Proposed Minimum and Guidance Levels for Crews Lake in Pasco County, Florida

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Draft

Ecologic Evaluation Section
Resource Conservation and Development Department

Southwest Florida
Water Management District

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Cover: Aerial photograph (looking south) of Crews Lake in 2004 showing the fishing pier along the western lakeshore in Crews Lake Wilderness Park (SWFWMD files).

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Proposed Minimum and Guidance Levels for Crews 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 used by the Southwest Florida Water Management District (District or SWFWMD) 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. Establishing a minimum flow or level does not in itself protect a water body from significant harm; however, resource protection, recovery and regulatory compliance may be ensured once the flow or level standards have been adopted.

Minimum flows and levels are 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 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 guidance and minimum lake levels is provided in SWFWMD (1999) and Leeper *et al.* (2001). Bedient *et al.* (1999) and Dierberg and Wagner (2001) provide peer-review findings regarding the lake-level methods.

Typically, two Minimum Levels and three Guidance Levels are established for lakes, and upon adoption by the District Governing Board, are 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 accordance with Chapter 40D-8, F.A.C., proposed Minimum and Guidance Levels (Table 1) were developed for Crews Lake, a Category 1 Lake located in Pasco County, Florida. Levels were established using best available information, including data that were obtained specifically for the purpose of minimum levels development. The data and analyses used for development of the proposed levels are described in the remainder of this report.

Table 1. Proposed Minimum and Guidance Levels for Crews Lake.

Minimum and Guidance Levels	Elevation (feet above NGVD)
Ten Year Flood Guidance Level	58.2
High Guidance Level	54.9
High Minimum Lake Level	52.4
Minimum Lake Level	51.0
Low Guidance Level	48.5

Data and Analyses Supporting Proposed Minimum and Guidance Levels for Crews Lake

Lake Setting and Description

Crews Lake is located in north-central Pasco County, Florida (Section 20, Township 24 South, Range 18 East; and numerous other sections) in the Coastal Rivers Basin of the Southwest Florida Water Management District (Figure 1). White (1970) classified the region of central or mid-peninsular Florida containing Crews 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 Weeki Wachee Hills (Griffith *et al.* 1997). Lakes in the region are mostly clear-water systems, with circumneutral pH, and moderately low alkalinity, nutrients and chlorophyll *a* levels.

Uplands in the immediate lake basin include extensive areas of native vegetation and altered areas that are used for livestock grazing, production of feed-grasses and low-density residential development. A public boat ramp, fishing pier and observation tower are situated along the lake's western shore in Crews Lake Wilderness Park, a 113-acre Pasco County park. The District maintains a water-level gauging station at the pier site (Figure 2). Portions of the lake basin that are regularly inundated are populated by numerous wetland and aquatic plant species, including spatterdock (*Nuphar luteum*), fragrant water lily (*Nymphaea odorata*), arrowhead (*Sagittaria* sp.), pickerelweed (*Pontederia cordata*), cypress (*Taxodium* sp.) and a variety of grasses and sedges.

The lake lies within the Crews Lake Outlet drainage basin in the Upper Coastal Areas watershed (U.S. Geological Survey Hydrologic Unit Classification System), and drains an area of 138 square miles (Florida Board of Conservation 1969, Foose 1981). Surface water inputs to the lake include precipitation on the lake basin proper, runoff from immediately adjacent upland areas, and inflow from the Masaryktown Canal and Jumping Gully (Figures 1 and 2). The Masaryktown Canal, a District-owned flood management system, was constructed in the mid-1960s to drain areas south and east of Masaryktown into the north end of Crews Lake. Hutchinson (1985) reports that flow in the canal is "known to be zero during most of the year". Jumping Gully conveys water into the lake from Unnamed Lake Number 22 (a.k.a. Loyce Lake) and other upstream water bodies, including Unnamed Lake Number 10, Pasco Lake, and various wetlands and ponds on the Cross Bar Ranch Wellfield. Jumping Gully discharge has been measured by the United States Geological Survey at a site (USGS 02310240, SWFWMD Universal Identification Number FLO 23 50) near U.S. Highway 41, from the mid-1960s through January 1988, and since January 1998. In recent years, there has

often been no flow in Jumping Gully. Prior to 1988, flows were typically less than 100 cubic feet per second, but reached as high as 890 cubic feet per second.

An earthen berm, located about three quarters of a mile north of where Jumping Gully enters the lake, bisects the Crews Lake basin into roughly equal-sized northern and southern sub-basins (Figure 2). A secondary berm partitions the most southeastern portion of the northern sub-basin from the rest of the sub-basin. Conveyance across the berm that separates the northern and southern sub-basins is provided by a 60-inch diameter corrugated metal pipe when water levels on either side of the pipe exceed 51.8 feet above NGVD (Figure 3). Dry-season drainage into a sinkhole (Figure 4) located north of the berm may significantly reduce the inundated area of the northern sub-basin and may result in northward flow through the berm-culvert from the southern basin. Historical photographs indicate that the berm has been in place since the 1940s, and also show that much of the northern sub-basin has frequently been dry (USDA 1941, 1952, 1957, SWFWMD 1967, 1969, USGS 1994, 1999, 2005, Woolpert Inc. 2003) (see Figures 5 through18). Crews Lake is the headwaters of the Pithlachascotee River, which extends about twenty-five miles from the southern sub-basin of the lake to the Gulf of Mexico (Figure 1). There are no surface withdrawals from the lake permitted by the District. There are, however, several permitted groundwater withdrawals in the lake vicinity.

Crews Lake is listed as a 693-acre lake in "Gazetteer of Florida Lakes" (Florida Board of Conservation 1969, Shafer *et al.* 1986). The 1954 U.S. Geological Survey 1:24,000 Port Richey NE, Fla. and Fivay, Fla. quadrangle 7.5 minute topographic maps show the lake surface at an elevation of 56 feet above NGVD, while the1954 U.S. Geological Survey Masaryktown, Fla. quadrangle topographic map shows a water-surface elevation of 55 feet above NGVD for the northernmost portion of the lake. The 1988 photorevised versions of the Port Richey NE and Fivay (Fivay Junction), Fla. maps show the lake surface at 56 feet above NGVD 1929 (see Figure 19 for a composite of recent USGS topographic maps of the Crews Lake area). A topographic map of the lake basin generated in support of minimum levels development (Figure 20) indicates that the lake would extend over 1,200 acres when the water level is at 56 feet above NGVD.

Figure 1. Location of Crews Lake, other regional water bodies, highways and major roads within and near Pasco County, Florida.

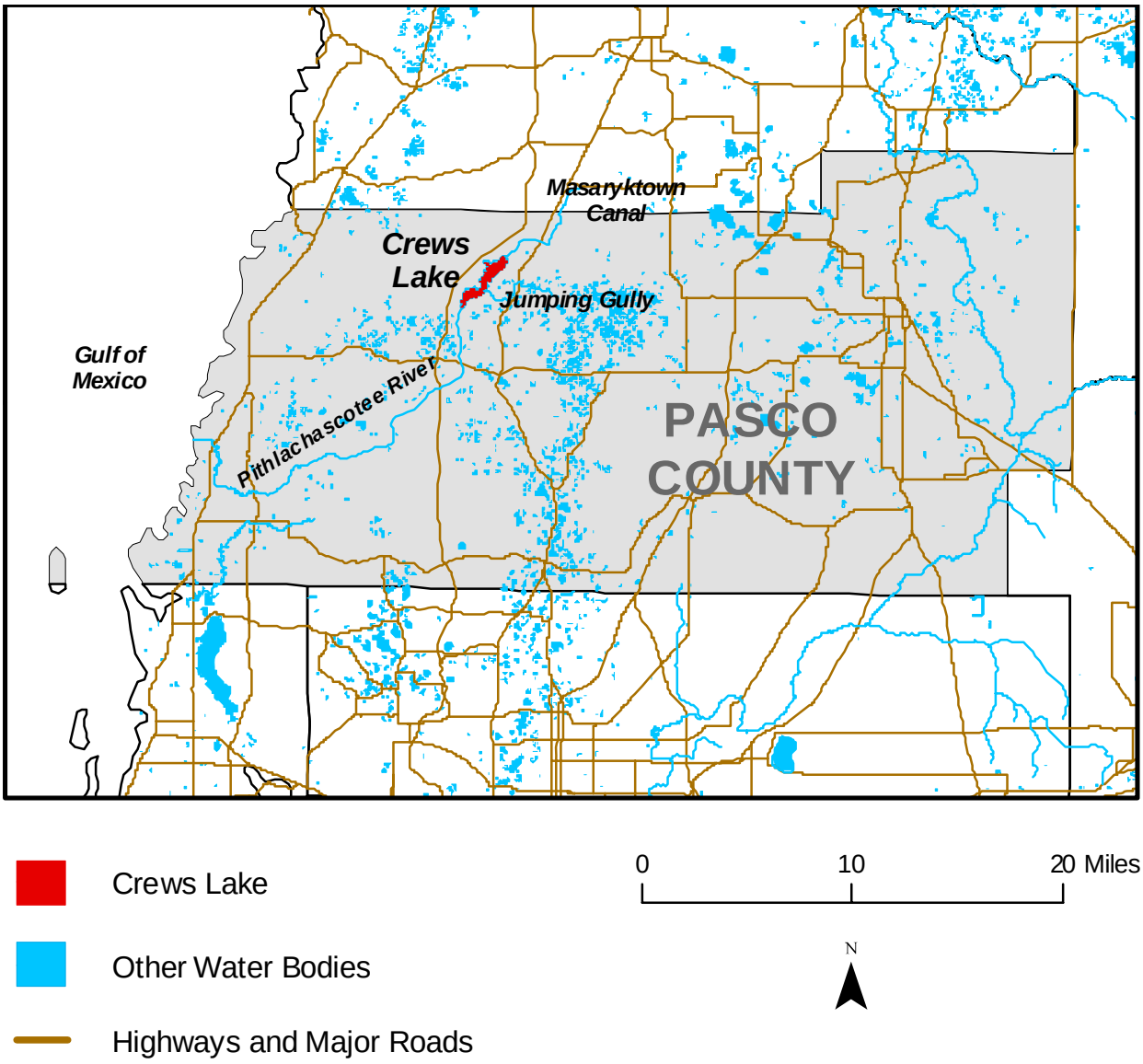


Figure 2. Aerial photograph of the Crews Lake area in 2005 (USGS 2005), showing the location of the District's Crews Lake water-level gauge, the earthen berm that bisects the lake basin, other nearby water bodies, sites where hydrologic indicators were measured, and major area roads.

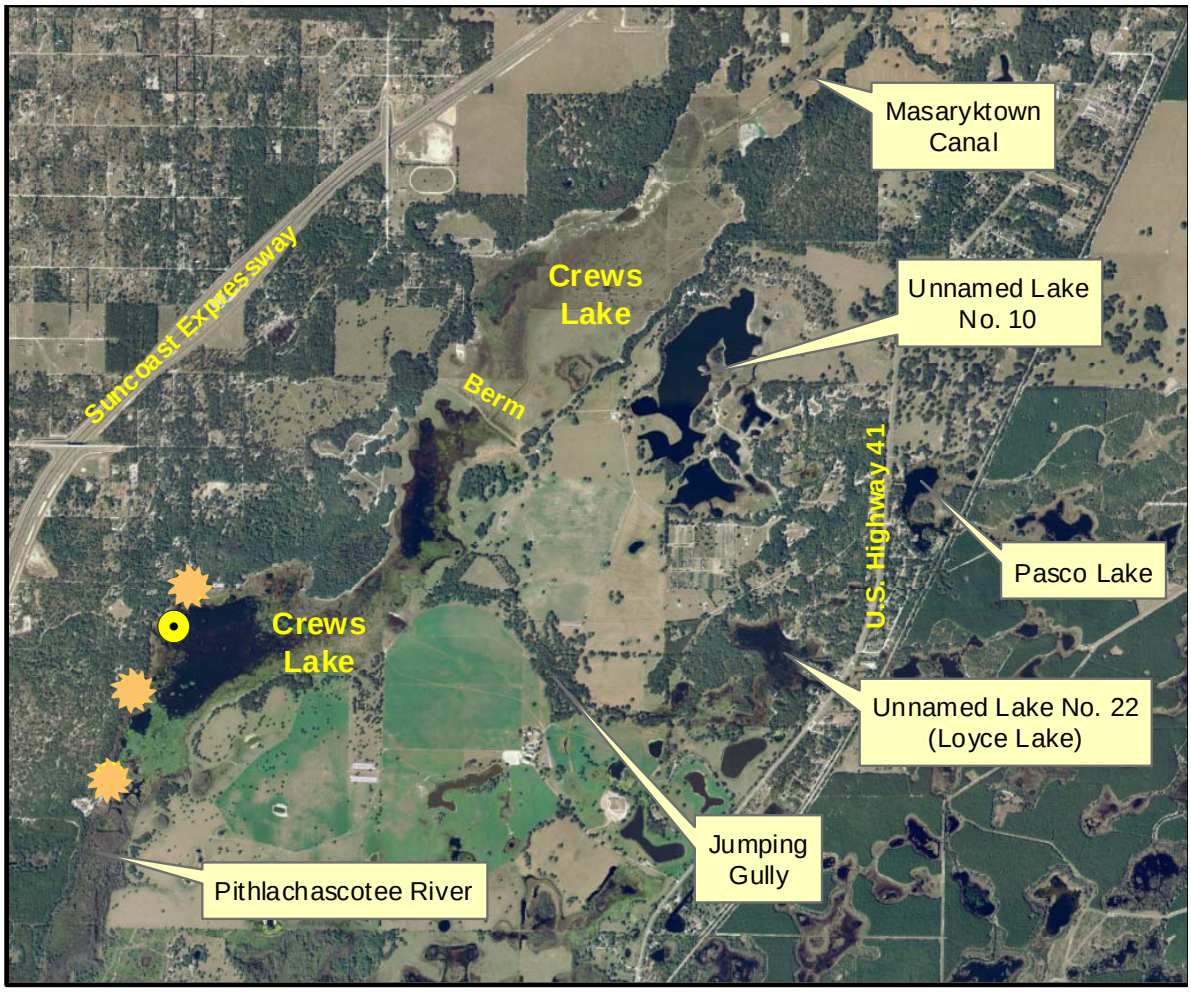


Figure 3. Earthen berms and culvert in the berm that separates the northern and southern sub-basins of Crews Lake in 1971 (upper panel) and 1982 (lower panel) (SWFWMD files). The 1971 photograph also shows a portion of a second berm in the north basin that partitions a portion of the northern sub-basin from the rest of the sub-basin.

Figure 4. Sinkhole in the northern sub-basin of Crews Lake in 1985 (SWFWMD files).

Figure 5. Aerial photograph of Crews Lake in January 1941 (USDA 1941b).

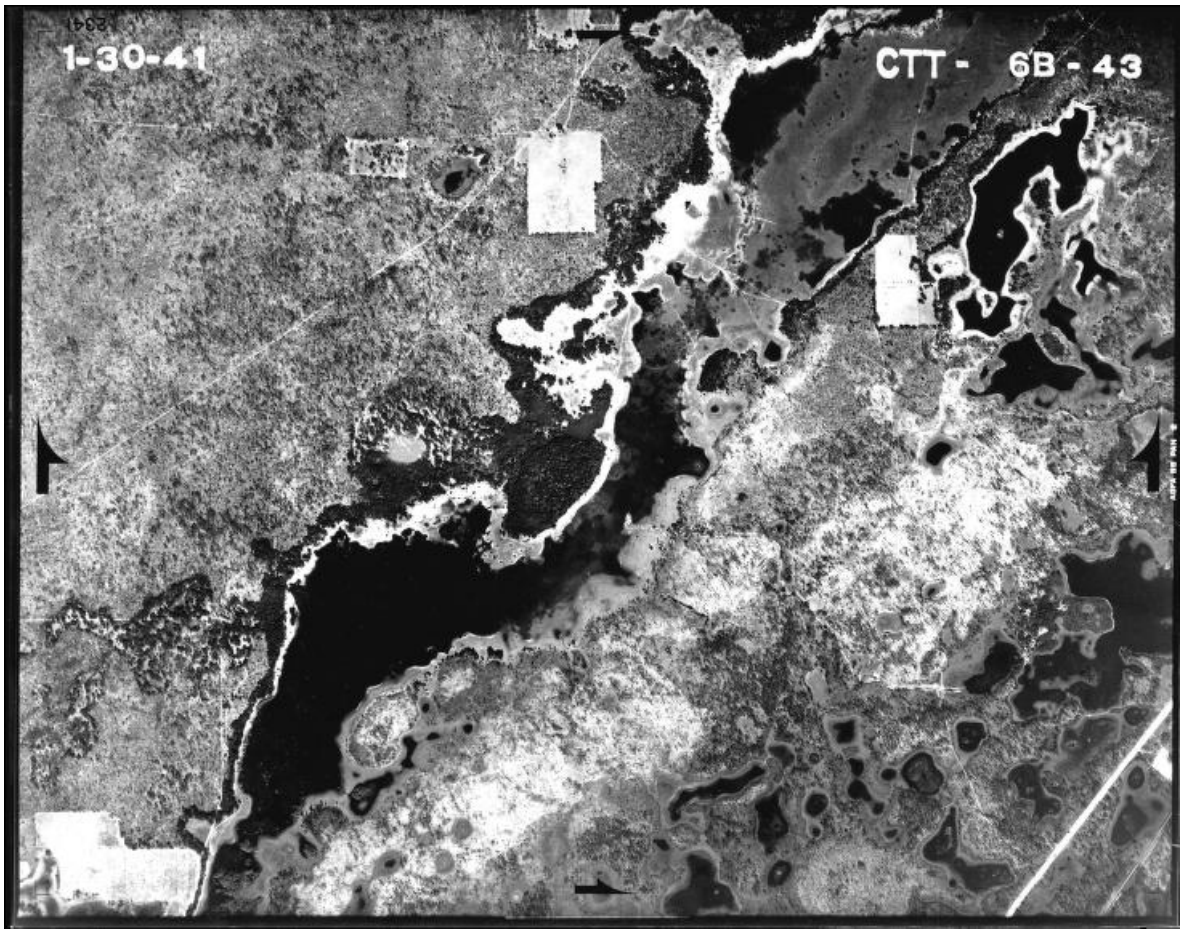


Figure 6. Aerial photograph of the northern portion of Crews Lake in March 1952 (USDA 1952b).

Figure 7. Aerial photograph of the southern portion of Crews Lake in March 1952 (USDA 1952c).

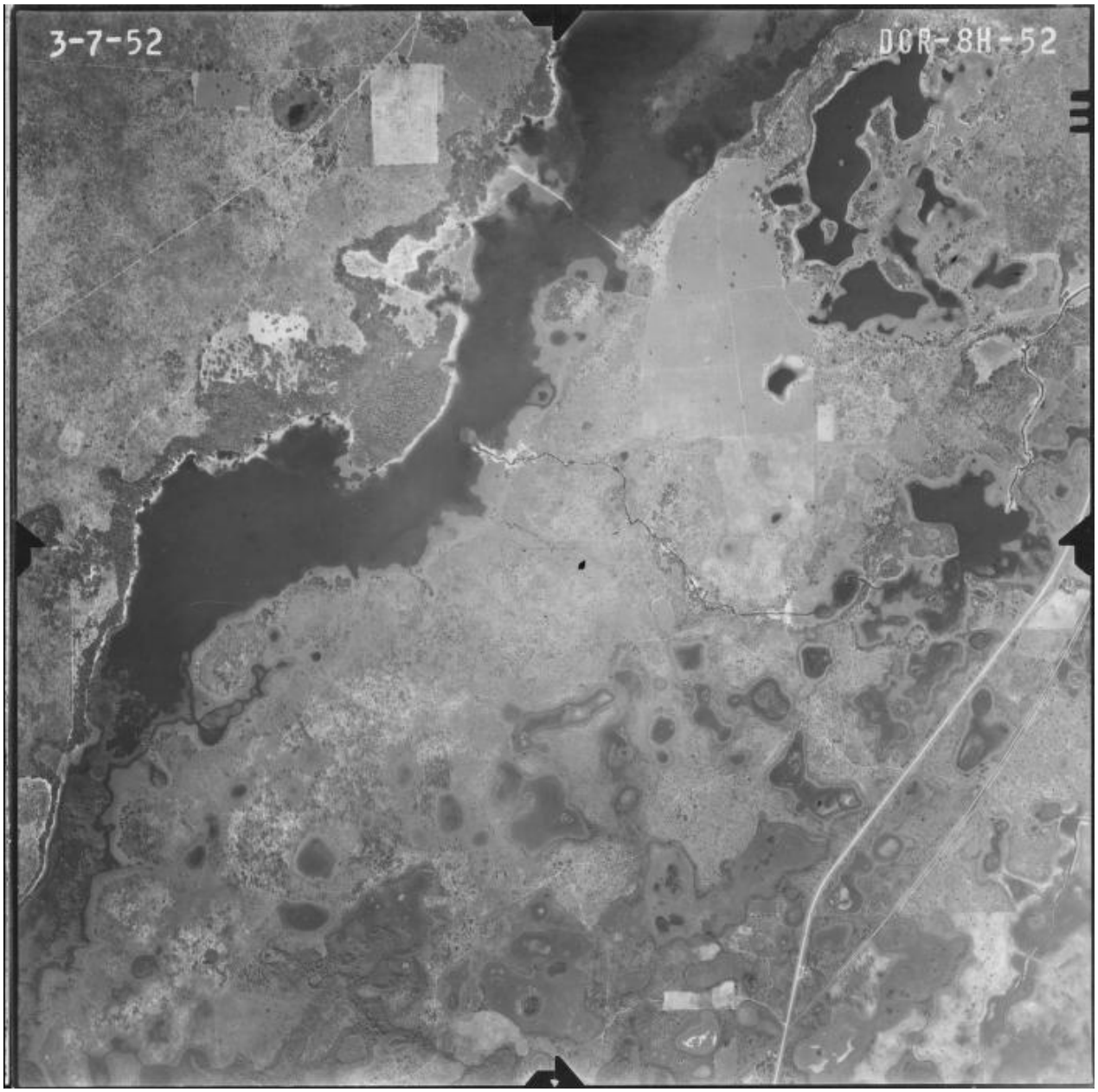


Figure 8. Aerial photograph of northern portion of Crews Lake in March 1957 (USDA 1957c).

Figure 9. Aerial photograph of the southern portion of Crews Lake in March 1957 (USDA 1957b).

Figure 10. Aerial photograph (looking northeast) of Crews Lake in 1967 (SWFWMD files).

Figure 11. Aerial photograph (looking east) of the northern portion of Crews Lake in 1969 (SWFWMD files).

Figure 12. Aerial photograph of Crews Lake in the 1973. Image is from Woolpert (2003).

Figure 13. Aerial photograph of Crews Lake in 1984. Image is from United States Geological Survey National High Altitude Aerial Photography (USGS 1984).

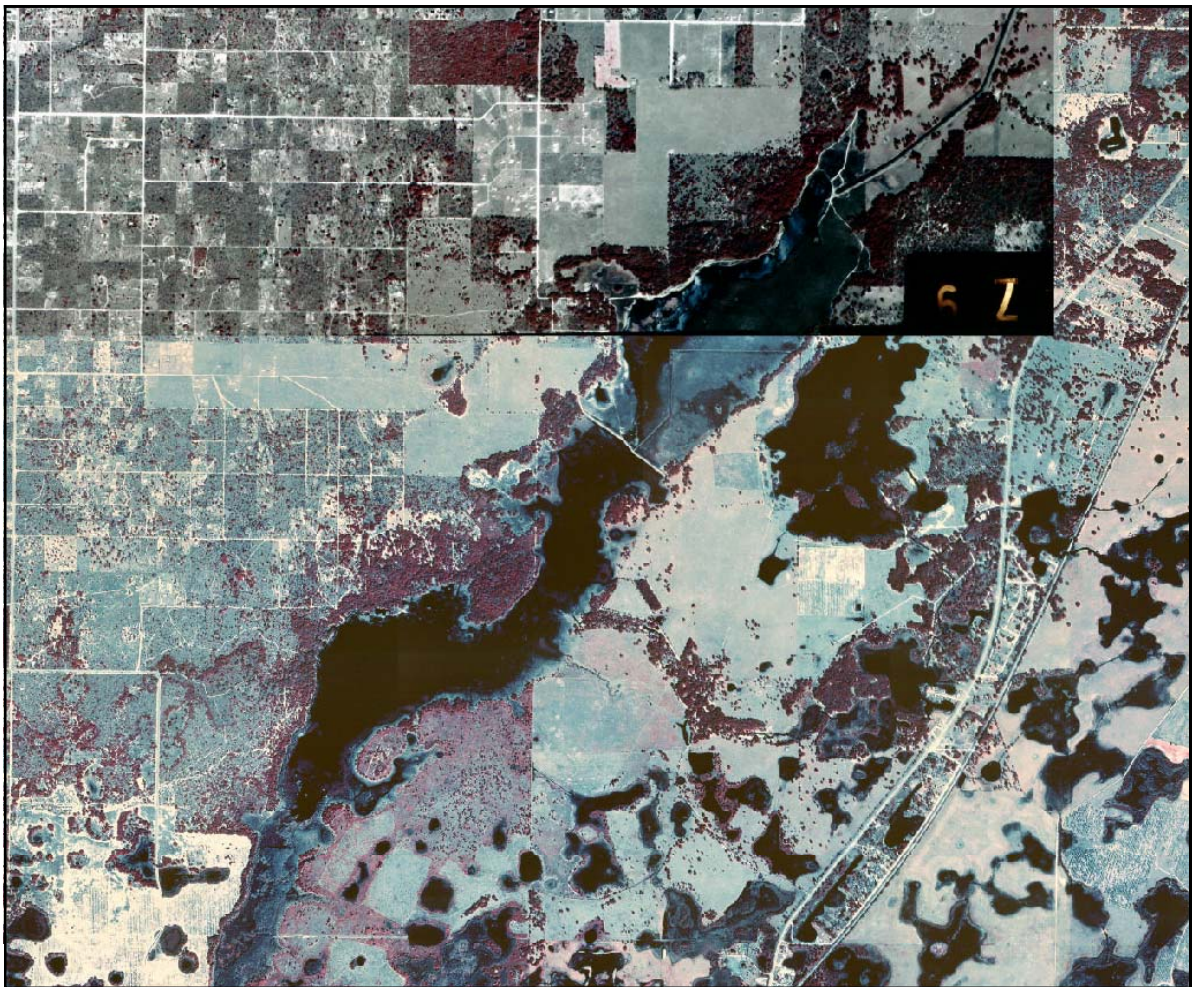


Figure 14. Aerial photograph of Crews Lake in 1994. Image is from United States Geological Survey digital orthophotography (USGS 1994).

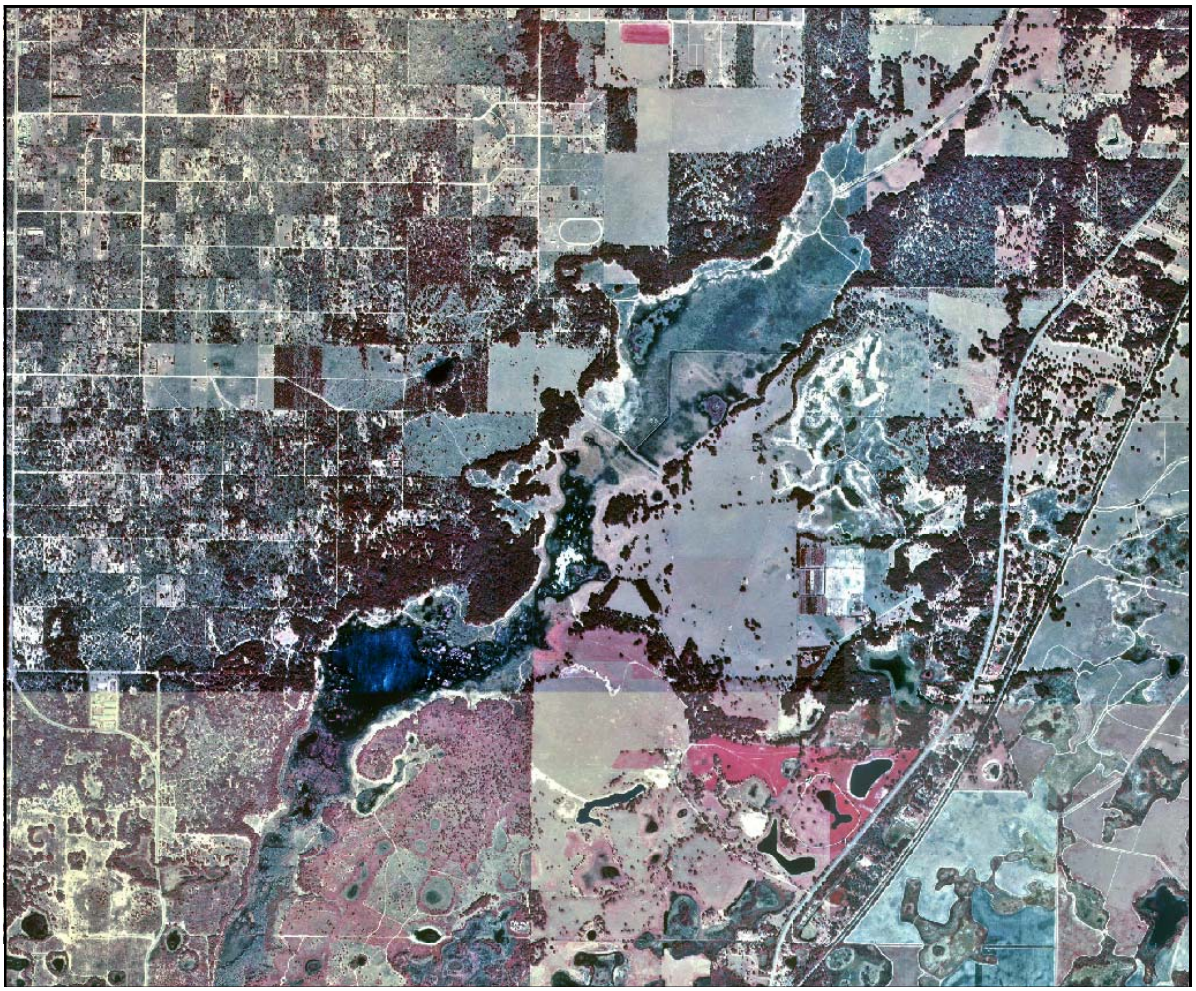


Figure 15. Aerial photograph (looking northwest) of the Crews Lake outlet in 1996 (SWFWMD files). This region marks the headwaters of the Pithlachascotee River.

Figure 16. Aerial photograph (looking southwest) of Crews Lake and the southern terminus of the Masaryktown Canal in 1998 (SWFWMD files).

Figure 17. Aerial photograph of Crews Lake in 1999. Image is from United States Geological Survey digital orthophotography (USGS 1999).

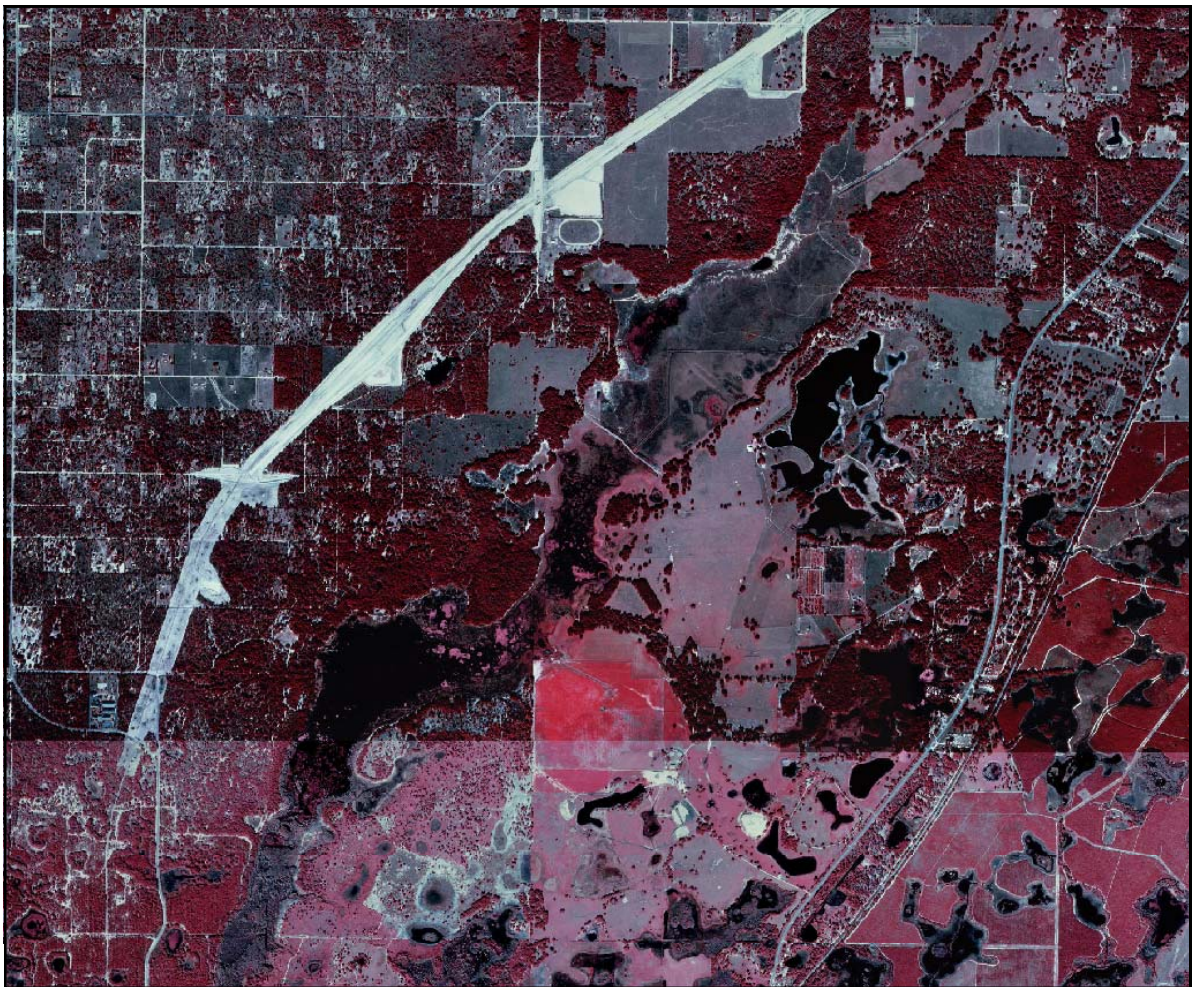


Figure 18. Aerial photograph (looking south) of Crews Lake in 2000. The fishing pier and observation tower in Crews Lake Wilderness Park are shown along the west shore of the lake basin (SWFWMD files).

Figure 19. Five-foot elevation (feet above NGVD) contours in the vicinity of Crews Lake as shown on United States Geological Survey 7.5 minute series topographic maps (USGS 1954a-d, 1988a-d). Image is from the U.S. Geological Survey 1:24,000 scale topographic map (DRG) layer available from the Mapping and GIS Section of the Southwest Florida Water Management District.

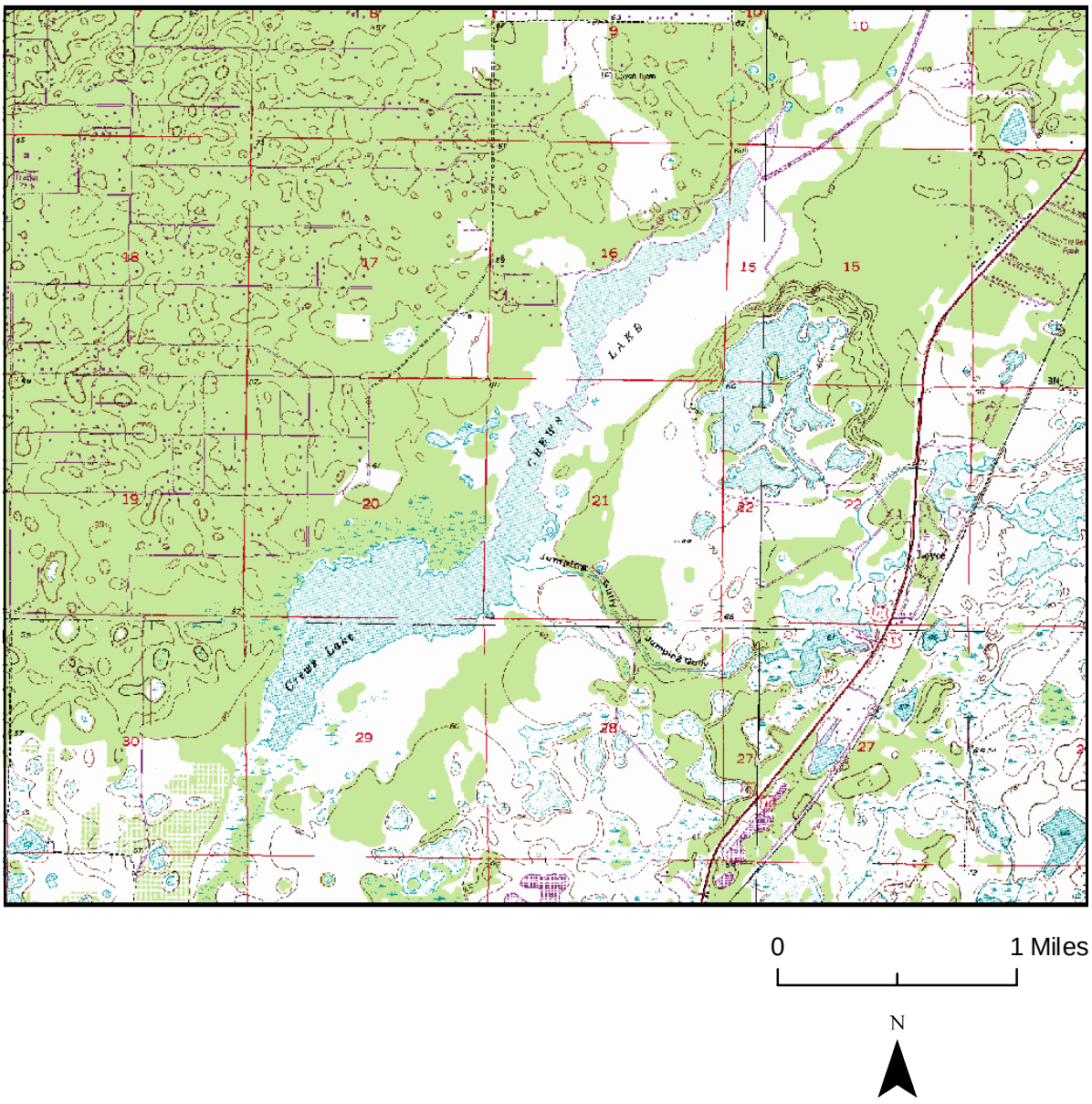
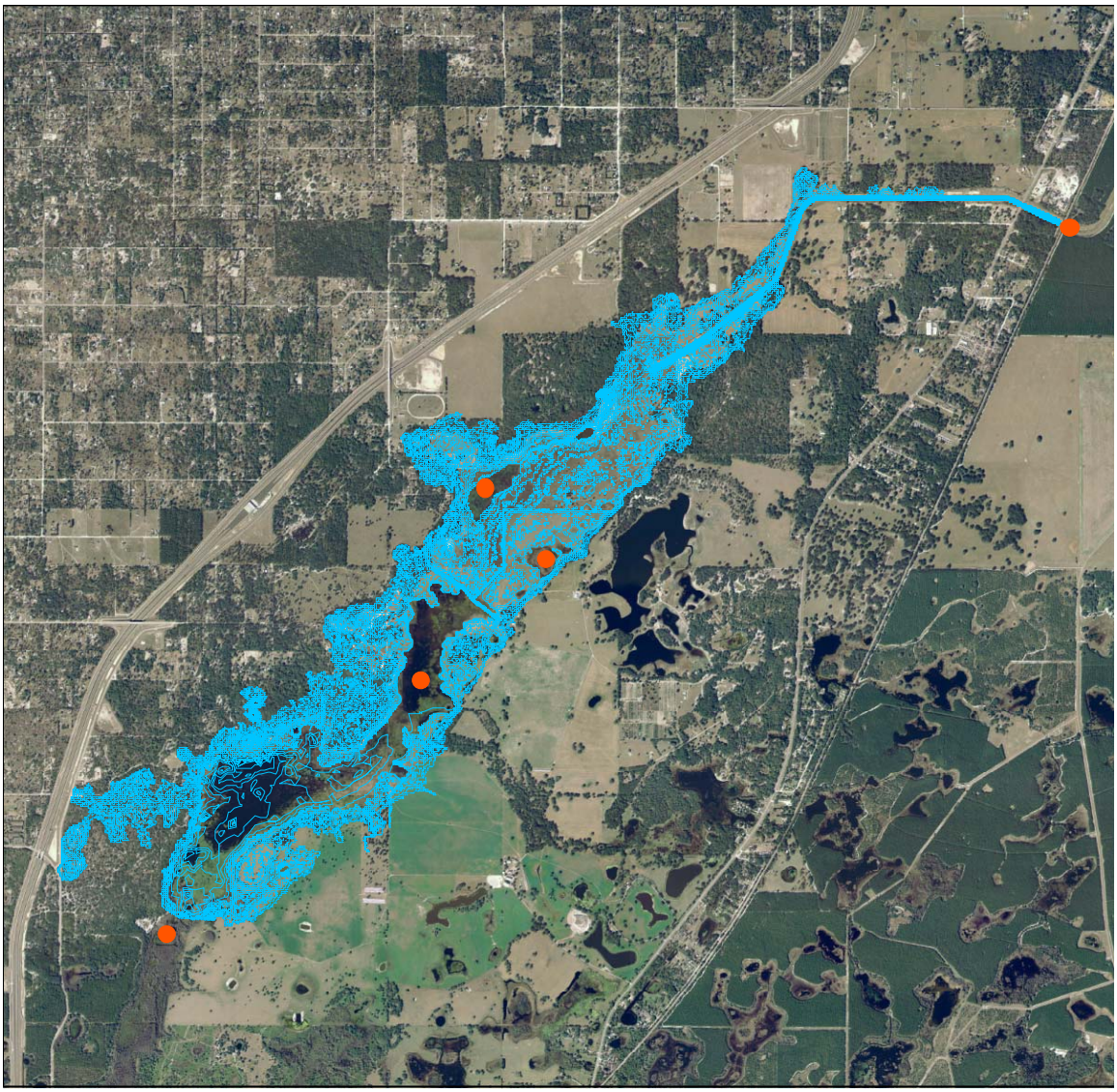


Figure 20. One-foot elevation contours (feet above NGVD) bounded by the 57-foot contour within the Crews Lake basin. Elevations of individual contour lines are not labeled to improve map clarity. Orange dots within the mapped area indicate regions where the lake bottom is lower than the lowest mapped contour but where spot elevation data were unavailable for map development. Orange dots at the periphery of the contour lines indicate regions where contour lines were truncated for mapping purposes.



Map prepared using spot elevation data collected by D.C. Johnson Associates in May 2005, LiDAR data collected by EarthData International, Inc. in 2004, and 2005 USGS digital orthophotography.

0 0.5 1 Miles

N

Currently 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 November 1984, the District adopted management levels (currently referred to as Guidance Levels) for Crews Lake and incorporated the levels into Chapter 40D-8, F.A.C. (Table 2). A Maximum Desirable Level of 54.50 feet above NGVD was also developed but was not adopted by rule. The adopted Guidance Levels and the Maximum Desirable Level were developed using a methodology that differs from the current District approach for establishing Minimum and Guidance Levels. The levels do not, therefore, necessarily correspond with levels developed using current methodologies. Upon adoption by the District Governing Board, Minimum and Guidance Levels developed using current methods will replace the existing Guidance Levels.

Annually since 1991, a list of stressed lakes has been developed to support the District's 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 Guidance 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. Crews Lake is included on the current Stressed Lakes List (Gant 2006) has been classified as a stressed lake since 1992.

Table 2. Currently adopted guidance Levels for Crews Lake.

Minimum and Guidance Levels	Elevation (feet above NGVD)
Ten Year Flood Guidance Level	57.00
High Level	55.00
Low Level	52.00
Extreme Low Level	50.00

Summary Data for Minimum and Guidance Level Development

Proposed Minimum and Guidance Levels were developed for Crews Lake using the methodology for Category 1 lakes described in Chapter 40D-8, F.A.C. Proposed 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. Proposed Minimum and Guidance Levels, lake stage exceedance percentiles, normal pool, control point elevation, significant change standards and associated surface areas for Crews Lake.

	Elevation (feet above NGVD)	Lake Area (acres)
Lake Stage Exceedance Percentiles		
Current P10	52.6	702
Current P50	50.2	411
Current P90	47.1	NA
Historic P10	54.9	1,069
Historic P50	51.4	523
Historic P90	48.5	205
Period of Record P10	53.6	865
Period of Record P50	51.2	500
Period of Record P90	47.6	NA
Other Levels		
Normal Pool	52.8	740
Control Point	54.1	942
Guidance Levels		
Ten Year Flood Guidance Level	58.2	NA
High Guidance Level	54.9	1,069
Low Guidance Level	48.5	NA
Significant Change Standards		
Cypress Standard	51.0	479
Basin Connectivity Standard*	55.7	1,177
Recreation/Ski Standard*	55.0	1,084
Species Richness Standard*	50.7	451
Wetland Offset*	50.6	443
Aesthetic Standard*	48.5	NA
Dock-Use Standard*	NA	NA
Lake Mixing Standard*	NA	NA
Minimum Levels		
High Minimum Lake Level	52.4	665
Minimum Lake Level	51.0	479

NA = not available or not applicable * = developed for comparative purposes only

Lake Stage Data and Exceedance Percentiles

Lake stage data, *i.e.,* surface water elevations, for Crews Lake (District Universal Identification Number STA 120 120) are available from the District Water Management Data Base from March 1964 through the present date (Figure 21, see Figure 2 for current location of the District water level gauge). The highest surface water elevation for the lake included in the database, 56.60 feet above NGVD, occurred on September 24 and October 3, 1964. Based on review of federal survey notes of the General Land Office, Wharton (1984b) estimates that Crews Lake was staged at approximately 55 feet above mean sea level in April 1847. Notes from this nineteenth century survey indicate that the lake level was "very high" at the time of the survey (Wharton 1984a). The low of record, 42.63 feet above NGVD, was recorded on April 16, 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 stage and regional ground water fluctuations, hydrologic data for Crews Lake collected after December 1984 were classified as Current data, and water level records collected prior to this date were considered to Historic data. The Current P10, *i.e.*, the water surface elevation equaled or exceeded ten percent of the time during the Current period, was 52.6 feet above NGVD. Current P50 and P90 elevations, which are water surface elevations equaled or exceeded fifty and ninety percent of the time, respectively, during the current period, were 50.2 and 47.1 feet above NGVD. Based on the relatively short "historic" period of record, measured Historic data were considered insufficient for calculating Historic lake-stage exceedance percentiles. Historic lake-stage exceedance percentiles were, instead, developed using a composite 56-year record of monthly mean lake surface elevations based on available stage records that were supplemented with modeled estimates. The 56-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 regional hydrologic variability (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 of organic correlation (see Helsel and Hirsch 1992). The procedure was used to describe the relationship between lake stage data for Jessamine Lake and potentiometric surface elevations for the Upper Floridan Aquifer system, as measured at the Sharpes Ferry West Floridan well site (District Universal Identification Number WEL 2555 1834; USGS Number 2911508592501) in Marion County. The line of organic correlation equation developed for the lake and well

data from March 1964 though December 1984 was used to estimate water surface elevation values for Crews Lake for the period from January 1946 through December 2002 (M. Hancock, SWFWMD unpublished data). A Historic, composite data set of monthly mean water surface elevations for Crews Lake was then developed using the modeled water surface elevations and available lake stage records (Figure 22). The composite record includes periods when estimated 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, 58.58 feet above NGVD, was estimated for October 1960.

The Historic P10 elevation, the elevation the lake water surface equaled or exceeded ten percent of the time during the 56-year historic period, was 54.9 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 51.4 feet above NGVD. The Historic P90, the elevation the lake water surface equaled or exceeded ninety percent of the time during the historic period, was 48.5 feet above NGVD. The Historic lake stage exceedance elevations are slightly higher than percentiles derived from the empirical data collected during the past 42 years. Period of record P10, P50 and P90 elevations are 53.6, 51.2 and 47.6 feet above NGVD, respectively.

Figure 21. Measured surface water elevations for Crews Lake through October 2006. Data were obtained from the District Water Management Database.

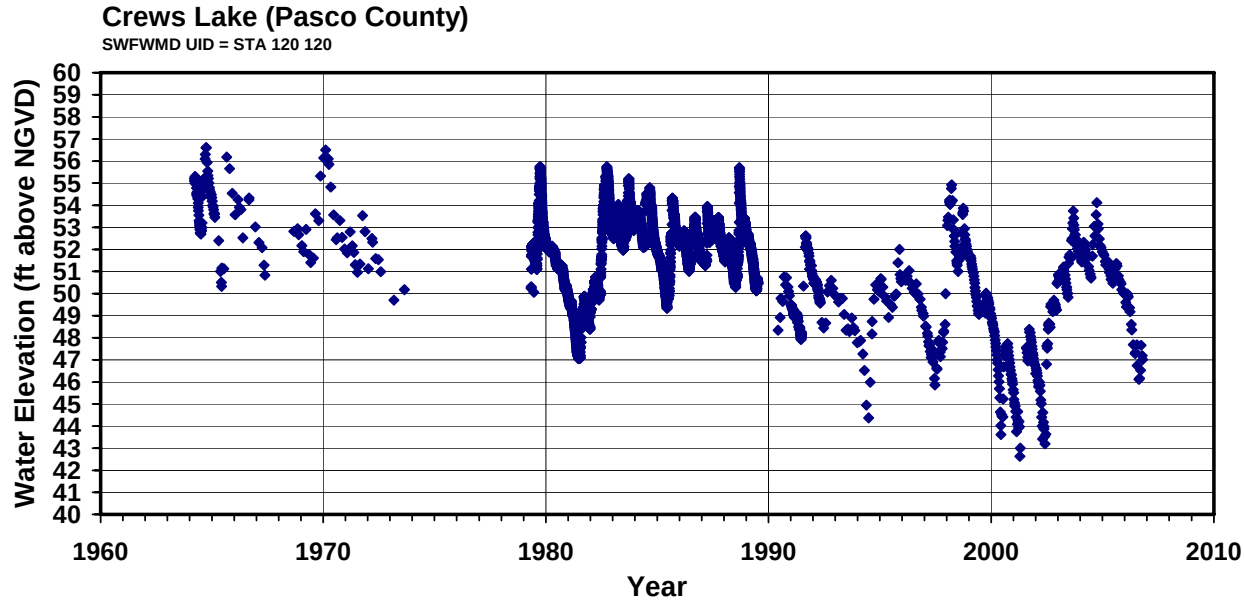
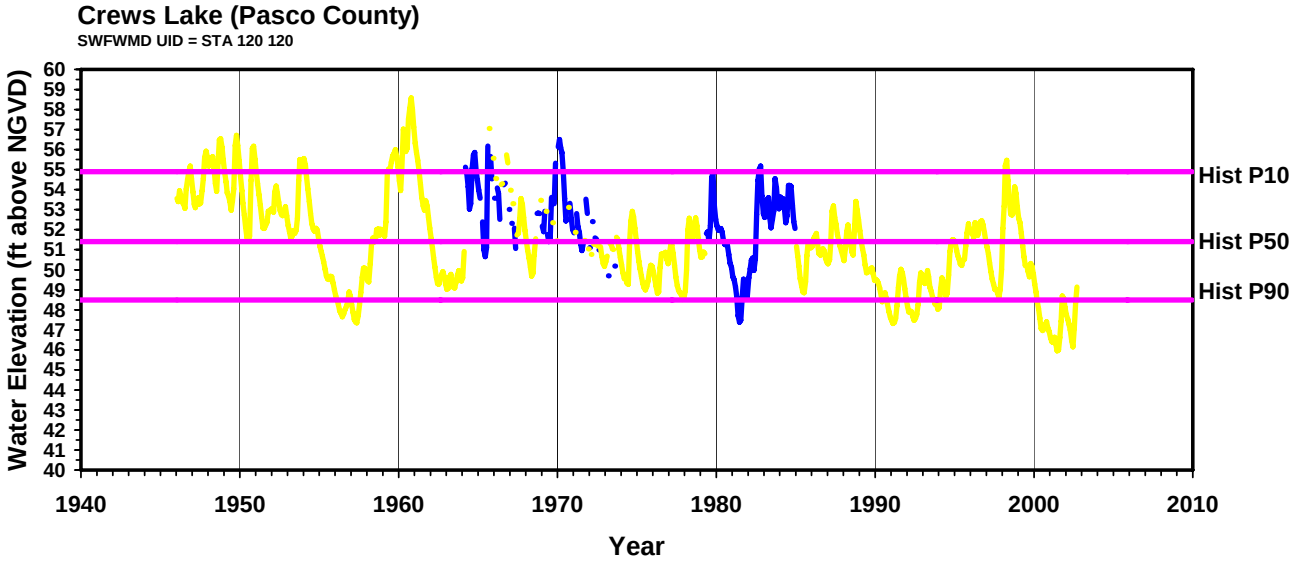


Figure 22. Composite monthly-mean surface water elevations and Historic lake-stage exceedance percentiles for Crews Lake, from January 1946 through September 2002. Composite data include values based on measured water surface elevations (blue) and modeled values (yellow). Historic exceedance percentiles 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 based on the distribution of Hydrologic Indicators of sustained inundation. Hydrologic indicators of Normal Pool include biological and physical features that become established as a result of recent or long-term water levels. For development of Minimum Lake Levels, the Normal pool elevation is considered an approximation of the Historic P10. Based on elevation of buttress inflection points measured on 31 cypress (*Taxodium* sp.) trees along the southwestern lakeshore, the Normal Pool elevation was established at 52.8 feet above NGVD (Table 4, Figures 2 and 23). The Normal Pool elevation is similar to the safe upland line of 52.0 feet above NGVD identified for the lake by the Florida Department of Environmental Protection, but is 2.6-2.7 feet lower than median ground elevations measured at the base of saw palmetto (*Serenoa repens*) shrubs and live oak (*Quercus virginian*a) trees (Table 5, Figure 24) populating the southwestern lakeshore.

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. Crews Lake was classified as an open basin lake because it receives inflow from the Masaryktown Canal and Jumping Gully, and is considered the headwaters of the Pithlachascotee River.

The Control Point elevation is the elevation of the highest stable point along the outlet profile of a surface water conveyance system (*e.g.,* 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 elevation is the lowest point on the portion of a water control structure that provides for conveyance of water across or through the structure. A crest elevation typically refers to the top or ridge of fixed-weirs or operable gates, over which water may flow. Based on review of available aerial photography with contours maps of the region (SWFWMD 1974a-f, 1978, 1982a,b), LiDAR data (EarthData International, Inc. 2004) and survey work completed for development of floodplain analyses for the Pithlachascotee River watershed (Ghiotto & Associates 1997), the control point elevation for Crews Lake was established at 54.1 feet above NGVD, at a high spot south of the lake in the wetlands associated with the Pithlachascotee River.

Structural alteration status is determined to support development of the High Guidance Level. Comparison of the control point elevation with the Normal Pool elevation 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. Although the Crews Lake basin has

been modified from it's presumed natural state (see Figures 2 through 18), based on the relative elevations of the Normal Pool and Control Point elevations, the lake was determined not to be Structurally Altered.

Table 4. Summary statistics for hydrologic indicator measurements (buttress inflection points of *Taxodium* sp. trees) used for establishing the Normal Pool Elevation for Crews Lake. Data were collected in February 2004 and July 2006 by District staff.

Statistic	Statistic Value (N) or Elevation (feet above NGVD)
N	31
Median	52.8
Mean (SD)	53.0 (0.7)
Minimum	51.7
Maximum	55.1

Table 5. Summary statistics for additional hydrologic indicator measurements (elevation at the base of *Serenoa repens* shrubs or *Quercus virginiana* trees) for Crews Lake. Data were collected in February 2004 and July 2006 by District staff.

Indicator	Statistic	Statistic Value (N) or Elevation (feet above NGVD)
Serenoa repens	N	52
	Median	55.5
	Mean (SD)	55.4 (0.6)
	Minimum	53.0
	Maximum	56.2
Quercus virginiana	N	19
	Median	55.4
	Mean (SD)	55.1 (0.8)
	Minimum	53.4
	Maximum	56.3

Figure 23. Cypress (*Taxodium* sp.) buttress inflection point elevations used to establish the Normal Pool elevation for Crews Lake.

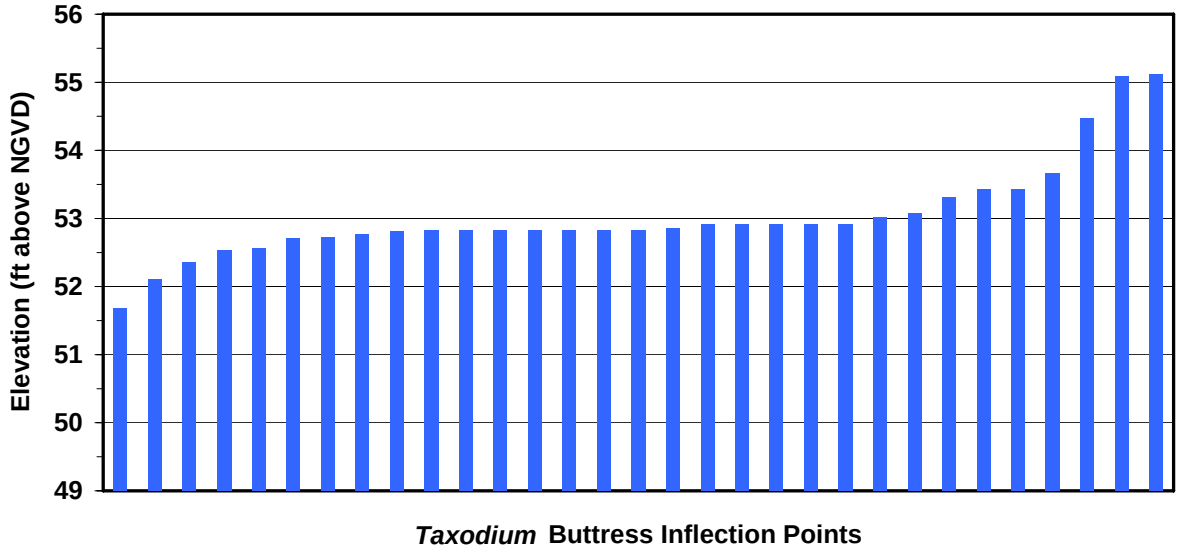
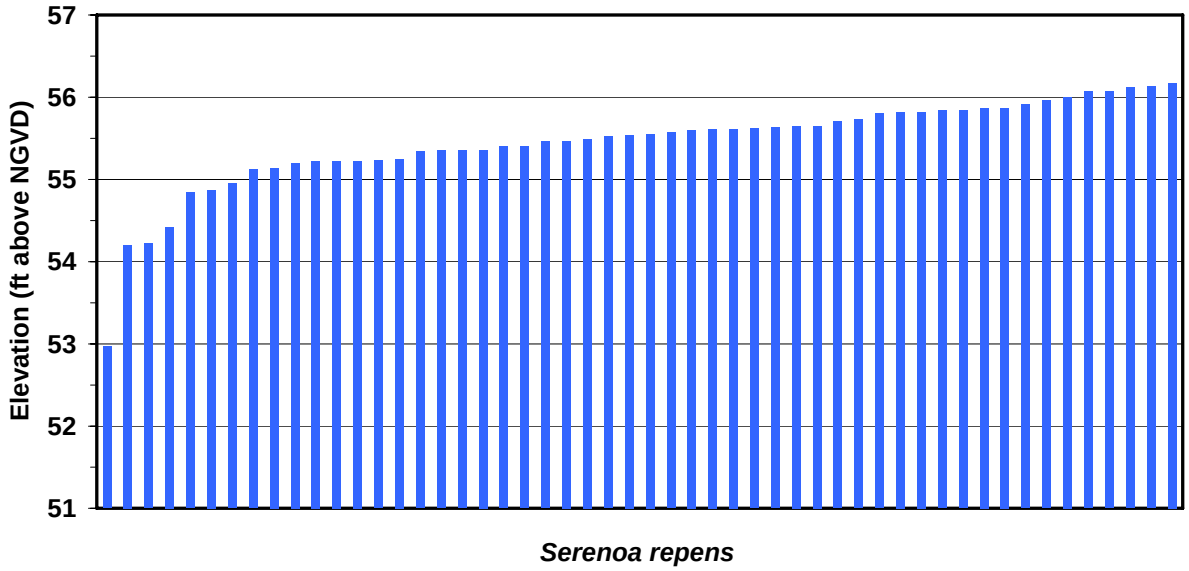
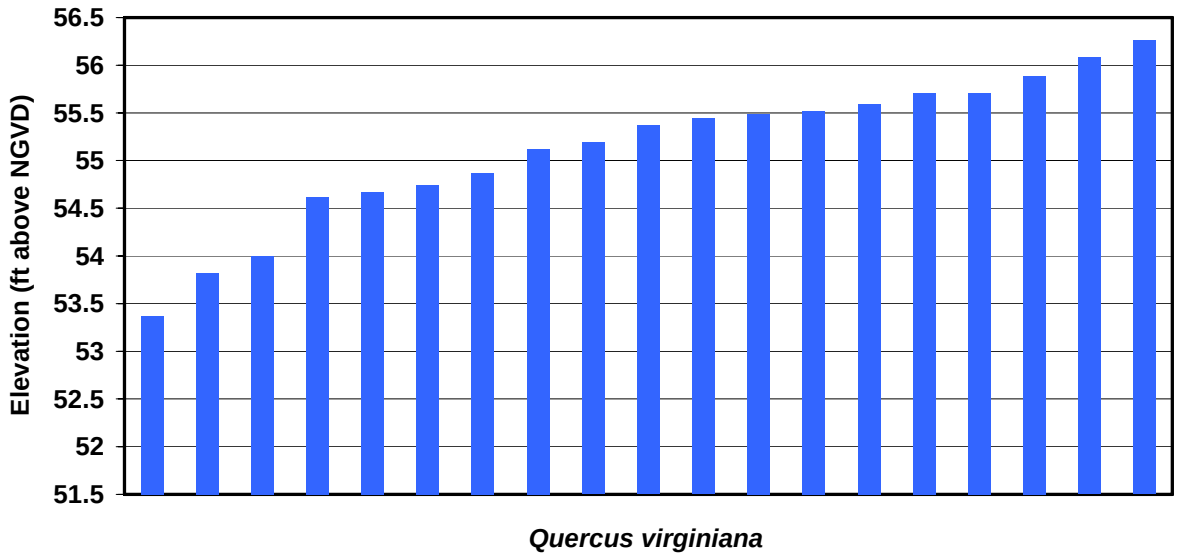


Figure 24. Ground elevations at the base of saw palmetto (*Serenoa repens*) shrubs (upper panel) and live oak (*Quercus virginiana*) trees (lower panel) near the margin of Crews Lake.





Proposed Guidance Levels

The Ten Year Flood Guidance Level is provided as an advisory guideline 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. The proposed Ten Year Flood Guidance Level for Crews Lake was established at 58.2 feet above NGVD using the methodology for open basin lakes described in current District Rules (Chapter 40D-8, F.A.C). Detailed information pertaining to development of the Ten Year Flood Guidance Level is currently being incorporated into a separate report on flood-stage frequencies for Crews Lake. The flood-stage frequency report will be cited and summarized in subsequent revisions of this report on proposed Minimum and Guidance Levels for Crews 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 the composite historic data set developed for Crews Lake, the High Guidance Level was established at the Historic P10 elevation, 54.9 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. Based on the Historic data set that was developed for Crews Lake, the Low Guidance Level was established at the Historic P90 elevation, 48.5 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, Crews 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 Crews Lake, the Cypress Standard was established at 51.0 feet above NGVD. The standard elevation was equaled or exceeded fifty-seven percent of the time during the Historic period; *i.e.*, the standard elevation corresponds to the Historic P57.

For Category 3 lakes, six significant change standards, including a Species Richness Standard, an Aesthetics Standard, a Lake Mixing Standard, a Recreation/Ski Standard, a Dock-Use Standard and a Basin Connectivity 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 Crews Lake is a Category 1 Lake, Category 3 Lake standards were developed for comparative purposes, but were not used to establish proposed Minimum Levels.

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 55.7 feet above NGVD, based on the elevation that ensures connectivity between the northern and southern sub-basins of the lake (51.8 feet above NGVD, the invert elevation of the culvert in the earthen berm that bisects the lake basin), a one-foot water depth in the area of connectivity to allow for movement of biota between the sub-basins, and the difference between the Historic P50 and Historic P90 elevations (2.9 feet). The standard elevation was equaled or exceeded only five percent of the time during the Historic period; *i.e.*, the standard elevation corresponds to the Historic P05.

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 Crews Lake, the Species Richness Standard was established at 50.7 feet above NGVD. The Species Richness Standard was equaled or exceeded sixty-one percent of the time during the Historic period; *i.e*., the standard elevation corresponds to the Historic P61.

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 Lake Iola occurs at an elevation of 48.5 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.

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. Because there are no docks currently located within the basin, a Dock-Use Standard was not developed for Crews Lake.

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 five-foot deep ski corridor delineated as a circular area with a radius of 418 ft, or a rectangular ski area 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 Crews Lake, the Recreation-Ski Standard was established at 55.0 feet above NGVD, based on the sum of the Ski Elevation (52.1 ft above NGVD) and the 2.9-foot difference between the Historic P50 and Historic P90. The standard elevation was equaled or exceeded nine percent of the time during the Historic period; *i.e*., the standard elevation corresponds to the Historic P09. Because the standard exceeds the Historic P50, it was not considered appropriate for Minimum Levels development. Also, based on the distribution of aquatic and wetland plants throughout most of the lake basin, it seems unlikely that Crews Lake is utilized for recreational skiing.

The Lake Mixing Standard is developed to prevent significant changes in patterns of wind-driven mixing of the lake water column and sediment re-suspension. 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. Data were not available for calculating dynamic

ratio values for the range of expected lake level fluctuations, so a Lake Mixing Standard was not developed for Crews Lake.

Herbaceous Wetland Information is taken into consideration to determine the elevation at which change in lake stage would result in substantial change in potential wetland area within the lake basin (*i.e*., basin area with a water depth of four or less feet). As of the date of this report, data were not available for determining the potential wetland area that would occur at the various Category 3 Lake significant change standards. Potential differences in herbaceous wetland area when the lake level is at the respective standard elevations versus the Historic P50 could not, therefore, be evaluated. However, based on the abundance of herbaceous wetlands within the lake basin, it was determined that an additional measure of wetland change could be evaluated 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 likely not lead to significant change in the herbaceous wetlands occurring within lake basins. A Wetland Offset elevation of 50.6 feet above NGVD was therefore established for Crews Lake by subtracting 0.8 feet from the Historic P50 elevation. The Wetland Offset elevation was equaled or exceeded sixty-three percent of the time during the Historic period; *i.e*., the standard elevation corresponds to the Historic P63.

Proposed 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 Level 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 proposed Minimum Lake Level for Crews Lake was therefore established at 51.0 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 proposed High Minimum Lake Level for Crews Lake was therefore established at 52.4 feet above NGVD.

Water surface elevations and the proposed minimum and guidance levels for Crews Lake are shown in Figure 25. Review of available data indicated that staging of the lake at the proposed minimum levels would not flood any man-made features within the immediate lake basin (see Figure 26 for the approximate lake margins when the water surface is at the proposed minimum levels). Based on recent field survey data (SWFWMD 2006), the proposed High Minimum Lake Level was found to be approximately 7.1 feet below the lowest residential home floor slab within the immediate lake basin, and about 5.1 feet below the floor slab of the public restroom located adjacent to the lakeshore in Crews Lake Wilderness Park (Table 6). Water depth at the bottom of the public boat ramp in the park would be approximately 3.3 and 1.9 feet, respectively, when the lake is staged at the proposed High Minimum Lake Level and Minimum Lake Level.

Figure 25. Mean monthly surface water elevation of Crews Lake through October 2006, and proposed Guidance and Minimum Levels. Proposed levels include the Ten Year Flood Guidance Level (10-YR), High Guidance Level (HGL), High Minimum Lake Level (HMLL), and Minimum Lake Level (MLL).

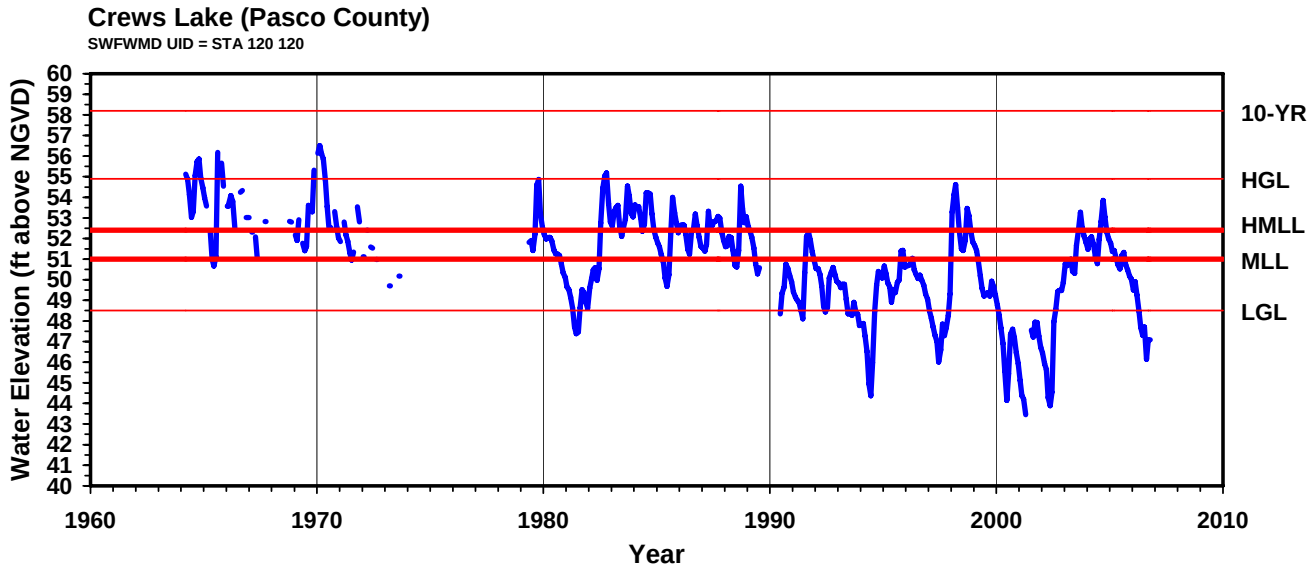
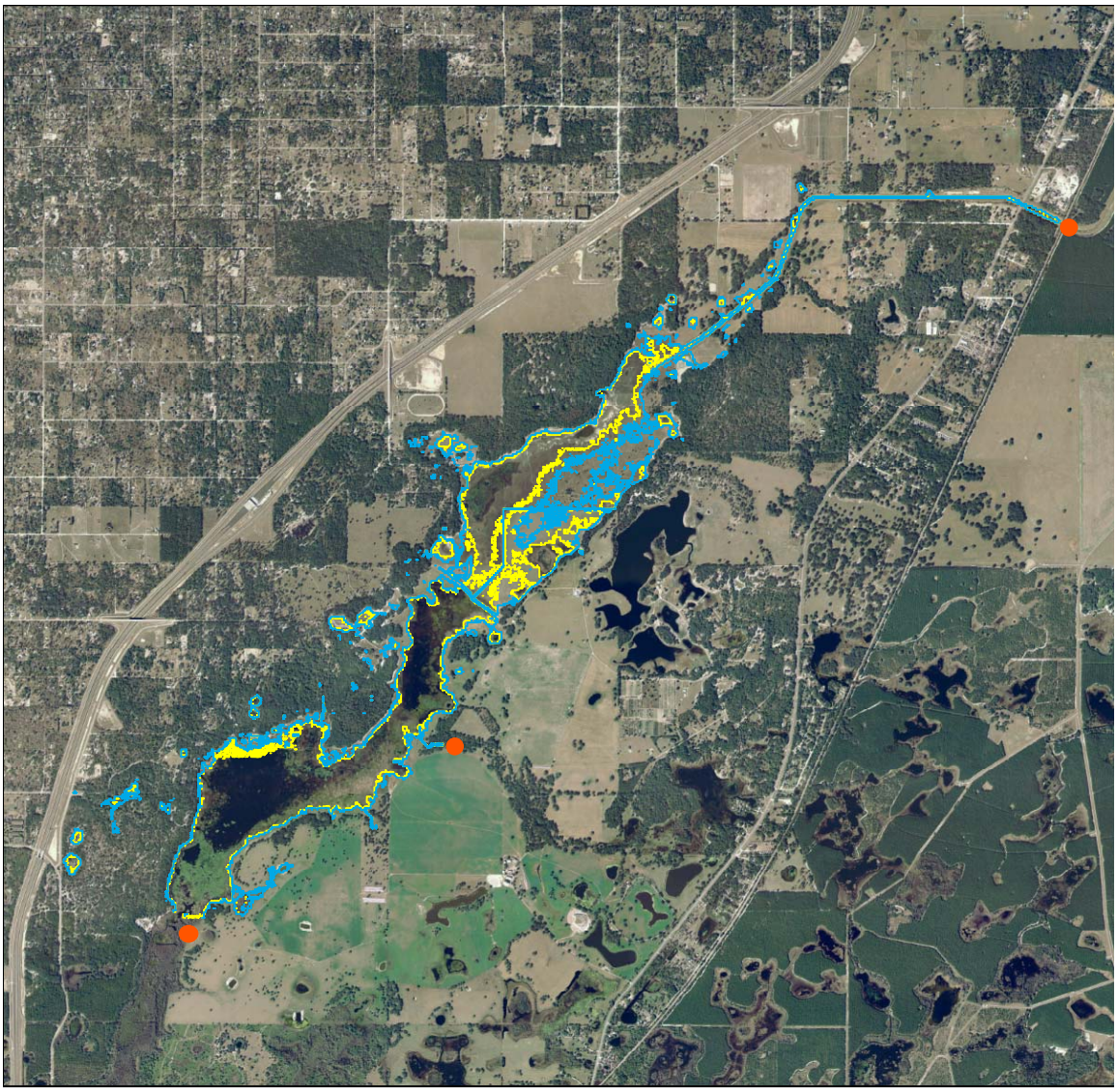


Table 6. Elevations of lake basin features in the immediate Crews Lake basin.

Lake Basin Features	Elevation (feet above NGVD)
Lowest floor slab – residential dwelling	59.50
Second lowest floor flab – residential dwelling	62.20
Concrete slab for picnic pavilions in Crews Lake Wilderness Park	57.62 & 58.45
Concrete slab for public restrooms in Crews Lake Wilderness Park	57.45
First floor of wooden observation tower in Crews Lake Wilderness Park	56.9
Platform of wooden boardwalk/fishing pier in Crews Lake Wilderness Park	54.9 – 55.4
Top/bottom of concrete boat ramp in Crews Lake Wilderness Park	54.2 / 49.1

Figure 26. Approximate location of the proposed Minimum Lake Level (MLL) and High Minimum Lake Level (HMLL) for Crews Lake. Orange dots indicate areas where elevation contours were truncated for mapping purposes.



Minimum Levels Contours

MLL = 51.0 feet above NGVD

HMLL = 52.4 feet above NGVD

0 0.5 1 Miles

N

Map prepared using spot elevation data collected by D.C. Johnson Associates in May 2005, LiDAR data collected by EarthData International, Inc. in 2004, and 2005 USGS digital orthophotography.

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