

**Minimum and Guidance Levels for
Crescent Lake
in Hillsborough County, Florida**



Draft – October 2004

Ecologic Evaluation Section

Resource Conservation and Development Department

Southwest Florida
Water Management District



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Proposed Minimum and Guidance Levels for Crescent 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 (MFLs) for lakes, wetlands, rivers and aquifers. As currently defined by statute, 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". Adoption of a minimum water level does not necessarily protect a water body from significant harm, however, protection, recovery or regulatory compliance can be gauged once a standard has been established.

Minimum flows and levels are to be established based upon the best available information and shall be developed with consideration of "...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, Florida Statutes). Additional guidance for the establishment of minimum flows and levels is provided in the Florida Water Resources Implementation Rule (Chapter 62-40.473, Florida Administrative Code; hereafter F.A.C.), which requires 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; j) and navigation."

To address this legislative mandate within its jurisdictional boundaries, the Southwest Florida Water Management District (District or SWFWMD) has developed methodologies for establishing minimum flows or levels for lakes, wetlands, rivers and aquifers, and adopted them into its Water Levels and Rates of Flow Rule (Chapter 40D-8, F.A.C). For lakes, specific methods are used to establish Minimum Levels based on the occurrence of lake-fringing cypress wetlands 0.5 acres or greater in size. 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 former levels are classified as Category 2 Lakes. Lakes without fringing cypress wetlands 0.5 acres or greater in size 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. 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 lake shore 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 lake shore 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 (P90) 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 (P10) 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 (P50) on a long-term basis.

The **Low Guidance Level** is provided as an advisory guideline for water dependent structures, information for lake shore 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 (P90) on a long-term basis.

In accordance with Chapter 40D-8, F.A.C., proposed Minimum and Guidance Levels were developed for Crescent Lake (Table 1), a Category 3 lake located in Hillsborough County, Florida. The levels were established using best available information, including field data that were obtained specifically for the purpose of Minimum Levels development.

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

| Minimum and Guidance Levels | Elevation (feet above NGVD) |
|-------------------------------|--------------------------------|
| Ten Year Flood Guidance Level | 43.4 |
| High Guidance Level | 41.9 |
| High Minimum Lake Level | 41.3 |
| Minimum Lake Level | 40.3 |
| Low Guidance Level | 39.8 |

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

Lake Setting and Description

Crescent Lake is located in Hillsborough County, Florida (Sections 3 and 10, Township 27 South, Range 17 East), in the Northwest Hillsborough River Basin of the Southwest Florida Water Management District (Figure 1). White (1970) classified the area of west-central Florida containing Crescent Lake as the Brooker Creek physiographic region. Brooks (1981) identified the area surrounding the lake as the Land-O-Lakes physiographic subdivision, and described the subdivision as a plain with elevations between 50 and 80 feet with many small lakes, despite the fact the silty sand overlying the limestone is moderately thick. As part of the Florida Department of Environmental Protection's Lake Bioassessment/Regionalization Initiative, the area has been identified as the Keystone Lakes region, and described as a small area of well-drained, sandy uplands, with slightly acidic, low nutrient, mostly clear water lakes (Griffith *et al.* 1997).

Crescent Lake lies within the Brooker Creek watershed and has a drainage area of 1.2 square miles (SWFWMD 1996). Three lakes flow into Crescent Lake. Lake Wastena discharges into the northeastern lake area, and Lakes Artillery and Fern discharge into the southeastern lobe of the lake through a forested wetland. Crescent Lake discharges to the south through a wetland and a District water control structure to Island Ford Lake. There are a number of permitted ground water withdrawals within the surrounding area, including those associated with the Eldridge Wilde and Cosme-Odessa Wellfields. There are no surface water withdrawals from the lake currently permitted by the District.

The 1974 (photorevised 1987) United States Geological Survey 1:24,000 Odessa, Fla. quadrangle map shows a surface water elevation of 42 ft above NGVD for Crescent Lake. The "Gazetteer of Florida Lakes" (Florida Board of Conservation 1969, Shafer *et al.* 1986) lists the lake elevation at 35 ft above NGVD with a surface area of 46 acres at this elevation. A topographic map of the lake basin generated in support of Minimum Levels development (Figure 3) indicates that the lake extends over 36 acres at an elevation of 35 ft above NGVD.

Medium density residential development and agricultural lands dominate the area surrounding Crescent Lake (Figure 2). Although development has altered some areas of the shoreline, the majority of the lake shore area remains in relatively natural condition. There is no public access to the lake. Wetland and aquatic vegetation observed along the shoreline and within the lake basin include, wax myrtle (*Myrica cerifera*), red maple (*Acer rubrum*), Brazillian pepper (*Schinus terebenthifolius*), Melaleuca (*Melaleuca quinquenervia*), cattail (*Typha* sp.), primrose willow (*Ludwigia* sp.), pennywort (*Hydrocotyle umbellata*), gum tree (*Nyssa* sp.), torpedo grass (*Panicum repens*), pickerelweed (*Pontederia cordata*), sword grass (*Scirpus cubensis*), spatterdock (*Nuphar luteum*), fragrant water lily (*Nymphaea odorata*), common salvinia

(*Salvinia rotundifolia*), water hyacinth (*Eichhornia crassipes*), swamp fern (*Blechnum serrulatum*), and arrowhead (*Sagittaria lancifolia*).

Figure 1. Location of Crescent Lake in Hillsborough County, Florida.

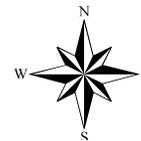
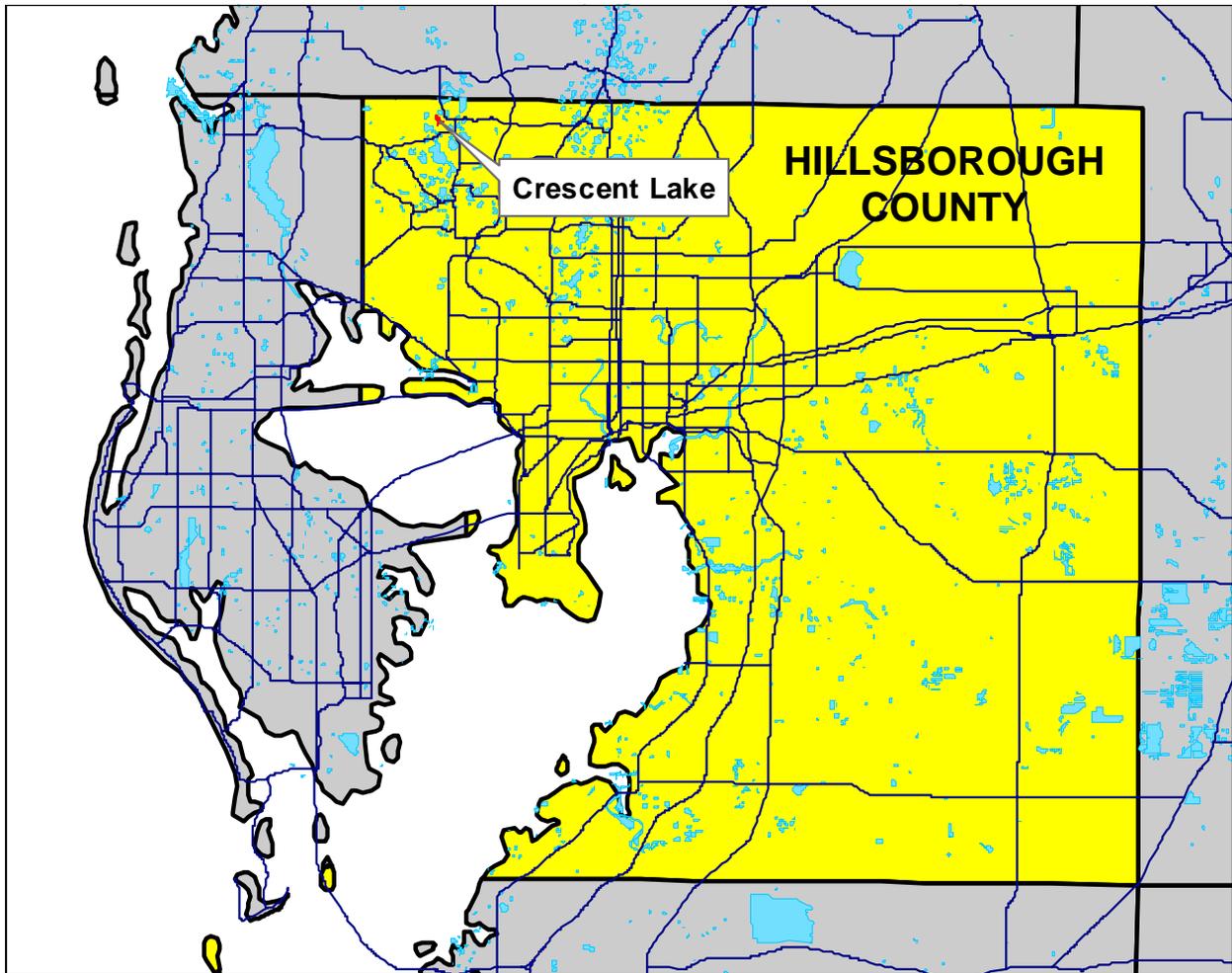
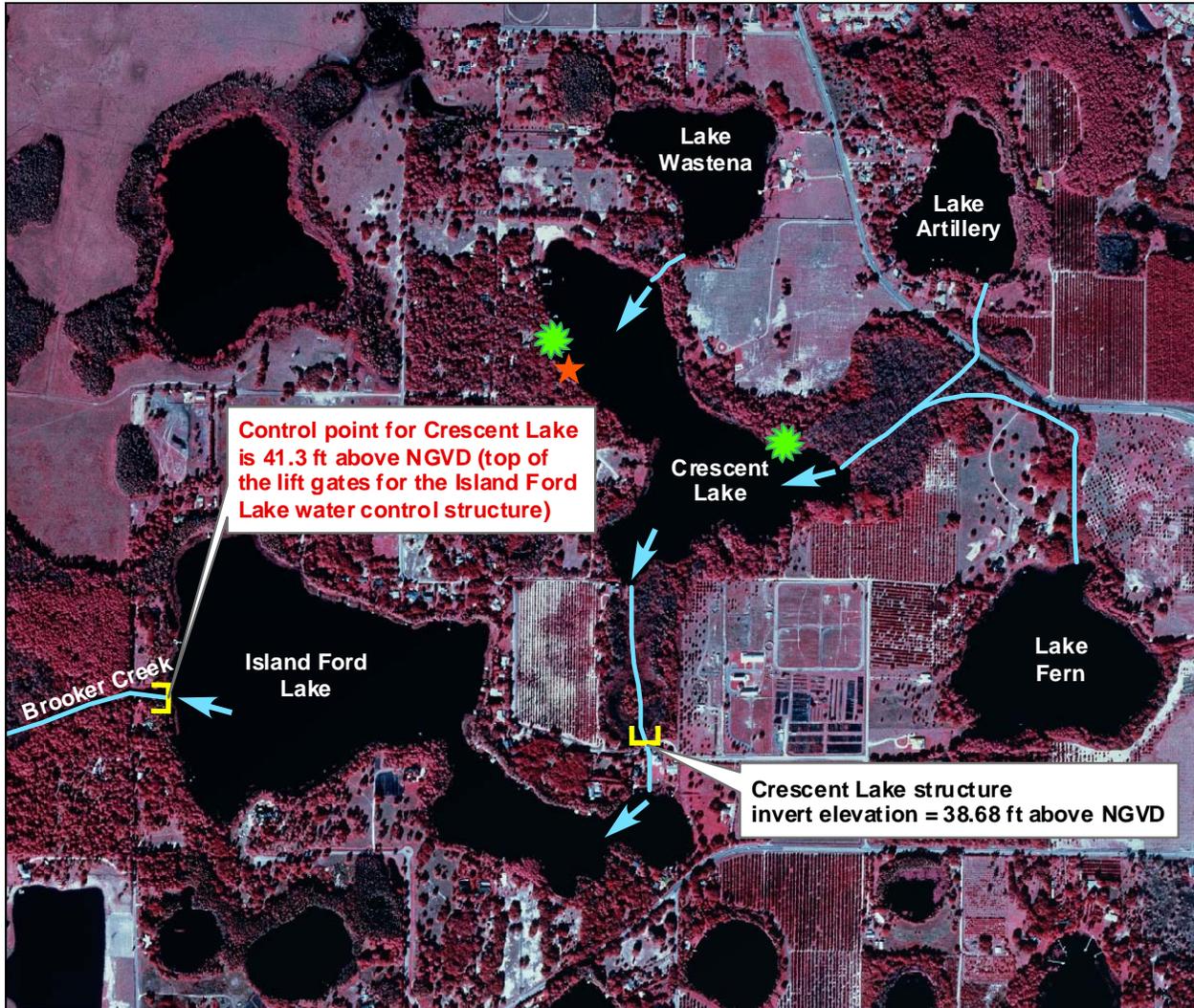
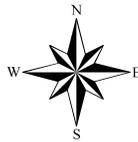


Figure 2. Location of lake water level gauge, hydrologic indicators, inlets, outlets, water control structures, and the control point for Crescent Lake.



Legend

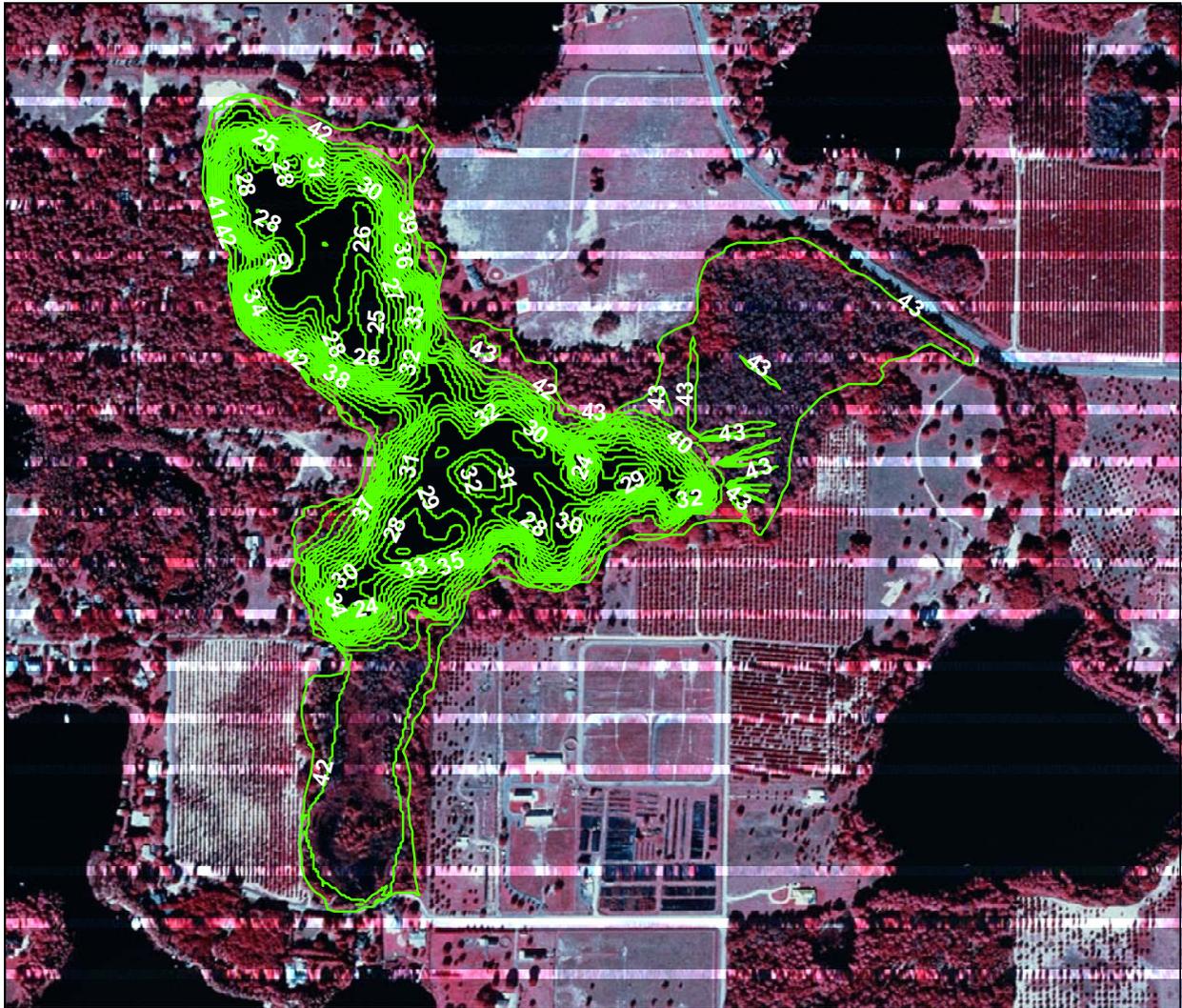
-  Staff gauge
-  Flow path
-  Inlets, outlets
-  Hydrologic indicators
-  Water control structure



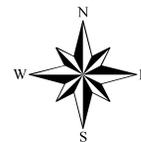
0 500 1,000 2,000 Feet

Map prepared using 1999 USGS digital orthophotography.

Figure 3. One foot contours within the Crescent Lake basin. Values shown are elevations in feet above the National Geodetic Vertical Datum of 1929.



Map prepared using 1999 USGS digital orthophotography, elevation data from 1989 SWFWMD aerial photography with contours maps (Sheet Nos. 3 and 10-27-17), and elevation data collected on October 2, 1998 by Hillsborough County Lake Management Program staff.



Currently Adopted Lake Guidance Levels

The 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 an initiative for establishing lake management levels based on hydrologic, biological, physical and cultural aspects of lake ecosystems. By 1996, management levels for nearly 400 lakes had been established.

Based on work conducted in the 1970s (see SWFWMD 1996), the District Governing Board adopted Guidance Levels for Crescent Lake in September 1980 (Table 2). A Maximum Desirable Level of 42.00 ft above NGVD was also developed, but was not adopted. The adopted Guidance Levels and 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. Minimum and Guidance Levels established during Minimum Levels development shall replace current Guidance Levels shown in Table 2 upon adoption by the District's Governing Board into 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 Chapter 40D-2, F.A.C., Consumptive Use of Water, "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, determination of stressed condition is determined on a case-by-case basis. Crescent Lake was listed as a stressed lake in 1995. It was later removed from the list in 1999 (Gant *et al.* 1999).

Table 2. Adopted Guidance Levels and associated surface areas for Crescent Lake.

| Management Levels | Elevation (feet above NGVD) | Lake Area (acres) |
|-------------------------------|--------------------------------|----------------------|
| Ten Year Flood Guidance Level | 44.20 | NA |
| High Level | 42.50 | 76 |
| Low Level | 40.00 | 55 |
| Extreme Low Level | 38.50 | 46 |

NA = not available/not applicable

Development of Minimum and Guidance Levels

Proposed Minimum and Guidance Levels for Crescent Lake were developed using the methodology for Category 3 lakes described in Chapter 40D-8, F.A.C. and best available information in accordance with Section 373.042, F.S. Additional information

gathered through field evaluations were also used. The levels and additional information are listed in Table 3, along with surface areas for each elevation. Detailed descriptions of the development and use of these data are provided in the remainder of this report.

Table 3. Proposed Minimum and Guidance Levels, Historic P50, lake stage percentiles, normal pool and control point elevations, and significant change standards for Crescent Lake.

| Levels | Elevation (feet above NGVD) | Lake Area (acres) |
|---|--|------------------------------|
| Lake Stage Percentiles | | |
| Current P10 | 41.90 | 58 |
| Current P50 | 39.58 | 50 |
| Current P90 | 37.20 | 42 |
| Other Levels | | |
| Normal Pool | 42.6 | 77 |
| Control Point | 41.3 | 56 |
| Guidance Levels and Historic P50 | | |
| Ten Year Flood Guidance Level | 43.4 | NA |
| High Guidance Level | 41.9 | 58 |
| Historic P50 | 40.9 | 54 |
| Low Guidance Level | 39.8 | 50 |
| Significant Change Standards | | |
| Dock-Use Standard | 40.3 | 52 |
| Aesthetics Standard | 39.8 | 50 |
| Recreation/Ski Standard | 39.1 | 48 |
| Species Richness Standard | 38.7 | 46 |
| Basin Connectivity Standard | 37.2 | 42 |
| Lake Mixing Standard | NA | NA |
| Minimum Levels | | |
| High Minimum Lake Level | 41.3 | 56 |
| Minimum Lake Level | 40.3 | 52 |

NA = not available/not applicable

Lake Stage Data and Percentiles

Lake stage data, *i.e.*, surface water elevations for Crescent Lake (District Universal ID Number STA 229 229) were obtained from the District Water Management Data Base. The period of record for the data extends from May 1981 through the present date (Figure 4, see Figure 2 for current location of the SWFWMD lake water level gauge). The highest surface water elevation for Crescent Lake recorded in the District Water Management Data Base, 42.45 ft above NGVD, occurred on September 15, 2003. The low of record, 35.34 ft above NGVD, occurred on June 26, 2001. Based on available lake stage data, monthly mean lake surface elevations were calculated and graphed (Figure 5).

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. 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. Historic lake stage data are not available for Crescent Lake because the lake occurs within an area where there are measurable impacts due to groundwater withdrawals (SWFWMD 1999). Lake stage data from January 1964 through the present date are classified as Current data for lakes affected by the draw-down of wellfields within this region.

Monthly mean lake surface elevations from January 1964 through December 2003 were used to calculate the **Current P10, P50, and P90** lake stage exceedance percentile elevations. The Current P10 elevation, the elevation the lake water surface equaled or exceeded ten percent of the time during the current period, was **41.90 ft above NGVD**. The Current P50 elevation, the elevation the lake water surface equaled or exceeded fifty percent of the time during the current period, was **39.58 ft above NGVD**. The Current P90 elevation, the elevation the lake water surface equaled or exceeded 90 percent of the time during the current period, was **37.20 ft above NGVD**.

Normal Pool and Control Point Elevations

The **Normal Pool** elevation, a reference elevation used for development of minimum lake and wetland levels, is established based on the elevation of Hydrologic Indicators of sustained inundation, including biological and physical features. Based on the median elevation of 14 saw palmetto (*Serenoa repens*) along the southeast and northwest shores of Crescent Lake, the Normal Pool elevation was established at **42.6 ft above NGVD** (Figure 2 and Table 4). The Normal Pool elevation is 0.7 ft higher than the Current P10 elevation.

Table 4. Summary data used for development of the Normal Pool elevation for Crescent Lake.

| Normal Pool Statistics | Elevations of 14 Saw Palmetto (feet above NGVD) |
|---------------------------|--|
| Mean (Standard Deviation) | 42.5 (0.21) |
| Median | 42.6 |
| Minimum | 42.2 |
| Maximum | 42.7 |

The **Control Point** elevation is defined as the highest stable point along the outlet profile of a surface water conveyance system (e.g., structure, ditch, culvert, or pipe) that principally controls lake water level fluctuations. Water discharges from Crescent Lake to Island Ford Lake through a wetland and a District water control structure consisting of a single slide gate attached to the headwall of an elliptical concrete culvert. Island Ford Lake discharges to Brooker Creek through a District water control structure that includes three lift gates. In the closed position, water discharges from the lake over the top of the lift gates. During times of high rainfall, the gates are lifted to allow greater flow through the structure. Because the Island Ford Lake water control structure ultimately controls water levels within Crescent Lake, the control point for Crescent Lake is the elevation of the top of the lift gates, **41.3 ft above NGVD** (Figure 2). Because the control point elevation is below the Normal Pool elevation, **Crescent Lake is considered to be Structurally Altered.**

Proposed Guidance Levels and the Historic P50

The **Ten Year Flood Guidance Level** is provided as an advisory guideline for lake shore 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 Ten Year Flood Guidance Level was established for Crescent Lake at **43.4 ft above NGVD** using the methodology for open basin lakes described in current District Rules (Chapter 40D-8, Florida Administrative Code). For the analysis, peak flood stages previously published by Hillsborough County were reviewed for accuracy. Evaluation of the 10 year flood elevation consisted of confirming model input data, reviewing the results of model runs for various storm events, and comparing the results to gauging records and high water mark data. Hillsborough County's published elevations were calculated with their modified version of the Environmental Protection Agency's Stormwater Management Model (SWMM), version 4.31Q, (Hillsborough County 1999). Model input was based on a 24-hour duration storm event with a 7 inch rainfall depth. Based on available lake stage data, the Ten Year Flood Guidance Level has not been exceeded (Figures 4 and 5). Although undocumented, a local resident estimated Crescent Lake reached a high water elevation of 45.0 ft above NGVD, probably in 1960 (SWFWMD 1981).

The **High Guidance Level** is provided as an advisory guideline for construction of lake shore development, water dependent structures, and operation of water management structures. The High Guidance Level is the expected Historic P10 of the lake. Because Historic data are not available for Crescent Lake, and the lake is Structurally Altered, the High Guidance Level was established at **41.9 ft above NGVD**, the higher of the Current P10 (41.90 ft above NGVD) and the Control Point (41.3 ft above NGVD) elevation.

The **Historic P50** elevation is the elevation that a lake's water levels are expected to equal or exceed fifty percent of the time on a long-term basis. It is derived to support development of minimum lake levels, and is established using Historic or Current data and, in some cases, reference lake water regime statistics. Reference lake water regime (RLWR) statistics are used to describe expected water level fluctuations for lakes that lack adequate Historic or Current data. The statistics include the RLWR50, RLWR5090, and RLWR90 and are derived using lake stage data for typical, regional lakes that exhibit little or no impacts from water withdrawals. Because Historic data are not available for Crescent Lake, and the difference between the Current P10 and the Current P50 (2.3 ft) is greater than the Northern Tampa Bay area RLWR50 (1.0 ft, SWFWMD 1999), the Historic P50 was established at **40.9 ft above NGVD** by subtracting the Northern Tampa Bay area RLWR50 from the High Guidance Level (41.9 ft above NGVD).

The **Low Guidance Level** is provided as an advisory guideline for water dependent structures, information for lake shore 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 (P90) on a long-term basis. Because Historic data are not available, and the difference between the Current P10 and the Current P90 (4.7 ft) is greater than the Northern Tampa Bay area Reference Lake Water Regime RLWR90 (2.1 ft, SWFWMD 1999), the Low Guidance Level was established at **39.8 ft above NGVD** by subtracting the Northern Tampa Bay area RLWR90 from the High Guidance Level (41.9 ft above NGVD).

Lake Categorization

Lakes are classified as Category 1, 2, or 3 for the purpose of Minimum Levels development. Those with fringing cypress wetlands greater than 0.5 acres in size where water levels currently rise to an elevation expected to fully maintain the integrity of the wetlands (*i.e.*, the Historic P50 is equal to or higher than the elevation 1.8 ft below the Normal Pool elevation) are classified as Category 1 lakes. Lakes with fringing wetlands greater than 0.5 acres in size that have been structurally altered such that the Historic P50 elevation is lower than the Cypress Standard, are classified as Category 2 lakes. Lakes without fringing cypress wetlands or with cypress wetlands less than 0.5 acres in size, are classified as Category 3 lakes. Because Crescent Lake does not have fringing cypress wetlands, the lake is classified as a **Category 3** 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 lakes in accordance with guidance provided in the Florida Water Resources Implementation Rule (Chapter 62-40.473, F.A.C.). Other information taken into consideration includes potential changes in the coverage of herbaceous wetland vegetation and aquatic plants.

For Category 3 lakes, six significant change standards are developed, 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. Potential changes in the coverage of herbaceous wetland vegetation and aquatic plants associated with use of standards for development of Minimum Levels for Category 3 lakes is also taken into consideration. Since Crescent Lake is a Category 3 lake, the applicable significant change standards were developed (Table 3) and evaluated with respect to potential changes in plant cover.

The **Dock-Use Standard** is developed to provide for sufficient water depth at the end of 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 clearance value for boat mooring, and use of Historic lake stage data or region-specific reference lake water regime statistics. Because Historic data are not available, the Dock-use Standard was established at **40.3 ft above NGVD** by adding a clearance value of 2 ft and the Northern Tampa Bay area RLWR5090 (1.1 ft, Leeper *et al.* 2001) to the elevation of sediments at the end of 90 percent of the 16 docks (37.2 ft) that were observed at the lake in May 2002 (Table 5).

Table 5. Summary statistics for elevations associated with docks (n = 16) at Crescent Lake. Percentiles (P10 and P90) represent elevations exceeded by 10 and 90 percent of the docks.

| Statistic | Elevation of Sediments at Waterward End of Docks (feet above NGVD) | Elevation of Dock Platforms (feet above NGVD) |
|------------------|---|--|
| Mean (SD) | 35.1 (2.1) | 43.1 (0.4) |
| P10 | 37.2 | 43.6 |
| P90 | 32.0 | 42.7 |
| Maximum | 38.5 | 43.7 |
| Minimum | 31.2 | 42.5 |

SD = Standard Deviation

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 below the values associated with the lake when it is staged at the Low Guidance Level. The Aesthetic Standard was established at the Low Guidance Level, which is **39.8 ft above NGVD**.

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 area 200 ft in width and 2,000 ft in length, and use of Historic lake stage data or region-specific reference lake water regime statistics. Because Historic data are not available, the Recreation/Ski Standard was established at **39.1 ft above NGVD**, based on the sum of the Ski elevation (38 ft above NGVD), and the Northern Tampa Bay area RLWR5090 (1.1 ft).

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 Florida lakes, the standard is established at the lowest elevation associated with less than a 15 percent reduction in lake surface area relative to the lake area at the Historic P50 elevation. The Species Richness Standard was established at **38.7 ft above NGVD**.

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 uses. The standard is based on the elevation of lake sediments at a critical high spot between lake basins or lake sub-basins, clearance values for movement of aquatic biota or powerboats and other watercraft, and use of Historic lake stage data or region-specific reference lake water regime statistics. Because Historic data are not available, the Basin Connectivity Standard was established at **37.2 ft above NGVD**, based on the sum of the critical high spot elevation (34.1 ft above NGVD), the clearance value for power boats and movement of biota (2 ft), and the Northern Tampa Bay area RLWR5090 (1.1 ft).

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 <0.8. Because the dynamic ratio does not shift across the 0.8 threshold, development of the Lake Mixing Standard is **not appropriate**.

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 less than or equal to four feet). Review of changes in potential herbaceous wetland area in relation to

change in lake stage did not indicate that there would be a significant increase or decrease in the area of herbaceous wetland vegetation associated with use of the applicable significant change standards (Figure 6).

Submersed Aquatic Macrophyte Information is taken into consideration to determine the elevation at which change in lake stage would result in substantial change in the area available for colonization by submersed aquatic plants. Review of the area available for submersed aquatic plant colonization in relation to change in lake stage did not indicate that there would be a significant increase or decrease in the area of submersed aquatic plant vegetation associated with use of the applicable standards (Figure 6).

Proposed Minimum Levels

The High Minimum Lake Level and the Minimum Lake Level are developed using lake-specific significant change standards, lake categorization, and other available information including substantial 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, and irrigation); surrounding land-uses; socio-economic effects; and public health, safety and welfare matters.

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 Minimum Lake Level for Category 3 Lakes is established at the elevation corresponding to the most conservative, *i.e.*, the standard with the highest elevation, except where that elevation is above the Historic P50 elevation, in which case, the Minimum Lake Level is established at the Historic P50 elevation. For Crescent Lake, the Minimum Lake Level was established at the Dock-Use Standard, **40.3 ft above NGVD**, the most conservative of the appropriate standards (Table 3, Figures 5 and 7). The water level equaled or exceeded fifty percent of the time (P50) over the past seven years was 1.1 ft below the Minimum Lake Level for Crescent Lake.

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. Because Crescent Lake is a Category 3 lake and Historic data are not available, the High Minimum Lake Level was established at **41.3 ft above NGVD**, an elevation corresponding to the Minimum Lake Level elevation plus the Northern Tampa Bay area RLWR50 (1.0 ft) (Table 3, Figures 5 and 7). The water level equaled or exceeded ten percent of the time (P10) over the past seven years was 0.7 ft above the High Minimum Lake Level for Crescent Lake.

Comparison of the High Minimum Lake Level with Lake Basin Features

Various man-made features occurring at relatively low elevations within the immediate Crescent Lake basin were surveyed to evaluate the potential for flooding when the lake surface is at the proposed High Minimum Lake Level. Based on review of available one-foot contour interval aerial maps for the region and field survey data, the proposed High Minimum Lake Level is 3.3 ft below a house on Crescent Road, 3.2 ft below a tiled patio at the same house, and 2.4 ft below the lowest spot on Crescent Road (Table 8).

Table 8. Elevations of lake basin features surrounding Crescent Lake.

| Lake Basin Features | Elevation (feet above NGVD) |
|----------------------------|--|
| Low Floor Slab (house) | 44.6 |
| Low Other (tiled patio) | 44.5 |
| Low Road (Crescent Road) | 43.7 |

Figure 4. Surface water elevations through December 2003 for Crescent Lake.

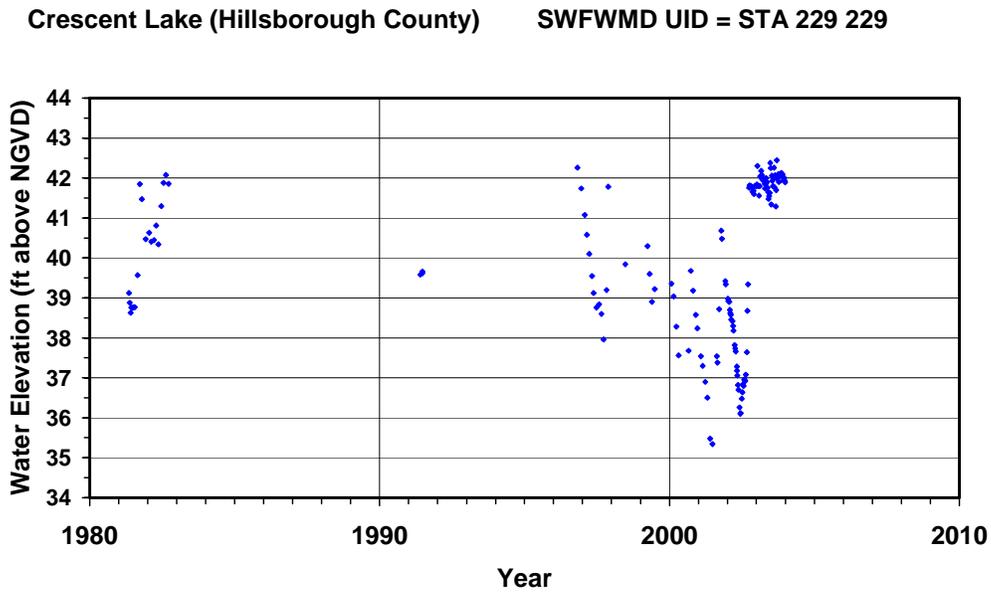


Figure 5. Mean monthly surface water elevations through December 2003, and proposed Guidance and Minimum Levels for Crescent Lake. Proposed levels include the Ten-Year Flood Guidance Level (10-YR), High Guidance Level (HGL), Low Guidance Level (LGL), High Minimum Lake Level (HMLL), and Minimum Lake Level (MLL).

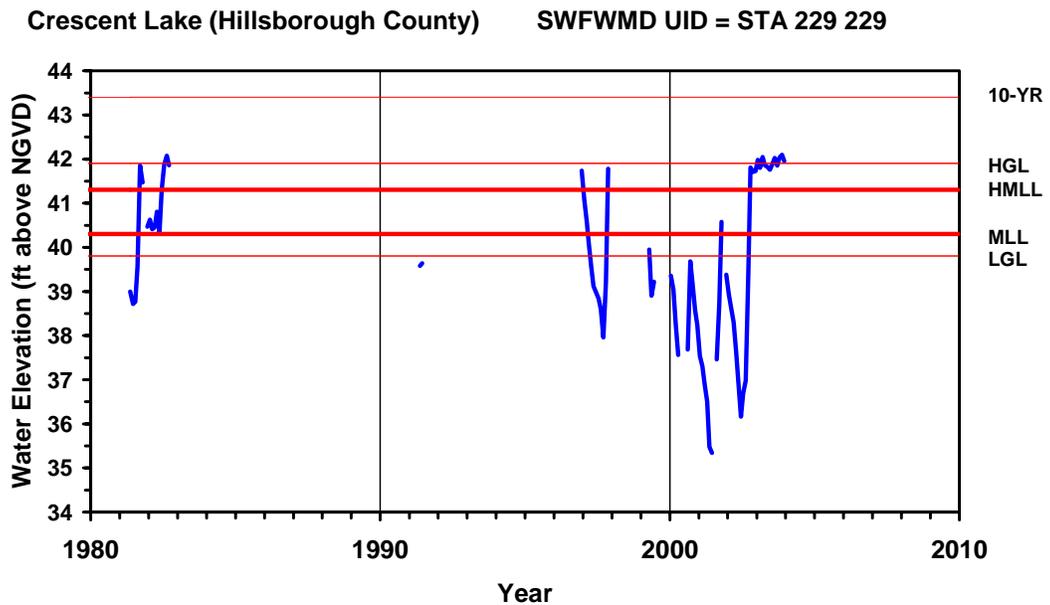


Figure 6. Surface area, volume, mean depth, dynamic ratio (basin slope), potential herbaceous wetland area, and potential aquatic macrophyte colonization area versus lake stage for Crescent Lake.

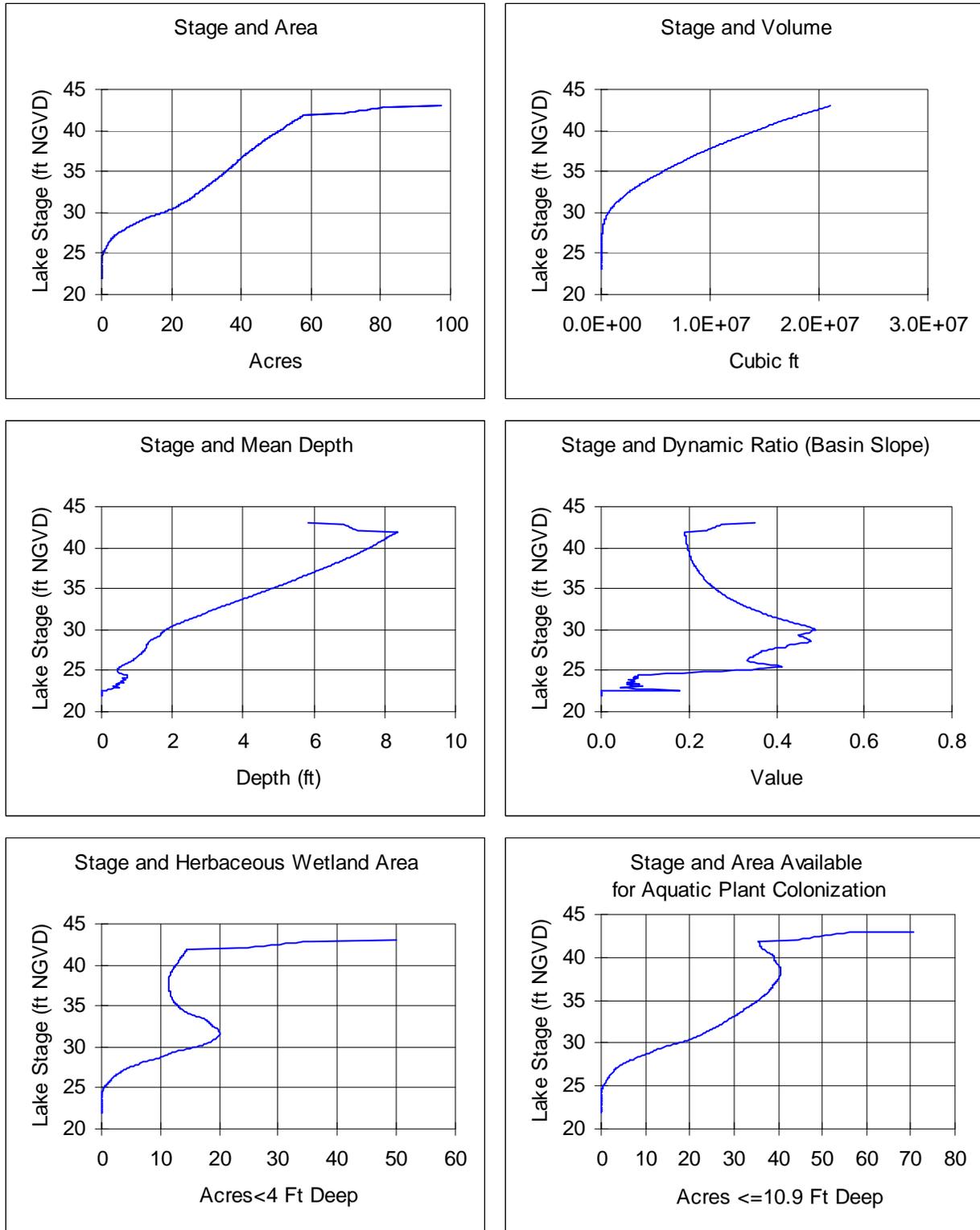


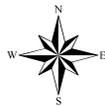
Figure 7. Approximate location of the proposed Minimum Lake Level (MLL) and High Minimum Lake Level (HMLL) for Crescent Lake.



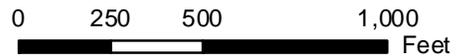
Legend

Crescent Minimum Levels

- 40.3 ft above NGVD = MLL
- 41.3 ft above NGVD = HMLL



Map prepared using 1999 USGS digital orthophotography, elevation data from 1989 SWFWMD aerial photography with contours maps (Sheet Nos. 3 and 10-27-17), and elevation data collected on October 2, 1998 by Hillsborough County Lake Management Program staff.



Documents Cited and Reviewed for Development of Proposed Minimum and Guidance Levels

Arnold, D. 2004. Memorandum – FY 2004 lakes 10-yr flood elevations. Southwest Florida Water Management District, Brooksville Florida.

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

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.

Cooke, C. W. 1939. "Scenery of Florida: interpreted by a geologist." Florida Geological Survey Bulletin No. 17.

Cowell, B. C., S. N. Young, *et al.* 1973. Aquatic insect survey of Upper Tampa Bay Watershed Project and Brooker Creek Watershed. Prepared for the Southwest Florida Water Management District, Brooksville, 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.

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

Florida Department of Agriculture and Consumer Services. 1938. Aerial photograph – Sections 2, 3, 10, and 11, Township 27 South, Range 17 East. Tallahassee, Florida.

Gant, R., D. Toole, and P. Meadors. 1999. Memorandum to Mario Cabana, John Parker, Brian Starford and Scott Laidlow, dated September 13, 1999, regarding the Historical List of Stressed Lakes. Southwest Florida Water Management District, Brooksville, Florida.

Gant, R., J. Hood, and D. Toole. 2004. Memorandum to Ralph Kerr, John Parker, Michael Balsler and Scott Laidlow, dated January 29, 2004, regarding the 2004 Stressed Lakes List. Southwest Florida Water Management District, Brooksville, Florida.

Griffith, G. E., D. E. Canfield Jr., C. A. Horsburgh, J. M. Omernik, and S. H. Azevedo. 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.

Hillsborough County. 1999. Hillsborough County Stormwater Management Model (SWMM), version 4.31Q. Modified from the Environmental Protection Agency's Stormwater Management Model.

Hillsborough County. 2004. Web site: Hillsborough Watershed Atlas. Lake Crescent. Developed by Hillsborough County, University of South Florida, Florida Center for Community Design + Research, and the Southwest Florida Water Management District.

Kucera International Photogrammetric Consultants. 1989. Aerial photography with contours. Northwest Hillsborough Basin, Northwest Re-Map II, Sheet Nos.: 3 and 10-27-17. Prepared for the 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, June 14, 2001 draft. Southwest Florida Water Management District, Brooksville, Florida.

Robertson, R. T. 1971. Water levels Northwest Hillsborough Basin. Southwest Florida Water Management District, Brooksville, Florida.

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

Solocheck, J. S. 2002. Lakes vs. lawns. St. Petersburg Times, Hernando Times Edition, St. Petersburg, Florida.

Southwest Florida Water Management District. 1973. Environmental assessment Upper Tampa Bay Watershed Hillsborough, Pasco and Pinellas Counties, Florida. Brooksville, Florida.

Southwest Florida Water Management District. 1981. An evaluation of lake regulatory stage levels on selected lakes in the Northwest Hillsborough Basin. Brooksville, Florida.

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

Southwest Florida Water Management District. 1991. Public facilities report, water control structures and facilities, Crescent Lake Structure. Brooksville, Florida.

Southwest Florida Water Management District. 1991. Public facilities report, water control structures and facilities, Island Ford Structure. Brooksville, Florida.

Southwest Florida Water Management District. 1996. Lake Levels Program lake data sheets / 1977-1996, Northwest Hillsborough River Basin – 14, Volume #2 – Lakes I thru Z. Brooksville, Florida.

Southwest Florida Water Management District. 1999. 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. 2001. Southwest Florida Water Management District, Structure Profile on the District water control facility, Crescent, water control structure, Northwest Hillsborough River Basin (14), Hillsborough County, February, 15, 2001. Brooksville, Florida.

Southwest Florida Water Management District. 2004. Survey Section Field Book 14/95, pages 37-63. Brooksville, Florida.

United States Geological Survey. 1943. Odessa quadrangle, Florida, 7.5 minute series (topographic) map, N2807.5-W8230/7.5, 1943, AMS 4440 II NE-Series V847. Department of Interior, Washington, D.C.

United States Geological Survey. 1974. Odessa quadrangle, Florida, 7.5 minute series (topographic) map, 28082-B5-TF-024, 1974, photorevised 1987, DMA 4440 II NE-Series V847. Department of Interior, Washington, D.C.

United States Geological Survey. 1981. Drainage areas of selected surface-water sites in Florida, by Donald W. Foote, Open-file report 81-482. Tallahassee, Florida.

Watson and Company. 1973. Lake Keystone water management study. Tampa, 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.