Minimum and Guidance Levels for Lake Placid in Highlands County, Florida

March 24, 2008

Ecologic Evaluation Section
Resource Projects Department

Southwest Florida
Water Management District

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On the cover: Lake Placid shoreline (image source: Southwest Florida Water Management District files).

Table of Contents

Minimum and Guidance Levels for Lake Placid

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 and revised (Leeper 2004, Southwest Florida Water Management District 2007a) for Lake Placid, a Category 3 Lake located in Highlands County, Florida. 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 Lake Placid.

Minimum and Guidance Levels	**Elevation (feet above NGVD)**
High Guidance Level	93.4
High Minimum Lake Level	92.6
Minimum Lake Level	91.4
Low Guidance Level	90.9

Data and Analyses Supporting Minimum and Guidance Levels for Lake Placid

Lake Setting and Description

Lake Placid (formerly known as Lake Childs) is located in central Highlands County, Florida (Sections 7, 18, 19, 20, 29, 30 31, Township 37 South, Range 30 East; Sections 13, 24, 25 and 36, Township 37 South, Range 29 East in the Peace River Basin of the Southwest Florida Water Management District (Figure 1). White (1970) classified the region of central or mid-peninsular Florida containing Lake Placid as the Intraridge Valley and the Lake Wales Ridge physiographic regions. Brooks (1981) categorized the area surrounding the lake as the Eastern Complex of the Central Ridge subdivision of the Lake Wales Ridge in the Central Lake Physiographic District, and described the region as an area of residual sandhills with numerous solution basins. As part of the Florida Department of Environmental Protection's Lake Bioassessment/Regionalization Initiative, the area has been identified as the Southern Lake Wales Ridge region (Griffith *et al.* 1997). Lakes in this region range from acidic to alkaline; most are clear-water, low color systems with low nutrient levels.

Uplands adjacent to Lake Placid have, for the most part, been cleared of native vegetation and are used for residential development or citrus production (Figure 2). Historical photographs from 1940 through 2006 (Figures 2-12) provide evidence for a long history of agriculture activity in the lake watershed. Natural vegetation remains intact along the south shore of the lake on state-owned land. The area, known as the Lake Placid Tract, is a component of the Lake Wales Ridge Wildlife Environmental Area and is managed by the Florida Fish and Wildlife Conservation Commission. Public access to the lake is available through the tract and at public boat ramps located on the west and northeast shores of the lake.

Common herbaceous wetland species within the basin include torpedograss (*Panicum repens*), maidencane (*Panicum hemitomon*), pickerelweed (*Pontedaria cordata*), primrose willow (*Ludwigia octovalvis*.), cattail (*Typha* sp.), rush fuirena (*Fuirena scirpoidea*), slender spikerush (*Eleocharis baldwinii*), duck potato (*Sagittaria lancifolia*), red root (*Lachnanthes caroliniana*), water pennywort (*Hydrocotyle umbellata*), bladderwort (*Utricularia* spp.) and various sedge species (Florida LAKEWATCH 1999). Wetland shrubs and trees within the basin include wax myrtle (*Myrica cerifera*), buttonbush (*Cephalanthus occidentalis*), willow (*Salix* spp.) and the invasive, exotic punk tree *(Melaleuca quinquenervia).*

The lake lies within the Lake Francis Outlet Drainage Basin of the Kissimmee River Watershed (United States Geological Survey Hydrologic Unit Classification System), and has a drainage area of 20.2 square miles (Florida Board of Conservation 1969, Foose 1981). An inlet along the south shore provides conveyance into the basin from Lake Annie (Figure 2). A second inlet drains into the basin along the southwestern lakeshore. Outlets from the lake have been extensively modified during the past century. Prior to 1930, an outlet along the northeast shore of the lake drained to Lake Huntley. This outlet system no longer conveys water out of the basin (Adams and Stoker 1985). Currently, a culvert system with an invert of 90.3 feet above NGVD along the north shore of the lake provides conveyance to Mirror Lake (Figure 13). At high lake stages, water typically flows from Lake Placid to Mirror Lake. Flow in the opposite direction may occur, however, depending on prevailing hydrologic conditions. Because Mirror Lake does not have a surface water outlet, losses from the basin through this outlet are restricted to evaporation, evapotranspiration and seepage. The primary surface water outlet for Lake Placid is located along the lake's west shore, where water drains to Lake June-In-Winter through Catfish Creek. Catfish Creek was dug in the 1930s to lower the surface of Lake Placid and was substantially modified in the late 1960s, when the channel was deepened and lateral canals were added to provide greater access to Lake June-In-Winter (Adams and Stoker 1985, Arnold 2002, Southwest Florida Water Management District 2003b). Currently, drainage into Catfish Creek is controlled by a water control structure (Figure 14) that was installed in 1965. At the structure site, water flows through up to four culverts under Placidview Drive when the lake surface elevation exceeds 93.1 ft above NGVD. Surface water withdrawals from the lake were common historically, but there are currently no District-permitted surface withdrawals. Currently, there are 46 permitted groundwater withdrawal points located within one mile of the lakeshore (Figure 15). The average daily permitted withdrawal volume for the points totals 3.95 million gallons per day.

The "Gazetteer of Florida Lakes" (Florida Board of Conservation 1969, Shafer *et al.* 1986) lists the size of Lake Placid as 3,320 acres. The 1952 and 1972 photorevised United States Geological Survey 1:24,000 Lake Placid quadrangle 7.5 minute topographic map includes an elevation of 92 ft above NGVD for the lake surface (Figure 16). A topographic map of the basin generated in support of minimum levels development (Figure 17) indicates that the lake extends over 3,436 acres when it is staged at 92 ft above NGVD. Lake water surface elevations are currently monitored at District-maintained gauge sites located along the north and northwest shores of the lake. The United States Geological Survey also maintains a water level gauging station at the lake.

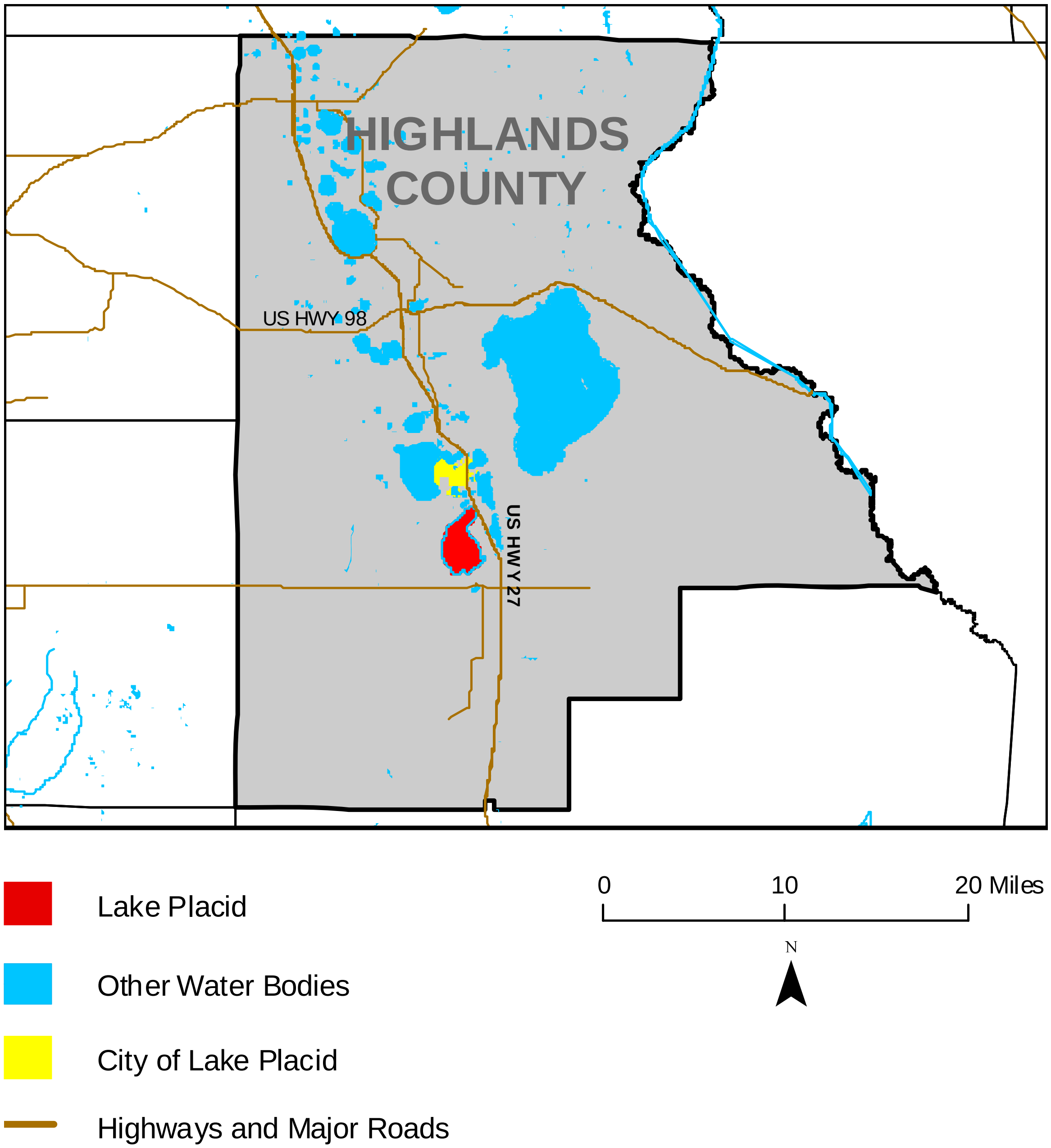


Figure 1. Location of Lake Placid, other regional water bodies, the City of Lake Placid, and highways/major roads in and around Highlands County, Florida.

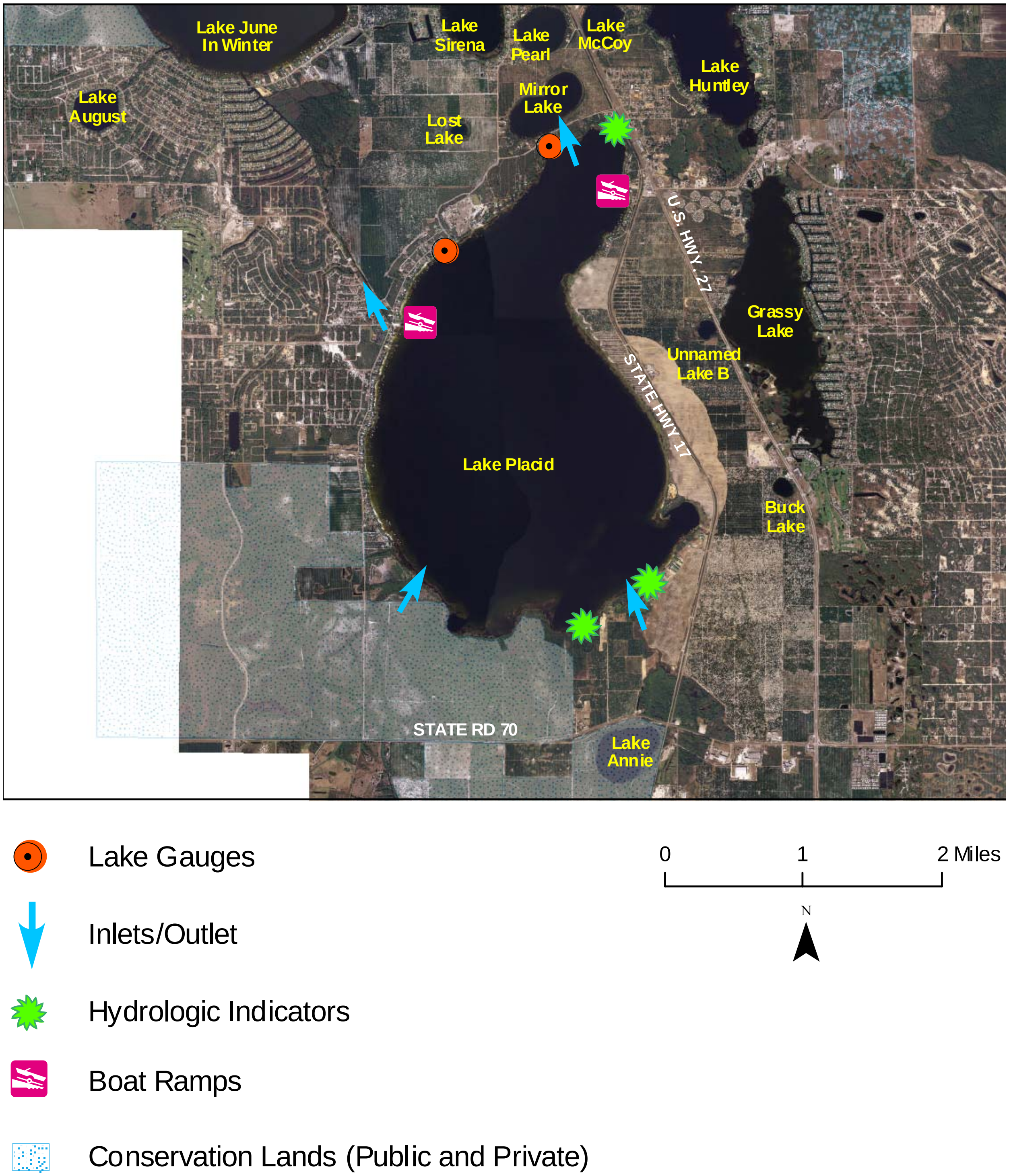


Figure 2. Aerial photograph (image source: 3001, Inc. 2006) of Lake Placid in 2006 showing the location of District lake-level gauges, inlets, outlets, boat ramps, sites where hydrologic indicators were measured, and conservation lands in the lake vicinity.

Figure 3. Aerial photography of Lake Placid in 2004 (image source: EarthData International 2004).

Figure 4. Aerial infrared photography of Lake Placid in 1999 (image source: Southwest Florida Water Management District 2002a).

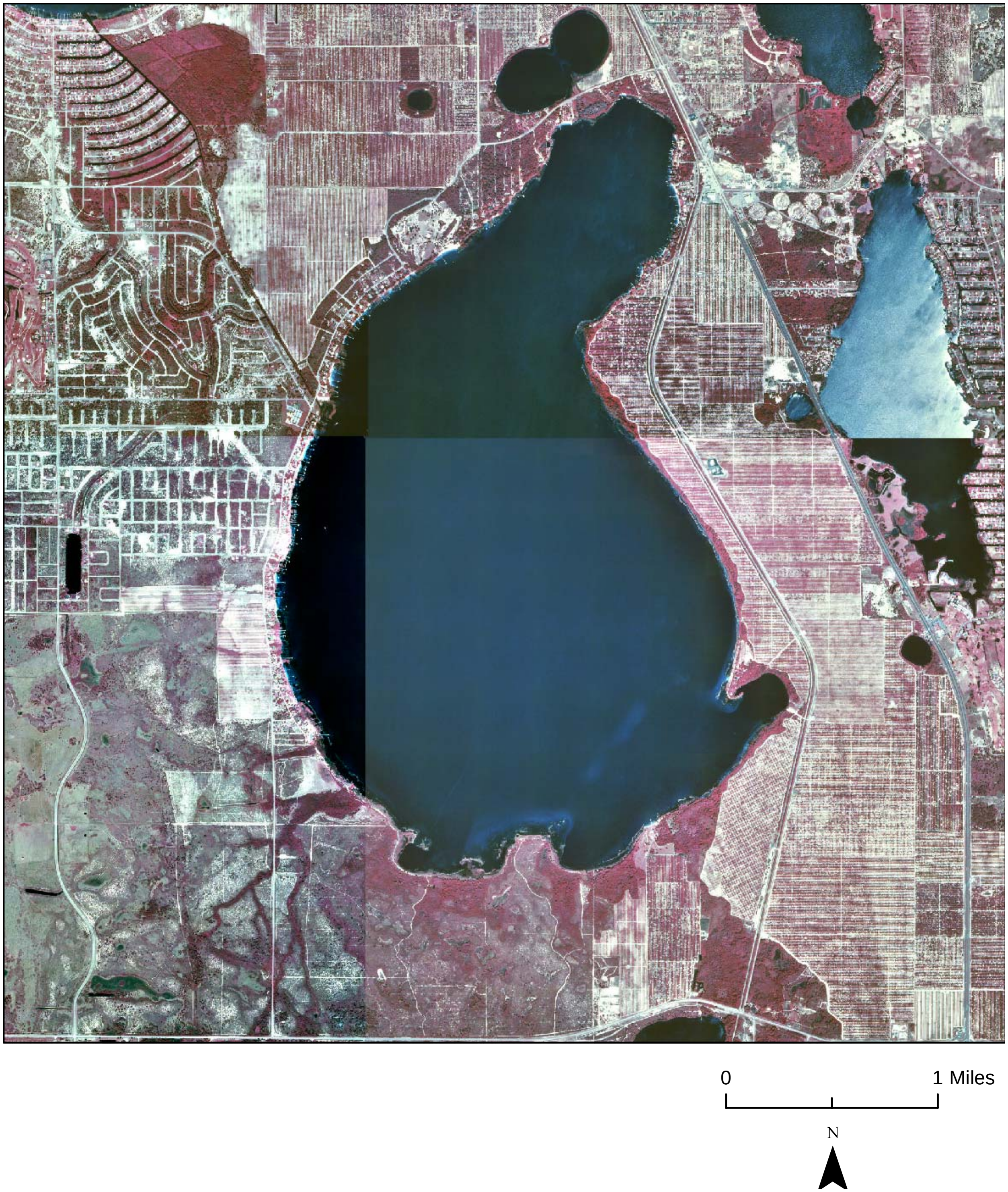


Figure 5. Aerial infrared photography of Lake Placid in 1994 (image source: Southwest Florida Water Management District, date unknown).

Figure 6. Aerial infrared photography of Lake Placid in 1984 (image source: United States Geological Survey 2004).

Figure 7. Aerial photograph of Lake Placid in November or December 1970 (image source: Woolpert, Inc. 2005a).

Figure 8. Aerial photograph of western shoreline of Lake Placid in December 1957 (image source: United States Department of Agriculture 1957a).

Figure 9. Aerial photograph of the southern portion of Lake Placid in December 1957 (image source: United States Department of Agriculture 1957b).

Figure 10. Aerial photograph of the southern portion of Lake Placid in April 1952 (image source: United States Department of Agriculture 1952a).

Figure 11. Aerial photograph of the northern portion of Lake Placid in April 1944 (image source: United States Department of Agriculture 1944).

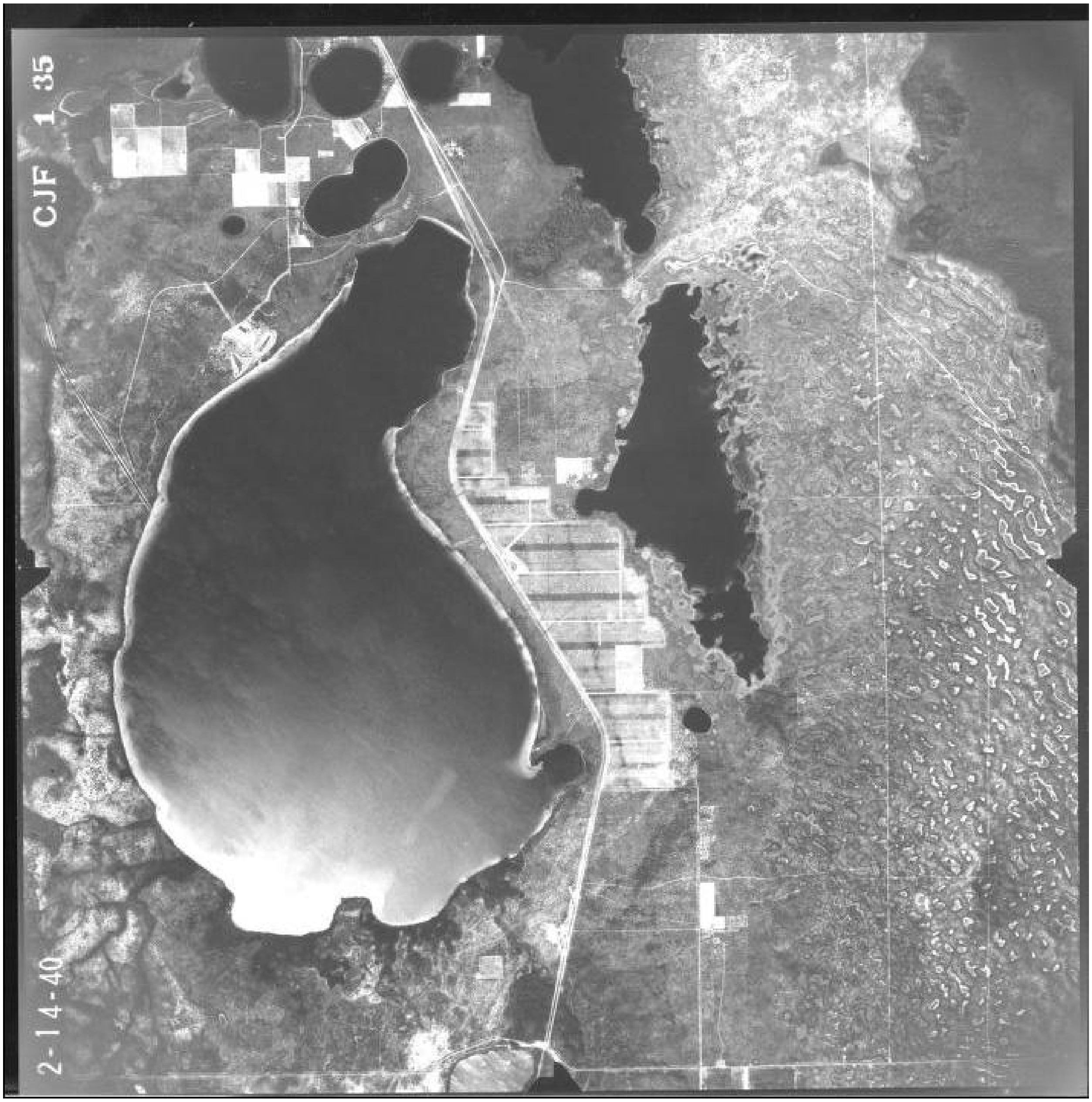


Figure 12. Aerial photograph of Lake Placid in February 1940 (image source: United States Department of Agriculture 1940).

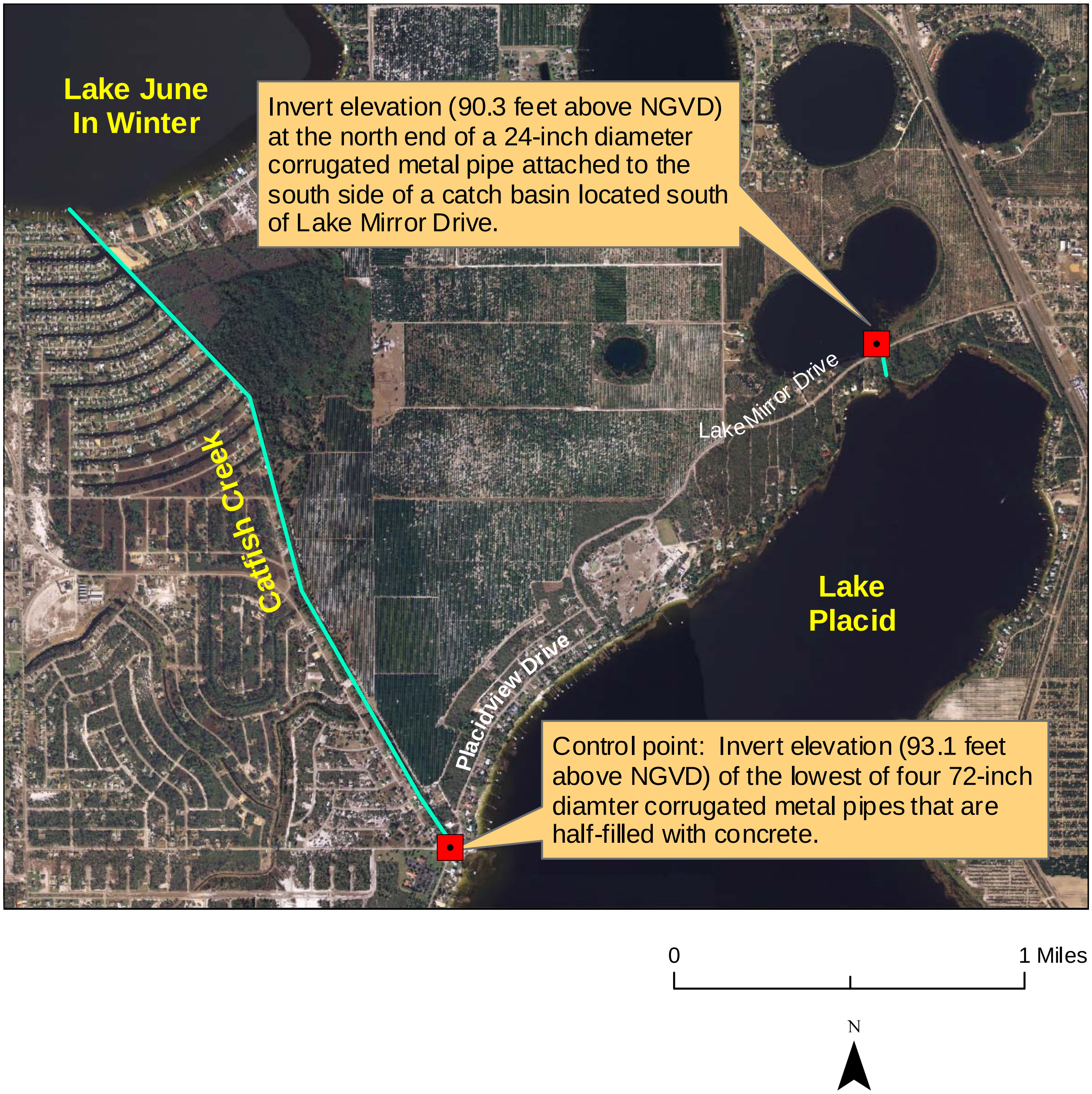


Figure 13. Outlet conveyance systems for Lake Placid in 2006 (image source: 3001, Inc. 2006). Ditched flow paths are indicated by the blue lines.

Figure 14. Upstream (upper panel) and downstream (lower panel) photographs of the water control structure at the Lake Placid outlet to Catfish Creek in 2003 (image source: Southwest Florida Water Management District files).

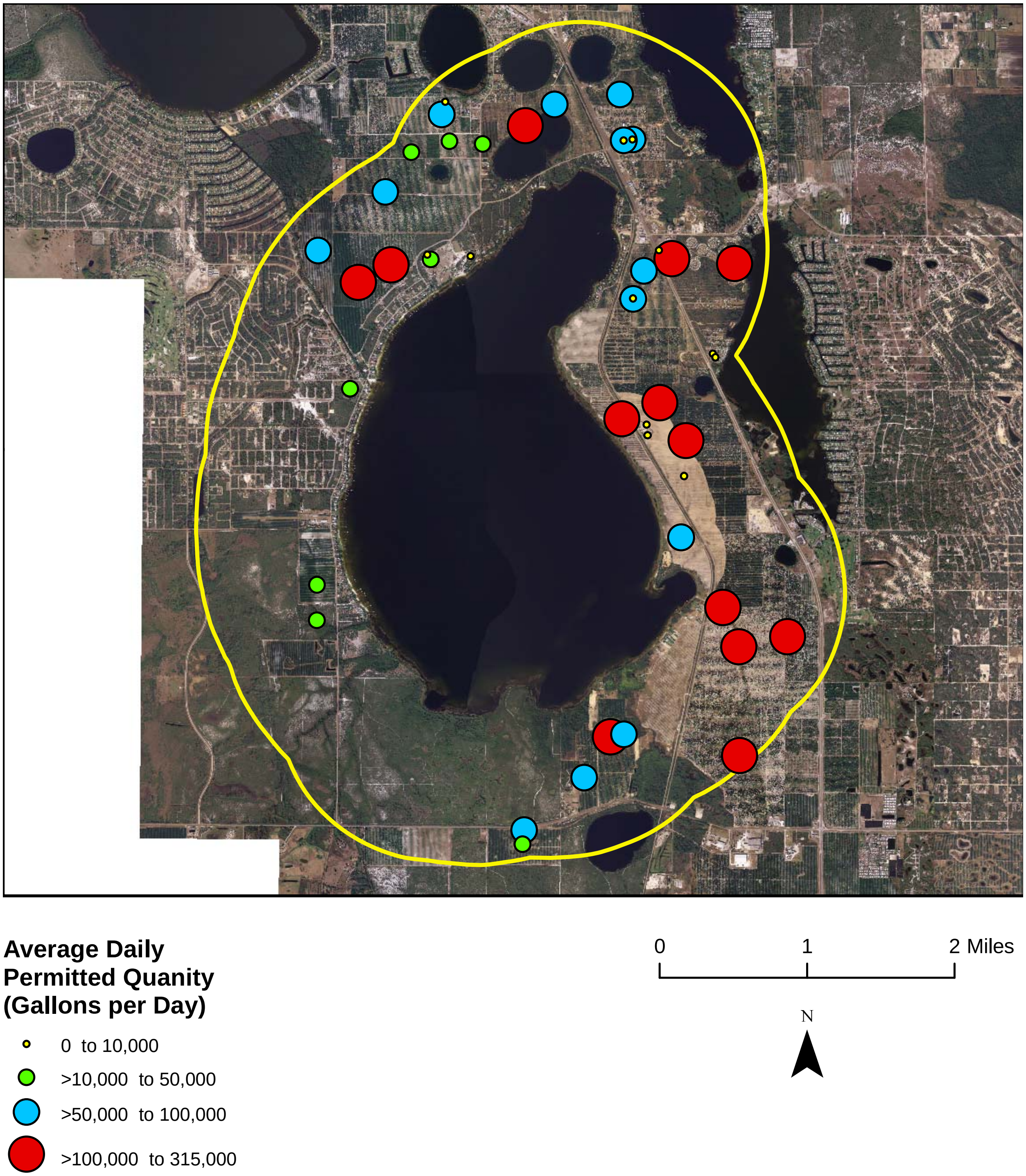


Figure 15. Permitted daily average groundwater withdrawal quantities (gallons per day as of June 2007) within one mile of the Lake Placid shoreline as delineated by the yellow line surrounding the lake (photographic image source: 3001, Inc. 2006; permitted quantity data source: Southwest Florida Water Management District 2007b).

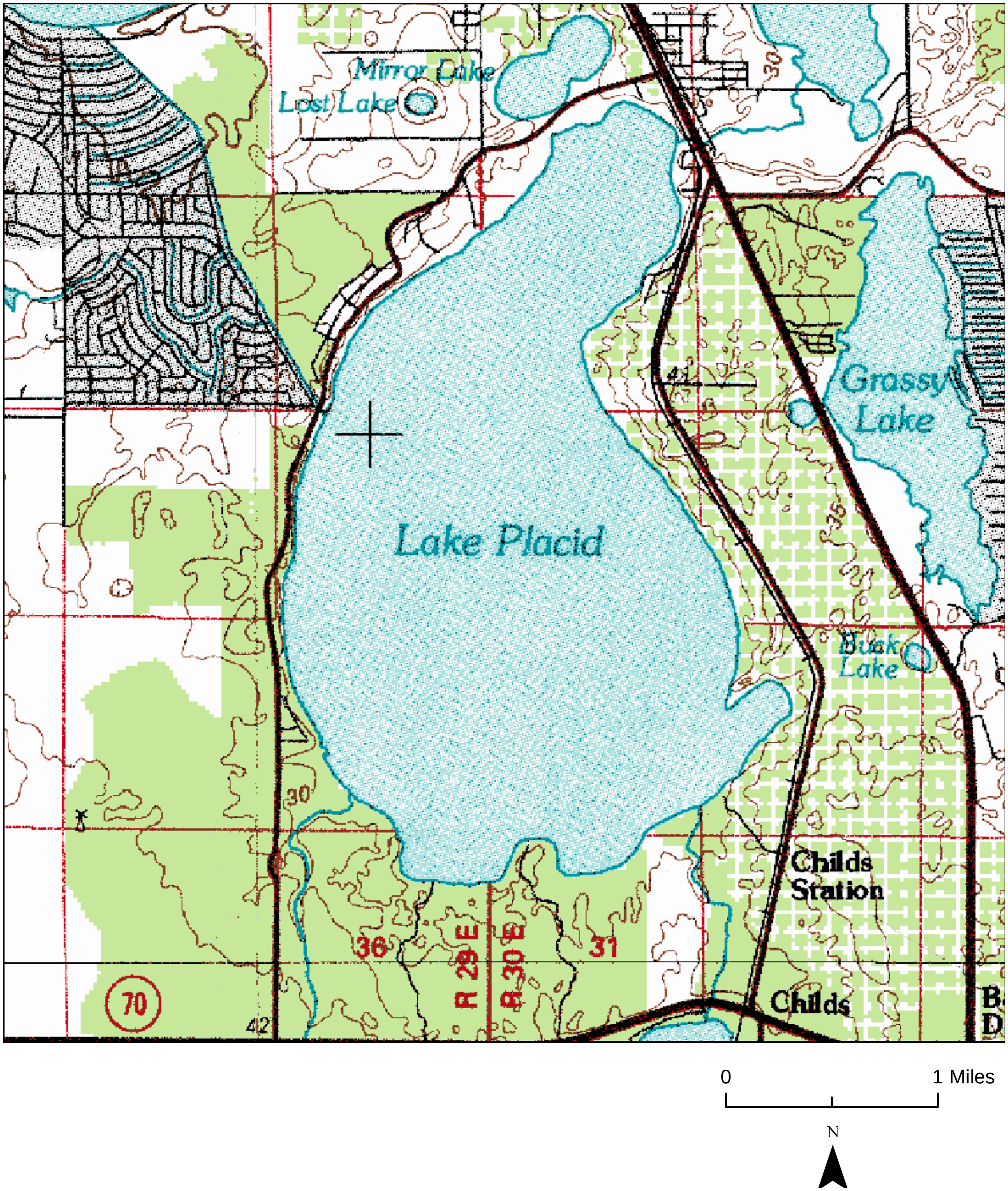
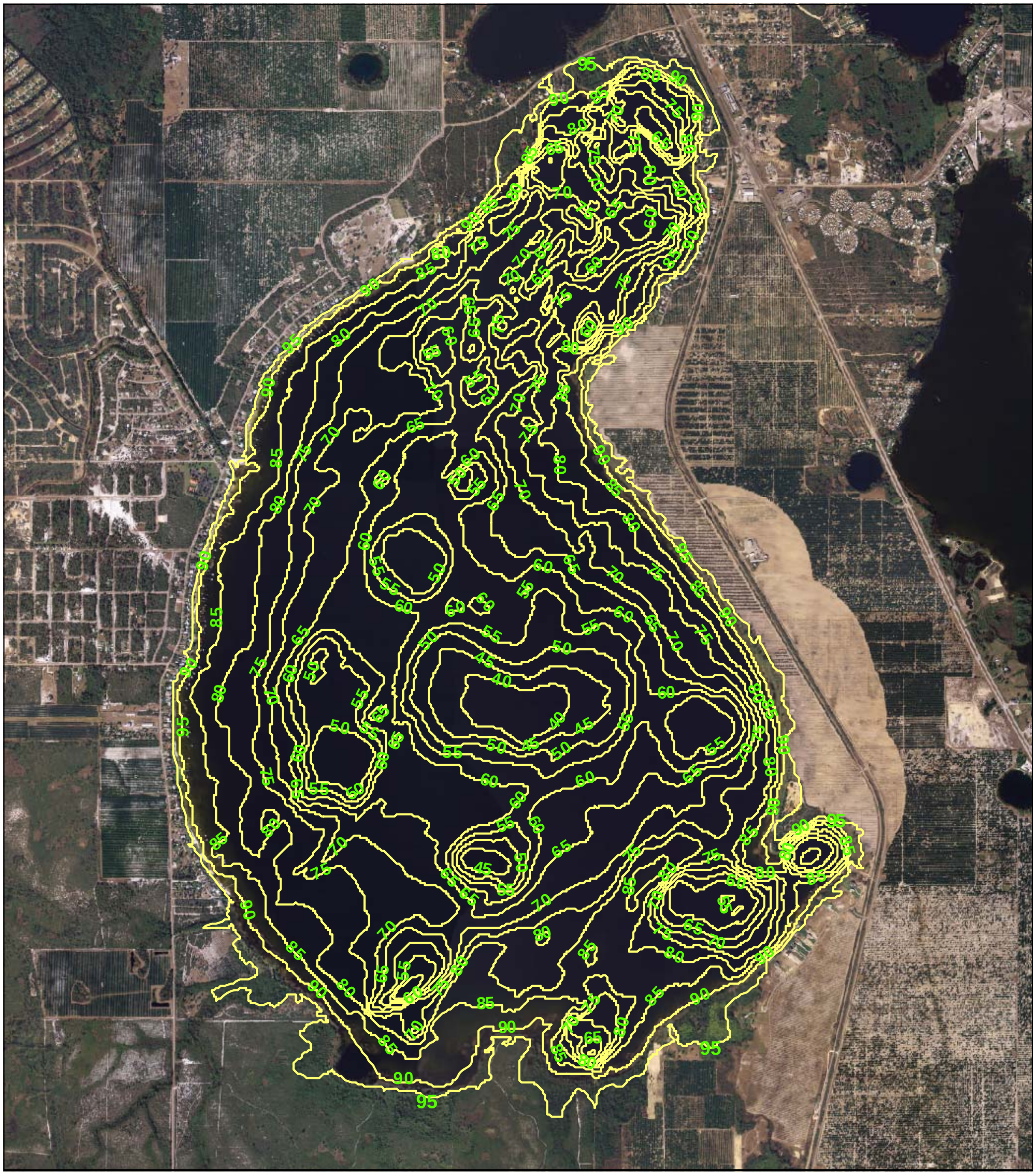


Figure 16. United States Geological Survey five-foot ground elevation contours (feet above NGVD 1929) in the vicinity of Lake Placid (image source: Southwest Florida Water Management District 2002b).



Elevation contours developed using data from 1981 District aerial photography with contours maps, and elevation data collected by District staff on February 26 and 27, 2002.

0 0.5 1 Miles

N

Figure 17. Five-foot ground elevation contours (feet above NGVD) within the Lake Placid basin. (photographic image source: 3001, Inc. 2006).

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.

Management levels for Lake Placid (Table 2, currently referred to as Guidance Levels) were approved by the Governing Board in August 1987 and incorporated into District rules (Chapter 40D-8, F.A.C.). A Maximum Desirable Level of 94.00 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 Lake Placid 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 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.

Lake Placid was not included on recent Stressed Lakes Lists (Gant 1999a, 2000, 2002, 2003, 2004, 2005, 2006, 2007), but was previously classified as a stressed lake (see Gant 1999b). Based on adoption of Minimum Levels for the lake in December 2007, Lake Placid 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 and associated surface areas for Lake Placid.

Level	Elevation (feet above NGVD)	Lake Area (acres)
Ten Year Flood Guidance Level	94.70	3,604
High Level	94.50	3,593
Low Level	91.50	3,410
Extreme Low Level	90.00	3,307

Summary Data Used For Minimum and Guidance Levels Development

Minimum and Guidance Levels were developed for Lake Placid using the methodology for Category 3 lakes described in Chapter 40D-8, F.A.C. The levels and additional parameters are listed in Table 3, along with surface areas for each parameter elevation. Detailed descriptions of the development and use of these data are provided 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 Lake Placid.

	Elevation (feet above NGVD)	Lake Area (acres)
Lake Stage Exceedance Percentiles		
Period of Record P10	93.9	3,544
Period of Record P50	92.6	3,466
Period of Record P90	90.3	3,326
Current P10	93.5	3,519
Current P50	91.8	3,426
Current P90	89.9	3,301
Historic P10	93.4	3,513
Historic P50	92.2	3,447
Historic P90	90.9	3,364
Normal Pool and Control Point		
Normal Pool	94.9	3,615
Control Point	93.1	3,495
Significant Change Standards		
Dock-Use Standard	93.2	3,501
Wetland Offset Elevation	91.4	3,456
Aesthetic Standard	90.9	3,364
Connectivity Standard	84.8	2,970
Species Richness Standard	84.3	2,933
Mixing Standard	70.4	1,686
Recreation/Ski Standard	46.3	121
Guidance and Minimum Levels		
High Guidance Level	93.4	3,513
High Minimum Lake Level	92.6	3,466
Minimum Lake Level	91.4	3,405
Low Guidance Level	90.9	3,364

Lake Stage Data and Exceedance Percentiles

Lake stage data, *i.e.,* surface water elevations, are available for Lake Placid from the United States Geological Survey and the District Water Management Data Base (Figure 18; see Figure 2 for the current location of the District water-level gauges). Data are available from June 1931 through July 2003 for the United States Geological Survey Lake Placid near Lake Placid gauge site (Number 02220750). The District water Management Database includes data from the United States Geological Survey gauge site for the period from January 1953 through October 1975 – these data are assigned the District Universal Identification Number STA 243 4372. The District database also included water level records for two District-maintained sites; the record for one site (Universal Identification Number STA 243 243) extends from October 1984 to the present date and the record for the other site (Universal Identification Number STA 243 1011) includes data for the period from October 1997 through June 2005. The highest surface water elevation recorded at the gauge sites, 96.0 feet above NGVD, occurred on September 11, 1960. The low of record for the lake, 88.3 feet above NGVD, was recorded on June 19, 1989.

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 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 collected prior to the mid-1960s for many lakes in the Lake Wales Ridge area may be classified as Historic data, and data collected since that period may be classified as Current data (Ellison 2002). Current monthly mean lake stage data collected from January 1965 through June 2007 at the three gauge sites in Lake Placid were, therefore, used to calculate Current P10, P50, and P90 lake-stage 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 93.5 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 91.8 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 89.9 ft above NGVD.

Although the measured water level record for Lake Placid extends back to June 1931, it was determined that the thirty-four years of data collected prior to 1965 were not appropriate for calculation of Historic lake stage exceedance percentiles due to the structural alterations that were made to the lake outlet conveyance system in the 1960s. The pre-1965 water level record was also considered to be of insufficient length for characterization of Historic lake stage fluctuations. Historic lake-stage exceedance percentiles were therefore calculated using a Historic composite sixty-year record of monthly mean lake surface elevations that was developed from available lake stage and rainfall records. The sixty-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 initially developed using a linear fitting procedure known as the line or organic correlation (see Helsel and Hirsch 1992). The procedure was used to describe the linear relationship between available monthly mean lake stage data for Lake Placid and regional rainfall, as measured at the Avon Park rainfall station (District Universal Identification Number RNF 146 146) located approximately 24 miles north of the lake in Highlands County. Monthly mean lake stage data used for the analysis were derived from water surface elevations measured at the three lake gauges in the basin. Rainfall values used for the procedure consisted of weighted twelve month cumulative totals that were developed based on a linear-decay series for monthly rainfall values for the twelve month periods. The line of organic correlation equation developed for lake and rainfall data collected from January 1946 through December 1964 was used to estimate water surface elevation values for Lake Placid for the period from January 1946 through December 2005 (unpublished District data). A sixty-year composite data set of monthly mean water surface elevations was then developed for Lake Placid using empirically derived monthly mean lake stage values for the period from January 1946 through December 1964 and modeled estimates for the period from January 1965 through December 2005.

The sixty-year composite data set was considered to be representative of expected water level fluctuations in Lake Placid in the absence of water withdrawal impacts with structural alteration impacts or effects associated with the lake outlet conveyance system that existed prior to 1965. The data set was, therefore, not considered to be a Historic data record because it did not represent expected water level fluctuations for the lake in the absence of withdrawals with structural alteration impacts similar to those that exist currently.

The sixty-year composite water level set was, however, appropriate for development of a Historic composite data set for the lake. The Historic composite data set was created by lowering each monthly mean lake stage value in the sixty-year composite data set by 0.2 to 0.6 feet, based on an analysis of simulated water level records that were presented in a recent water budget study of Lake Placid (Southwest Florida Water Management District 2003b). For the analysis, differences between simulated lake stage elevations derived for existing and pre-1960s conditions of the lake outlet conveyance system were calculated. The differences were then associated with the corresponding simulated lake stage elevations for the pre-1960s condition and mean differences were calculated for one-foot increment elevation categories derived for the range of water surface elevations in the pre-1960 simulated lake stage data set. The mean difference values derived for each one-foot elevation category where then used to lower each monthly mean lake stage value in the sixty-year composite data set. The resulting sixty-year water level record (Figure 19) was considered to be a Historic composite data set for Lake Placid, since it characterized long-term water level fluctuations within the basin in the absence of water withdrawal impacts and incorporated impacts associated with the currently existing structural alterations to the lake outlet conveyance system.

Based on the Historic composite data set, the Historic P10 elevation, which is the elevation the lake water surface equaled or exceeded ten percent of the time during the Historic period, was 93.4 feet above NGVD. The Historic P50, the water surface elevation that was equaled or exceeded fifty percent of the time during the Historic period, was 92.2 feet above NGVD. The Historic P90, the lake water surface elevation equaled or exceeded ninety percent of the time during the historic period, was 90.9 feet above NGVD. The Historic P10 and P50 elevations are 0.5 and 0.4 feet lower than the corresponding lake stage exceedance percentiles based on measured water surface elevations for the period of record. The Historic P90 is 0.6 feet higher than the P90 based on measured period of record data.

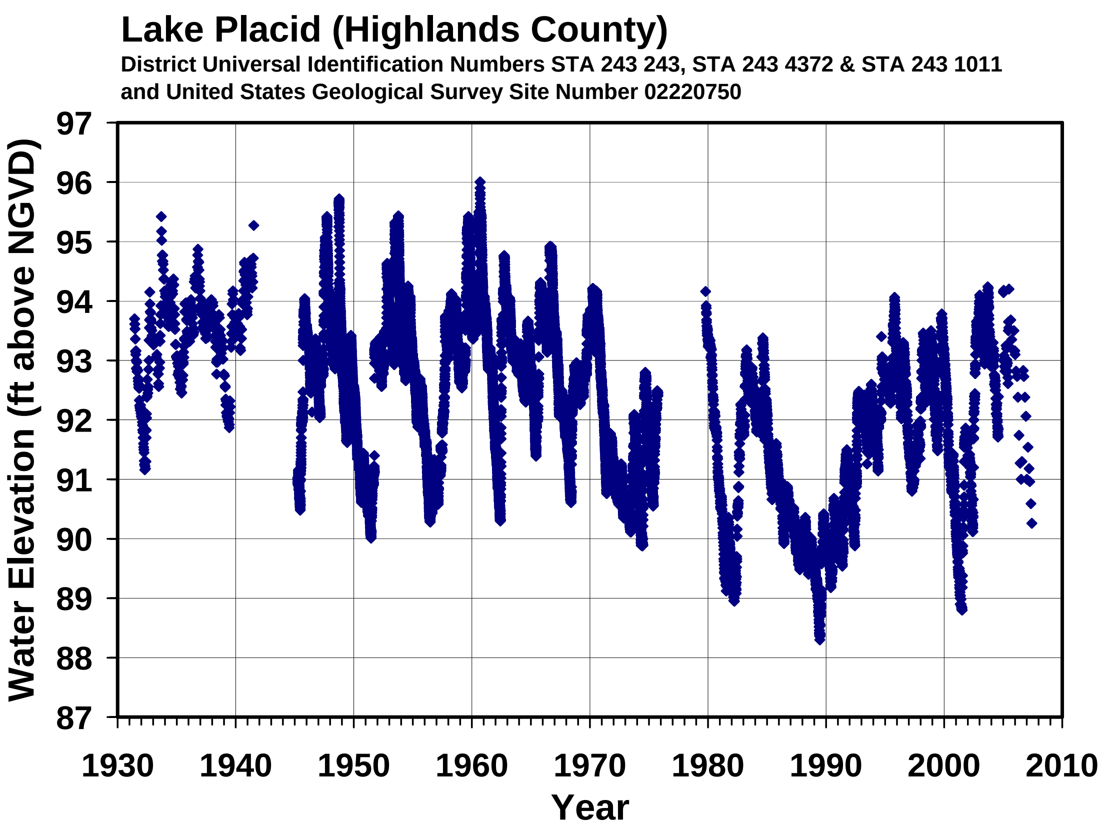


Figure 18. Measured water surface elevations in Lake Placid through June 2007.

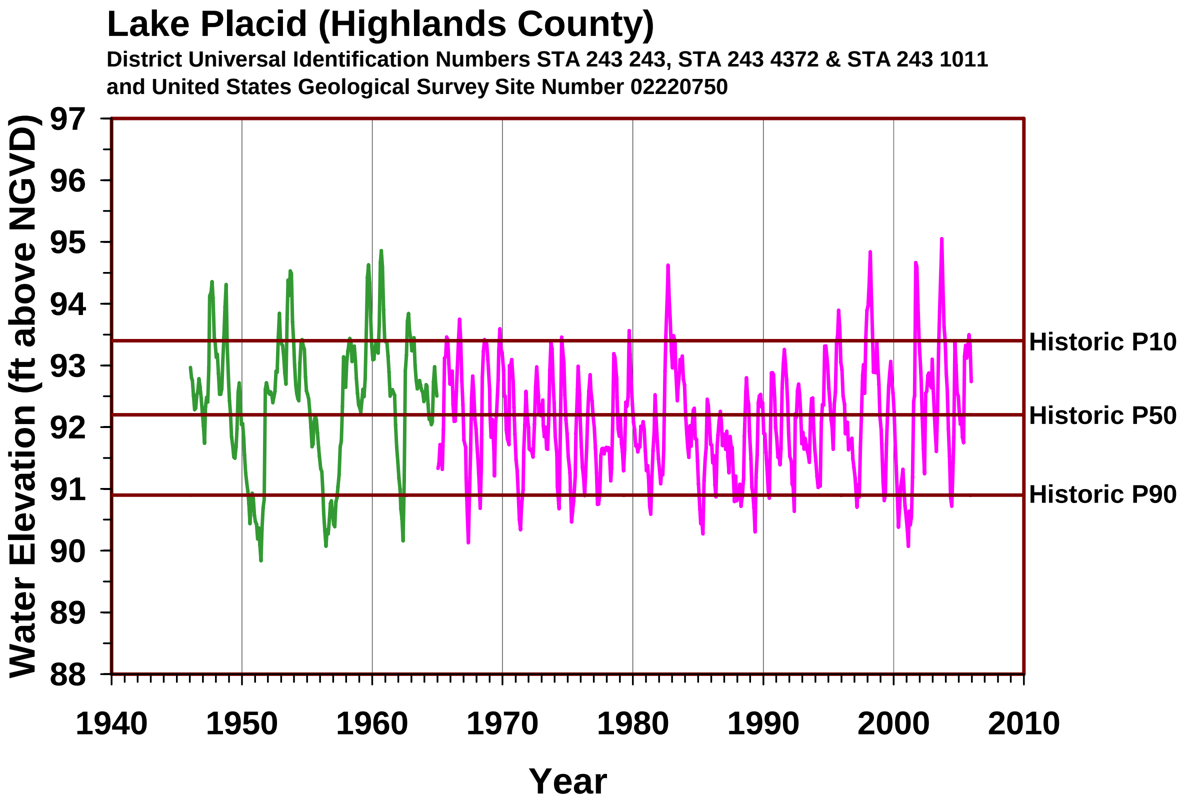


Figure 19. Historic composite monthly-mean water surface elevations for Lake Placid from January 1946 through December 2005, and Historic lake-stage exceedance percentiles. Historic composite data included modified values derived from measured data (green) and modified values derived using a lake stage – rainfall model (fuchsia).

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 ground elevations measured in March 2003 at the base of saw palmetto (*Serenoa repens*) shrubs along the north and south shores of the lake, the Normal Pool elevation was established at 94.9 feet above NGVD (Table 4, Figures 2 and 20). The Normal Pool elevation is similar to a "high water" line (95.03 ft above NGVD) established previously for the lake based on analysis of stratified beach deposits (Bishop 1967), and is also similar to the elevation of 94.5 ft reported by the Florida Department of Environmental Protection as being at, or above the ordinary high water line (Maddux 2002). The Normal Pool elevation is 1.1 feet lower than the median elevation measured for large pine (*Pinus* sp.) trees growing near the lake shore (Table 5).

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 existence of Catfish Creek, which conveys water from the western shore of Lake Placid to Lake June In Winter, Lake Placid 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 Lake Placid was established at 93.1 feet above NGVD, the invert elevation associated with the lowest of the four half-filled with concrete 72-inch corrugated metal pipes that provide for conveyance under Placidview Drive at the lake outlet to Catfish Creek (Figures 13 and 14).

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 known modifications to the outlet canal that drains Lake Placid to Lake June In Winter, and given that the Control Point elevation (93.1 feet above NGVD) is lower than the Normal Pool elevation (94.9 feet above NGVD), Lake Placid was classified as a structurally altered lake.

Table 4. Summary statistics for hydrologic indicator measurements (ground elevation at the base of individual saw palmetto, *Serenoa repens*, shrubs) used for establishing the Normal Pool Elevation for Lake Placid. Elevations were measured by District staff in February 2002.

Hydrologic Indicator	Statistic	Statistic Value (N) or Elevation (feet above NGVD)
Base of saw palmetto shrub	N	29
	Median	94.9
	Mean (SD)	94.9 (0.5)
	Minimum	94.0
	Maximum	95.8

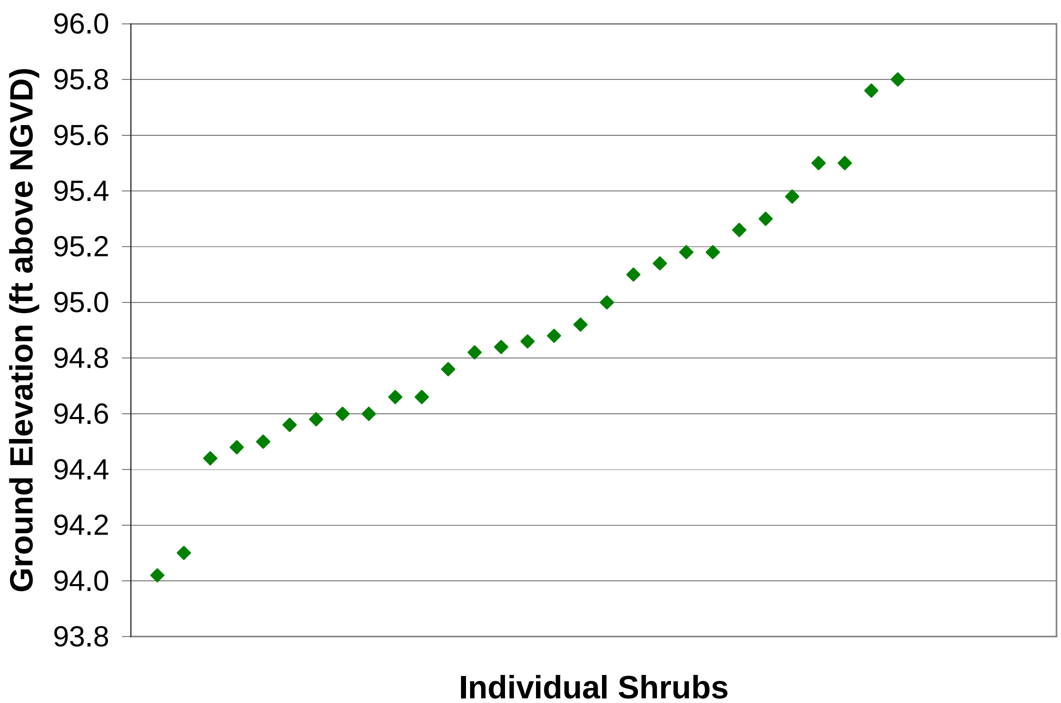


Figure 20. Ground elevations at the base of saw palmetto (*Serenoa repens)* shrubs used to establish the Normal Pool elevation for Lake Placid.

Table 5. Summary statistics for additional hydrologic indicator measurements (ground elevations at the base of large pine, *Pinus* sp., trees) near the shore of Lake Placid. Elevations were measured by District staff in February 2002.

Hydrologic Indicator	Statistic	Statistic Value (N) or Elevation (feet above NGVD)
Base of pine tree	N	9
	Median	96.0
	Mean (SD)	96.1 (0.4)
	Minimum	95.6
	Maximum	96.9

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. District rules (Chapter 40D-8, F.A.C.) previously included a Ten Year Flood Guidance Level of 96.0 feet above NGVD for Lake Placid. Recent work completed in support of the District's Watershed Management Program has yielded a new, provisional ten-year recurrence flood stage for the lake. Based on a statistical analysis of available lake stage records from 1931 through 2003, Arnold (2003, 2005) identified a peak ten-year recurrence elevation of 95.0 feet above NGVD for Lake Placid.

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 Lake Placid.

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 water level record for Lake Placid, the High Guidance Level was established at the Historic P10 elevation, 93.4 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 the composite Historic water level record for Lake Placid, the Low Guidance Level was established at the Historic P90 elevation, 90.9 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 lack of lake-fringing cypress wetlands within the lake-basin, Lake Placid was 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 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 at the elevation 1.8 feet below the Normal Pool elevation. This standard, operationally referred to as the Cypress Standard, is used to identify a desired median lake stage that may be expected to preserve the ecological integrity of lake-fringing cypress wetlands. Because Lake Placid is a Category 3 Lake, a Cypress Standard was not developed for the basin.

For Category 3 lakes, six significant change standards, including a Dock-Use Standard, an Aesthetics Standard, a Basin Connectivity Standard, a Species Richness Standard, a Lake Mixing Standard, and a Recreation/Ski 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.

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 for Lake Placid was established at 93.2 feet above NGVD, based on the elevation of sediments at the end of ninety percent of the 150 docks within the basin (89.9 feet above NGVD, Table 6), a two-foot water depth based on use of powerboats in the lake, and the 1.3 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 sixteen percent of the time, *i.e*., the standard elevation corresponds to the Historic P16.

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 84.8 feet above NGVD, based on the elevation that ensures connectivity between the major sub-basins of the lake (81.5 feet above NGVD), a two-foot water depth in the area of connectivity to allow for movement of boats between the sub-basins, and the 1.3 foot difference between the Historic P50 and Historic P90 elevations. The Basin Connectivity Standard was equaled or exceeded one hundred percent of the time for the Historic period defined by the Historic composite water level record.

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 Placid occurs at an elevation of 90.9 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 composite data set.

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 Lake Placid, the Species Richness Standard was established at 84.3 feet above NGVD. Based on the Historic composite data record, the Species Richness Standard was equaled or exceeded one hundred percent of the time during the Historic period.

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. This standard was established at an elevation of 70.4 ft above NGVD for Lake Placid. This elevation was equaled or exceeded one hundred percent of the time during the Historic period. (Figure 21).

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 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 Lake Placid, the Recreation-Ski Standard was established at 46.3 feet above NGVD, based on the sum of the Ski Elevation (45.0 feet above NGVD) and the 1.3 foot difference between the Historic P50 and Historic P90. The standard elevation was equaled or exceeded one hundred percent of the time during the Historic period defined by the Historic composite water level record.

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 considered, based on water transparency values. Review of changes in potential herbaceous wetland area in relation to change in lake stage indicated that use of the Recreation/Ski Standard would not be appropriate for minimum levels development. At the Recreation/Ski Standard elevation, half the inundated area would be shallow enough to support herbaceous wetland vegetation and the lake would be shallow enough to support colonization of the entire basin by submersed or floating-leaved macrophytes (Figure 22). Also, the lake surface area at the Recreation/Ski Standard elevation would be less than 4% of the surface area at the Historic P50 elevation (Table 3, Figure 21).

Because herbaceous wetlands are common within the Lake Placid 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 91.4 feet above NGVD was therefore established for Lake Placid by subtracting 0.8 feet from the Historic P50 elevation. The standard elevation was equaled or exceeded seventy-nine percent of the time during the Historic period defined by the Historic composite water level record, *i.e.*, the standard elevation corresponds to the Historic P79.

Table 6. Summary statistics for elevations associated with docks at Lake Placid, based on measurements made by District staff in March 2003. Percentiles (P10, P50 and P90) represent elevations exceeded by 10, 50 and 90 percent of the docks.

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	150	150
Mean (SD)	88.2 (1.4)	94.7 (0.8)
P10	89.9	95.7
P50	88.2	94.7
P90	86.6	93.8
Maximum	90.7	97.4
Minimum	82.5	92.5

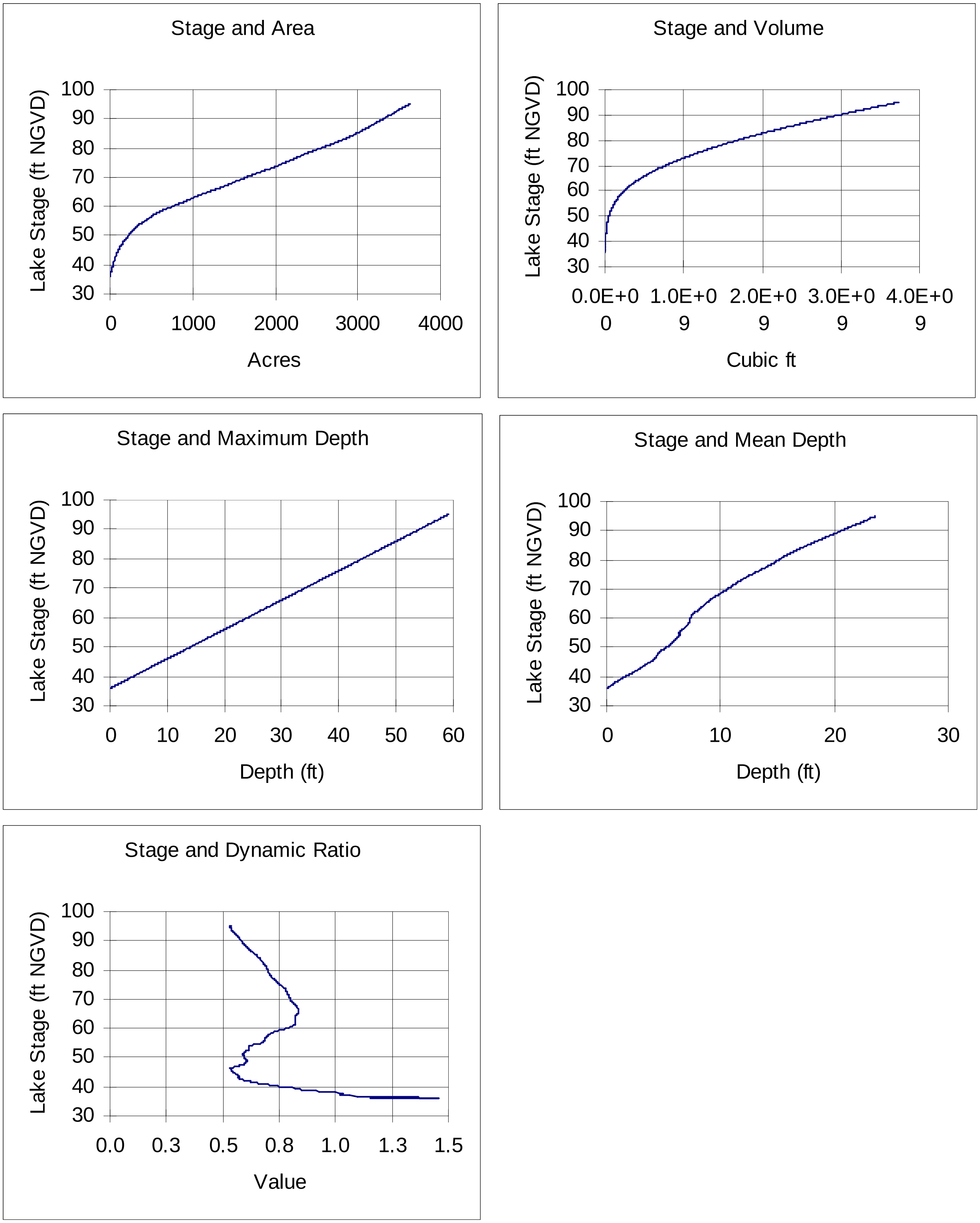


Figure 21. Lake Placid surface area, volume, maximum depth, mean depth, and dynamic ratio (basin slope) and potential herbaceous wetland area versus lake stage.

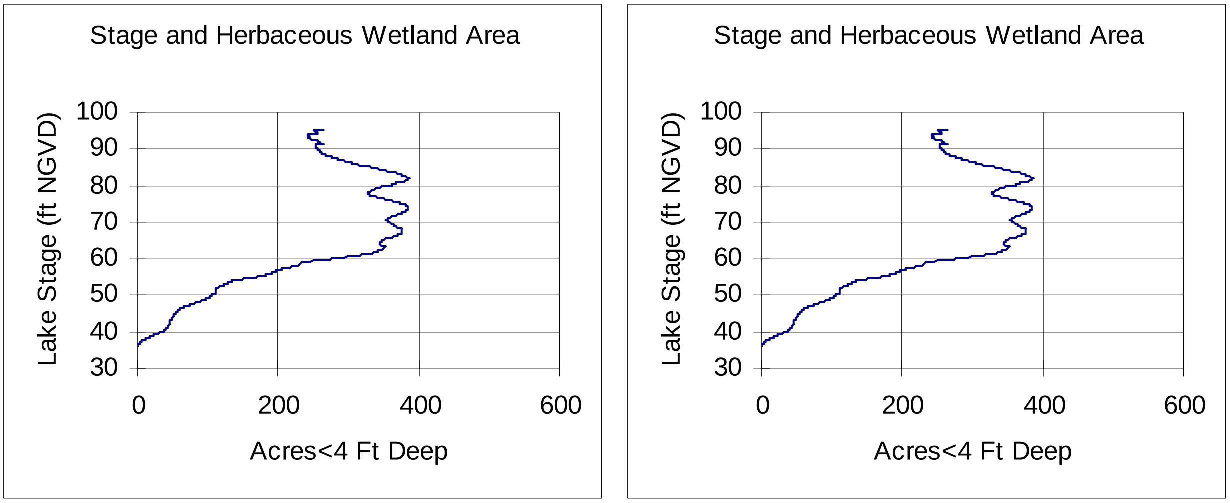


Figure 22. Potential herbaceous wetland area in Lake Placid and area available for aquatic plant colonization versus lake stage.

Minimum Levels

Minimum Lake Levels, including the Minimum Lake Level and the High Minimum Lake Level, 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 3 lakes, the Minimum Level is typically established at the elevation corresponding to the most conservative significant change standard*, i.e.,* the standard with the highest elevation, except where that elevation is above the Historic P50 elevation, in which case, the Minimum Level is established at the Historic P50 elevation. Because the Dock-Use Standard for Lake Placid is higher than the Historic P50 elevation, the Minimum Level could be established at the Historic P50 elevation, 92.2 feet above NGVD. However, because the Dock-Use Standard for the lake corresponds to the Historic P16 elevation, and because establishment of the Minimum Lake Level at the Historic P50 elevation would mean that any withdrawal impact, no matter how small, would not be permitted, it was determined that it would not be appropriate to use the Dock-Use Standard for establishing the Minimum Lake Level.

The Minimum Lake Level was, instead, established at 91.4 feet above NGVD, the elevation corresponding to the Wetland Offset elevation. Because the Wetland Offset elevation is higher than the other available significant change standards (with the exception of the Dock-Use Standard) it may be expected to be protective of lake values represented by the standards associated with lower surface water elevations. The 0.8-foot decrease in the median lake stage associated with use of the Wetland Offset elevation for development of the Minimum Lake Level (the Wetland Offset elevation is 0.8 feet lower than the Historic P50) would also not be expected to significantly change the amount of time water levels equal or exceed the Dock-Use Standard. Assuming a 0.1 foot reduction in water levels over the entire range of lake water levels for the Historic composite water level record, the amount of time that water levels would have equaled or exceeded the Dock-Use Standard would have been decreased from one seventeen percent of the time to fifteen percent of the time, based on the unmodified and modified Historic water level record.

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 3 lakes, the High Minimum Lake Level is developed using the Minimum Lake Level, Historic data or reference lake water regime statistics. If Historic Data are available, the High Minimum

Lake Level is established at an elevation corresponding to the Minimum Lake Level plus the difference between the Historic P10 and Historic P50. If Historic data are not available, the High Minimum Lake Level is set at an elevation corresponding to the Minimum Lake Level plus the region-specific RLWR50. Based on the availability of the Historic composite water level record for Lake Placid, the High Minimum Lake Level was established at 92.6 feet above NGVD, by adding the 1.2 foot difference between the Historic P50 and Historic P10 elevations to the Minimum Lake Level.

The Minimum and Guidance levels for Lake Placid are shown in Figure 23 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 High Minimum Lake Level would not be expected to flood existing man-made features within the immediate lake basin (see Figure 24 for the approximate lake margins when the water surface is at the minimum levels). The High Minimum Lake Levels is approximately 2.7 feet lower than the elevation of the floor of the lowest-sited residential building adjacent to the lakeshore (Table 7).

Table 7. Elevations of selected man-made features occurring at relatively low elevations within the immediate Lake Placid basin.

Lake Basin Features	Elevation (feet above NGVD)
Low floor slab – residential building	95.3
Low spot on the paved roads near the lake	None lower than the low floor slab

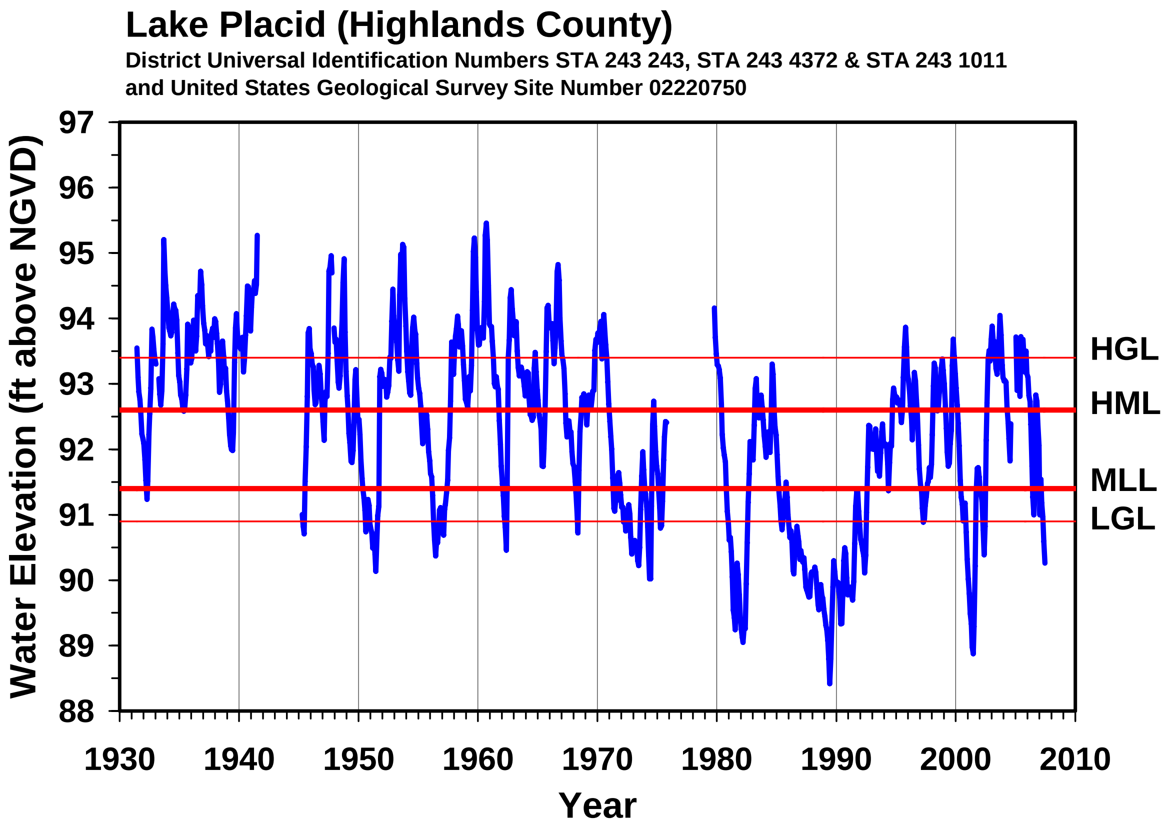
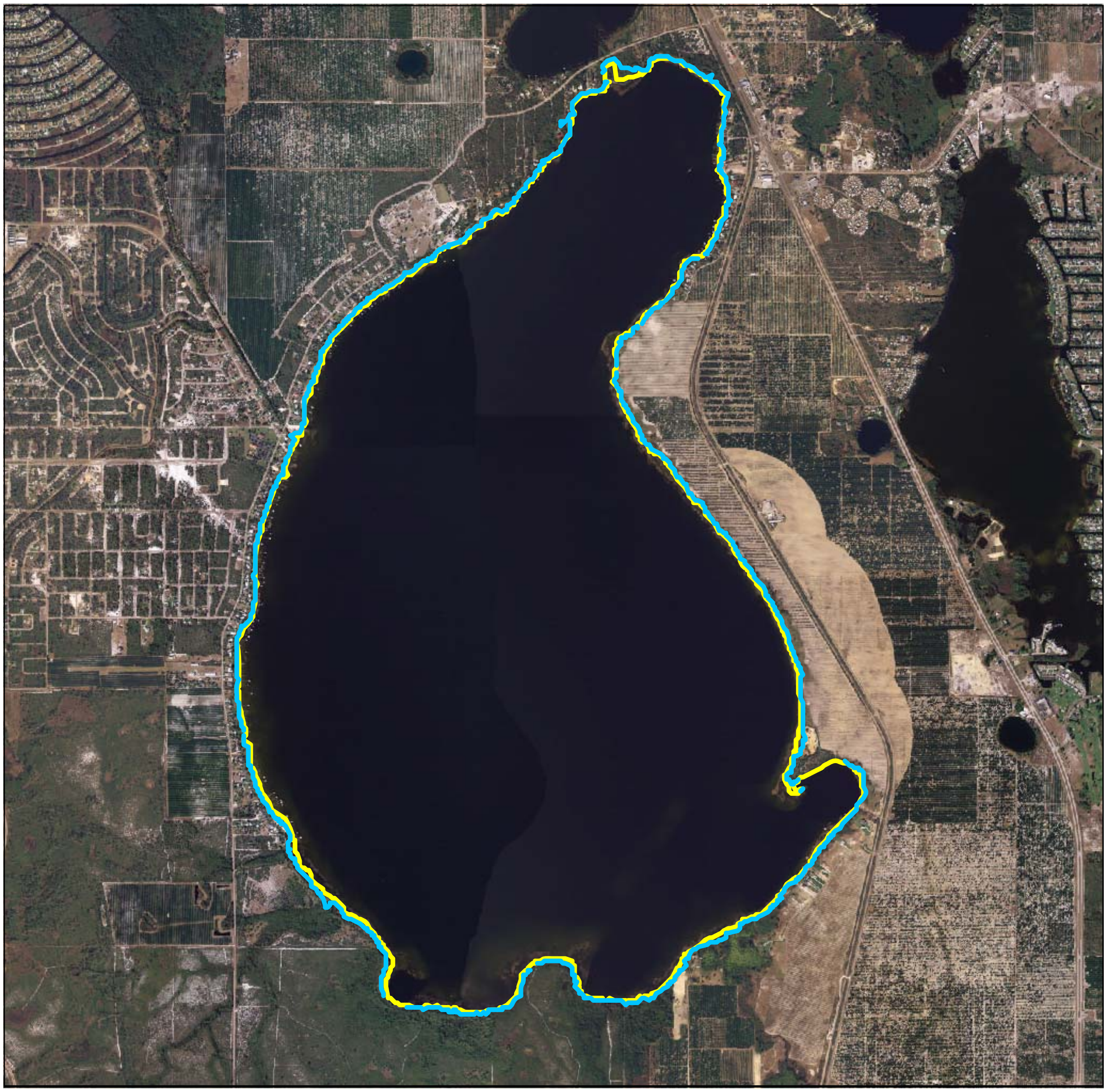


Figure 23. Mean monthly water surface elevations in Lake Placid through June 2007 based on measured lake stage records (blue line), and Guidance and Minimum Levels (red lines). Adopted levels include the High Guidance Level (HGL), High Minimum Lake Level (HMLL), Minimum Lake Level (MLL) and Low Guidance Level (LGL).



Minimum Levels

Minimum Lake Level = 91.4 feet above NGVD

High Minimum Lake Level = 92.6 feet above NGVD

0 0.5 1 Miles

N

Elevation contours developed using data from 1981 District aerial photography with contours maps, and elevation data collected by District staff on February 26 and 27, 2002..

Figure 24. Approximate location of the Minimum Lake Level and High Minimum Lake Level for Lake Placid (photographic image source: 3001, Inc. 2006).

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