburgh, C., Omernik, and J. Azevedo, S. 1997. Lake regions of Florida (map). United States Environmental Protection Agency, University of Florida Institute of Food and Agricultural Sciences, Florida Lakewatch, Florida Department of Environmental Protection, and the Florida Lake Management Society. Gainesville and Tallahassee, Florida.

Hancock, M. 2006. Draft memorandum to file, dated April 24, 2006. Subject: a proposed interim method for determining minimum levels in isolated wetlands. Southwest Florida Water Management District. Brooksville, Florida.

Helsel, D.R. and Hirsch, R.M. 1992. Statistical methods in water resources. Studies in Environmental Science 45. Elsevier. New York, New York.

Henderson, S.E. 1983. Hydrology of Lake Padgett, Saxon Lake and adjacent area, Pasco County, Florida. U.S. Geological Survey Water-Resources Investigations Open-File Report 82-759. Tallahassee, Florida.

Hutchinson, C.B. 1985. Hydrogeology of the Cross Bar Ranch Well-Field area and projected impact of pumping, Pasco County, Florida. Water Resources Investigations Report 85-4001. United States Department of the Interior, United States Geological Survey. Tallahassee, Florida.

Kelly, M. H. 1999. Letter to Mr. Peter Gottschalk, dated March 19, 1999. Subject: King Lake (West), Pasco County. Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

Kelly, M. 2004. Florida river flow patterns and the Atlantic Multidecadal Oscillation. Southwest Florida Water Management District. Brooksville, Florida.

Leeper, D. 2003. Memorandum to file, dated December 11, 2003. Subject: proposed minimum and guidance levels for Lake Padgett in Pasco County, Florida. Southwest Florida Water Management District. Brooksville, Florida.

Leeper, D. 2003. E-mail to Wojciech M. Mroz, dated September 5, 2003. Subject: King Lake structure. Southwest Florida Water Management District. Brooksville, Florida.

Leeper, D. 2005. Memorandum to file, dated February 7, 2005. Subject: proposed minimum and guidance levels for Bell Lake in Pasco County, Florida. Southwest Florida Water Management District. Brooksville, Florida.

Leeper, D. 2006a. E-mail to Wojciech M. Mroz, David Sua, Randall Maciuszek and Michael Garrett, dated August 11, 2006. Subject: King Lake outlet structure project. Southwest Florida Water Management District. Brooksville, Florida.

Leeper, D. 2006b. E-mail to Randall Maciuszek, dated October 13, 2006. Subject: Re: King Lake outlet structure project. Southwest Florida Water Management District. Brooksville, Florida.

Leeper, D. 2006c. Proposed methodological revisions regarding consideration of structural alterations for establishing Category 3 Lake minimum levels in the Southwest Florida Water Management District, April 21, 2006 peer-review draft. Southwest Florida Water Management District. Brooksville, Florida.

Leeper, D., Kelly, M., Munson, A. and Gant, R. 2001. A multiple-parameter approach for establishing minimum levels for Category 3 Lakes of the Southwest Florida Water Management District, June14, 2001 draft. Southwest Florida Water Management District. Brooksville, Florida.

Malloy, R. L. 2005. E-mail to Doug Leeper, dated December 27, 2005. Subject: request for info on OHWL or SUL for selected lakes. Florida Department of Environmental Protection, Bureau of Surveying and Mapping. Tallahassee, Florida.

Maseda, N. 2003. Fax transmittal to David S. (Sua), dated August 27, 2003. Content: documents pertaining to a flood claim submitted to an insurance company. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

Murphy, W. R., Jr., Evans, R .P., and Whalen, J. K. 1984. Flooding in northwestern Hillsborough and southern Pasco Counties, Florida, in 1979. Open-File Report 82-96. U.S. Geological Survey in cooperation with the Southwest Florida Water Management District, Tallahassee, Florida.

Parsons. 2007. Cypress Creek/South Lakes Watershed (K938-13). Volume II floodplain analysis report SWFWMD Agreement No. 04CONC000154, May 2007. Tampa, Florida. Prepared for Southwest Florida Water Management District. Brooksville, Florida.

Romie, K. 2000. Water chemistry of lakes in the Southwest Florida Water Management District. Brooksville, Florida.

Sacks, L.A. 2002. Estimating ground-water inflow to lakes in central Florida using the isotope mass-balance approach. Water-Resources Investigations Report 02-4192.

United States Department of the Interior, United States Geological Survey. Tallahassee, Florida.

Shafer, M. D., Dickinson, R. E., Heaney, J. P., and Huber, W. C. 1986. Gazetteer of Florida lakes. Publication No. 96, Water Resources Research Center, University of Florida. Gainesville, Florida.

Southwest Florida Water Management District. Date unknown. 1994 digital orthophotographs color infrared. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Southwest Florida Water Management District. 1971. Pinellas-Anclote Basin, aerial photography with contours, Sheet No. J-8. Brooksville, Florida. Prepared by Black, Crow and Eidsness, Inc., Clearwater, Florida.

Southwest Florida Water Management District. 1972. Hillsborough River Basin, Big Cypress Swamp aerial photography with contours, Sheet No. 07-26-19. Brooksville, Florida. Prepared by Abraham Aerial Survey Corporation, Lansing, Michigan.

Southwest Florida Water Management District. 1972. Hillsborough River Basin, Big Cypress Swamp aerial photography with contours, Sheet No. 18-26-19. Brooksville, Florida. Prepared by Abraham Aerial Survey Corporation, Lansing, Michigan.

Southwest Florida Water Management District. 1991 (updated 1992). Flood-stage frequency relations for selected lakes within the Southwest Florida Water Management District. Brooksville, Florida.

Southwest Florida Water Management District. 1996. Lake Levels Program lake data sheets / 1977-1996, Hillsborough River Basin – 13. Brooksville, Florida.

Southwest Florida Water Management District. 1999a. Establishment of minimum levels for Category 1 and Category 2 lakes, *in* Northern Tampa Bay minimum flows and levels white papers: white papers supporting the establishment of minimum flows and levels for isolated cypress wetlands, Category 1 and 2 lakes, seawater intrusion , environmental aquifer levels and Tampa Bypass canal, peer-review final draft, March 19, 1999. Brooksville, Florida.

Southwest Florida Water Management District. 1999b. Establishment of minimum levels in palustrine cypress wetlands, *in* Northern Tampa Bay minimum flows and levels white papers: white papers supporting the establishment of minimum flows and levels for isolated cypress wetlands, Category 1 and 2 lakes, seawater intrusion , environmental aquifer levels and Tampa Bypass canal, peer-review final draft, March 19, 1999. Brooksville, Florida.

Southwest Florida Water Management District and Pasco/Hillsborough County. 2001. Potogrammetric mapping of Cypress Creek, aerial photography with contours, Sec.07, T 26S, R19E. Brooksville, Florida. Prepared by 3Di Florida, LLC, Holly Hill, Florida.

Southwest Florida Water Management District and Pasco/Hillsborough County. 2001. Potogrammetric mapping of Cypress Creek, aerial photography with contours, Sec.12, T 26S, R18E. Brooksville, Florida. Prepared by 3Di Florida, LLC, Holly Hill, Florida.

Southwest Florida Water Management District and Pasco/Hillsborough County. 2001. Potogrammetric mapping of Cypress Creek, aerial photography with contours, Sec. 13, T 26S, R18E. Brooksville, Florida. Prepared by 3Di Florida, LLC, Holly Hill, Florida.

Southwest Florida Water Management District and Pasco/Hillsborough County. 2001. Potogrammetric mapping of Cypress Creek, aerial photography with contours, Sec.18, T 26S, R19E. Brooksville, Florida. Prepared by 3Di Florida, LLC, Holly Hill, Florida.

Southwest Florida Water Management District. 2002a. 1999 digital orthophotographs color infrared. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Southwest Florida Water Management District. 2002b. United States Geological Surveys 1:24,000 scale topographic map (DRG). Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Southwest Florida Water Management District. 2003a. 1:24,000 detailed roads. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Southwest Florida Water Management District. 2003b. 2002 satellite imagery, natural color. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Southwest Florida Water Management District. 2003c. Florida counties. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Southwest Florida Water Management District. 2003d. Generalized streams and rivers. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Southwest Florida Water Management District. 2006. Surveyor's report: lake level data for the establishment of minimum flows and levels – King Lake – Paso County, Florida. Survey Section. Brooksville, Florida.

Southwest Florida Water Management District. 2007a. Proposed minimum and guidance levels for King Lake in Pasco County, Florida, November 7, 2007 draft. Ecologic Evaluation Section. Brooksville, Florida.

Southwest Florida Water Management District. 2007b. WUPPNT. File is updated daily and is available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Sua, D.Z. 2003a. E-mail to Michael Garrett, dated September 11, 2003. Subject: Hale Road culvert (King Lake structure). Southwest Florida Water Management District. Brooksville, Florida.

Sua, D.Z. 2003b. Memorandum to Martin H. Kelly, dated September 2, 2003. Subject: King Lake (West) outfall – Hal Road cross-drain. Southwest Florida Water Management District. Brooksville, Florida.

Tamney, C. 2004a. E-mail to Clarke Tamney, dated October 8, 2004. Subject: King Lake weir. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

Tamney, C. 2004b. Letter to Richard Gant, dated October 12, 2004. Content: transmittal letter for computer disc containing photographs of flooding at King Lake. Available from the Southwest Florida Water Management District Ecologic Evaluation Section. Brooksville, Florida.

United States Department of Agriculture. 1941a. Aerial photograph number CTT-8B-80, dated February 15, 1941. Washington, D.C. Available on-line at the Aerial Photography: Florida web site (www.uflib.ufl.edu/digital/collections/FLAP) maintained by the University of Florida. Gainesville, Florida.

United States Department of Agriculture. 1941b. Aerial photograph number CTT-8B-82, dated February 15, 1941. Washington, D.C. Available on-line at the Aerial Photography: Florida web site (www.uflib.ufl.edu/digital/collections/FLAP) maintained by the University of Florida. Gainesville, Florida.

United States Department of Agriculture. 1941c. Aerial photograph number CTT-8B-83, dated February 15, 1941. Washington, D.C. Available on-line at the Aerial Photography: Florida web site (www.uflib.ufl.edu/digital/collections/FLAP) maintained by the University of Florida. Gainesville, Florida.

United States Department of Agriculture. 1952a. Aerial photograph number CTT-7H-112, dated January 7, 1952. Washington, D.C. Available on-line at the Aerial Photography: Florida web site (www.uflib.ufl.edu/digital/collections/FLAP) maintained by the University of Florida. Gainesville, Florida.

United States Department of Agriculture. 1952b. Aerial photograph number CTT-7H-113, dated January 7, 1952. Washington, D.C. Available on-line at the Aerial Photography: Florida web site (www.uflib.ufl.edu/digital/collections/FLAP) maintained by the University of Florida. Gainesville, Florida.

United States Department of Agriculture. 1957a. Aerial photograph number CTT-1T-5, dated March 23, 1957. Washington, D.C. Available on-line at the Aerial Photography: Florida web site (www.uflib.ufl.edu/digital/collections/FLAP) maintained by the University of Florida. Gainesville, Florida.

United States Department of Agriculture. 1957b. Aerial photograph number CTT-1T-6, dated March 23, 1957. Washington, D.C. Available on-line at the Aerial Photography: Florida web site (www.uflib.ufl.edu/digital/collections/FLAP) maintained by the University of Florida. Gainesville, Florida.

United States Geological Survey. 1943. Lutz quadrangle, Florida, 7.5 minute series (topographic) map; Lutz, Fla., N2807.5-W8222.5/7.5. 1974. AMS 4540 III NW-Series V847. United States Department of the Interior Geological Survey. Washington, D.C.

United States Geological Survey. 1974. Lutz quadrangle, Florida, 7.5 minute series (topographic) map; Lutz, Fla., 28082-B4-TF-024, 1974, DMA 4540 III NW-Series V847. Department of Interior. Washington, D.C.

United States Geological Survey. 1987. Lutz quadrangle, Florida, 7.5 minute series (topographic) map; Lutz, Fla., 28082-B4-TF-024, 1974, Photorevised 1987, DMA 4540 III NW-Series V847. Department of Interior. Washington, D.C.

United States Geological Survey. 2004a. 1984 National high altitude photography (NHAP). Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

United States Geological Survey. 2004b. National hydrography dataset – water bodies and swamps.. United States Department of the Interior Geological Survey. Washington, D.C. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Wagner, K. and Dierberg, F. 2006. A review of "Proposed methodological revisions regarding consideration of structural alterations for establishing Category 3 Lake minimum levels in the Southwest Florida Water Management District" by D. Leeper, 2006. Prepared for the Southwest Florida Water Management District. Brooksville, Florida.

Walsh, T. 2006. E-mail to Doug Leeper, dated August 14, 2006. Subject: Re: Datum conversion. Southwest Florida Water Management District. Brooksville, Florida.

Water and Air Research, Inc. 1997. Determination of lake chains and hydrologic overview for the King and Deer groups of lakes in the Land O' Lakes and Lutz areas of Pasco and Hillsborough Counties. Gainesville, Florida. Prepared for the West Coast Regional Water Supply Authority, Clearwater, Florida.

White, W. A. 1970. The geomorphology of the Florida peninsula. Geological Bulletin, No. 51. Bureau of Geology, Florida Department of Natural Resources. Tallahassee, Florida.

Wiatrowski, K. 2008. Switfmud sets rules for lake levels. Published in the January 9, 2008 edition of the Pasco Tribune – Tampa Tribune. Tampa, Florida.

Woolpert, Inc. 2005a. 1970's black and white aerial photography. Englewood, Colorado. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Woolpert, Inc. 2005b. 2005 one foot natural color ortho photographs – west Pasco County. Winter Park, Florida. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.

Woolpert, Inc. 2006. 2006 one foot natural color ortho photographs – northern District. Orlando, Florida. Available from the Southwest Florida Water Management District Mapping and GIS Section. Brooksville, Florida.