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# TECHNICAL SUPPORT DOCUMENT FOR MINIMUM LAKE LEVELS: CHERRY LAKE, FLORIDA

August 2023

Prepared for:



Suwannee River Water Management District  
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Live Oak, FL 32060

The Suwannee River Water Management District (SRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 15 counties in north central Florida. The mission of SRWMD is to ensure the sustainable use and protection of water resources for the benefit of the people of the District and the state of Florida. SRWMD accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; and land acquisition and management.

This document is published to disseminate information collected by SRWMD in pursuit of its mission. Copies of this document can be obtained from:

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## Executive Summary

Under task work assignment (TWA): 19/20-061.008, Environmental Consulting and Technology, Inc. (ECT) was authorized by the Suwannee River Water Management District (SRWMD or District) to prepare a report titled Technical Support Document for Minimum Lake Levels: Cherry Lake, Florida. These technical analyses are based on work performed by Greenman-Pederson, Inc. (GPI), ECT, and SRWMD staff using methodology developed by the Southwest Florida Water Management District (SWFWMD).

This report presents the technical content that was utilized in development of minimum flows and levels (MFLs) for Cherry Lake in Madison County, Florida. During MFL development, water budget modeling results revealed that Cherry Lake levels are largely controlled by rainfall and the condition of the outfall canal that drains the lake. Groundwater withdrawals were found to have relatively little effect on lake levels due to a thick clay confining unit that buffers the lake from drawdowns in the Floridan aquifer. The outfall canal has experienced erosion and debris blockages over time. Erosion in the outfall canal appears to have lowered lake levels in the past two decades. The blockages can temporarily cause increased lake levels that then recede when the blockages are removed. To further investigate the role of the outfall canal condition on lake levels, three different lake Control Point (CP) scenarios were simulated. These simulation results were used to evaluate how the outfall canal condition affects lake levels and the water resource values assessed during MFL development.

The SWFWMD methodology (SWFWMD 1999a, 1999b, and 2021; Leeper *et al.* 2001; Hancock 2007) was utilized to assess MFLs for Cherry Lake. Minimum levels determination is based on the evaluation of observed and model simulated stage data, vegetation sampling, hydrologic indicators of sustained inundation, control point elevation, bathymetry, water quality, and elevations of anthropogenic features such as docks. This information was used to develop lake levels needed to protect eight significant change standards: Cypress, Dock-Use, Wetland Offset, Aesthetics, Lake Mixing, Species Richness, Recreation/Ski, and Basin Connectivity. Additionally, the effects of lake level changes on herbaceous wetlands and submerged aquatic macrophytes were also assessed. The significant change standard that requires the highest lake levels below the Historic P50 elevations is typically used to set the minimum lake levels.

To support assessment of minimum levels for Cherry Lake, a total of three CP scenarios were selected by the District to represent the existing and predicted structural alterations in the outfall canal (ECT, 2023):

- High CP Scenario: 150.80 ft NAVD88 at the top of the beaver dam in the outfall canal.
- Medium CP Scenario: 150.20 ft NAVD88 at the highest point along the outfall canal.
- Low CP Scenario: 149.52 ft NAVD88 at the invert of the culvert beneath NE Cherry Lake Cir.

The high and medium CP scenarios are based on elevations in the outfall canal that were surveyed in 2017. These two scenarios represent conditions that have occurred in recent decades, during which beaver dams have been periodically removed and then reconstructed. The low CP scenario represents a predicted future condition in which the canal continues to erode down to the culvert invert elevation at NE Cherry Lake Cir. These CP elevations were held constant during the water budget model simulations.

Long-term water budget simulation results indicate that most of the significant change standards would be maintained for all the three CP scenarios, even with substantial drawdowns in the Floridan

aquifer (ECT, 2023). The Dock-Use Standard cannot be achieved under any of the three CP scenarios because the outfall canal elevations are too low to maintain the required lake levels. The low CP scenario results show that the Cypress Standard would have minimal freeboard (0.08 ft) before not being met, and the cypress wetlands around Cherry Lake could be impacted if the erosion in the outfall canal continues.

Due to limited potential for groundwater withdrawals to lower lake levels and due to the erosion issues in the outfall canal, District staff do not recommend moving forward with minimum lake level rule development and adoption at this time. The technical content presented in this report is expected to provide useful information for understanding changes in lake levels and their effects on the water resources values evaluated to develop the minimum levels. The District will continue to work with state agencies, local government, residents, and other stakeholders to develop management options for Cherry Lake.

## 1.0 Introduction

Under task work assignment (TWA): 19/20-061.008, Environmental Consulting and Technology, Inc. (ECT) was authorized by the Suwannee River Water Management District (SRWMD or District), to provide technical support for establishment of regulatory lake levels for Cherry Lake, Madison County, Florida.

This MFL evaluation is based on prior work performed by SRWMD staff and Greenman-Pederson, Inc. (GPI), and utilized by ECT following methods developed by the Southwest Florida Water Management District (SWFWMD). The work effort included separate analyses of both the collected field information and the creation of a long-term lake water budget model. The model is documented in a separate report titled “*Cherry Lake Water Budget Modeling – Updated to Include Reference Timeframe Analysis*” (ECT 2023).

## 2.0 MFLs Program Overview

### 2.1 Statutory Framework

The SRWMD MFLs program is based on the requirements of Sections 373.042 and 373.0421, F.S., and is subject to the provisions of Chapter 40B-8, F.A.C. The MFLs program provides technical support to the SRWMD regional water supply planning process (Section 373.0361, F.S.), consumptive use permitting (Chapter 40B-2, F.A.C.), and environmental resource permitting (Chapter 40B-4, F.A.C.) programs.

Based on the provisions of Rule 40B-8.011(3), F.A.C., "... the Governing Board shall use the best information and methods available to establish limits which prevent significant harm to the water resources or ecology." Significant harm is prohibited by Section 373.042(1), F.S. Additionally, "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..." (Rule 62-40.473(2), F.A.C.).

### 2.2 Water Resource Values

According to Rule 62-40.473(1), F.A.C., in establishing MFLs pursuant to Sections 373.042 and 373.0421, F.S., consideration shall be given to natural seasonal fluctuations in water flows or levels, non-consumptive uses, and environmental values associated with coastal, estuarine, riverine, spring, aquatic, and wetlands ecology. These environmental values, also referred to as water resource values (WRVs) are listed below with their respective working definitions. All relevant items were considered through determination of the Cypress Standard, explained in Section 2.3, and other significant change standards. WRVs are listed as follows:

- Recreation in and on the water;
- Fish and wildlife habitats and the passage of fish;
- Estuarine resources;
- Transfer of detrital material;
- Maintenance of freshwater storage and supply;
- Aesthetic and scenic attributes;
- Filtration and absorption of nutrients and other pollutants;
- Sediment loads;
- Water quality; and
- Navigation.

In addition to these factors, based on Section 373.0421(1), F.S., the following considerations are also required:

"When establishing minimum flows and levels pursuant to Section 373.042, the department or Governing Board shall consider 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 an affected watershed, surface water, or

aquifer, provided that nothing in this paragraph shall allow significant harm as provided by Section 373.042(1) caused by withdrawals.”

## 2.3 Hydrologic Regime

MFLs designate an environmentally protective hydrologic regime (i.e., hydrologic conditions that prevent significant harm) and identify levels and/or flows above which water may be available for reasonable–beneficial use.

MFLs developed using the SWFWMD methodology define the high and average levels and their frequency necessary to protect relevant water resource values and prevent significant harm to aquatic and wetland habitats. The SWFWMD has developed specific methodologies for establishing MFLs for lakes, wetlands, rivers, estuaries, and aquifers, subjected the methodologies to independent, scientific peer-review, and has incorporated minimum levels for specific waterbodies determined by rules thereof into its Water Level and Rates of Flow Rule (Chapter 40D-8, F.A.C.).

Information regarding the development of adopted methods for establishing minimum lake levels is included in SWFWMD (1999a, 1999b, and 2021), Leeper *et al.* (2001), and Hancock (2007). For lakes, methods 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 with less than 0.5 acres of fringing cypress wetlands are classified as Category 3 Lakes.

Categorical significant change standards and other available information are developed to identify criteria that are sensitive to long-term changes in hydrology and can be used for establishing minimum levels. For all lake categories, the most sensitive, appropriate criterion or criteria is/are used to develop minimum levels. For Category 1 or 2 Lakes, a significant change standard, referred to as the Cypress Standard, is developed. For Category 3 Lakes, seven significant change standards, including a Basin Connectivity Standard, a Recreation/Ski Standard, an Aesthetics Standard, a Species Richness Standard, a Lake Mixing Standard, Dock-Use Standard, and Wetland Offset Standard are typically developed. Other available information, including potential changes in the coverage of herbaceous wetland vegetation and submersed aquatic plants, is also considered when establishing minimum levels for Category 3 Lakes. Under the SWFWMD approach, two Minimum Levels (High Minimum Lake and Minimum Lake Levels) are typically established for lakes. The levels, which are expressed as elevations in feet above the North American Vertical Datum of 1988 (ft NAVD88), may include the following (SWFWMD 1999a, 1999b, and 2021; Leeper *et al.* 2001; Hancock 2007; Rule 40D-8.021, F.A.C.).

- High Minimum Lake Level (HMLL) that 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.
- Minimum Lake Level (MLL) that is the elevation that the lake’s water levels are required to equal or exceed fifty percent of the time on a long-term basis.

MFLs apply to decisions affecting permit applications, declarations of water shortages, and assessments of water supply sources. Surface water and groundwater computer simulation models

are used to evaluate existing and/or proposed consumptive uses and their likelihood to cause significant harm. Actual or projected instances where water levels fall below established MFLs may require the SRWMD Governing Board to develop recovery or prevention strategies (Section 373.0421(2), F.S.). MFLs are to be reviewed periodically and revised as needed (Section 373.0421(5), F.S.).

## 2.4 Management Stakeholders

As part of the District's work to ensure adequate and sustainable water supplies are available to meet both existing and future needs while protecting the environment, the District prepares water supply plans per the provisions of Chapter 373, F.S. Cherry Lake is located within the District's western water supply planning region which includes Dixie, Lafayette, Madison, Taylor, and part of Jefferson and Levy counties. The District is currently working on the development of the first regional Water Supply Assessment and Plan for these counties and the water use estimates and projections are currently in the stakeholder review process. The stakeholders include city and county managers, water and wastewater utilities, public services and works representatives, industry professionals (e.g., Foley Cellulose, Nutrien), agricultural interests, and academic research and extension representatives (University of Florida Institute of Food and Agricultural Sciences [IFAS]). The stakeholders' mission is to protect the shared resources of the Floridan aquifer system through collaborative planning, scientific-tool development, and other efforts.

A group of concerned citizens, composed predominantly of property owners adjacent to Cherry Lake proper, has formed a working group known as the Cherry Lake Focus Group. The Focus Group includes 152 property owners who have incorporated the participation of representatives from various public entities and their consultants, including the District, the Florida Department of Environmental Protection (FDEP), the Florida Fish and Wildlife Conservation Commission (FWC), Madison County, and the University of Florida IFAS 4H Camp located on the northwest corner of the lake.

## 2.5 Consideration of Environmental Values

As described in SWFWMD (2020), specific categorical significant change standards are developed to identify criteria that are sensitive to long-term changes in hydrology and therefore useful for establishing minimum levels. For all lake categories, the most sensitive, appropriate criterion is used to develop minimum levels, as described in Section 2.3 above.

The standards and other available information are associated with the environmental values identified for consideration in Rule 62-40.473, F.A.C., when establishing MFLs (Table 2-1). Descriptions of the specific standards and other information evaluated to support development of minimum levels for Cherry Lake are provided in subsequent sections of this report.

Table 2-1. Environmental values from the Water Resource Implementation Rule (62-40.473, F.A.C.), and the significant change standards (and other information) associated with each that are considered when establishing minimum flows and levels (SWFWMD 2021).

Environmental Value	Associated Significant Change Standards and Other Information for Consideration
Recreation in and on the water	Basin Connectivity Standard, Recreation/Ski Standard, Aesthetics Standard, Species Richness Standard, Dock-Use Standard, Herbaceous Wetland Information, Submersed Aquatic Macrophyte Information
Fish and wildlife habitats and the passage of fish	Cypress Standard, Wetland Offset Standard, Basin Connectivity Standard, Species Richness Standard, Herbaceous Wetland Information, Submersed Aquatic Macrophyte Information
Estuarine resources	<i>This value is not applicable for consideration for most priority lakes.</i>
Transfer of detrital material	Cypress Standard, Wetland Offset Standard, Basin Connectivity Standard, Lake Mixing Standard, Herbaceous Wetland Information, Submersed Aquatic Macrophyte Information
Maintenance of freshwater storage and supply	<i>This value is addressed by development of minimum levels based on appropriate significant change standards and other information and use of minimum levels in permitting programs.</i>
Aesthetic and scenic attributes	Cypress Standard, Dock-Use Standard, Wetland Offset Standard, Aesthetics Standard, Species Richness Standard, Herbaceous Wetland Information, Submersed Aquatic Macrophyte Information
Filtration and absorption of nutrients and other pollutants	Cypress Standard, Wetland Offset Standard, Lake Mixing Standard, Herbaceous Wetland Information, Submersed Aquatic Macrophyte Information
Sediment loads	<i>This value is not applicable for consideration for most priority lakes.</i>
Water quality	Cypress Standard, Wetland Offset Standard, Lake Mixing Standard, Dock-Use Standard, Herbaceous Wetland Information, Submersed Aquatic Macrophyte Information
Navigation	Basin Connectivity Standard, Submersed Aquatic Macrophyte Information

## 2.6 Consideration of Structural Alterations and Other Changes

Based on the provisions of Section 373.0421(1)(a), F.S., when establishing MFLs, SRWMD considers changes and structural alterations to watersheds, surface waters, and aquifers and the effects such changes or alterations have had, and the constraints such changes and alterations have placed, on the hydrology of an affected watershed, surface water, or aquifer. However, when considering such changes and alterations, SRWMD cannot allow significant harm caused by withdrawals. To accomplish this, SRWMD reviews and evaluates available information, and makes site visits to ascertain the following information concerning the subject watershed, surface water body, or aquifer:

- The nature of changes and structural alterations that have occurred.

- The effects the identified changes and alterations have had.
- The constraints the changes and alterations have placed on hydrology.

SRWMD has developed hydrologic models (ECT 2023), which addressed existing structural features, and has used these models to consider the effects these changes have had on the long-term hydrology of water bodies.

SRWMD considered that the existing hydrologic conditions, which were used to calibrate and verify the models, reflected the hydrologic changes due to structural alterations that have occurred in addition to changes that are the result of groundwater withdrawals existing at the time of model development.

This consideration may also apply to vegetation and soils conditions if the hydrologic changes, structural alterations, and water withdrawals have been sufficiently large to affect vegetation and soils and have been in place for a sufficiently long period of time to allow vegetation and soils to respond to the altered hydrology. However, the condition of vegetation and soils may not reflect the long-term existing hydrologic condition if the hydrologic changes, structural alterations, and water withdrawals are relatively recent. This is because vegetation and soil conditions do not respond to all hydrologic changes nor respond rapidly to changes in hydrology that are sufficiently large to cause such change.

SRWMD typically develops MFLs based on vegetation and soils conditions that exist at the time fieldwork is being performed to support the development of these MFLs.

## 3.0 Lake Setting and Description

### 3.1 Lake Basin Morphometry

Cherry Lake is located in the northern part of Madison County, within 1.5 miles of the Florida-Georgia border. County Road 253 (CR 253) runs along the perimeter of the lake and intersects with State Road 53 (SR 53) to the west of the lake (Figure 3-1). Cherry Lake has a boat ramp and 4-H club campground on the northwestern shore of the lake. This lake has an approximate surface area of 479 acres, according to the Gazetteer of Florida Lakes created by the University of Florida (Dickinson *et al.* 1982). Cherry Lake is found within the eastern part of the Tifton/Tallahassee Uplands region as determined by FDEP (Griffith *et al.* 1997). The Tifton/Tallahassee region changes distinctly as you move from west to east, with very few natural lakes in the west and predominantly solution basins, swampy depressions, and a few large swamp lakes in the east. This lake region comprises a heterogeneous mosaic of mixed forest, pasture, and agricultural lands. Lakes in this region tend to be slightly acidic to neutral, colored, softwater lakes with moderate nutrient values (Griffith *et al.* 1997). Some lakes in this region drain periodically when their karst drainage system becomes unplugged. ECT (2022) estimated that the Cherry Lake watershed, including Cherry Lake, the adjacent Garden Pond, and their contributing drainage areas, encompasses a total area of approximately 964.6 acres.

Cherry Lake's historical drainage was altered by a canal dug in the 1940s to power a grist mill (Norris 2014), shown as "Outfall Canal" in Figure 3-1. Anecdotal reports suggest that over time the bottom of the canal may have been scoured deeper by the passage of water (Norris 2014). Based on the ground survey data (Appendix A) and field observations by the District and ECT staff on March 2, 2017, the highest point of the outfall canal was a beaver dam, located approximately 100 feet upstream of NE Cherry Lake Cir., with a top elevation of 150.80 ft NAVD88. At the time of the survey, the 42" RCP beneath NE Cherry Lake Cir. seems to have been blocked by debris (likely due to beaver activities). This beaver dam and culvert blockage together seemed to control the outfall flow discharge from the lake during years preceding the survey but is no longer present.

The bathymetric data depicted in Figure 3-2 was surveyed by GPI on June 15, 2017. The lake elevation was reported as 150.81 ft NAVD88 at the stage gauge (USGS 02319150) near Cherry Lake, FL during this event. The lake has a mean depth of approximately 9 ft (Figure 3-2 and Figure D6).

The lake watershed covers approximately 964.6 acres (Table 3-1). As summarized in Table 3-1 and illustrated in Figure 3-3, the majority of the land uses in the watershed is waters (50.5%), followed by urban and built-up (24.4%) and upland forests (13.1%). Agricultural and rangeland comprise 7.8% of the watershed; while wetlands comprise 4.3%.

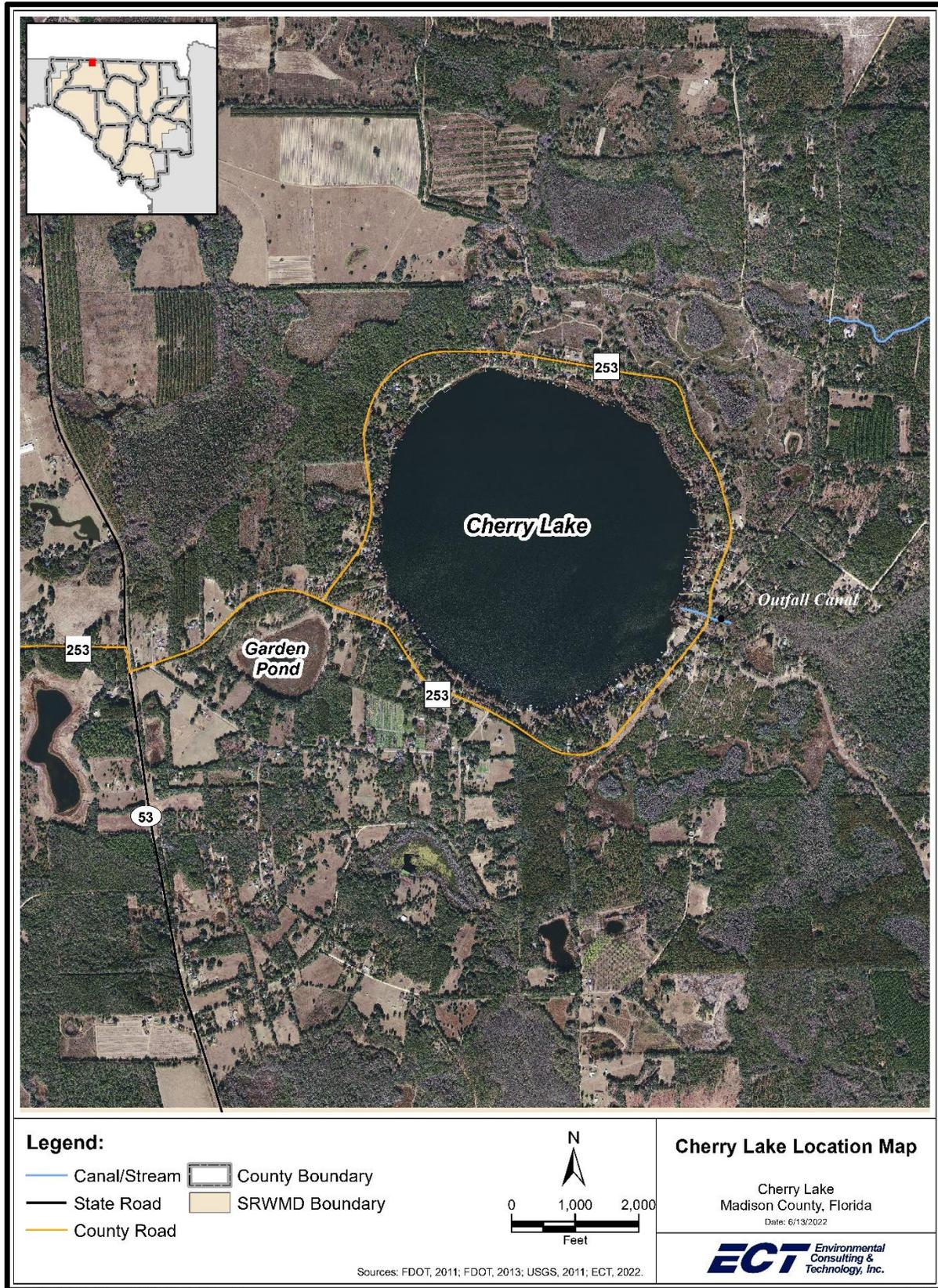


Figure 3-1. Cherry Lake location map.

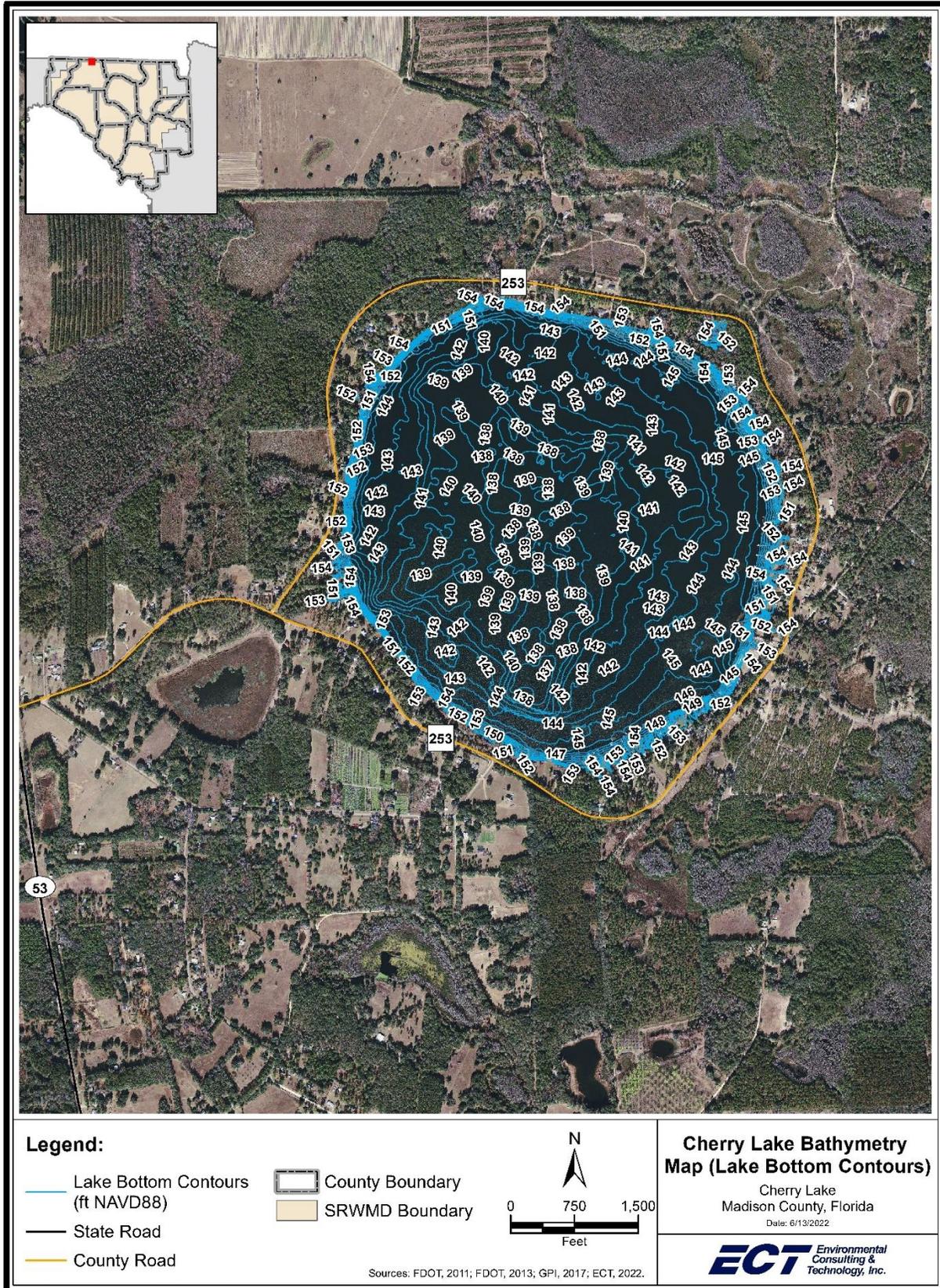


Figure 3-2. Cherry Lake bathymetry map (lake bottom contours in ft NAVD88).

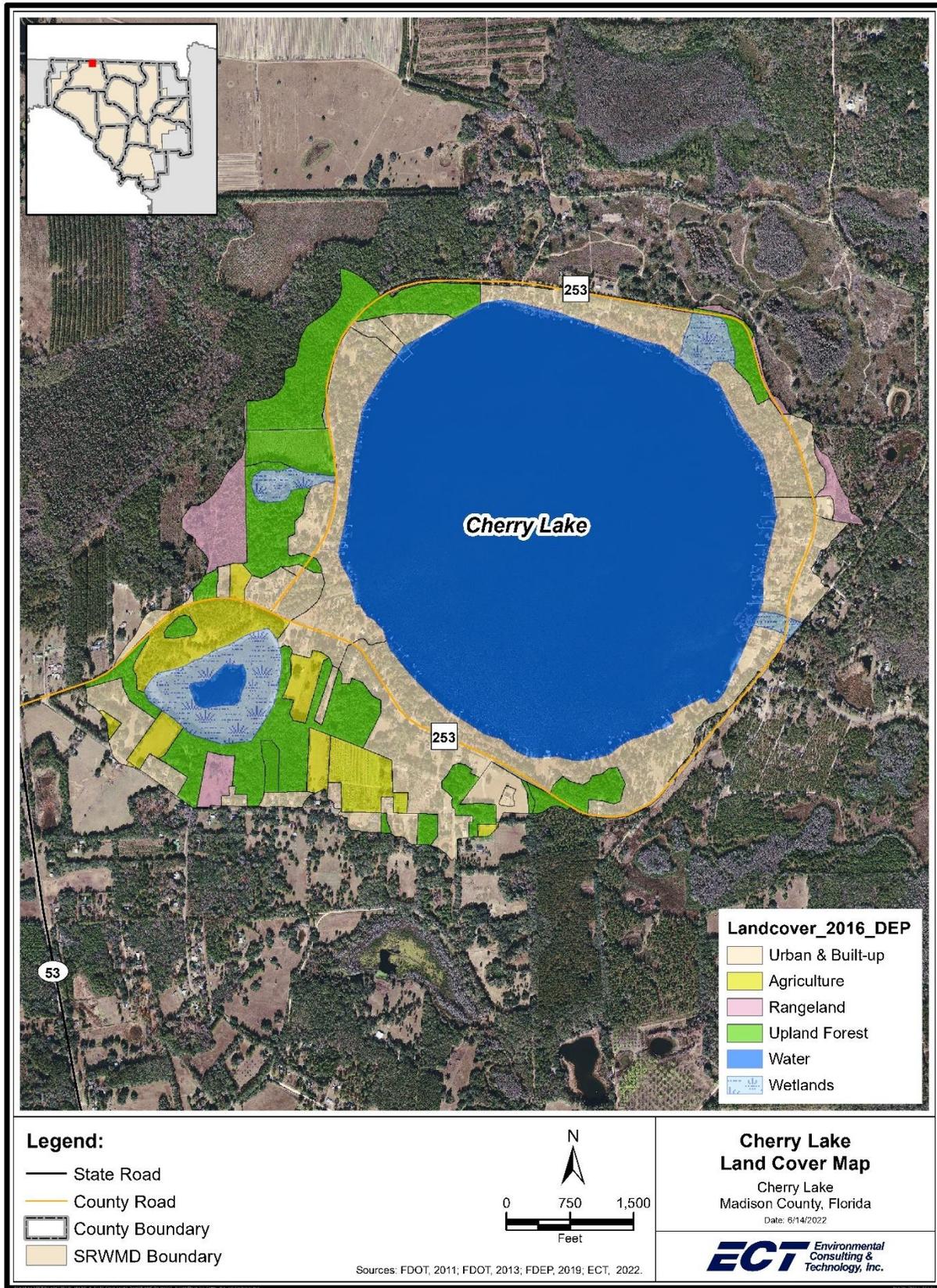


Figure 3-3. Land cover within the Cherry Lake watershed (colored areas).

Table 3-1. Statistical summary of 2016 land use in Cherry Lake watershed.

FLUCCS	Description	Area (acre)	Percentage
1000	Urban & Built-up	235.1	24.4%
2000	Agriculture	49.5	5.1%
3000	Rangeland	24.9	2.6%
4000	Upland Forests	126.4	13.1%
5000	Waters	487.1	50.5%
6000	Wetlands	41.6	4.3%
	Total	964.6	100.0%

### 3.2 Water Quality

In 2019, Cherry Lake was designated as impaired for nutrients based on “other information” indicating an imbalance of aquatic flora and was placed on the FDEP’s list of waterbodies not meeting applicable water quality standards. The “other information” evaluated included documentation by the University of South Florida (USF) Water Institute (see Appendix C) and FDEP (FDEP 2016) that there had been a shift in the aquatic vegetation in the lake from a diverse, native macrophyte-based system to one dominated by periphyton and more invasive macrophyte species, including algal mats (Dewberry 2023).

The raw water quality data on Cherry Lake was retrieved from the FDEP Watershed Information Network (WIN) by the District and provided to ECT. Based on the data review, Cherry Lake is a clear and softwater lake with true color readings averaging below 40 Platinum Cobalt Units (PCU) and Alkalinity reading average below 20 mg/L. Since Cherry Lake has no site-specific nutrient criteria, water quality criteria are set by 62-302.531 F.A.C., Numeric Interpretations of Narrative Nutrient Criteria (Table 3-2).

Table 3-2. Numeric nutrient criteria in lakes, 62-302.531 (2) (b) 1, F.A.C.

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll-a	Minimum calculated numeric interpretation		Maximum calculated numeric interpretation	
		Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen	Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen
≥ 40 Platinum Cobalt Units	20 µg/L	0.05 mg/L	1.27 mg/L	0.16 mg/L <sup>1</sup>	2.23 mg/L
≤ 40 Platinum Cobalt Units and ≥ 20 mg/L CaCO <sub>3</sub>	20 µg/L	0.03 mg/L	1.05 mg/L	0.09 mg/L	1.91 mg/L
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L CaCO <sub>3</sub>	6 µg/L	0.01 mg/L	0.51 mg/L	0.03 mg/L	0.93 mg/L

<sup>1</sup> For lakes with color ≥ 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit shall be the 0.49 mg/L TP streams threshold for the region.

There are a total of 79 unique days of sampling of any of the following three parameters: Total Nitrogen (TN), Total Phosphorus (TP), and Chlorophyll-a, over a period from 1995 through 2021. The daily means for each unique date were used to estimate annual geometric means of TN, TP, and Chlorophyll-a (Table 3-3).

*Table 3-3. Annual geometric means of TN, TP, and Chlorophyll-a at Cherry Lake (1995-2021).*

Year	TN (mg/L)	TP (mg/L)	Chlorophyll-a (µg/L)
1995	0.83	0.035	-
1996	0.49	0.028	10.00
1997	0.47	0.027	-
1998	0.27	0.028	0.90
2002	-	0.030	0.85
2003	0.34	0.026	1.78
2004	0.35	0.021	0.85
2005	0.63	0.024	3.20
2006	0.62	0.022	2.59
2007	0.62	0.026	11.53
2008	0.58	0.040	14.34
2011	0.41	0.015	2.90
2012	0.42	0.016	2.30
2013	0.47	0.019	1.90
2014	0.45	0.026	2.20
2015	0.52	0.016	5.54
2016	0.48	0.020	2.67
2017	0.45	0.013	1.47
2018	0.58	0.019	2.87
2019	0.69	0.028	10.76
2020	0.53	0.016	4.39
2021	0.64	0.023	7.72

As stated in Rule 62-302.531 F.A.C., the applicable interpretations for TN and TP will vary on an annual basis, depending on the availability of chlorophyll-a data and the concentrations of nutrients and chlorophyll-a in the lake, as described below. The applicable numeric interpretations for TN, TP, and chlorophyll-a shall not be exceeded more than once in any consecutive three year period.

- a. If there are sufficient data to calculate the annual geometric mean chlorophyll-a and the mean does not exceed the chlorophyll-a value for the lake type listed in Table 3-2, then the TN and TP numeric interpretations for that calendar year shall be the annual geometric means of lake TN and TP samples, subject to the minimum and maximum limits in Table 3-2.
- b. If there are insufficient data to calculate the annual geometric mean chlorophyll-a for a given year or the annual geometric mean chlorophyll-a exceeds the values in Table 3-2 for the lake

type, then the applicable numeric interpretations for TN and TP shall be the minimum values in Table 3-2.

The annual geometric means for Chlorophyll-a have a relatively broad range from 0.9 µg/L in 1998 to 14.34 µg/L in 2008, with an average level of 4.54 µg/L and a standard deviation of 4.07 µg/L. 75% of these readings are below the annual geometric mean standards for chlorophyll-a (6 µg/L), and there is no apparent trend during the sampling period.

The annual geometric means for TN have remained relatively stable since 1996. For the years with an annual geometric mean Chlorophyll-a below 6 µg/L, the annual geometric means for TN are all below the maximum numeric criterion of 0.93 mg/L. While in the seven years (1995, 1996, 1997, 2007, 2008, 2019, and 2021) with an annual geometric mean Chlorophyll-a greater than 6 µg/L or there are insufficient data to calculate the annual geometric mean Chlorophyll-a, these values exceeded the minimum numeric criterion of 0.51 mg/L in Years 1995, 2007, 2008, 2019, and 2021 and more than once in consecutive three year periods of 2007-2009 and 2019-2021.

The annual geometric means for TP show no apparent trend during the sampling period. For the years with an annual geometric mean Chlorophyll-a below 6 µg/L, the average annual geometric means for TP do not exceed the maximum numeric criterion of 0.03 mg/L. While in the seven years with an annual geometric mean Chlorophyll-a greater than 6 µg/L or there are insufficient data to calculate the annual geometric mean Chlorophyll-a, these values exceeded the minimum numeric criterion of 0.01 mg/L and more than once in consecutive three-year periods of 1995-1997, 2007-2009, and 2019-2021.

Cherry Lake (a public Class III fresh waterbody) is located in the Big Bend bioregion, per a map of the bioregions contained in SCI 1000: Stream Condition Index Methods (DEP-SOP-003/11 SCI 1000) dated March 1, 2014. According to Rule 62-302.533 F.A.C., Dissolved Oxygen Criteria for Class I, Class II, Class III, and Class III-Limited Waters, no more than 10 percent of the daily average percent dissolved oxygen (DO) saturation values shall be below 34 percent in the Northeast and Big Bend bioregions. DO saturation values, collected at Cherry Lake from 1995 through 2021 (Figure 3-4), include a total of 72 daily means of DO saturation values ranging from 81.0 to 136.5 percent, i.e., the DO criteria is met at Cherry Lake. This also supports anecdotal and observational evidence of robust submerged aquatic vegetation growth (Appendix C).

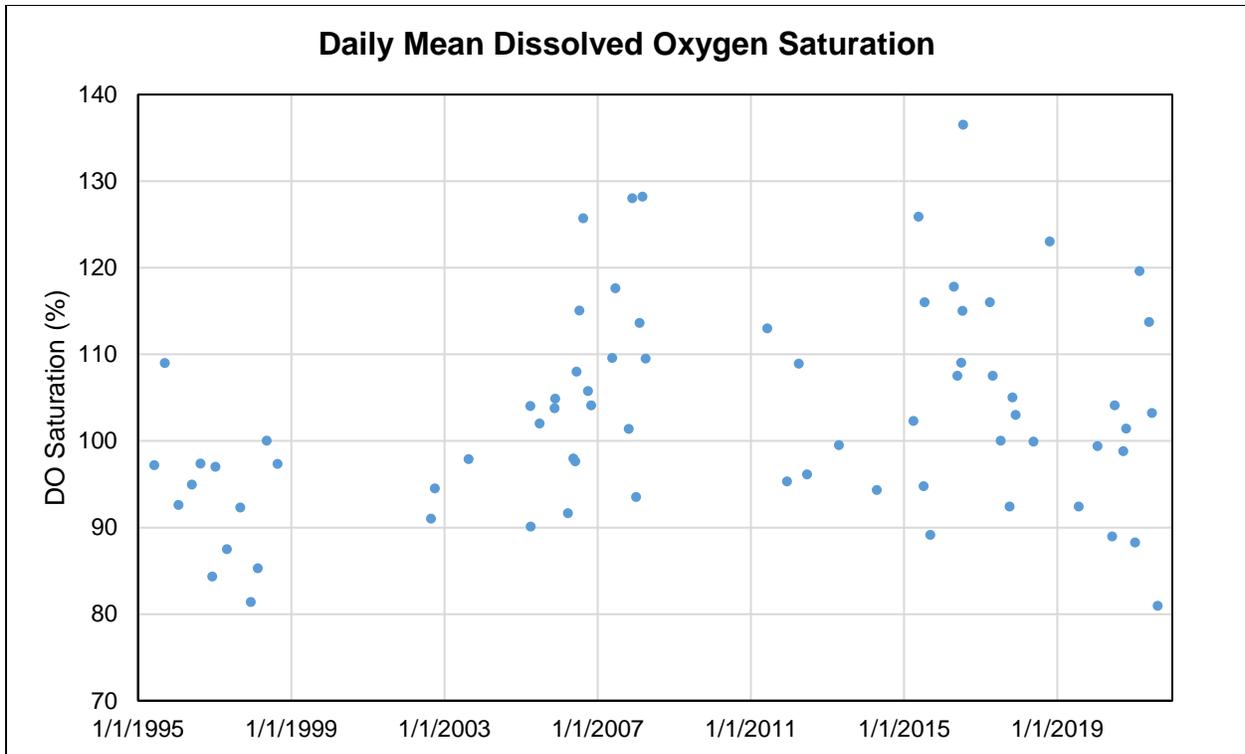


Figure 3-4. Mean daily dissolved oxygen saturation values for Cherry Lake.

In addition to the water quality data analysis described above and the special studies (Appendix C and FDEP 2016), there have been numerous public meetings since 2015 at which local residents have voiced concerns regarding the decline of water quality in Cherry Lake. In order to gain some added stakeholder perspectives, Dewberry prepared a questionnaire and sent it to the Friends of Cherry Lake Focus Group (Dewberry 2023).

From a total of eight survey responses received from residents who lived full-time or part-time on the lake for at least the last 10 years, the concerns raised by stakeholders included the following:

- Increase in the number of homes around the lake.
- Increased power boats on the lake, especially since the addition of a new boat club.
- More trash in the lake.
- Decreased water clarity, with more vegetation along the shore, algal mats in the lake since 2012 and the presence of hydrilla since the 2000s.
- Water quality problems peak in the summertime.
- Water levels in the lake have declined.

Dewberry (2023) elaborated and summarized these concerns and recommended potential restoration options and funding sources to address these concerns. Two of the major concerns are relevant to increased motorized watercraft and falling lake levels. Due to the shallow nature of the lake, and as a result of falling lake levels, the increase in the number of boats with large motors may be a significant source of nutrients to the lake as they stir up nutrient laden sediments in shallow lakes (Asplund, 2000). Asplund found that impacts on lake water clarity and algal growth due to

motorized watercrafts are related to lake depth, boat size, engine size, boat speed, and substrate type. Potential impacts in Cherry Lake are exacerbated by the fact that highest boat use occurs in the summer months when light levels and temperatures are higher, which allows for greater algal growth in response to the increase in nutrients in the water column.

Since Cherry Lake has been formally listed as impaired and placed on Florida's 303(d) Verified List, it can be prioritized for development of a Total Maximum Daily Load (TMDL) that establishes the loading that will attain water quality standards. However, stakeholders are provided an opportunity to develop restoration plans as an alternative to developing a TMDL. The alternative restoration plan can be a Reasonable Assurance Plan that is adopted by Final Order of the FDEP Secretary, or the stakeholders in the affected watershed can propose a series of restoration actions as part of a Pollutant Reduction Plan (Dewberry 2023).

### 3.3 Wetlands

Natural wetlands that are either contiguous or hydrologically connected to Cherry Lake were mapped using data produced by the US Fish and Wildlife Service, National Wetlands Inventory (NWI) and are shown in Figure 3-5. This geospatial data was developed for the purpose of mapping and tracking the status of wetlands and deepwater habitats in the United States and its territories. The NWI classifies wetlands by a hierarchical structure (Federal Geographic Data Committee 2013). In the case of Cherry Lake, wetland classification is based mainly upon dominant vegetation type and hydrologic regime.

Wetlands contiguous to the lake are shown in Figure 3-4 and classified accordingly:

- Deciduously vegetated, semi-permanently flooded wetland (PFO6F); and
- Deciduous, seasonally flooded wetland (PFO6C), which is located upslope of the lake.

The water regimes in the preceding list are sorted from wetter to drier in the following order: semi-permanently flooded is flooded more often than seasonally flooded.

Cherry Lake has a relatively thin band of wetlands surrounding it (approximately 15-foot wide in many areas and occasionally wider), representing the emergent portion of the lacustrine (lake) system, which supports emergent zone plants (e.g., maidencane [*Panicum hemitomon*]) and mature pond cypress (*Taxodium ascendens*) trees. This thin band of wetlands are not shown by the NWI polygons in Figure 3-4 but are described in Appendix B of this report.

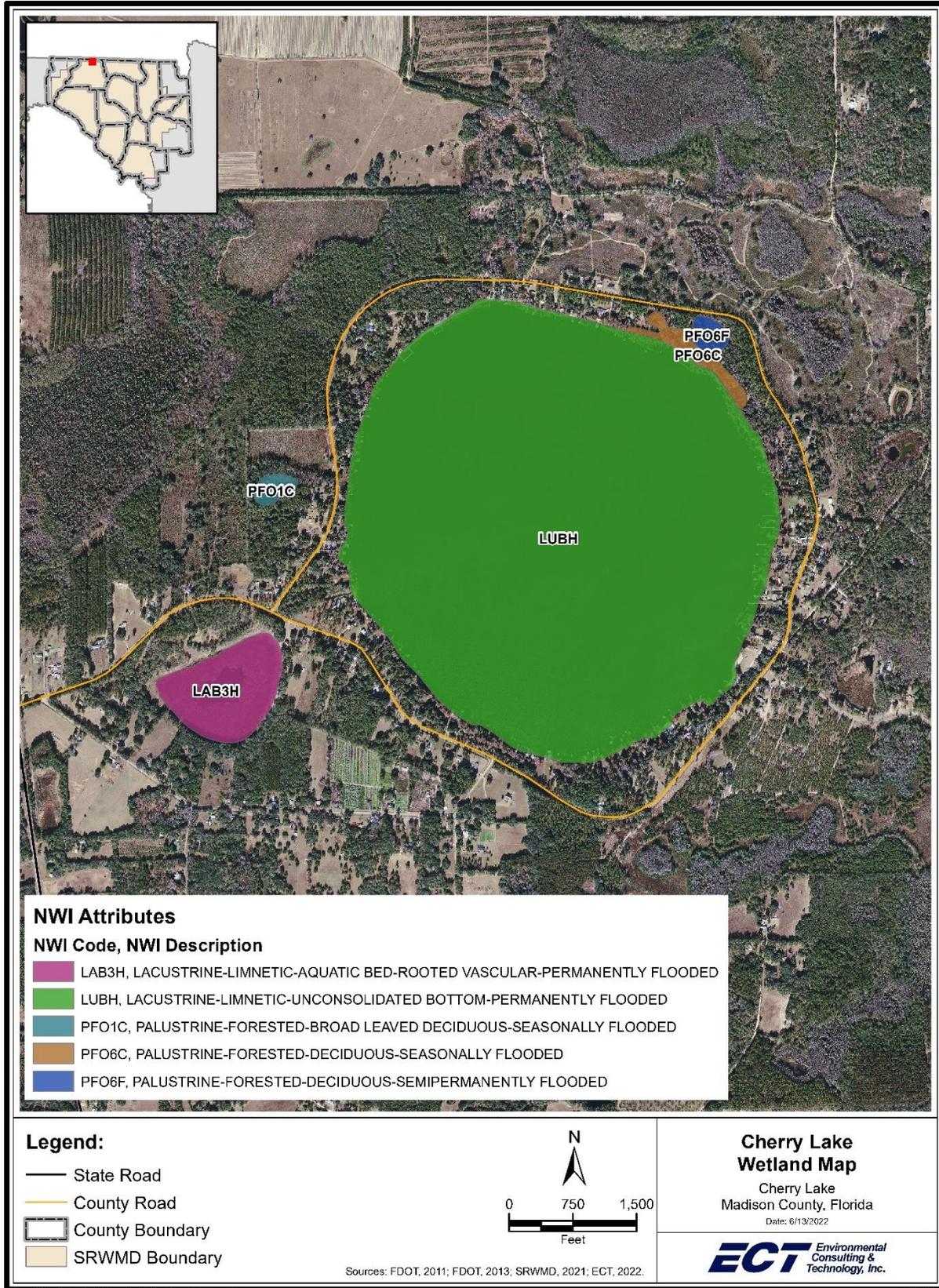


Figure 3-5. Cherry Lake wetlands map.

### 3.4 Lake Stage Record

The U.S. Geological Survey (USGS) has a long-term stage gauge, USGS 02319150 Cherry Lake, located at a wood dock on the west lakeshore (ECT 2023). This gauge provides a long-term lake stage record at various reporting frequencies from November 11, 1974, to the present (Figure 3-6) and has been operated by the District since inception. The highest lake stage elevation on record is 152.81 ft NAVD88 and occurred on April 15, 1975. The lowest lake stage elevation on record is 149.31 ft NAVD88 and occurred on May 28, 2012.

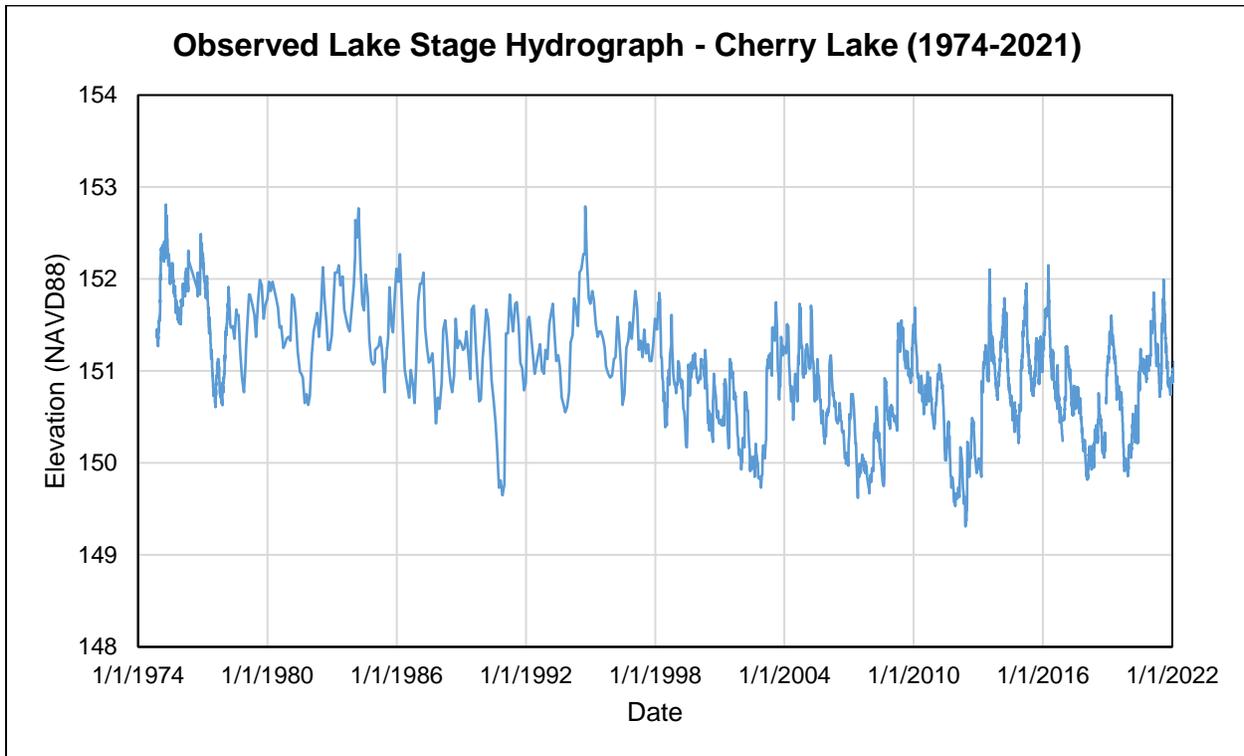


Figure 3-6. Hydrograph for Cherry Lake observed stage data for the period of record of 11/11/1974 - 12/31/2021.

### 3.5 Lake History

Determination of whether a site is considered structurally altered is an important part of the SWFWMD MFL method for lake analysis. A lake which is considered structurally altered has an anthropogenically-modified outfall that results in lake water levels no longer rising to a level sufficient to maintain the integrity of surrounding wetlands.

Local resident, Mike Holton, provided useful information about the history of the lake during a meeting on March 23, 2017, including a discussion of the outfall canal located in the southeast area of the lake (Figure 3-1). He explained that the outfall canal was constructed to provide power for a grist mill, which was known to be in operation as early as 1936. The canal was dug by hand. He also referred us to internet resources accessible using the key words “Cherry Lake Farms” which was a historical project completed in 1935 under Franklin Roosevelt’s “New Deal” that involved the relocation of 500 needy families from Tampa, Miami, and Jacksonville onto a 15,000-acre

communal tract around the lake. The workers formed the cooperatively-owned Cherry Lake Farms and constructed a school, an auditorium, a coop store, barracks, a lumber yard, and a mill (Florida 1935). Mr. Holton and others have observed the canal getting deeper over time, eroding down into a clay layer in the bottom of the canal. There is a road crossing the canal (CR 253) with a culvert, and Mr. Holton noted that the road was modified around 1963. He also noted that the forest had been clear cut up to the lake to provide for agriculture.

Mr. Holton reported that water quality in the lake is generally good, although the lake has had occasional fish kills and algae blooms. He noted that docks that were built during dry times in the late 1980s have been submersed during high lake stage events. He also mentioned that in 1958 a shallow area in the lake became exposed during a low water period. During a field visit on February 6, 2018, Mr. Holton shared memories with GPI and the SRWMD of levels he recalled the lake reaching regularly approximately 50 years ago (note Mr. Holton's location in Figure 3-7 at his recollected high water line). The robust growth of lichens at the bases of the pond cypress trees show that water levels have not regularly exceeded levels at the bases of these trees for multiple days for many years (Figure B4 in Appendix B).



*Figure 3-7. Mr. Holton indicating historical high water levels regularly achieved approximately 50 years ago (by location of his feet).*

## 4.0 MFLs Methodology for Cherry Lake

This section provides an overview of the methods and assumptions used in the minimum water levels evaluation process for Cherry Lake, including procedures such as site selection, field data collection, and data analyses. Detailed methods are provided in respective appendices of this report. The SWFWMD Lake MFLs methods are detailed in SWFWMD (1999a, 1999b, and 2021), Leeper et al. (2001), and Hancock (2007).

The field data collection procedures focused on collection of indicators of historical inundation, specifically indicators of Historical Normal Pool (HNP). Other items surveyed in the field included all docks at the lake and certain culverts and conveyances identified by ECT, as well as a bathymetric survey of the lake bottom. In addition to sampling procedures presented for field data collection, aerial imagery, maps, and other reliable information were obtained and reviewed for planning and studied for evidence of alterations that may have occurred within the lake and its watershed.

Initial survey field operations took place between June 12 and June 26, 2017, with the bathymetric survey being performed on June 15, 2017. A submerged aquatic vegetation survey was performed by the USF Water Institute on August 10 and 11, 2017. Hydrologic indicators were marked in the field by GPI environmental scientists on February 6, 2018. Subsequent field surveys to locate and determine the elevations of the hydrologic indicators were performed during the period February 12 through 15, 2018.

### 4.1 Site Selection

Using aerial imagery and the NWI map as guides, two areas were chosen for detailed investigation during an initial field reconnaissance performed by GPI staff using boat on March 23, 2017. These two wetland areas, designated as W1 and W2 in Figure 4-1, were selected as sampling areas due to their relatively high concentrations of mature pond cypress trees that were needed to reliably estimate Cherry Lake's HNP elevation.

### 4.2 Site Survey

To relate relevant benchmarks to existing hydrologic data, two detailed elevation surveys were conducted by a Florida-licensed Professional Surveyor and Mapper (PSM). Detailed procedures are presented in Appendix A. The major surveying tasks are listed below:

- Establishment of horizontal and vertical control for the project area;
- Surveying culverts, water levels, roadway centerline “crown” elevations, and other drainage features requested by ECT to support hydrologic modeling;
- Gathering elevation data for all docks and end-of-dock sediment elevations;
- Performing a bathymetric survey; and
- Gathering elevation data for hydrologic indicators at two wetland areas.

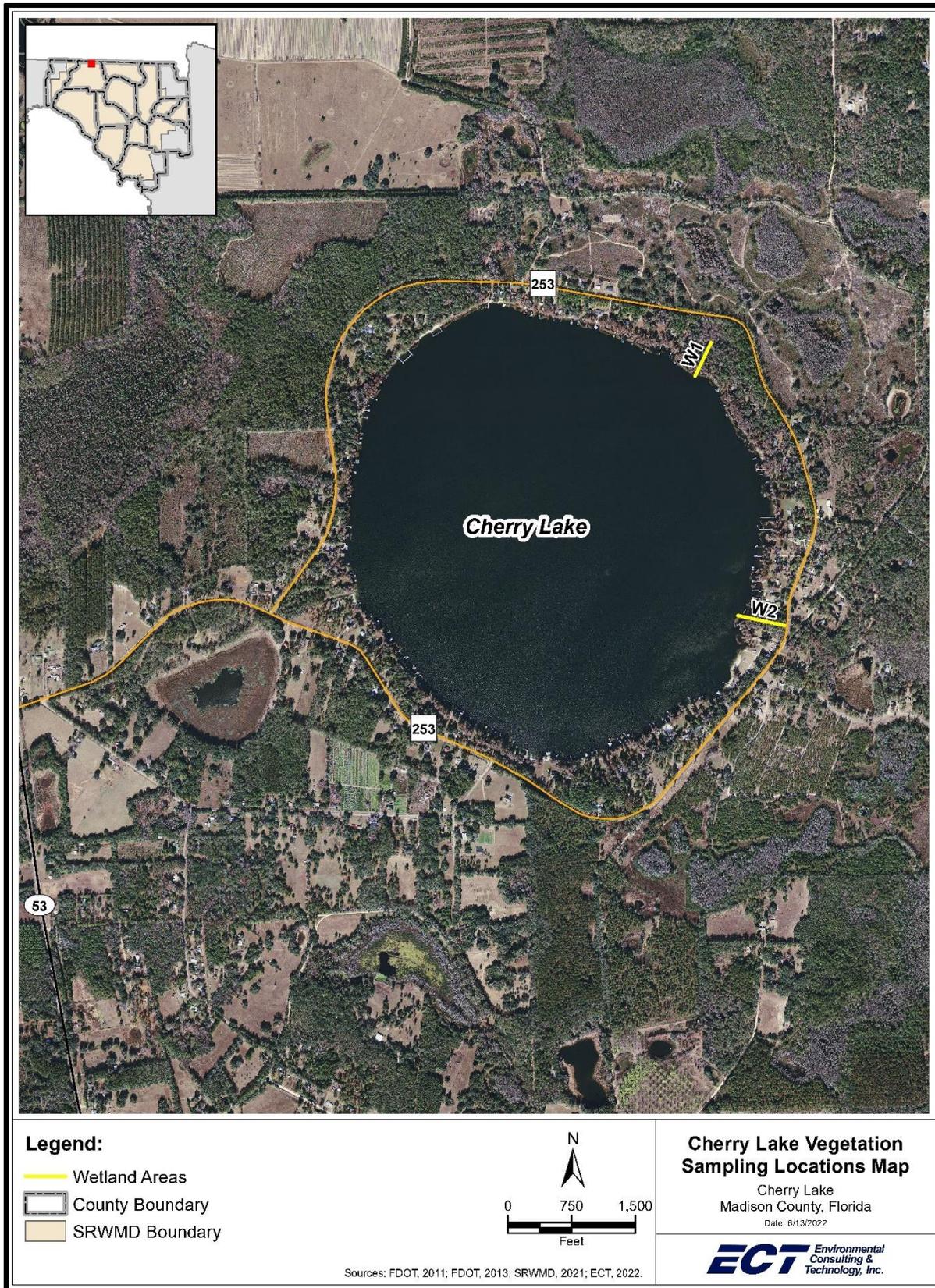


Figure 4-1. Cherry Lake vegetation sampling locations

### 4.3 Hydrologic Indicator Sampling Procedures

Hydrologic indicators selected for the MFL determination included cypress (*Taxodium* spp.) buttress inflection points, which may represent the Historic Normal Pool of a lake (SWFWMD 1999a, 1999b, and 2021; Leeper *et al.* 2001; Hancock 2007). Other indicators of normal pool are illustrated in Figure 4-2 (Carr *et al.* 2006). These indicators identify boundaries where morphological plant adaptations occur in response to ponding or flooding. Such adaptations may occur above or below the waterline. Buttressing of tree bases, adventitious rooting, and moss collars are also morphological plant adaptations used in delineating the landward extent of wetlands and other surface waters (Rule 62-340.500(9), F.A.C.). Detailed sampling procedures are presented in Appendix B of this report.

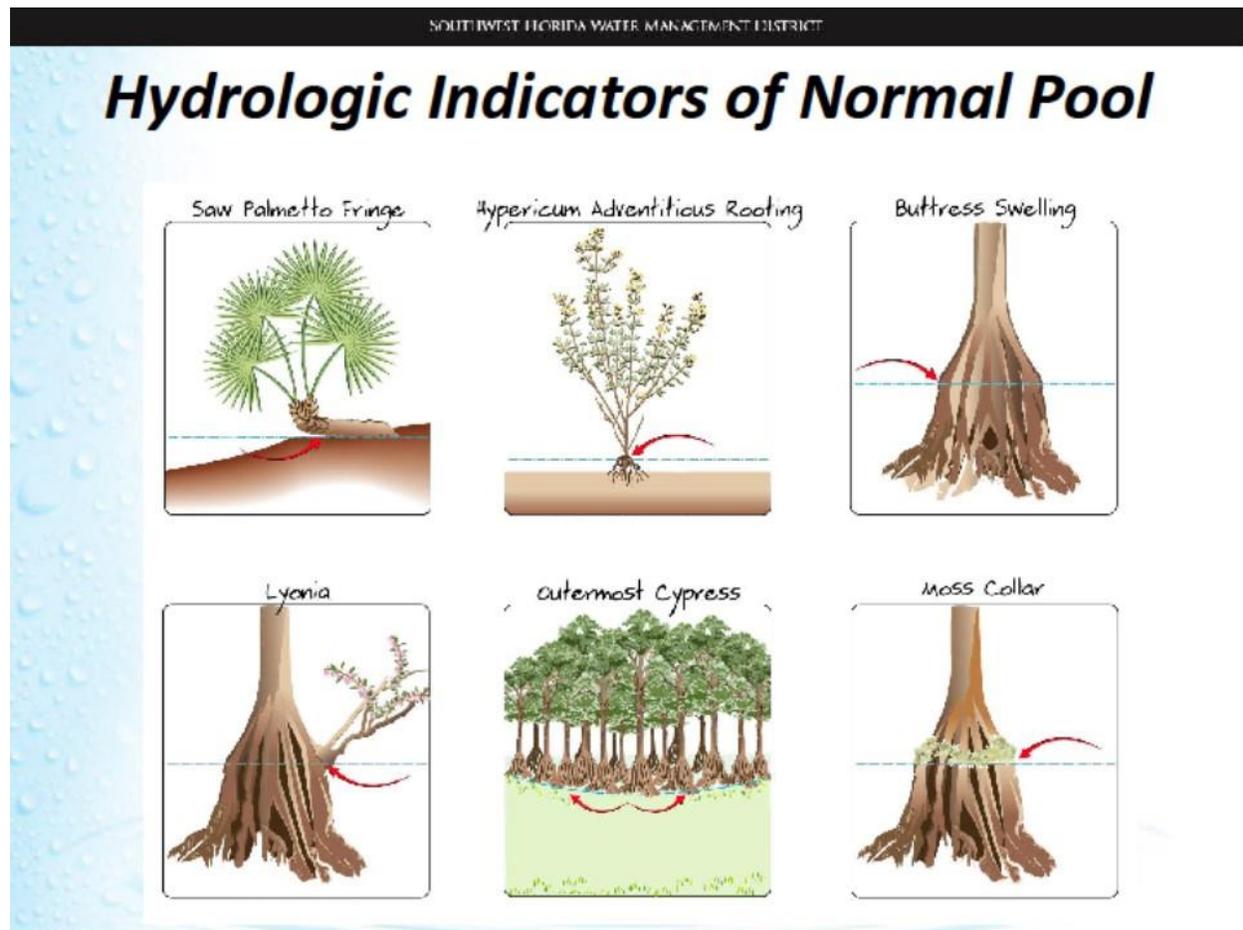


Figure 4-2. Hydrologic indicators of normal pool (Courtesy of Doug Leeper, SWFWMD). Adventitious roots occur on stems or trunks of certain plants when inundated; and *Lyonia* is a wetland shrub shown rooted above normal pool.

### 4.4 Submerged Aquatic Vegetation Mapping

The USF Water Institute was tasked with assessing the submerged aquatic vegetation (SAV) community for Cherry Lake. The goal of this assessment was to identify the species composition,

their relative dominance, distribution, percent area covered, and percent volume inhabited. The field data were collected on August 10 and 11, 2017.

The USF Water Institute utilized a dual sampling method including manual vegetation sampling and analysis of concurrently collected sonar data. Concurrently, a frotus sampling device (double-sided rake) was used to sample the SAV community (FDEP 2011). Detailed sampling procedures are presented in Appendix C of this report.

## 4.5 Data Analyses

Statistical data analyses and figures were prepared using the following software programs: Microsoft Excel, R (R Core Team 2014), and Statistica (StatSoft 2004). Statistical analyses were performed on surveyed elevation data after assigning elevation data to hydrologic indicators. The median of all cypress buttress elevations was the most important statistic as it defined the HNP for Cherry Lake. The ArcGIS 10.8.1 3D Analyst Extension Surface Volume tool was used to calculate the 2D and 3D areas of the lake associated with various levels. All percentiles were calculated using the Weibull plotting position formula.

Detailed procedures are provided in Appendices B through D for wetlands and hydrologic indicator sampling, submerged aquatic vegetation mapping, and supporting information for development of minimum levels, respectively.

## 5.0 Development of Minimum Levels for Cherry Lake

Minimum Levels for Cherry Lake were developed using the SWFWMD methodology (SWFWMD 1999a, 1999b, and 2021; Leeper *et al.* 2001; Hancock 2007). Levels, significant change standards, and additional information are provided in Table 5-1, along with lake surface areas for each level, for a total of three Control Point (CP) scenarios recommended by the District, as listed below:

- High CP Scenario: 150.80 ft NAVD88 at the top of the beaver dam in the outfall canal;
- Medium CP Scenario: 150.20 ft NAVD88 at the highest point along the outfall canal; and
- Low CP Scenario: 149.52 ft NAVD88 at the invert of the culvert beneath NE Cherry Lake Cir.

*Table 5-1. Minimum levels and significant change standards for Cherry Lake for three selected Control Point scenarios.*

Levels	High CP Scenario		Medium CP Scenario		Low CP Scenario	
	Elevation (ft NAVD88)	Lake Area (Acres)	Elevation (ft NAVD88)	Lake Area (Acres)	Elevation (ft NAVD88)	Lake Area (Acres)
<b>Lake Stage Percentiles</b>						
Historic P10	151.15	481	150.68	478	150.45	476
Historic P50	150.52	476	150.03	473	149.76	471
Historic P90	149.28	468	148.82	464	148.55	463
<b>Other Levels</b>						
Historic Normal Pool	151.48	484	151.48	484	151.48	484
Control Point	150.80	479	150.20	474	149.52	469
<b>Significant Change Standards</b>						
Cypress Standard	149.68	470	149.68	470	149.68	470
Dock-Use Standard	150.58	477	150.55	477	150.55	477
Wetland Offset Standard	149.72	471	149.23	467	148.96	465
Aesthetics Standard	149.28	468	148.82	464	148.55	463
Lake Mixing Standard	147.36	454	147.36	454	147.36	454
Species Richness Standard	144.99	405	144.94	402	144.91	400
Recreation/Ski Standard	145.31	418	145.28	417	145.28	417
Basin Connectivity Standard	NA	NA	NA	NA	NA	NA
<b>Minimum Levels</b>						
High Minimum Lake Level	150.35	475	150.33	475	150.37	475
Minimum Lake Level	149.72	471	149.68	470	149.68	470

NA - not available/not appropriate

Detailed descriptions of the development and use of these levels and the significant change standards are provided in subsequent sections of this report.

For the purpose of minimum levels and guidance levels determination, lake stage data are classified as “Historic” for periods when there are no measurable impacts due to water withdrawals, and the impacts due to structural alterations are similar to existing conditions. “Structural alterations,” in this context, means 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.

## 5.1 Bathymetry

Relationships between lake stage, inundated area, and volume can be used to evaluate expected fluctuations in lake size that may occur in response to climate, other natural factors, and anthropogenic impacts such as structural alterations or water withdrawals. Long term reductions in lake stage and size can be detrimental to many of the environmental values identified in the Water Resource Implementation Rule for consideration when establishing MFLs. Stage-area-volume relationships are therefore useful for developing significant change standards and other information identified in the methods for developing minimum lake levels.

Stage-area-volume relationships were determined for Cherry Lake by building and processing a triangular irregular network (TIN) and a digital elevation model (DEM) of the lake bathymetry and land surface elevations of the surrounding watershed. The 2017 SRWMD bathymetric survey data and the 2011 USGS topographic DEM data (NGC 2011) were used to build the bathymetric TIN and DEM through a series of analyses using ArcGIS 3D and Spatial Analyst Extensions. The bathymetric TIN and DEM maps are illustrated in Figures D1 and D2 in Appendix D, respectively.

The bathymetric TIN was used to calculate the stage areas and volumes at 0.5-foot elevation change increments using the Surface Volume tool in the Functional Surface toolset of the ArcGIS 3D Analyst toolbox. The resultant stage-area-volume relationships are listed in Appendix D, Table D1, from the deepest pool of 137.0 ft NAVD88 to the land elevation of 154.0 ft NAVD88. The stage-area relationship in this table was used to estimate the surface lake areas relative to the levels that are listed in Table 5-1, e.g., Historic Normal Pool and Cypress Standard.

The stage-area (2D area) relationship created from Appendix D, Table D1 is plotted in Figure 5-1, along with the Historic Normal Pool and Cypress Standard elevations. The stage-area data was also utilized for the development of lake water budget models that estimate the lake’s response to rainfall and runoff, outfall or discharge, evaporation, leakage, and groundwater withdrawals.

The relationships of stage versus surface area (2D area), bottom area (3D area), volume, mean depth, and maximum depth, are illustrated in Figures D3 through D7 in Appendix D, respectively.

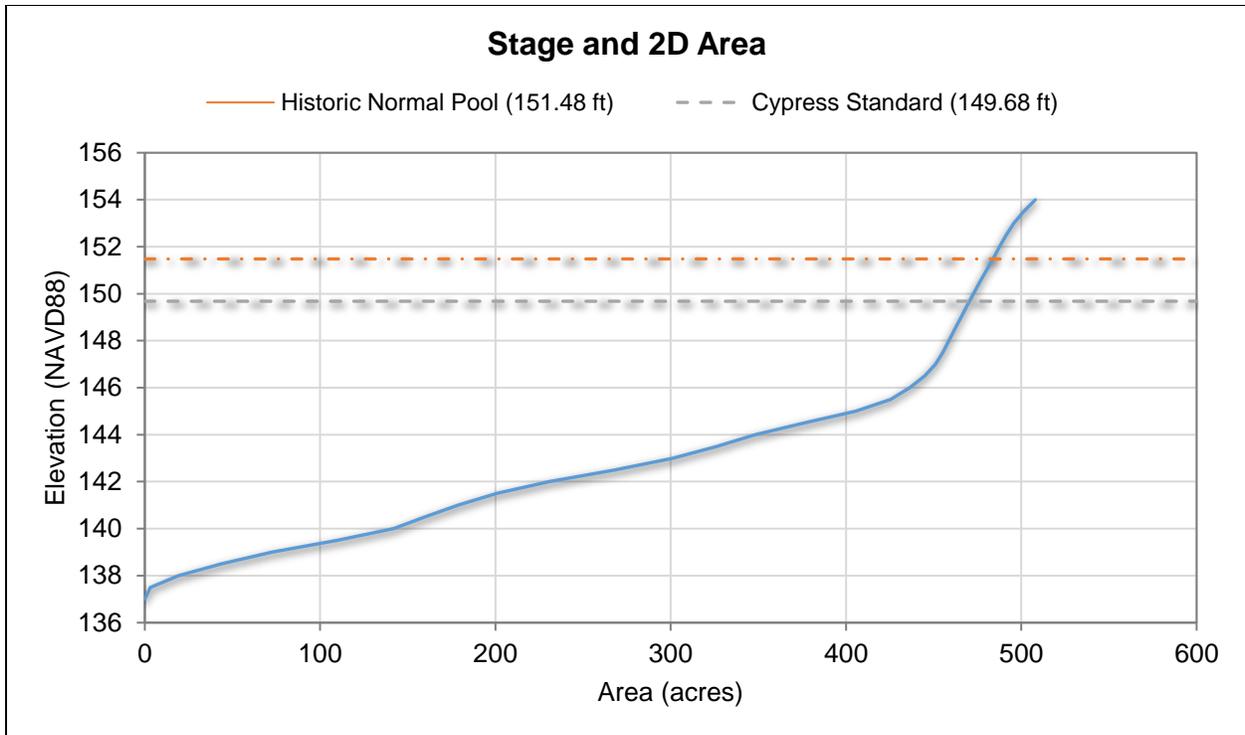


Figure 5-1. Lake stage to surface area for Cherry Lake with Historic Normal Pool and Cypress Standard elevations.

## 5.2 Lake Stage Data and Exceedance Percentiles

A key part of establishing minimum levels is the development of exceedance percentiles based on historic lake stage data. For the purpose of minimum level determinations, lake stage data are categorized as “Historic” for periods when there were no measurable impacts due to water withdrawals and impacts due to structural alterations were similar to existing conditions. In the context of minimum levels development, “structural alterations” means 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.

A long-term historic lake stage record is critical for development of exceedance percentiles. As described in Section 3.4 above, there is a stage gauge (USGS 02319150) near Cherry Lake, Florida located at a wood dock on the west lakeshore. This gauge provides a long-term lake stage record at various reporting frequencies from November 11, 1974, to the present (Figure 3-6). The period of record (POR) at this gauge appears to show a downward trend in water levels with a decrease of about one foot occurring around April 1998. The date of April 1998 was derived by performing a changepoint analysis in R using the changepoint package considering both changes in mean and variance of the time series (Killick and Eckley 2014). As observed by Mr. Holton and others, the outfall canal had been lowered over time, eroding down into a clay layer in the bottom of the ditch. The downward trend in lake levels did not continue after April 1998. In addition, the beaver dam and culvert blockage observed in the canal need to be considered when evaluating the historic lake stage data. In summary, the “measured” lake stage data during the POR does not adequately

represent the Historic conditions at Cherry Lake, since a stable high point in the outlet conveyance system did not exist throughout the entire POR (ECT 2023).

To better represent the Historic conditions and the impacts due to structural alterations in the existing outfall canal and in the absence of groundwater withdrawals, the calibrated Cherry Lake water budget model was used, with necessary adjustments, to run long-term simulations for an extended period of 55.7 years from April 29, 1960, to December 31, 2015.

As described in Section 5.3 below, three lake Control Point elevations, i.e., 150.80, 150.20, and 149.52 ft NAVD88, were selected to represent the existing and possible structural alterations that occurred or could occur in the outfall canal. In the long-term water budget models, the invert elevations of the weir and channel links along the outfall canal were adjusted according to the selected Control Point elevations.

Based on the reference timeframe (RTF) analysis results provided by the District, the groundwater level data set for the no-pumping scenario was created using the “measured” groundwater data set estimated at Cherry Lake. This “measured” groundwater dataset was estimated using data collected at the USGS groundwater well station Lovette Tower near Hamburg, FL (USGS ID: 303400083305301 / SRWMD ID: N020822002), the USGS Blackwater Plantation station near Ashville, FL (USGS ID: 303812083362401 / SRWMD ID: N030727001), and the USGS 19E009 station near Valdosta, GA (USGS ID: 304949083165301). The “no-pumping” groundwater levels were created by adding the time-varying RTF adjustment factors to the “measured” groundwater level data set (ECT 2023).

A technical memorandum “*Development of a Reference Timeframe Flow (RTF) Regime for the Minimum Flows and Minimum Water Levels (MFLs) Re-Evaluation of the Lower Santa Fe and Ichetucknee Rivers and Priority Springs*” was developed by the District in 2019 and published as Appendix D of a recent MFL report “*Minimum Flows and Minimum Water Levels Re-Evaluation for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs*” (HSW 2021). This memo outlines the process used to develop reference timeframe flow and/or groundwater-head (head) time-series (e.g., “no-pumping” condition) at groundwater monitoring locations, springs and/or stream gauge locations using observed and modeled data and an estimated time series of historic groundwater withdrawals. The model used in this analysis is the North Florida Southeast Georgia Groundwater Model, (NFSEG 1.1) (Durden *et al.* 2019).

The groundwater level data set developed for the no-pumping scenario was implemented in the long-term model simulations to estimate the groundwater loss from the lake for the Historic conditions. It was assumed that the 55.7-year simulated lake stage data set for the no-pumping scenario is a statistically representation of the hydrology, absent significant climatological changes, under each selected Control Point elevation representing structural alterations at the outfall canal, over the 55.7-year model duration (ECT 2023). This approach was considered appropriate in developing no-pumping lake stage exceedance percentiles under the high, medium, and low Control Point scenarios.

Based on the daily model simulated lake stage data sets for the no-pumping scenario for the high, medium, and low Control Point scenarios (Figures 5-2A through 5-2C), the Historic P10, P50, and P90 elevations were developed for Cherry Lake (Figures 5-3A through 5-3C and Table 5-2).

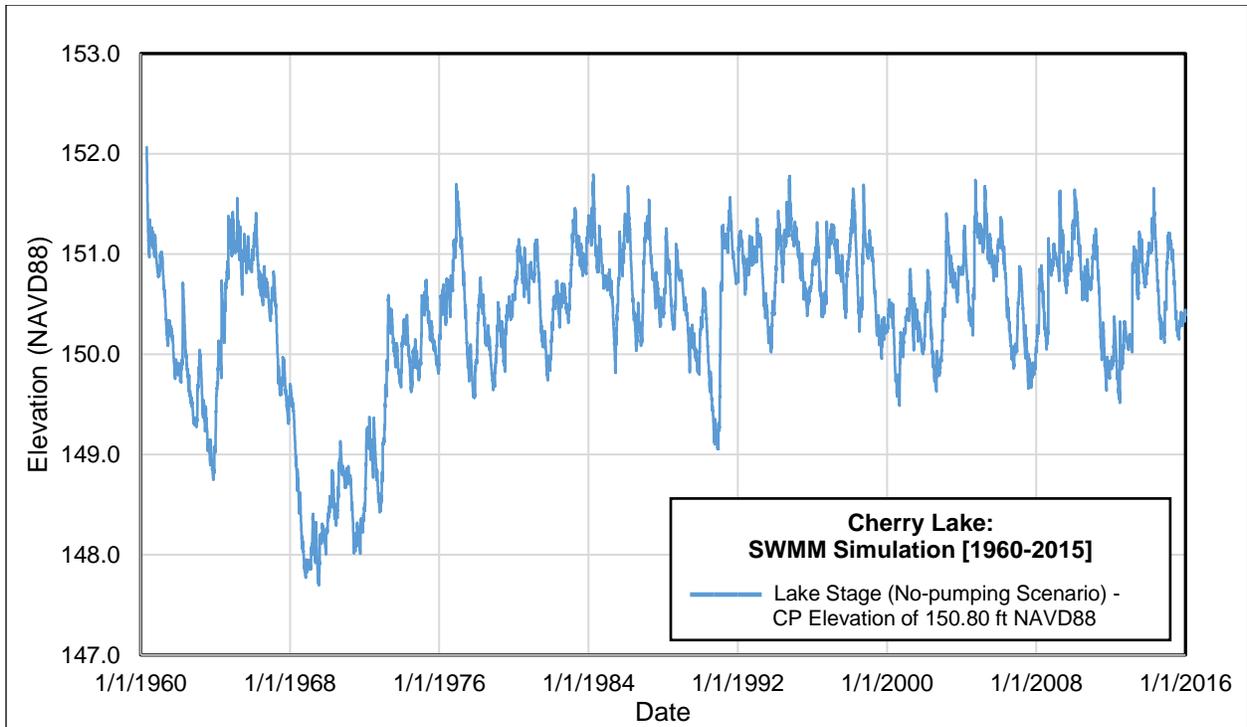


Figure 5-2A. Hydrograph for Cherry Lake model simulated stage data for no-pumping scenario for the period of 4/29/1960 - 12/31/2015 for the High Control Point Scenario.

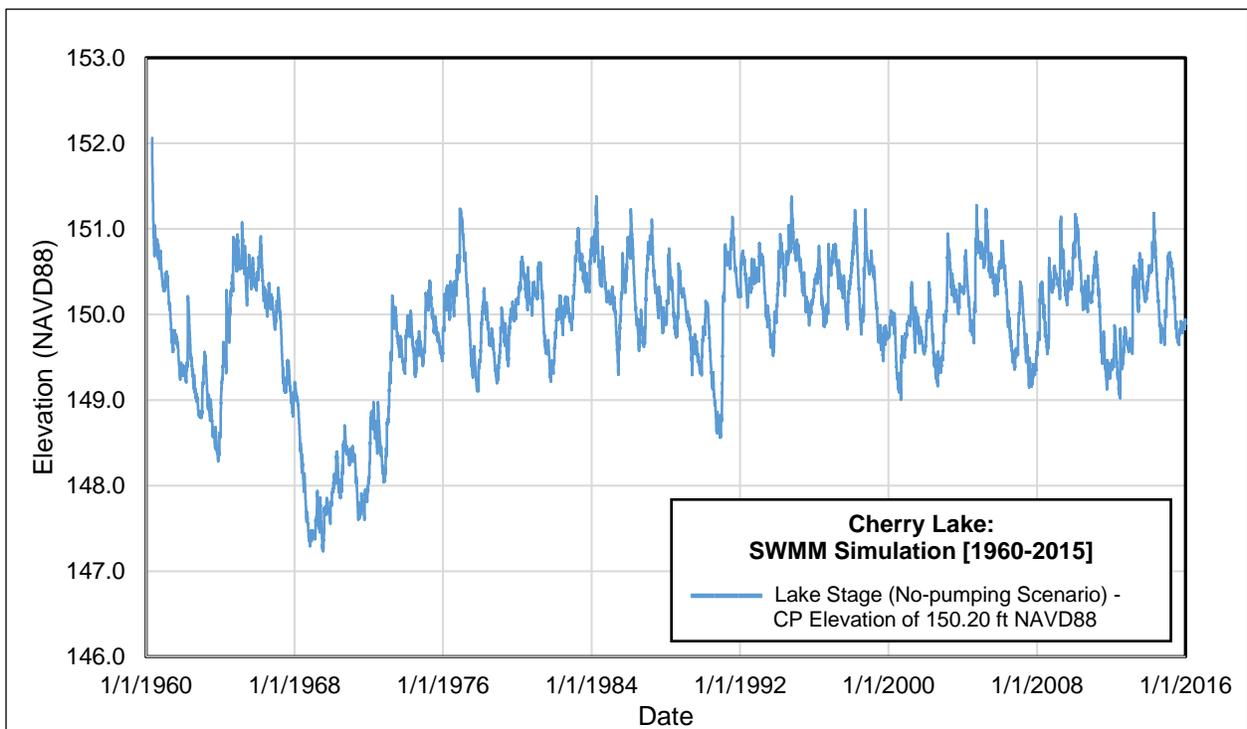


Figure 5-2B. Hydrograph for Cherry Lake model simulated stage data for no-pumping scenario for the period of 4/29/1960 - 12/31/2015 for the Medium Control Point Scenario.

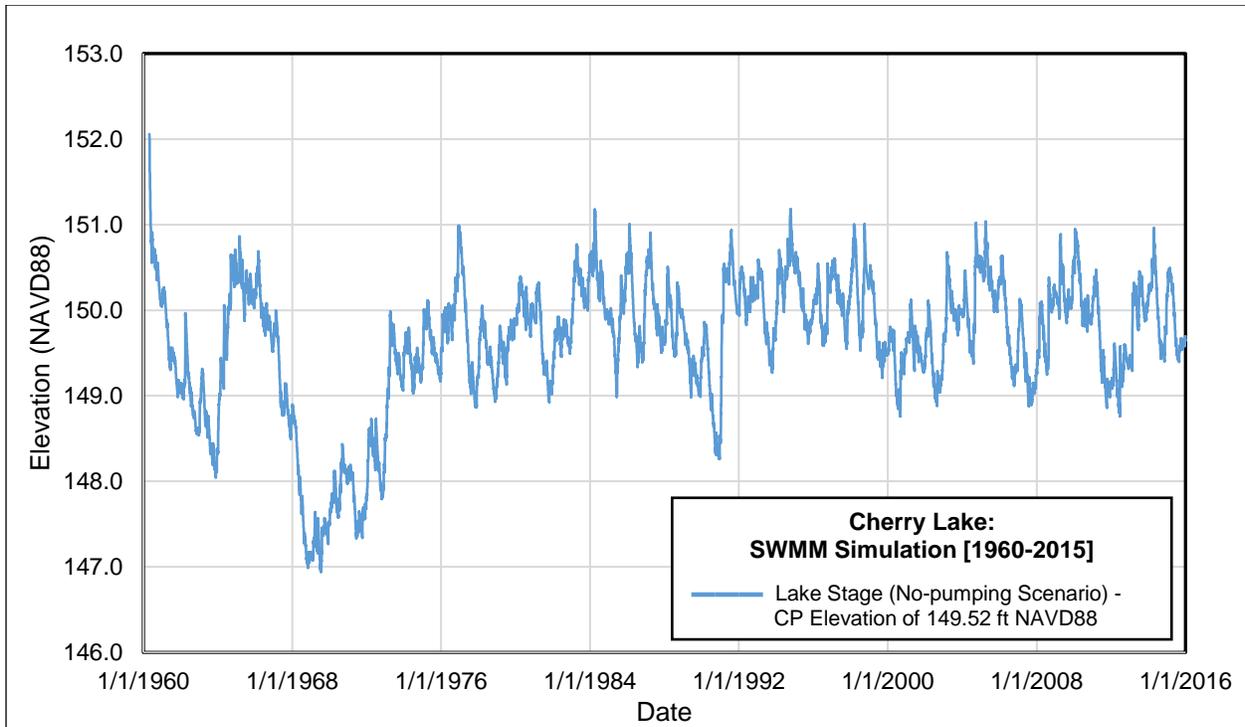


Figure 5-2C. Hydrograph for Cherry Lake model simulated stage data for no-pumping scenario for the period of 4/29/1960 - 12/31/2015 for the Low Control Point Scenario.

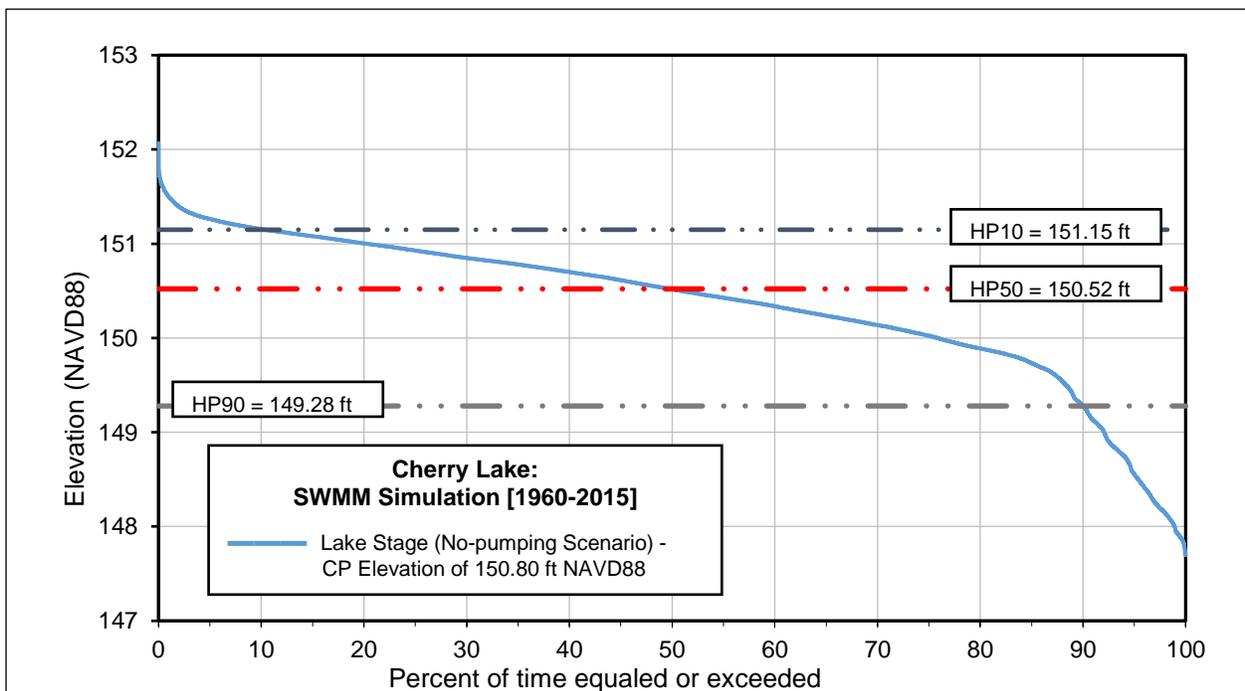


Figure 5-3A. Exceedance probability chart for Cherry Lake model simulated stage data for no-pumping scenario, HP10, HP50, and HP90 for the period of 4/29/1960 - 12/31/2015 for the High Control Point Scenario.

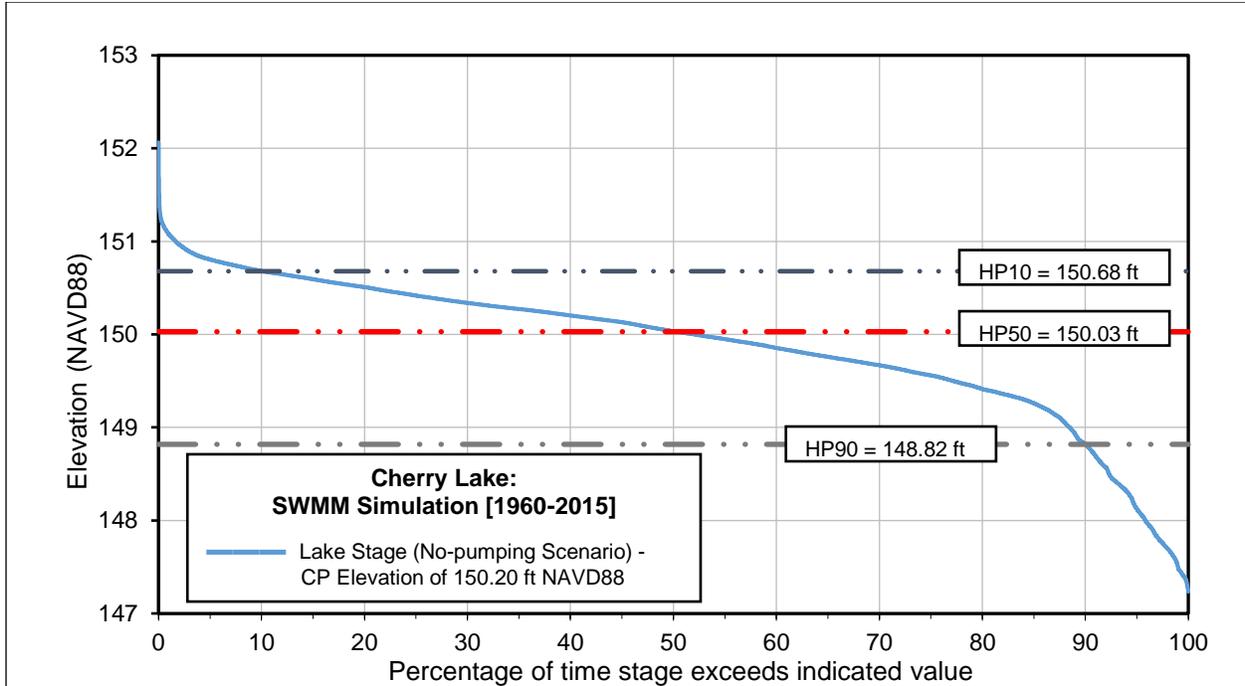


Figure 5-3B. Exceedance probability chart for Cherry Lake model simulated stage data for no-pumping scenario, HP10, HP50, and HP90 for the period of 4/29/1960 - 12/31/2015 for the Medium Control Point Scenario.

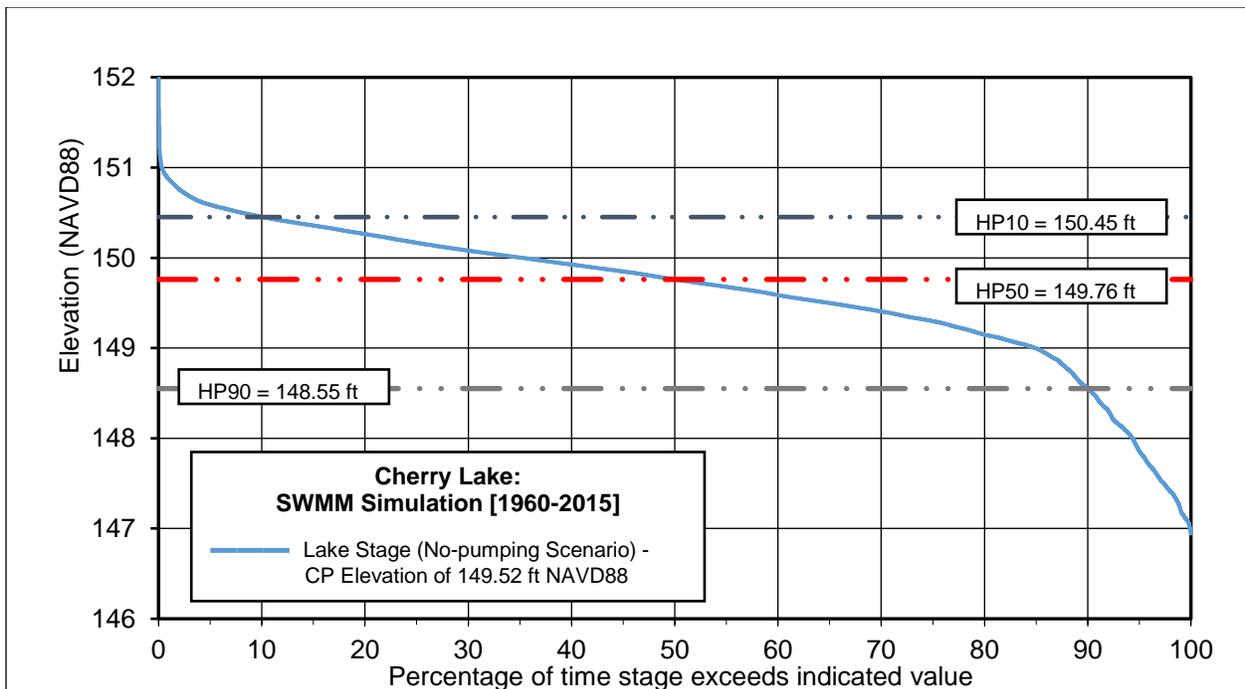


Figure 5-3C. Exceedance probability chart for Cherry Lake model simulated stage data for no-pumping scenario, HP10, HP50, and HP90 for the period of 4/29/1960 - 12/31/2015 for the Low Control Point Scenario.

Table 5-2. Daily stage frequency percentiles for Cherry Lake. These levels were determined using daily model simulated lake stage data set for the period of 4/29/1960 – 12/31/2015.

Percentile	Daily readings for the period of 4/29/1960 – 12/31/2015 (ft NAVD88)		
	High CP Scenario	Medium CP Scenario	Low CP Scenario
Historic P10 (HP10)	151.15	150.68	150.45
Historic P50 (HP50)	150.52	150.03	149.76
Historic P90 (HP90)	149.28	148.82	148.55

Note: See definitions below

Definitions:

- “P10” means the elevation of the water surface of a lake or wetland that is equaled or exceeded 10% of the time as determined from a long-term stage frequency analysis.
- “P50” means the elevation of the water surface of a lake or wetland that is equaled or exceeded 50% of the time as determined from a long-term stage frequency analysis.
- “P90” means the elevation of the water surface of a lake or wetland that is equaled or exceeded 90% of the time as determined from a long-term stage frequency analysis.

### 5.3 Historic Normal Pool Elevation, Control Point Elevation, and Structural Alteration Status

The Historic Normal Pool (HNP) elevation, a reference elevation used for development of minimum lake levels, is established based on the elevations of hydrologic indicators of sustained inundation. The indicators selected change slowly with changing hydrology (Figure 4-2), so they are considered useful for defining the Historic water level regime. The buttress inflection points on the trunks of *Taxodium* spp. (Figure 5-4) are known to be reliable biologic indicators of historical hydrology (Carr *et al.* 2006). A total of 32 cypress buttress inflection points were surveyed, distributed along two wetland areas (Figure 4-1). The median elevation of 151.48 ft NAVD88 (Table B1 in Appendix B) represents the HNP elevation on Cherry Lake (Table 5-1).



*Figure 5-4. Example of marked buttress inflection point on cypress tree.*

The Control Point elevation is the elevation of the highest stable point along the outlet profile of a surface water conveyance system (e.g., weir, ditch, and culvert) representing the principal control of water level fluctuations in the lake. In the case of Cherry Lake, the outlet conveyance is a hand-dug canal located in the lake's southeast corner, believed to have been in place since 1936. Based on the field observations by the District and ECT staff on March 2, 2017, the highest point of the outfall canal appears to be the beaver dam located approximately 100 feet upstream of NE Cherry Lake Cir., which has a top elevation of 150.80 ft NAVD88, approximately 1 foot above the normal canal bottom near this dam, per the 2017 topographic survey conducted by GPI. At the time of the survey, the 42" Reinforced Concrete Pipe (RCP) beneath NE Cherry Lake Cir. seems to have been blocked by debris (likely due to beaver activities) (Appendix A). The beaver dam and culvert blockage together seem to control the outfall flow discharge from the lake during years preceding the survey but is no longer present (ECT 2023). The canal/culvert does get clogged with debris until Madison County or local residents clear it out periodically.

Upon review of the historic lake stage data since April 1998 (Figure 3-6) and the field observations of beaver dams in the outfall canal, the lake Control Point elevation in the outfall canal under the existing conditions is defined at 150.80 ft NAVD88, or the top of the beaver dam located approximately 100 feet upstream of NE Cherry Lake Cir. per the topographic survey conducted by GPI in 2017. The lake Control Point elevation of 150.80 ft NAVD88 is also referred to as the high Control Point scenario, in which we assumed that the observed beaver dams will stay in place or be replaced with an equivalent permanent structure to maintain lake levels as observed in the past two decades.

As recommended by the District, two additional Control Point scenarios were developed to represent the potential structural alterations that could occur in the outfall canal:

- Medium Control Point scenario: the lake Control Point elevation is defined at 150.20 ft NAVD88 or the highest point along the outfall canal, assuming that the existing canal bottom is stable without further erosion, sediment deposition, and human/beaver activities; and
- Low Control Point scenario: the lake Control Point elevation is set at 149.52 ft NAVD88 or the invert elevation of the culvert beneath NE Cherry Lake Cir., assuming the outfall canal bottom will be eventually incised to be lower than the culvert invert elevation. This scenario represents the lowest possible Control Point elevation for this lake as long as the culvert stays unchanged.

In the long-term models for the no-pumping conditions, the invert elevations of the weir and channel links along the outfall canal, assumed constant throughout the entire 55.7-year model duration, were adjusted for each Control Point scenario to evaluate the impacts on lake levels due to the existing and predicted structural alterations in the outfall canal.

Structural alteration status is determined to support development of minimum levels and for the modeling of historic lake stage records. In addition to identification of outlet conveyance characteristics, comparison of the Control Point elevation and HNP elevation is typically used to determine if a lake with cypress fringing wetlands has been structurally altered. If the Control Point elevation is below the HNP, the lake is classified as a structurally altered system. If the Control Point elevation is above the HNP and the lake has no outlet, the lake is not considered to be structurally altered. Based on the existence of the outfall canal and given that the HNP of 151.48 ft NAVD88 is considerably higher than the highest Control Point elevations of 150.80 ft NAVD88 representing the existing structural alterations (Table 5-1), Cherry Lake was classified as structurally altered.

## 5.4 Lake Classification

Lakes are classified as Category 1, 2, or 3 for the purpose of minimum lake 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 HNP 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 elevation is more than 1.8 ft below the HNP elevation 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.

Cherry Lake meets the classification as a Category 1 lake, based on the presence of the lake-fringing cypress wetlands of 0.5 acre or more in size, and because the Historic P50 elevations of the high, medium, and low Control Point scenarios (150.52, 150.03, and 149.76 ft NAVD88) are all higher than the elevation 1.8 ft below the HNP elevation of 151.48 ft NAVD88.

## 5.5 Significant Change Standards and Other Information for Consideration

Lake-specific significant change standards and other available information are considered for establishing minimum lake levels. The standards are used to identify thresholds for preventing

significant harm to environmental values associated with lakes in accordance with guidance provided in the Florida Water Resources Implementation Rule (62-40.473, F.A.C.). Other information taken into consideration includes potential changes in the coverage of herbaceous wetland vegetation and aquatic plants (Table 2-1).

SWFWMD had employed the lake categories and category-specific lake MFLs methods in establishing minimum lake levels since 1999. In 2021, the category-specific methods have been removed from the SWFWMD rules, which allows for more consideration of all relevant significant change standards and use of best information available for a specific lake. In conjunction with the rule changes, minimum lake levels have been re-evaluated for lakes formerly classified as Category 2 and Category 3 lakes, and at least two lakes formerly classified as Category 1, based on consideration of the previously developed and applied Category 3 standards (SWFWMD 2021). Based on this new methodology currently used by SWFWMD and best information available at Cherry Lake, all relevant significant change standards for all lake categories were developed, as described below, and used in determining the most appropriate elevations for use as the minimum lake levels for the high, medium, and low Control Point scenarios.

For Category 1 or 2 Lakes, a significant change standard is established at 1.8 ft below the HNP elevation. This standard identifies a desired median lake stage that if achieved, is expected to preserve the ecological integrity of cypress lake-fringing wetlands. This elevation 1.8 ft below HNP is typically referred to as the Cypress Standard in the SWFWMD documents pertaining to minimum levels development. For Cherry Lake, the Cypress Standard was established at 149.68 ft NAVD88 (Table 5-1). The differences between the Cypress Standard elevation and the Historic P50 elevations for the high, medium, and low Control Point scenarios range from 0.08 to 0.84 ft, suggesting median water levels could drop somewhat from historic median levels without violating the Cypress Standard.

Seven significant change standards for Category 3 Lakes, including a Wetland Offset Standard, a Dock-Use Standard, a Basin Connectivity Standard, an Aesthetics Standard, a Recreation/Ski Standard, a Species Richness Standard, and a Lake Mixing Standard were determined for Cherry Lake. Potential changes in the coverage of herbaceous wetland vegetation and submersed aquatic plants were also considered when establishing minimum lake levels for this lake. These standards identify desired median lake stages that if achieved, are intended to preserve various environmental values (Table 2-1).

### 5.5.1 Dock-Use Standard

The Dock-Use Standard is developed to provide for sufficient water depth at the end of existing docks to allow 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 water depth value for boat mooring, and use of Historic lake stage data. The Dock-Use Standard elevations were established at 150.58, 150.55, and 150.55 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively, based on the P10 of the 127 dock sediment elevations surveyed at the lake (147.34 ft NAVD88, see Figure D8 in Appendix D), plus a two-foot water depth based on use of powerboats in the lake and the difference between the Historic P50 and Historic P90 (Table 5-1).

### 5.5.2 Wetland Offset Standard

The Wetland Offset Standard is developed to protect non-cypress fringing wetlands. Based on the rationale used to develop the Cypress Standard for Category 1 and 2 Lakes (1.8 ft below the HNP elevation), a Wetland Offset Standard for Category 3 Lakes was developed. Because hydrologic indicators of sustained inundation used to determine the HNP elevation usually do not exist on Category 3 Lakes, another datum, in this case the Historic P50 elevation, was used in the development of the Wetland Offset Standard. Based on an evaluation of the relationship of the Cypress Standard with the Historic P50 for hydrologically unimpacted cypress wetlands, the Wetland Offset Standard for Category 3 Lakes is established at an elevation 0.8 ft below the Historic P50 elevation (Hancock 2007). For Cherry Lake, the Wetland Offset Standard elevations were established at 149.72, 149.23, and 148.96 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively.

### 5.5.3 Aesthetics Standard

The Aesthetics Standard is intended to protect aesthetic values associated with the median lake stage from becoming degraded below the values associated with the lake when it is staged at the Historic P90 elevation. The Aesthetic Standard elevations for Cherry Lake were established at the Historic P90 elevations of 149.28, 148.82, and 148.55 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively.

### 5.5.4 Lake Mixing Standard

The Lake Mixing Standard is developed to prevent substantial 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 (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. The dynamic ratio shift across the 0.8 threshold occurred at 147.36 ft NAVD88 (Table D2 and Figure D9 in Appendix D). Based on the 55.7-year model simulated lake stage data sets for the no-pumping scenario, the standard was equaled or exceeded 100, 99.8, and 98.4 percent of the time for the high, medium, and low Control Point scenarios, respectively (Figures 5-2A through 5-3C). The implication of ratio values being below 0.8 for most of the 55.7-year model duration is that not all areas of the lake bottom have been subject to periodic wind-driven wave disturbance given the depth of the lake relative to its surface area (Bachmann *et al.* 2000).

### 5.5.5 Species Richness Standard

The Species Richness Standard is developed to prevent a decline in the number of bird species that may be expected to utilize a lake ecosystem. Based on an empirical relationship between lake surface area and the number of birds expected to occur at Florida lakes (Bachmann and Hoyer 1999, Emery *et al.* 2009), 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 elevations for Cherry Lake were established at 144.99, 144.94, and 144.91 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively (Figure 5-1, for a plot of lake stage versus lake surface area [2D Area]). Based on the 55.7-year model simulated lake stage data sets for the no-pumping scenario, the standard elevations were equaled or exceeded 100 percent of the time for the high, medium, or low Control Point scenarios (Figures 5-2A through 5-3C).

### 5.5.6 Recreation/Ski Standard

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 (i.e., 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 as used in this case, a rectangular ski corridor 200 feet in width and 2,000 feet in length (Figure D2 in Appendix D), and use of historic lake stage data. The Recreation/Ski Standard elevations were established at 145.31, 145.28, and 145.28 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively, based on the sum of the elevation at which the lake could provide an area suitable for safe skiing (144.07 ft NAVD88) and the difference between the Historic P50 and Historic P90. Based on the 55.7-year model simulated lake stage data set for the no-pumping scenario, the standard elevations were equaled or exceeded 100 percent of the time for the high, medium, or low Control Point scenarios (Figures 5-2A through 5-3C).

### 5.5.7 Basin Connectivity Standard

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 lake-use. The standard is based on the elevation of lake sediments at a critical elevation saddle between lake sub-basins, clearance water depths 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. A review of the morphology of the Cherry Lake basin (Figure 3-1 and Figure D1 in Appendix D) indicates that Cherry Lake is composed of one main basin with no navigable surface water connections to other waters, so no Basic Connectivity Standard was developed.

### 5.5.8 Herbaceous Wetlands Information for Consideration

Information on herbaceous wetlands is taken into consideration when determining the elevation at which changes in lake stage would result in substantial changes in potential emergent wetland area within the lake basin (i.e., basin area with a water depth of four or less feet). A review of a graph of lake stage versus area of Cherry Lake less than 4 ft deep (Figure D10 in Appendix D) indicates there would be an increase of approximately 9.2, 5.0, and 1.2 acres of potential herbaceous coverage, for the high, medium, and low Control Point scenarios, respectively, with a lowering of the median water level from the Historic P50 (150.52, 150.03, and 149.76 ft NAVD88) to the MLLs (149.72, 149.68, and 149.68 ft NAVD88). The increased herbaceous coverage area is a relatively small value compared to the total lake bottom area at the Historic P50. Further lowering of the median water level below the MLLs would be expected to allow substantially larger increases in herbaceous coverage based on the shape of the function plotted in Figure D10 in Appendix D. For example, a drop from the Historic P50 to the Recreation/Ski Standard of 145.28 ft NAVD88 under the low Control Point scenario would potentially boost the coverage of herbaceous wetlands by 185.5 acres, likely greatly impacting recreational use of the lake.

### 5.5.9 Submersed Aquatic Macrophyte Information for Consideration

Changes in lake stage associated with changes in area available for colonization by rooted submersed macrophytes are also evaluated, using water transparency values (Figure D11 in Appendix D). Based on average Secchi disk data and using the equation of Caffrey (2006), we concluded that the maximum depth of colonization (MDC) of submersed aquatic vegetation (SAV) is approximately 11.5 ft. Since the deepest part of the lake is 137.0 ft NAVD88, the depth at the

Historic P50 ranges from 13.52 to 12.76 ft, light penetration is expected to be a limiting factor on SAV growth at the lake bottom at median stage for all Control Point scenarios. As a result of SAV having the potential to grow within a water depth of 11.5 or less feet, the change in area that is available for SAV colonization is a function of lake stage versus lake bottom area (i.e., 3D area) less than 11.5 ft deep (Figure D12 in Appendix D). A change from the Historic P50 to a lower level proposed here as the MLL would increase the submerged lake bottom areas suitable for SAV colonization by approximately 38.3, 14.9, and 3.3 acres, or 8.0%, 3.1%, and 0.7%, of the total submerged areas at the Historic P50 of 476.6, 473.0, and 471.1 acres, for the high, medium, and low Control Point scenarios, respectively. It is interesting to note that decline in lake stage is not linearly related to an increase in area suitable for SAV colonization due to morphometry of the lake bottom.

A SAV survey was recently conducted at Cherry Lake by the USF Water Institute in August 2017, see Appendix C. A Secchi disk depth was taken near the center of the lake during the assessment on August 10 and 11, 2017. Both values were reported as being visible on bottom in 12.7 ft (3.87 meters) and 13.2 ft (4.02 meters) of water. Using the average Secchi disk depth of 3.95 meters assessed in August 2017 and the equation of Caffrey (2006), the MDC value was estimated at 16.2 ft, which was deep enough to support SAV colonization for the entire lake bottom (Table D1 and Figure D7 in Appendix D). As expected for a relatively shallow and clear water system, the SAV community covered the majority of the lake (98.27% of the lake area) during the time of assessment.

## 5.6 Minimum Levels

The significant change standards for all lake categories, as described above, were utilized in developing the minimum lake levels for this lake, in conjunction with professional experience and judgement (SWFWMD 2021).

### 5.6.1 Minimum Lake Level

The Minimum Lake Level (MLL) 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 MLL for the high Control Point scenario at Cherry Lake was established at the Wetland Offset Standard elevation of 149.72 ft NAVD88, which is lower than the Historic P50 and Dock-Use Standard, but higher than other significant change standards for Category 3 Lakes and the Cypress Standard for Category 1 and 2 Lakes.

The MLLs for the medium and low Control Point scenarios at Cherry Lake were established at the Cypress Standard of 149.68 ft NAVD88, which is lower than the Historic P50 and Dock-Use Standard, but higher than other significant change standards for Category 3 Lakes (Table 5-1).

### 5.6.2 High Minimum Lake Level

The High Minimum Lake Level (HMLL) 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 HMLL may be established using one of two methods. The High Minimum Lake Level is established at the elevation corresponding to the MLL plus the difference between the Historic P10 and the Historic P50, or alternatively, the HMLL is established at the elevation corresponding to the MLL plus the RLWR value.

Due to the availability of Historic percentiles, the HMLLs were established using the first method, resulting in HMLLs of 150.35, 150.33, and 150.37 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively. These elevations account for a natural fluctuation of lake levels.

Minimum levels at Cherry Lake are plotted on the 55.7-year model simulated lake stage hydrographs for the no-pumping scenario for the high, medium, and low Control Point scenarios (Figures 5-5A through 5-5C).

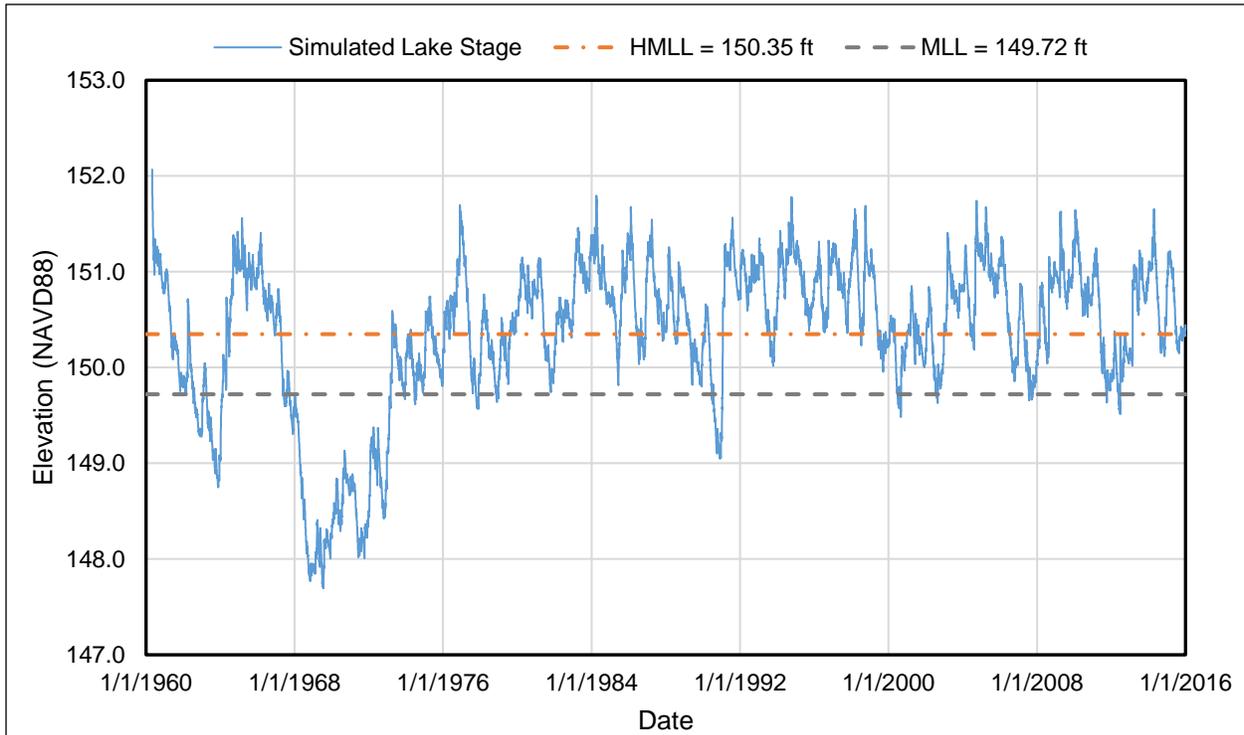


Figure 5-5A. Hydrograph for model simulated stage data for no-pumping scenario for the period of 4/29/1960 - 12/31/2015 with minimum lake levels for the High Control Point Scenario.

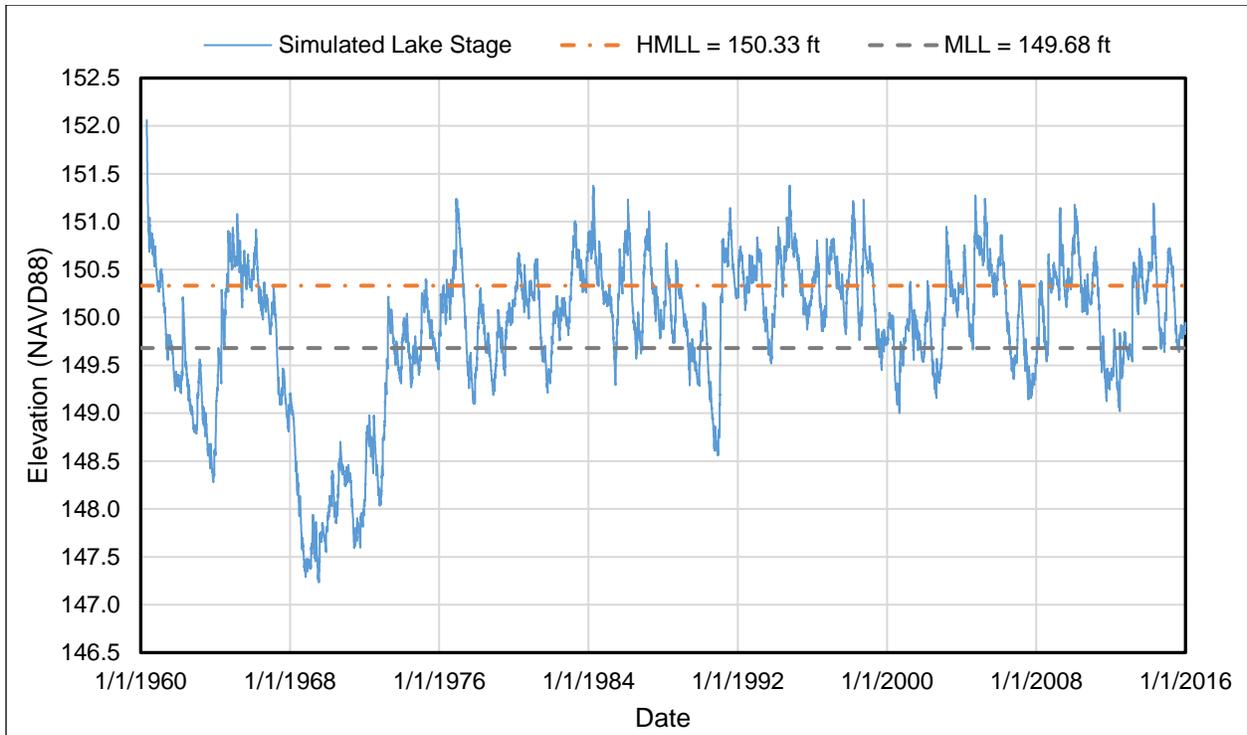


Figure 5-5B. Hydrograph for model simulated stage data for no-pumping scenario for the period of 4/29/1960 - 12/31/2015 with minimum lake levels for the Medium Control Point Scenario.

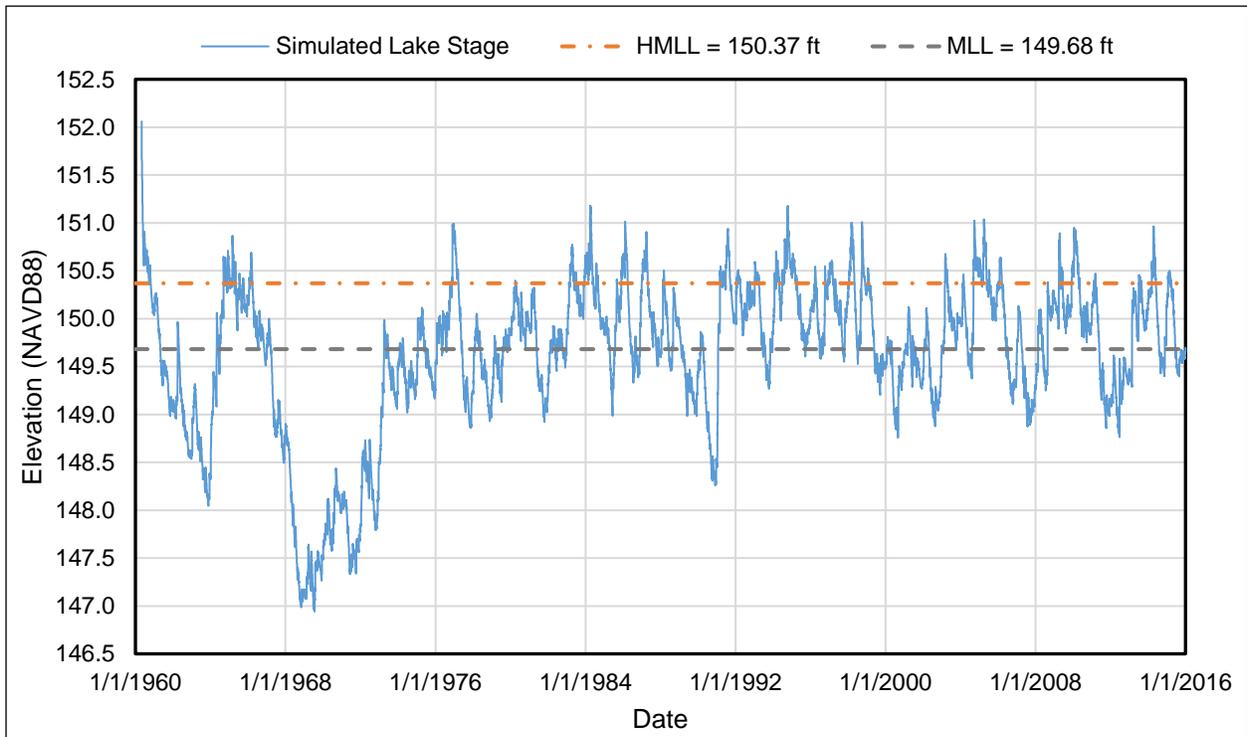


Figure 5-5C. Hydrograph for model simulated stage data for no-pumping scenario for the period of 4/29/1960 - 12/31/2015 with minimum lake levels for the Low Control Point Scenario.

## 6.0 Consideration of Environmental Values

The minimum levels for Cherry Lake are protective of all relevant environmental values (also referred to as water resource values) identified for consideration in the Water Resource Implementation Rule when establishing MFLs (Rule 62-40.473, F.A.C.). When developing MFLs, the District evaluates the categorical significant change standards and other available information as presented above to identify criteria that are sensitive to long-term changes in hydrology and represent significant harm thresholds.

Two environmental values identified in Rule 62-40.473, F.A.C., were not considered relevant to development of minimum lake levels for Cherry Lake. Estuarine resources were not considered relevant because the lake is not connected to an estuarine resource. Sediment loads were similarly not considered relevant for the lake, because the transport of sediments as bedload or suspended load is a phenomenon associated with flowing water systems.

### High Control Point Scenario

For the high Control Point scenario, the Wetland Offset Standard was used for developing minimum levels at Cherry Lake. This standard is associated with the protection of several environmental values identified in Rule 62-40.473, F.A.C., including: fish and wildlife habitats and the passage of fish, transfer of detrital material, and filtration and absorption of nutrients and other pollutants (Table 2-1).

The cypress fringing wetlands at Cherry Lake will be protected because under the proposed Minimum Lake Levels, the Cypress Standard is also met. The Wetland Offset Standard is associated with the protection of non-cypress fringing wetlands and also protective of the Species Richness Standard and Lake Mixing Standard. The Species Richness Standard is associated with the prevention of a decline in the number of bird species. The Lake Mixing Standard is associated with the prevention of substantial changes in patterns of wind-driven mixing of the lake water column and sediment re-suspension and assures the maintenance of herbaceous wetlands and the potential for establishment of submersed aquatic vegetation would not be greatly affected.

### Medium and Low Control Point Scenarios

For the medium and low Control Point scenarios, the Cypress Standard was used for developing minimum levels for Cherry Lake. This standard is associated with protection of cypress fringing wetlands and several environmental values identified in Rule 62-40.473, F.A.C., including: fish and wildlife habitats and the passage of fish, transfer of detrital material, filtration and absorption of nutrients and other pollutants (Table 2-1).

The non-cypress fringing wetlands at Cherry Lake will be protected because under the proposed Minimum Lake Levels, the Wetland Offset Standard is met. The Wetland Offset Standard is also protective of the Species Richness Standard and Lake Mixing Standard.

### High, Medium, and Low Control Point Scenarios

For the high, medium, and low Control Point scenarios, the environmental value, navigation is partially met because the potential for establishment of submersed aquatic vegetation would not be greatly affected with a lowering of the median water level from the Historic P50 elevations to the proposed Minimum Lake Levels (less than 10% increase in area suitable for SAV Colonization). Note

that Cherry Lake is composed of one main basin with no navigable surface water connections to other waters; therefore, no Basic Connectivity Standard was developed.

The environmental value, maintenance of freshwater storage and supply is protected by the minimum levels based on the relatively small potential changes in storage associated with the minimum flows hydrologic regime as compared to the non-withdrawal impacted Historic conditions. The reduction in volume held by the lake at the MLL relative to the Historic P50 is estimated to be a reduction from 1.30 to 1.18 billion gallons or 9% less for the high Control Point scenario, from 1.23 to 1.17 billion gallons or 4% less for the medium Control Point scenario, and from 1.18 to 1.17 billion gallons or 1% less for the low Control Point scenario. Maintenance of freshwater supply is also expected to be protected by the minimum levels based on inclusion of conditions in water use permits that stipulate that permitted withdrawals will not lead to violation of adopted minimum flows and levels.

However, the environmental values, recreation in and on the water, aesthetic and scenic attributes, and water quality are not fully met, because the proposed Minimum Lake Levels are below the Dock-Use Standard (Table 5-1). As mentioned in Section 3.2, two of the stakeholders' concerns are related to the increased motorized watercraft and falling lake levels. Due to the shallow nature of the lake, and as a result of falling lake levels, this increase in the number of boats with large motors may be a significant source of nutrients to the lake as they stir up nutrient laden sediments in shallow lakes (Asplund, 2000). Being lower than the Dock-Use Standard, the proposed Minimum Lake Levels will not provide sufficient water depth at the end of existing docks to allow mooring of boats and will adversely impact bottom-dwelling plants and animals caused by boat operation and create man-induced disturbance of sediments that causes discoloration, excess turbidity, and increased nutrient in the water column and adversely impacts the aesthetic and scenic attributes and water quality of the lake.

## 7.0 Conclusions

The SWFWMD methodology (SWFWMD 1999a, 1999b, and 2021; Leeper *et al.* 2001; Hancock 2007) was utilized to assess the minimum lake levels for Cherry Lake. Minimum levels assessment is based on the evaluation of observed and model simulated stage data, vegetation sampling, hydrologic indicators of sustained inundation, control point elevation, bathymetry, water quality, and elevations of anthropogenic features such as docks.

The minimum levels assessment results for Cherry Lake are summarized in Table 7-1. Results for the high, medium, and low Control Point (CP) scenarios demonstrate the potential impacts due to structural alterations that occurred or could occur in the outfall canal. These results could be used to support selection of an appropriate lake Control Point elevation as well as the minimum levels that are protective of all relevant environmental values identified for consideration in the Water Resource Implementation Rule when establishing MFLs (Rule 62-40.473, F.A.C.).

Table 7-1. Minimum levels for Cherry Lake (elevations in ft NAVD88).

Level	High CP Scenario	Medium CP Scenario	Low CP Scenario	Level Description
High Minimum Lake Level (HMLL)	150.35	150.33	150.37	Elevation that lake stage is <u>required</u> to equal or exceed 10% of the time on a long-term basis.
Minimum Lake Level (MLL)	149.72	149.68	149.68	Elevation that lake stage is <u>required</u> to equal or exceed 50% of the time on a long-term basis.

Both the Cypress Standard for Category 1 Lakes and the significant change standards for Category 3 Lakes were developed and used to assess the minimum levels for Cherry Lake.

The High Minimum Lake Levels (HMLLs) for Cherry Lake are 150.35, 150.33, and 150.37 ft NAVD88, and the Minimum Lake Levels (MLLs) are 149.72, 149.68, and 149.68 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively (Table 7-1). The MLLs for the high Control Point scenario was established at the Wetland Offset Standard, or the elevation 0.8 ft below the Historic P50 elevation. The MLL for the medium and low Control Point scenarios were established at the Cypress Standard, or 1.8 ft below the Historic Normal Pool (HNP). The HMLLs were established at the elevation corresponding to the MLLs plus the difference between the Historic P10 and Historic P50.

For the purpose of allowing the lake to continue to periodically achieve historic levels, the HMLLs are required to be reached or exceeded 10% of the time over a long-term record. The MLL elevation for the high Control Point scenario should be reached or exceeded at least 50% of the time for the purpose of preserving the ecological integrity of the non-cypress fringing wetlands and meeting other environmental values outlined in Rule 62-40.473, F.A.C., including: fish and wildlife habitats and the passage of fish, transfer of detrital material, and filtration and absorption of nutrients and other pollutants. The MLLs for the medium and low Control Point scenarios should be reached or exceeded at least 50% of the time for the purpose of preserving the ecological integrity of the cypress fringing wetlands and meeting other environmental values outlined in Rule 62-40.473, F.A.C., including: fish and wildlife habitats and the passage of fish, transfer of detrital material, and filtration and

absorption of nutrients and other pollutants. However, the environmental values, recreation in and on the water, aesthetic and scenic attributes, and water quality are not fully met, because the proposed minimum lake levels are lower than the dock-use standard for the high, medium, and low Control Point scenarios.

Due to limited potential for groundwater withdrawals to lower lake levels (as described in ECT 2023) and due to the erosion issues in the outfall canal, District staff do not recommend moving forward with minimum lake level rule development and adoption at this time. The technical content presented in this report is expected to provide useful information for understanding changes in lake levels and their effects on the water resources values evaluated to develop the minimum levels. The District will continue to work with state agencies, local government, residents, and other stakeholders to develop management options for Cherry Lake.

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## Appendix A: Site Survey

### Survey Report for Phase I

#### Introduction

This section contains an outline of the Survey and Mapping Services that supported SRWMD Cherry Lake Minimum Flows and Levels Project, in Madison County, Florida; SRWMD Work Order 14/15-029.04; Greenman-Pedersen, Inc. (GPI) Project Number FTP-2016104.04.

#### Project Area

The project area encompasses Cherry Lake and bordering shores in Madison County, Florida, within Sections 3 & 4, Township 2 North, Range 9 East, and Sections 33 & 34, Township 3 North, Range 9 East.

#### Purpose

The purpose of this survey was to:

- Set horizontal and vertical control: establish 2 vertical control points (benchmarks) near the body of water at the boat ramp, and horizontal and vertical control for Environmental Consulting and Technology, Inc. (ECT) Survey Sites 1 through 7;
- At ECT Survey Sites 3, 4, 5, and 6: locate culverts, water levels, and culvert end treatments. Also locate roadway centerline “crown” elevations;
- At ECT Sites 1, 2, and 7: locate centerline cross sections;
- At ECT Site 4: locate benchmark previously established by Briggs, Washington & Thompson Land Surveying, Inc.;
- Locate point at end of docks, including elevation of lake bottom (top of muck and lake bottom), and top of dock;
- Locate 1 public boat ramp; and
- Bathymetric survey of Cherry Lake.

#### Date of Survey

All ground survey field operations took place between June 12, 2017, and June 26, 2017. The Bathymetric survey was performed on June 15, 2017. The Staff Gauge was located in the field on June 16, 2017, at 8:56 AM.

#### Datum Reference and Final Coordinates

Horizontal control coordinates shown herein are based on the North American Datum of 1983, 2011 adjustment (NAD83/2011), Florida State Plane Coordinate System, North Zone, U.S. Survey Feet.

Control elevations shown herein are based on the North American Vertical Datum of 1988 (NAVD88), U.S. Survey Feet, with elevations verified by GPS/RTK check into National Geodetic (NGS) Survey benchmark “FLGPS71”, with a published elevation of 94.99 ft NAVD88.

GPS-derived elevations were used for some of the non-control locations. These GPS elevations were computed from the GPS-derived ellipsoid heights and geoid heights obtained from the GEOID12A geoid model published by the National Geodetic Survey and were verified through redundant ties to the project control benchmarks.

## Methodology

### Horizontal Control

GPI established horizontal control points consisting of 5/8" rebar 18" in length with plastic caps marked "TRAV. PT. LB 7560", and they were observed with Leica survey grade dual frequency Global Positioning System (GPS) receivers operating in Real Time Kinematic (RTK) mode on the Florida Department of Transportation's (FDOT) Florida Permanent Reference Network (FPRN).

Redundant observations on various days and times were taken at each control point. The measured horizontal accuracy is better than 0.10 feet.

To find out more about the FDOT FPRN go to: <https://www.fdot.gov/geospatial/fprn.shtm>

### Vertical Control

GPI established vertical control on all established horizontal control points, 1 vertical control point (benchmarks) at boat ramp set by this firm, and 1 existing vertical control point (benchmark) set by others at ECT Site 4, utilizing differential leveling techniques between project control points, and adjusted to NAVD88, using an average of GPS/RTK observations. The measured vertical relative accuracy is better than 0.10 feet.

### Topographic features / cross sections / low points / boat ramp, and others

Surveyed points and elevations were established using a combination of GPS/RTK observations, trigonometric total station observations, or differential leveling, based on set horizontal and vertical control.

### Dock Locations

GPI located a single survey point at the end of every dock with a GPS/RTK observation. The dock measured to determine elevation of the deck, in addition, elevations were determined for the lake bottom (firm / hard bottom of lake), and top of muck typically overlaying mineral sediments on the lake bottom adjacent to the dock. Multiple deck elevations were recorded in certain cases, for docks that had a secondary lower deck for boat boarding.

### Bathymetric Mapping

Hydrographic sounding data was collected in a spiral pattern at approximately 200-foot intervals around the lake, utilizing single beam hydrographic surveying equipment and data collection software. Horizontal and vertical control were based on GPS/RTK observations. Vertical control was verified with lake water elevation, at the time of the bathymetric survey.

Hydrographic sounding data were processed to remove outliers associated with reduced GPS or SONAR quality as well as to remove unusually abrupt elevation changes. Data were then interpolated to develop a continuous lake bottom surface by performing ordinary kriging in ArcGIS using the 24 nearest neighbors and spherical semivariogram model settings (output at 17.71 foot grid cell size). The kriging output grid was converted to points. These lake bottom points (shapefile named

pointsfromkrigos24nnfortin\_v2trimmed.shp) were incorporated into a TIN (named cherrytin) as mass point features along with two other point data sources. The other two sources were ground elevations collected by GPI surveyors (named Combined\_Survey\_Points\_selected\_for\_TIN.shp) and the Light Detection and Ranging (LiDAR) data (named LiDAR\_Cherry\_Lake\_Area\_v1.shp) obtained from The National Oceanic and Atmospheric Administration (NOAA), representing ground conditions in the period January 3, 2011, to January 30, 2011.

Additional information about the LiDAR dataset is available at:

[https://coast.noaa.gov/hdata/lidar1\\_z/geoid12b/data/4889/supplemental/fl2011\\_srwm\\_upper\\_suwannee\\_m4889\\_surveyreport.pdf](https://coast.noaa.gov/hdata/lidar1_z/geoid12b/data/4889/supplemental/fl2011_srwm_upper_suwannee_m4889_surveyreport.pdf)

## Survey Report for Phase II

### Introduction

This section contains an outline of the Survey and Mapping Services that supported the SRWMD Cherry Lake Minimum Flows and Levels Project, in Madison County, Florida; SRWMD Work Order 14/15-029.04, Phase 2; GPI Project Number FTP-2016104.05.

### Project Area

The project area encompasses Cherry Lake and bordering shores in Madison County, Florida, within Sections 3 & 4, Township 2 North, Range 9 East, and Sections 33 & 34, Township 3 North, Range 9 East.

### Purpose

The purpose of this survey is to locate relevant physical indicators of historical inundation at two wetland areas, as identified by GPI environmental scientists, as part of the overall Work Order listed above, to include:

- Set horizontal and vertical control: establish 2 vertical control points (benchmarks) near two wetland areas;
- Locate physical indicators; and
- Locate Wetland points.

### Date of Survey

All ground survey field operations for Phase 2 took place between February 12, 2018, and February 15, 2018.

### Datum Reference and Final Coordinates

Horizontal control coordinates shown herein are based on NAD83/2011, Florida State Plane Coordinate System, North Zone, U.S. Survey Feet.

Control elevations shown herein are based on NAVD88, U.S. Survey Feet, with elevations verified by GPS/RTK check into NGS Survey benchmark "FLGPS71", with a published elevation of 94.99 ft NAVD88.

## Methodology

### **Horizontal Control**

GPI established horizontal control points consisting of 5/8" rebar 18" in length with plastic caps marked "TRAV. PT. LB 7560", and they were observed with Leica survey grade dual frequency GPS receivers operating in RTK mode on the FDOT FPRN.

Redundant observations on various days and times were taken at each control point. The measured horizontal accuracy is better than 0.10 feet.

### **Vertical Control**

GPI established vertical control on established horizontal control points, utilizing differential leveling techniques between project control points, and adjusted to NAVD88, using an average of GPS/RTK observations. The measured vertical relative accuracy is better than 0.10 feet.

GPI established vertical control between established horizontal control points, utilizing closed loop, differential level runs.

### **Horizontal Location of Relevant Physical Indicators**

Indicators were located horizontally using survey grade total stations from secondary traverse and side tie points, or with GPS/RTK techniques.

### **Vertical Elevation Location of Relevant Physical Indicators.**

Indicators were located using a survey grade differential level as side ties from closed loop differential level runs, from established vertical control.

### **Survey Records**

Survey field notes are recorded in GPI survey field book M169, Pages 41 through 52, and electronic records associated with this project.

## Survey Report for Phase III

### Introduction

This section contains an outline of the Survey and Mapping Services that supported the SRWMD Cherry Lake Minimum Flows and Levels Project, in Madison County, Florida; SRWMD Work Order 14/15-029.05; GPI Project Number FTP-2016104.05.

### Project Area

The project area encompasses Cherry Lake and bordering shores in Madison County, Florida, within Sections 3 & 4, Township 2 North, Range 9 East, and Sections 33 & 34, Township 3 North, Range 9 East.

### Purpose

The purpose of this survey was to locate relevant physical features as part of the overall Work Order listed above, including:

Task 1.A. Field Survey – Two wells, Permit numbers: 231086 and 231087

1. Recovered and verified horizontal and vertical control as shown on the Specific Purpose Survey, prepared by GPI, file # 3M/1489, dated June 27, 2017, for SRWMD (Vertical datum of NAVD88);
2. Surveyed horizontal location of wells;
3. Determined elevation of wells: performing differential level runs from control as shown on the Specific Purpose Survey, locating:
  - a. Top of well casing: Located the “North Side” of PVC well casing; and
  - b. Surveyed existing benchmark point adjacent to well.
4. Performed measure down from top of well casings to top of water to determine water elevation at the time of survey; and
5. Surveyed elevation of the lake water level.

#### Task 1.B. Field Survey – Finished Floors

1. Recovered and verified horizontal and vertical control as needed, provided in GPI’s Survey Report for Phase 3, signed and sealed by Harold B. Peters, PSM, on April 18, 2019;
2. Set additional horizontal and vertical control using GPS, or traditional survey techniques, relative to the horizontal control as shown on the Specific Purpose Survey;
3. Verified location of nine residential structures depicted in a shapefile and listed in a text file provided by the SRWMD. SRWMD staff provided notice to property owners by mail prior to survey activities. Performed horizontal location of residential structures; and
4. Finished Floor Elevations of residential structures:
  - a. Horizontally located approximate (accurate to 0.1’) Finished Floor Elevation; and
  - b. Performed Differential Level run elevation of Finished Floor Elevation.

#### Task 1.C. Field Data Collection and Survey – Outer Cypress

1. Recovered and verified horizontal and vertical control as needed, provided in GPI’s Survey Report for Phase 3, signed and sealed by Harold B. Peters, PSM, on April 18, 2019; and
2. Surveyed cypress tree line points at 14 locations as marked by GPI Environmental staff.

#### Task 1.D. Field Data Collection and Survey – Soil Sample Location

1. Recovered and verified horizontal and vertical control as needed, provided in GPI’s Survey Report for Phase 3, signed and sealed by Harold B. Peters, PSM, on April 18, 2019;
2. Set temporary Horizontal and Vertical control points to be used to locate Soil Sample Locations;
3. Located temporary control points with GPS, and differential level runs; and
4. Horizontally and vertically located Soil Sample Locations SB1 through SB12 with total station, from temporary control points.

#### Date of Survey

All ground survey field operations for these survey tasks took place between February 26 and March 22, 2019.

## Datum Reference and Final Coordinates

Horizontal control coordinates shown herein are based on NAD83/2011, Florida State Plane Coordinate System, North Zone, U.S. Survey Feet.

Control elevations shown herein are based on NAVD88, U.S. Survey Feet, with elevations verified by GPS/RTK check into NGS Survey benchmark "FLGPS71", with a published elevation of 94.99 ft NAVD88.

## Methodology

### **Horizontal Control**

GPI established horizontal control points consisting of 5/8" rebar 18" in length with plastic caps marked "TRAV. PT. LB 7560", as shown on the Specific Purpose Survey, prepared by Greenman-Pedersen, Inc., file # 3M/1489, dated June 27, 2017, for the SRWMD.

GPI set additional horizontal temporary control points as needed for these tasks, and they were observed with Leica survey grade dual frequency GPS receivers operating in RTK mode on the FDOT FPRN.

Redundant observations on various days and times were taken at each control point. The measured horizontal accuracy is better than 0.10 feet.

### **Vertical Control**

GPI recovered vertical control points consisting of 5/8" rebar 18" in length with plastic caps marked "TRAV. PT. LB 7560", as shown on the Specific Purpose Survey, prepared by Greenman-Pedersen, Inc., file # 3M/1489, dated June 27, 2017, for the SRWMD.

GPI established vertical control on established temporary horizontal control points, utilizing differential leveling techniques between project control points, and adjusted to NAVD88, as shown on the Specific Purpose Survey, prepared by Greenman-Pedersen, Inc., file # 3M/1489, dated June 27, 2017, for the SRWMD.

### **Horizontal Location of Relevant Physical Indicators**

Indicators were located horizontally using survey grade total stations from control points, temporary control points, secondary traverse and side tie points, or with GPS / RTK techniques.

### **Vertical Elevation Location of Relevant Physical Indicators.**

Indicators were located using a survey grade differential level as side ties from closed loop differential level runs, from established vertical control, unless stated otherwise.

### **Survey Records**

Survey field notes are recorded in GPI survey field book M169, Pages 53 through 78, and electronic records associated with this project.

## Appendix B: Wetlands and Hydrologic Indicator Sampling, Analyses, and Results

The subsections within this appendix describe general observations about the wetland areas chosen for identification of hydrologic indicators, results from analysis of the hydrologic indicators, and detailed methods and supporting information used to assess water resource values for Cherry Lake.

### Site Visits

March 2017 site visit by Hunter Blair, Dan Schmutz, and Diane Willis from Greenman-Pedersen, Inc. (GPI) by boat. February 2018 site visit by Dan Schmutz and Diane Willis from GPI to set hydrologic indicators by boat.

There was a roughly 15-foot-wide band of mature pond cypress (*Taxodium ascendens*) with thin discontinuous bands of maidencane (*Panicum hemitomom*) along the waterward edge around the majority of the lakeshore. Behind most of the cypress fringe there was a relatively steep upland bank about 10 to 15 feet wide. Almost the entire lake fringe was developed with residential housing, many of which were vacation homes. A few spots had a wider band of cypress a little further out into the lake.

Louis Mantini with the SRWMD stated that he would like identification and mapping of submerged aquatic vegetation (SAV) on Cherry Lake. The water quality is generally good, which favors SAV. Residents do not have water quality issues, except that every once in a while, particularly in hot weather, there will be an algae bloom on the lake. Louis has taken a couple of specimens of SAV and had them identified as variable-leaf pondweed (*Potamogeton diversifolius*), and a species of filamentous algae from the genus *Oedogonium*.

During the February 2018 field visit, the boat was put in at a campground near wetland area W2, known as the Landings, LLC. Mike Holton, a neighboring resident, was there to greet us and show us where water levels were recently along the lake banks near the boat ramp, and when he was a kid (about 50 years ago) growing up near the lake (Figure 3-7).

The team walked along the mill ditch (Figure B1) and noted the area of the old mill, thick clay in bottom of ditch, and a small spring emerging from a buried pipe. The team also walked along a path located south of the mill ditch that was believed to be the historical lake outfall which became drier after the construction of the mill ditch.

Observations at the outfall canal area showed multiple good hydrologic indicators on cypress trees, including stain lines, lichen lines, and buttressing. Buttressing was fairly indistinct (but detectible) which is consistent with a frequently fluctuating level (consistent with the stage data). Isolated systems where water levels tend to rise to a wet season high and stay for prolonged periods tend to develop more distinct buttressing.



Figure B1. Hand-dug mill ditch representing outlet conveyance for Cherry Lake - 03/23/2017 (looking upstream from NE Cherry Lake Cir).

### W2 (Outfall Canal)

There was a much wider band of pond cypress and maidencane that extended approximately 50 to 80 feet out into the lake adjacent to the outfall canal (Figure B2). Underneath the cypress canopy, there was a dense coverage of the native SAV, southern naiad (*Najas guadalupensis*) under approximately 2.5 feet of standing water in March 2017. There were also a few small patches of the floating plant water hyacinth (*Eichhornia crassipes*), which is a non-native, nuisance plant. A few patches of pink, non-native apple snail eggs were observed on cypress trunks, most likely laid by the island apple snail (*Pomacea insularum*). A few bryozoans, resembling the colonial species *Pectinatella magnifica*, were also observed growing on spikerush (*Eleocharis* sp.). Along the bank, there was a wide band of swamp tupelo trees (*Nyssa sylvatica* var. *biflora*) and Virginia willow shrubs (*Itea virginica*). There were relatively distinct water level indicators on the cypress trunks (i.e., lichen lines, stain lines, and cypress buttressing).



*Figure B2. Cypress fringe at wetland area W2 showing cypress buttressing and lichen line hydrologic indicators - 02/06/2018.*

The pond cypress trees were dominant in areas along the lake edge that were frequently flooded. Historical Normal Pool indicators (HIs) were set on the cypress trees and a few large cypress knees. The lichen lines were consistently several inches higher than the cypress buttresses. A narrow strip of mature forested wetland dominated by swamp tupelo was present upslope of the cypress in an area that had no signs of above-ground flooding (Figure B3). Many pond cypress and a few red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*) trees were mixed in with the swamp tupelo. The understory was composed of dense Virginia willow shrubs. The soils under the tupelo forest were mucky with clay underneath a one-inch layer of duff, indicating frequent saturation to the soil surface. The tupelo forest was clearly a jurisdictional wetland.



Figure B3. Tupelo-dominated forested wetland located between cypress fringe and upland - 02/06/2018 (upland stakes in foreground)

Above the tupelo forest was a cleared area that was dominated by grasses (also visible in Figure B3). This area is dominated by bunched beaksedge (*Rhynchospora microcephala*), with witchgrasses (*Dichanthelium* spp.) mixed in, and soft rush (*Juncus effusus* subsp. *solutus*) in low spots with Baldwin's spikerush (*Eleocharis baldwinii*). There were no above-ground hydrologic indicators in this grassy area. It appeared from elevation differences that the low spots collected rainfall, which flowed into the outfall canal without standing for a lengthy period. The low spots were vegetated with more Obligate wetland species, and the soil contained more organic matter and clay, with few sand grains, and the areas were clearly jurisdictional wetland. Further upslope of the low spots, the vegetation was dominated by Facultative Wetland and Facultative species, and the soils contained more sand grains. GPI set five stakes along the wetland jurisdictional boundary. JD stake 1 was set upslope of a patch of sphagnum moss (hydrologic indicator of saturation). JD stakes 2 to 4 were set where the soils become sandier, and the vegetation was growing on the ground rather than on tussocks. JD stake 5 was set in a stand of trees at the place where pond cypress and sweetgum were replaced by American holly (*Ilex opaca*) and laurel oak (*Quercus laurifolia*), and the soils became sandier.

Upslope of the grassy area was a wooded area bordering the outfall canal. It was dominated by mature water oak (*Quercus nigra*) with many laurel oak. The understory was dominated by saw greenbriar (*Smilax bona-nox*). High water marks in the outfall canal (scarps) were 2 to 3 feet below grade in the woods. The soils in the woods were darkly coated sands but not hydric.

## W1 (Northeast Wetland)

This was a relatively wide band of swamp similar to the wetland area W2 near the outfall canal. Mature pond cypress extended from the bank well out into the lake, with thin bands of maidencane along the waterward edge, and the non-native nuisance SAV hydrilla (*Hydrilla verticillata*) growing densely on the lake bottom under the cypress canopy. The upper zone of the swamp along the lake bank had a canopy of mature swamp tupelo trees mixed in with the pond cypress. Further up the bank was a thin canopy of mature red maple with scattered sweet bay (*Magnolia virginiana*) and a few large sweetgum trees. The shrub understory was sparse except for a few wax myrtles and a dense patch of an unidentified shrub (*possibly azalea*). The understory was composed of dense ferns, mostly netted chain fern (*Woodwardia areolata*) with large patches of Virginia chain fern (*Woodwardia virginica*) and cinnamon fern (*Osmundastrum cinnamomeum*). There were also large patches of slender woodoats (*Chasmanthium laxum*) along the lake edge. The soils were organic in nature. A thick dense band of grape vine (*Vitis rotundifolia*) and blackberry (*Rubus* sp.) occurred along the upland edge of the swamp. Landward of the vines was a narrow ridge with sandy soils that was dominated by a dense canopy of the upland tree pignut hickory (*Carya glabra*), with a few water oaks mixed in and a sparse understory that was mostly composed of a thick layer of leaf litter.

Beyond the narrow upland ridge was a round-shaped, relatively deep swamp dominated by large swamp tupelo. There also was no understory, except for a few patches of duckweed (*Lemna minor*). There was shallow standing water with lichen lines on the tree trunks that were three feet higher than the standing water. There appeared to be no low point or connection to Cherry Lake, therefore, we determined that this wetland was isolated, and it was not appropriate for inclusion in the proposed lake wetland area evaluation.

The jurisdictional wetland line (JD stakes 6 to 10) were set at the edge of the dense blackberry, where the ferns ended. JD stake 10 was also next to two large live oak (*Quercus virginiana*), which are upland trees. The soils were dark, but with many sand grains. The former wetland edge may have been at the edge of the pignut hickory, but it appeared that water levels had not reached that level in many years. HI indicators were set on the cypress based mostly on lichen lines and cypress buttressing, with a few moss collars. Some exposed lateral roots were present on a small number of trees, suggesting possible soil subsidence or erosion (Figure B4).



*Figure B4. Cypress knee showing lichen line and exposed lateral roots - 02/06/2018.*

## Hydrologic Indicators

GPI Environmental Scientists (Dan Schmutz and Diane Willis) marked the locations of various indicators of Historical Normal Pool (HNP) and other indicators of inundation (e.g., lichen lines) at the two wetland sampling areas (Figure 4-1) on February 6, 2018 (e.g., placing nails at cypress buttress inflection points). Subsequent field surveys to locate and elevate the hydrologic indicators were performed between February 12 and 15, 2018.

After joining each elevation with the sampled indicator, the results are summarized in Table B1 and Figure B5. A total of 93 individual indicators were sampled, including relatively large numbers of lichen lines (n=40), cypress buttress inflection points (n=32), and wetland jurisdictional poles (n=10, Table B1). Smaller numbers of moss collars, Virginia willow root crowns, and exposed roots were sampled as well.

Table B1. Elevations of hydrologic indicators at Cherry Lake (ft NAVD88).

Hydrologic Indicator	N	Standard Deviation	Minimum Elevation	Q25 Elevation	Mean Elevation	Median Elevation	Q75 Elevation	Maximum Elevation
Lichen	40	0.09	152.03	152.19	152.24	152.23	152.28	152.49
Cypress Buttress	32	0.13	151.21	151.44	151.50	151.48	151.59	151.80
Moss Collar	7	0.12	150.47	150.63	150.70	150.75	150.80	150.80
Virginia Willow	1	0.00	151.44	151.44	151.44	151.44	151.44	151.44
Exposed Root	3	0.50	151.11	151.11	151.46	151.23	152.03	152.03
Wetland JD	10	0.68	152.81	153.10	153.71	153.65	154.15	154.81

The elevational distributions of the lichen lines, cypress buttresses, and moss collars occurred in narrow ranges as evidenced by their relatively small standard deviations (less than 0.13 foot in all three cases, Table B1) and narrow interquartile ranges (Figure B5). Tight ranges imply that these features were reliably determined and consistent among sampling points.

Past research has shown that, except in cases where soil subsidence has occurred, HNP indicators (including cypress buttress inflection points [Figure 5-4]) are consistent and reliable indicators of historical hydrology, representing inundation approximately 2 to 3% of the POR in undisturbed isolated cypress domes (Carr *et al.* 2006). Moss collars (Figure B6) are also reliable indicators of hydrology, but they tend to creep down the trees in response to altered hydrology, so they represent recent normal pool indicators. Other recent normal pool indicators were adventitious roots. Lichen lines (Figure B4) are known to be reset on tree boles by single extreme water levels, provided the inundation event lasts six days or longer (Hale 1984).

Given the importance of accurate determination of the HNP for establishment of minimum levels, we also compared the distribution of sampled elevations between the two wetland areas. Exactly half the cypress buttress inflection points were recorded at W1 and half at W2 (16 at each). A boxplot of the cypress buttress inflection points by wetland area shows the similarity in the medians, although the range is somewhat larger in W2 (Figure B7). There was no significant elevation distribution difference between the two wetland areas (Mann-Whitney U = 99, n1 = n2 = 16, p=0.287088, two-tailed). If one of the areas had been lower than the other, it would be more likely that soil subsidence had altered elevations away from true representation of historical hydrology. In summary, the cypress buttress inflection points appear to represent reliable and consistent indicators of historical hydrology at Cherry Lake.

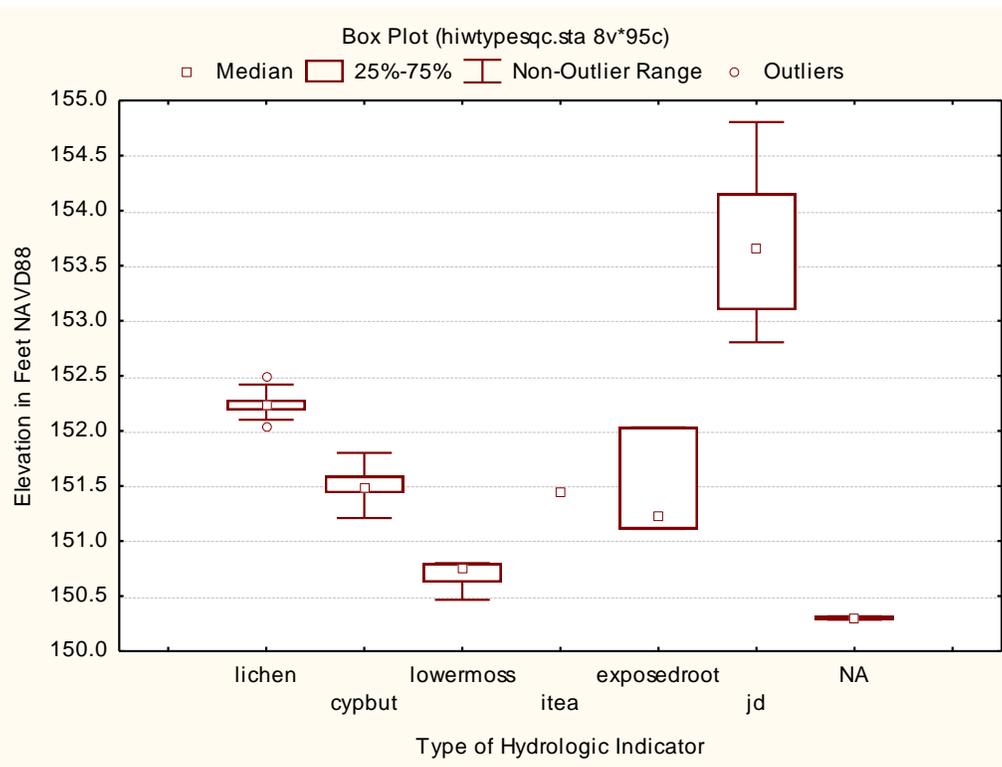


Figure B5. Boxplot of hydrologic indicator elevation distributions by type at Cherry Lake.



Figure B6. Lower limit of moss collar hydrologic indicator - 02/06/2018.

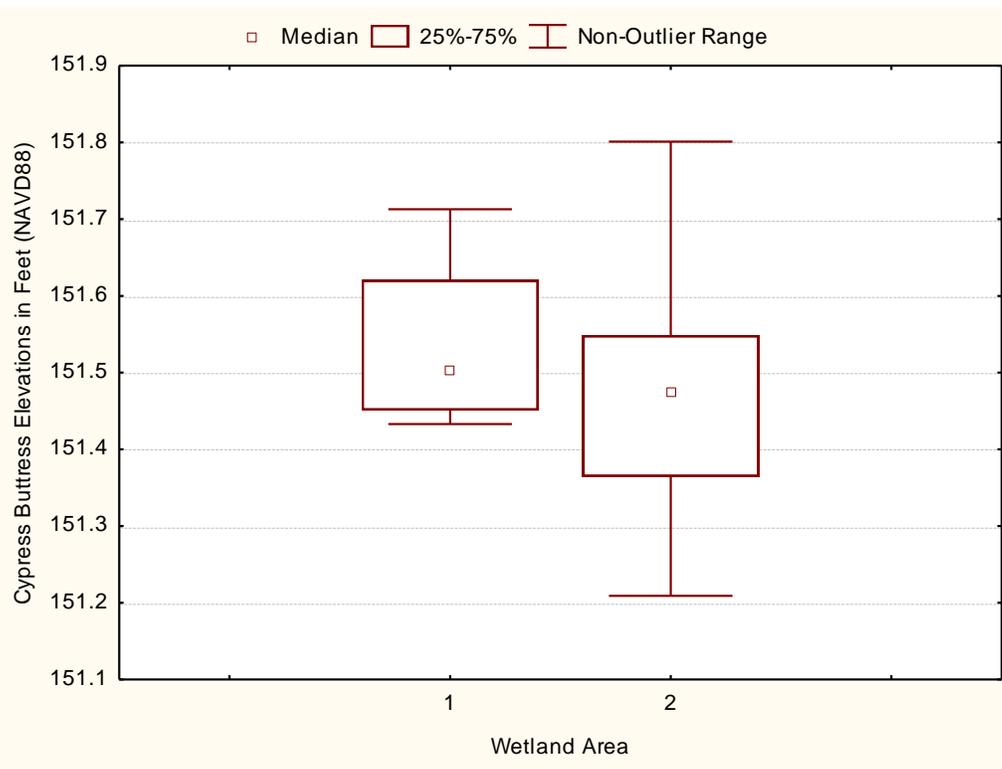


Figure B7. Boxplot of cypress buttress inflection points by wetland area at Cherry Lake.

## **Appendix C: Submerged Aquatic Vegetation Mapping**

# CHERRY LAKE SUBMERGED AQUATIC VEGETATION SURVEY

FINAL REPORT TO GREENMAN-PEDERSEN, INC.

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## BACKGROUND

The University of South Florida Water Institute (WI) was tasked with assessing the submerged aquatic vegetation (SAV) community for Cherry Lake near Madison, Florida. The goal of this assessment was to identify the species composition, their relative dominance, distribution, percent area covered and percent volume inhabited. The field data was collected on August 10 and 11, 2017.

## METHODOLOGY

To accomplish these tasks the WI utilized a dual sampling method including manual vegetation sampling and analysis of concurrently collected sonar data. During this procedure Cherry Lake was mapped using a 12' JonBoat equipped with a Lowrance HDS-5 Gen2 with Structure Scan. Transects were spaced approximately 50 meters apart for mapping purposes. The information from the Lowrance unit was saved to a SD card for data transfer in the laboratory for data analysis. SONAR TRX software was utilized to analyze the collected sonar data to determine;

- 1) The presence or absence of SAV at each sonar "ping"
- 2) The height of the SAV where present
- 3) The deep water extent of the SAV community.

The results of the SAV analysis are provided as a table of percent area covered (PAC) with SAV of the surface area of Cherry Lake, percent volume inhabited (PVI) with SAV of the total volume of Cherry Lake and the deep water extent of the SAV community.

Concurrently, a frodus sampling device (double sided rake) was used to sample the SAV community. This device was deployed multiple times per transect in the zone of SAV where SAV has been detected during the sonar based assessment as well as in depths beyond the normal deep edge of SAV. These samples were used to determine a species presence list for the SAV community as well as determine dominant species. SAV species were identified in field when possible. All unknown species or species that require further effort to identify, filamentous algae for example, were collected and preserved on ice for later identification. At each sample deployment;

- 1) A GPS waypoint coordinate was taken
- 2) All species contained in the sample were identified
- 3) A dominant species was determined

From the collected data, GIS layers were generated for the manual vegetation sampling locations, SAV dominant species, PAC of SAV, height of SAV and PVI by SAV.

## SONAR DERIVED DATA

Collected sonar data was analyzed in SONAR TRX software to determine the presence/absence of SAV as well as the height of SAV where present and percentage of the volume of Cherry Lake occupied by SAV. To accomplish this task the depth data was exported from the sonar data for all sonar pings. Next, first echo returns were manually digitized and calculated to correspond to the top of the SAV sonar signals. The resulting first echo return data corresponds to the depth at the top of SAV at each sonar ping. Figure 1 shows an example of the

SONAR TRX processing window where the sonar chart indicates vertical spikes of SAV as the light green/yellow above the bottom, indicated by the top of the red/yellow band.

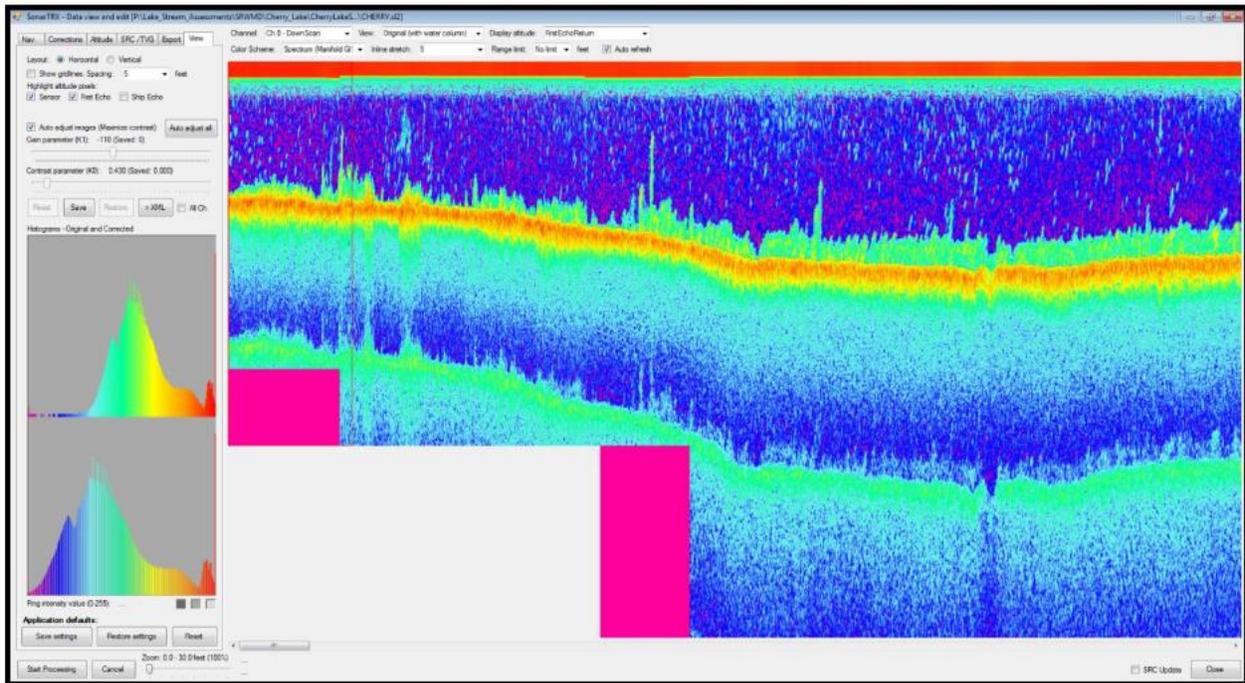


Figure 1 SONAR TRX screen showing SAV returns

From the depth and top of SAV data, the height of SAV and the percent inhabited of SAV in the water column was calculated for each ping. The resulting data was processed in ArcGIS to generate rasters of SAV height, SAV PAC and SAV PVI.

The analysis of the sonar data and resulting raster datasets showed that the majority of the lake contains SAV with a percent surface area covered (PAC) of 98.27%, see Figure 2 which shows SAV presence/absence. This SAV community occupies approximately 15.6% of the volume of Cherry Lake (PVI) as shown in Figure 3 where the PVI values have been classified in 10% intervals. Figure 4 shows the height of SAV raster for Cherry Lake. There was not a deep edge of the SAV community identified as SAV was found in the deepest parts of the lake. While there is not a deep edge of SAV for the complete community, the SAV community did have noticeable zonation among dominant species as discussed later. The Sonar derived data is summarized in Table 1.

SAV Sonar Derived Statistics	
Parameter	Value
Percent Area Covered (PAC)	98.27%
Percent Volume Inhabited (PVI)	15.60%
Mean SAV Height	1.33 feet
Estimated Deep Edge of SAV	N/A

Table 1 Summary Statistics for Sonar Derived Data

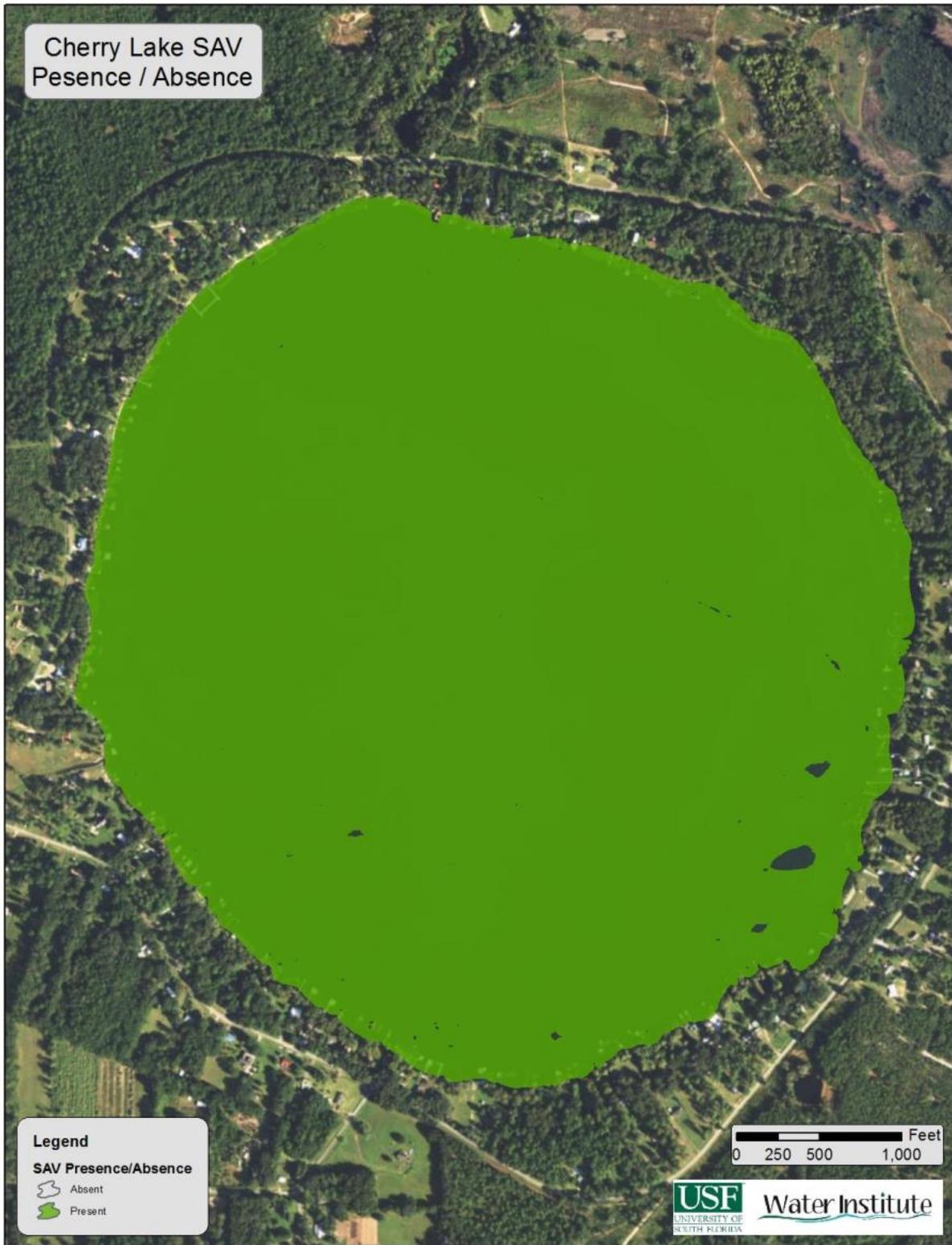


Figure 2 Cherry Lake SAV community Presence and Absence raster. The SAV community occupies 98.27% of the surface area of the lake.

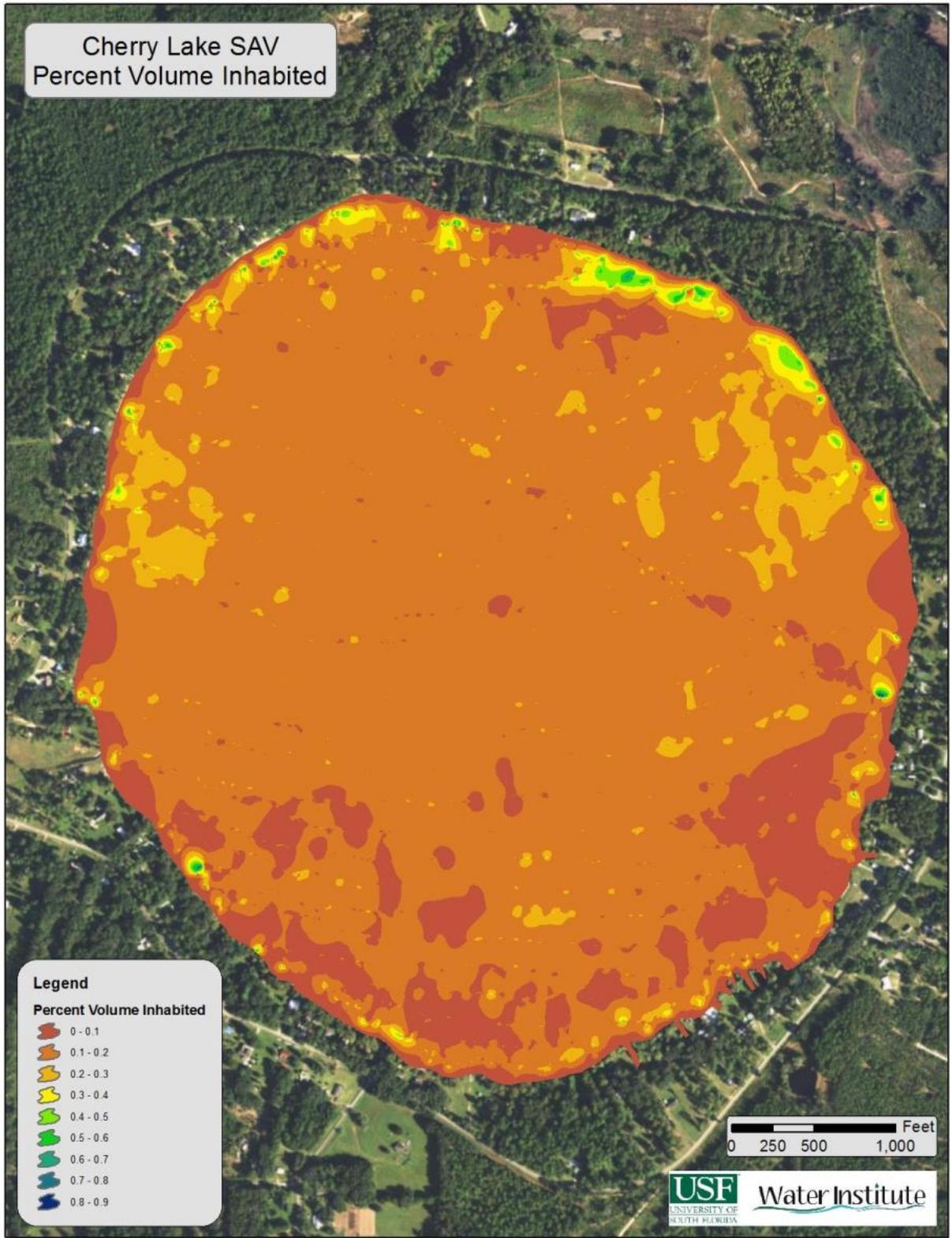


Figure 3 Cherry Lake SAV Percent Volume Inhabited (PVI) raster. Classified values indicate the percentage of the water column occupied by SAV at a location. The PVI for the entire lake was 15.6%

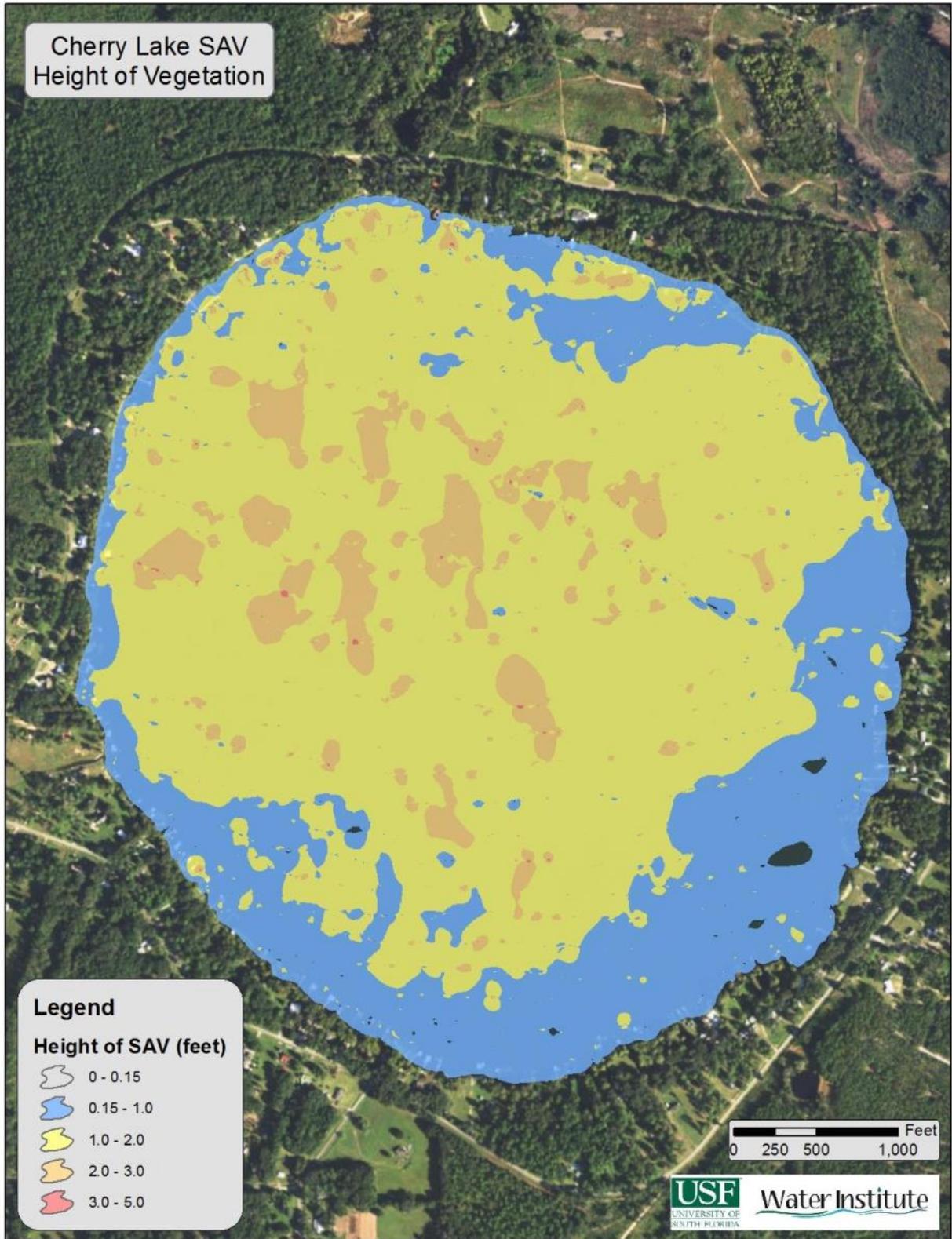


Figure 4 Cherry Lake Height of SAV raster. Classified values indicate the height in feet above the bottom of the lake of the SAV community.

## MANUAL SAV SAMPLE DATA

Concurrently collected while recording the previous sonar data, 426 manual vegetation samples were taken with the frodus device. The samples were analyzed for species present and a dominant species for each sample was assigned. The manual sampling identified 13 species of SAV including filamentous algae. The filamentous algae were classified as Filamentous Algae 1, Filamentous Algae 2, Filamentous Algae 3 and Filamentous Algae 4 in the field based on having unique characteristics either by sight or feel. Samples of each were collected and preserved on ice to be identified in the laboratory under magnification.

Filamentous Algae 1 was identified as *Lyngbya spp.* with no other filamentous genera observed in the sample. The sample was taken in shallow water on the northeastern quadrant of the lake in association with *hydrilla verticillata* and *potamogeton pusillus*. In the field this group was observed as being a dark green/ brown short mat of entangled filaments. Filamentous Algae 2 was identified as *Lyngbya spp.* dominant with *Spyrogyra spp.* also present and was collected in the northwestern portion of the lake in approximately 7.5 feet of water. Filamentous Algae 3 was one of the most commonly encountered SAV in Cherry Lake at the time of the assessment. It was identified as *Lyngbya spp.* dominant with *Spyrogyra spp.* and *Oscillatoria spp.* also present. In the field this grouping was characterized as a dark green, long entangled mat of filaments, somewhat rough to the touch, shown in the field and under magnification in Figure 5. This grouping of algae was common throughout the lake becoming the dominant species in depths between 6 feet and 8 feet of water.



Figure 5 Left -Frodus sample of Filamentous Algae 3. Right- Filamentous Algae 3 under magnification with *Spyrogyra* on top, *Lyngbya* in the middle and *Oscillatoria* on the bottom.

Filamentous Algae 4, shown in Figure 6, was identified as *Spyrogyra spp.* without other genera present. This group was observed in close association with *Nitella spp.* dominated samples. In the field it was observed as being bright green, slimy to the touch with long filaments.

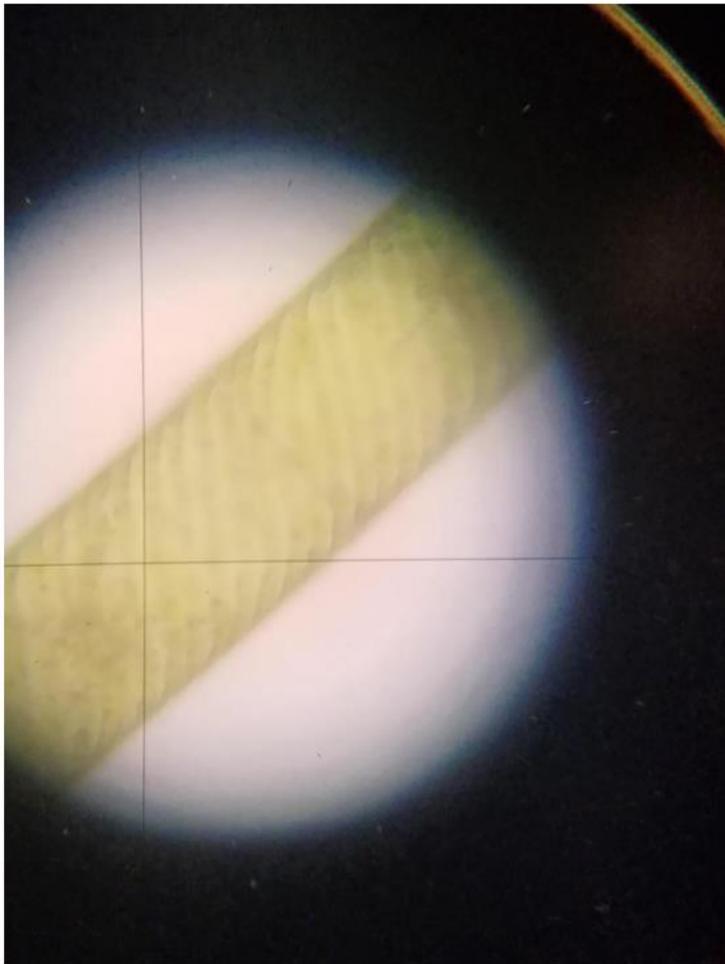


Figure 6 Filamentous Algae 4 (*Spyrogyra*) under Magnification

The remaining 10 species of SAV identified larger species readily identified in the field. Filamentous Algae 3 was the most common occurring in 49.3% of the 426 samples (dominant in 40.14%) followed by *Nitella*, found in 47.89% of samples (dominant in 45.07%). By occurrence, Filamentous Algae 4 (33.33%) and *Hydrilla verticillata* (22.77%) were the next most common in all samples. *Hydrilla verticillata* was dominant in 9.39% of samples. The locations of the 426 manual SAV samples are shown in Figure 7, symbolized by the dominant species found at each location. The summary of the manual SAV sampling efforts are shown below in Table 2. The dominant species vegetation data was further analyzed in ArcGIS to create approximate polygons indicating the areas of each dominant SAV species and their percent of lake surface area covered . These results are shown in Figure 8 and summarized in Table 3.

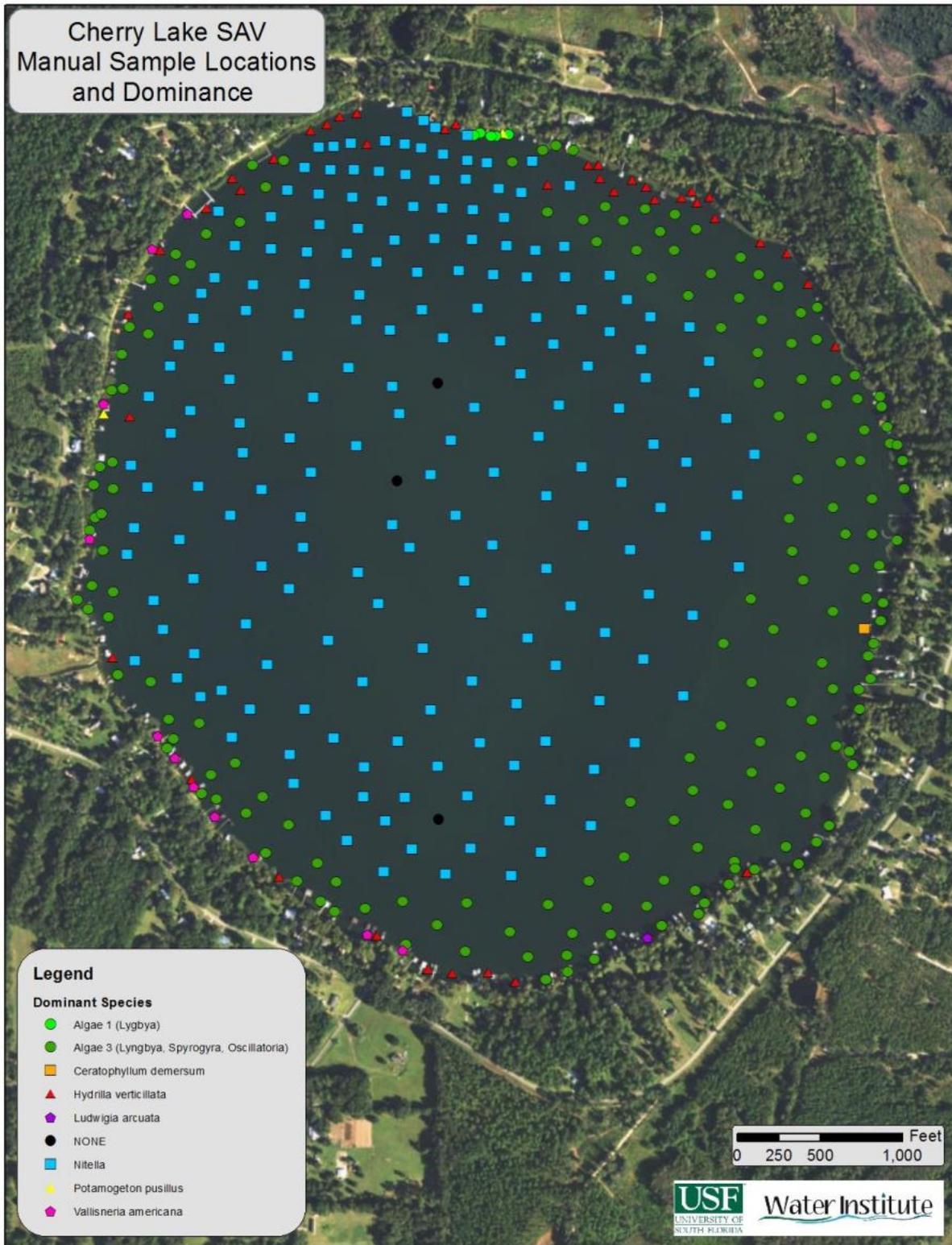


Figure 7 Locations of Manual SAV samples symbolized by the dominant species at each location.

Table 2 Summary of Manual SAV Sampling Results

Species	Code	Number of Samples Present	Percentage of Samples Present	Number of Samples Dominant	Percentage of Samples Dominant
Filamentous Algae 1 ( <i>Lyngbya</i> )	ALG1	12	2.82%	5	1.17%
Filamentous Algae 2 ( <i>Lyngbya</i> , <i>Spyrogyra</i> )	ALG2	1	0.23%	0	0.00%
Filamentous Algae 3 ( <i>Lyngbya</i> , <i>Spyrogyra</i> , <i>Oscillatoria</i> )	ALG3	210	49.30%	171	40.14%
Filamentous Algae 4 ( <i>Spyrogyra</i> )	ALG4	142	33.33%	0	0.00%
<i>Najas guadalupensis</i>	NGS	2	0.47%	0	0.00%
<i>Nitella spp.</i>	NIT	204	47.89%	192	45.07%
<i>Vallisneria americana</i>	VAA	18	4.23%	11	2.58%
<i>Ludwigia arcuata</i>	LRA	9	2.11%	1	0.23%
<i>Eleocharis baldwinii</i>	EBI	8	1.88%	0	0.00%
<i>Utricularia radiata</i>	URA	3	0.70%	0	0.00%
<i>Utricularia gibba</i>	UGA	1	0.23%	0	0.00%
<i>Ceratophyllum demersum</i>	CDM	12	2.82%	1	0.23%
<i>Potamogeton pusillus</i>	POT	6	1.41%	2	0.47%
<i>Hydrilla verticillata</i>	HVA	97	22.77%	40	9.39%
No Vegetation	NONE	3	0.70%	3	0.70%
<b>Total Samples</b>		<b>426</b>			

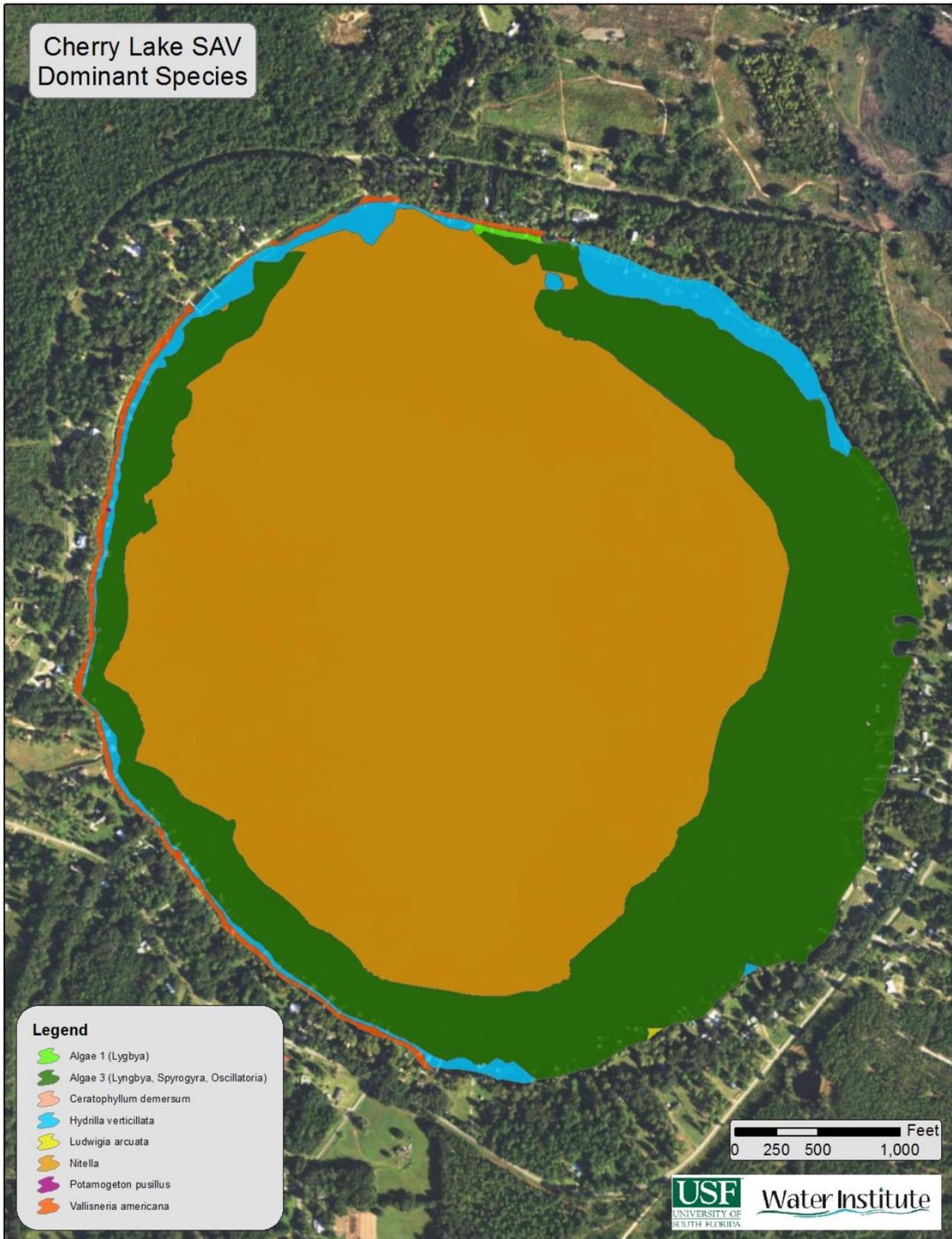


Figure 8 Polygons indicating the spatial distribution of SAV dominant species.

Table 3 Summary of SAV Dominant Species Surface Area

Dominant Vegetation	Surface Area (ft <sup>2</sup> )	Acres	Percent Area Covered
Filamentous Algae 1 ( <i>Lygbya</i> )	16,731.74	0.38	0.08%
Filamentous Algae 3 ( <i>Lyngbya</i> , <i>Spyrogyra</i> , <i>Oscillatoria</i> )	6,333,930.82	145.41	30.08%
<i>Ceratophyllum demersum</i>	349.68	0.01	0.00%
<i>Hydrilla verticillata</i>	728,984.42	16.74	3.46%
<i>Ludwigia arcuata</i>	3,614.64	0.08	0.02%
<i>Nitella</i>	13,356,413.34	306.62	63.43%
<i>Potamogeton pusillus</i>	807.70	0.02	0.00%
<i>Vallisneria americana</i>	233,598.86	5.36	1.11%

The SAV community of Cherry Lake showed a zonal pattern of species, particularly in the northern and western portions of the lake. In these regions, the depths between 0.5 and 2.75 feet was occupied by *Vallisneria Americana* with other species (*Najas guadaleupensis*, *Ceratophyllum demersum*, *Ludwigia arcuata* and *Potamogeton pusillus*). Beyond that zone in depths between 2.75 and approximately 5.5 feet *Hydrilla verticillata* became the dominant species. This zone extended slightly deeper in the northern portions of the lake. Between 5.5 and 8 feet of depth, the overwhelming majority of the SAV community was Filamentous Algae 3 (*Lyngbya*, *Spyrogyra*, *Oscillatoria*). The deeper portions of the lake were dominated by *Nitella* commonly with a covering of Filamentous Algae 4 (*Spyrogyra*). A Secchi Disk Depth was taken near the center of the lake during the assessment on August 10 and 11, 2017. Both of these values were reported as being visible on bottom in 12.7 feet of water and 13.2 feet of water. In both cases, the secchi disk was visible until reaching the SAV community (*Nitella*).

## CONCLUSION

Cherry Lake in Madison County, Florida is a relatively shallow (maximum depth of approximately 14 feet at the time of the assessment), clear water (Secchi disk depth greater than maximum depth) system. As expected in a system like this, the submerged aquatic vegetation community covers the majority of the bottom of the lake (98.27% of the surface area). The vegetation occupies approximately 15.6% of the volume of Cherry Lake. The submerged aquatic vegetation community consists of 10 species of macrophytes (including macroalgae) as well as at least 3 species of filamentous algae. The macroalgae *Nitella* covered approximately 306.62 acres of Cherry Lake (63.43% of the surface area). The “Filamentous Algae 3” group (*Lyngbya*, *Spyrogyra*, *Oscillatoria*), was the second most commonly encountered SAV covering 145.41 acres (30.08% of the lakes surface area).

## Appendix D: Supporting Information for Development of Minimum Levels

### Bathymetry

The stage-area-volume relationships were developed for Cherry Lake by building and processing a triangular irregular network (TIN) of the lake bathymetry and land surface elevations of surrounding watershed (Figure D1). The Cherry Lake TIN data was further converted to a digital elevation model (DEM). Figure D2 illustrates the bathymetric contours and DEM for the lake bottom and land surface below 154.0 ft NAVD88.

The resultant stage-area-volume relationships created from the 2017 SRWMD bathymetric survey and 2011 USGS topographic DEM data are listed in Table D1. The elevation data of the 2017 SRWMD bathymetric survey and 2011 USGS topographic DEM was provided in the vertical datum of NAVD88.

The relationships of lake stage versus surface area (2D area), bottom area (3D area), volume, mean depth, and maximum depth, are graphically presented in Figures D3 through D7, respectively.

Table D1. Stage-area-volume table for Cherry Lake.

Elevation (ft NAVD88)	Area_2D (ft <sup>2</sup> )	Area_3D (ft <sup>2</sup> )	Volume (ft <sup>3</sup> )	Area_2D (acres)	Area_3D (acres)
137.0	17.07	17.07	0.01	0.00	0.00
137.5	139,858.48	139,862.88	23,906.17	3.21	3.21
138.0	829,266.29	829,303.71	247,435.03	19.04	19.04
138.5	1,891,273.79	1,891,377.58	914,613.14	43.42	43.42
139.0	3,151,312.06	3,151,495.02	2,174,160.44	72.34	72.35
139.5	4,775,447.97	4,775,712.71	4,159,687.27	109.63	109.64
140.0	6,180,577.12	6,180,921.80	6,937,779.01	141.89	141.89
140.5	6,964,855.72	6,965,260.77	10,229,729.35	159.89	159.90
141.0	7,786,589.56	7,787,051.62	13,915,367.00	178.76	178.77
141.5	8,752,428.24	8,752,953.41	18,046,882.88	200.93	200.94
142.0	10,062,367.28	10,062,963.84	22,726,895.68	231.00	231.01
142.5	11,666,575.18	11,667,257.24	28,162,710.56	267.83	267.84
143.0	13,112,713.32	13,113,482.25	34,369,596.50	301.03	301.04
143.5	14,202,874.21	14,203,724.64	41,206,126.56	326.05	326.07
144.0	15,163,171.92	15,164,114.80	48,541,788.70	348.10	348.12
144.5	16,377,510.93	16,378,547.25	56,418,720.45	375.98	376.00
145.0	17,666,623.64	17,667,774.49	64,931,966.00	405.57	405.60
145.5	18,530,511.46	18,531,810.45	74,008,752.71	425.40	425.43
146.0	19,004,230.65	19,005,724.69	83,399,311.90	436.28	436.31
146.5	19,382,315.52	19,384,041.50	92,997,666.97	444.96	445.00
147.0	19,650,572.28	19,652,591.24	102,764,354.78	451.12	451.16

Table D1. Stage-area-volume table for Cherry Lake.

Elevation (ft NAVD88)	Area_2D (ft <sup>2</sup> )	Area_3D (ft <sup>2</sup> )	Volume (ft <sup>3</sup> )	Area_2D (acres)	Area_3D (acres)
147.5	19,827,320.88	19,829,665.87	112,636,103.79	455.17	455.23
148.0	19,980,357.00	19,983,047.03	122,588,184.21	458.69	458.75
148.5	20,131,771.70	20,134,827.11	132,616,381.71	462.16	462.23
149.0	20,283,079.32	20,286,523.80	142,720,045.45	465.64	465.71
149.5	20,435,563.39	20,439,420.08	152,899,657.07	469.14	469.22
150.0	20,589,139.55	20,593,432.47	163,155,793.95	472.66	472.76
150.5	20,747,637.45	20,752,442.95	173,489,509.74	476.30	476.41
151.0	20,917,579.02	20,923,216.76	183,905,423.89	480.20	480.33
151.5	21,083,485.05	21,090,532.05	194,405,918.60	484.01	484.17
152.0	21,236,691.31	21,245,663.11	204,986,061.62	487.53	487.73
152.5	21,404,997.39	21,416,193.63	215,645,451.50	491.39	491.65
153.0	21,595,442.29	21,609,019.05	226,394,202.66	495.76	496.07
153.5	21,838,224.51	21,854,293.37	237,248,112.35	501.34	501.71
154.0	22,128,874.56	22,147,433.03	248,239,779.97	508.01	508.44

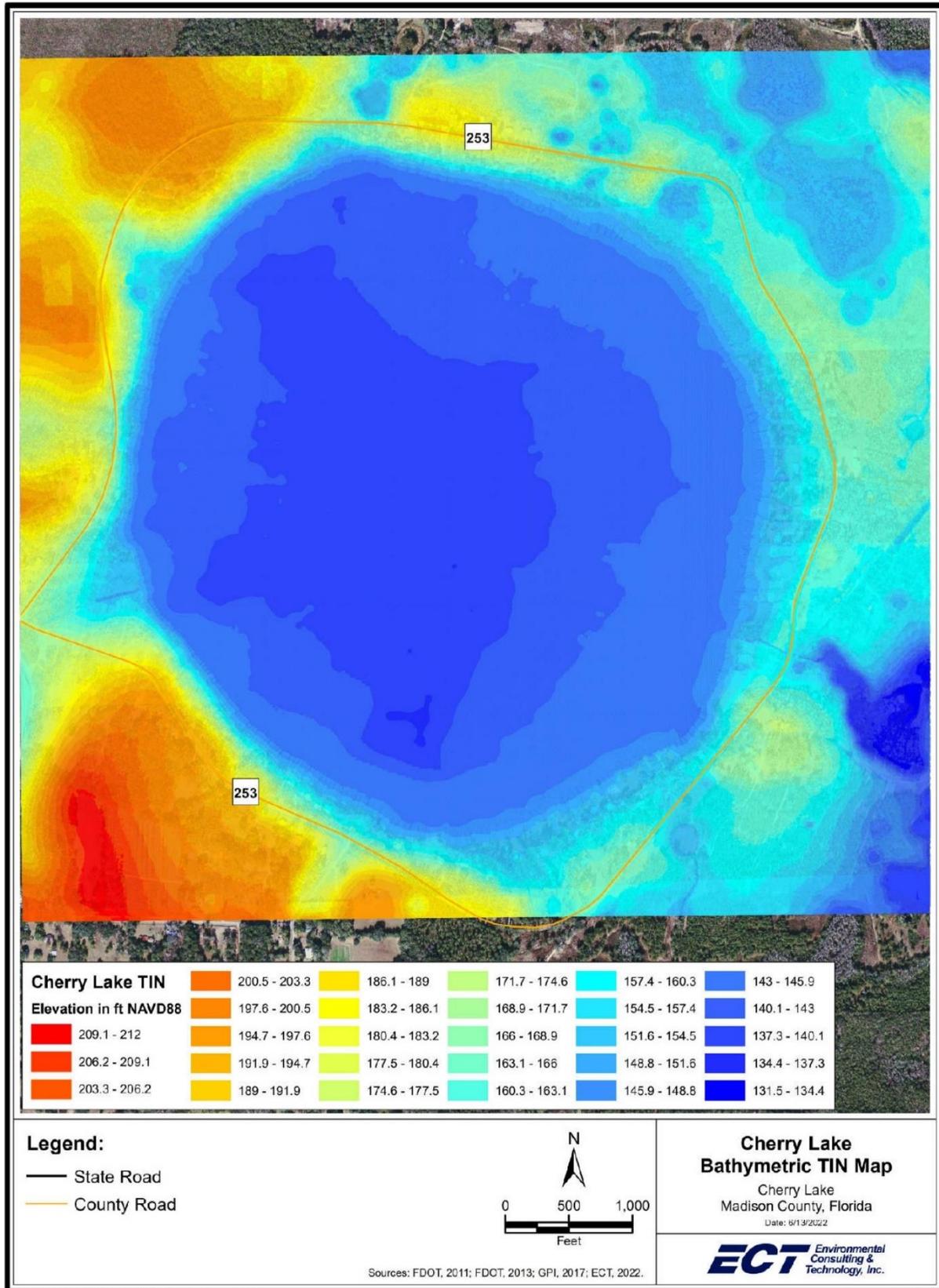


Figure D1. Cherry Lake bathymetric TIN map (elevation in ft NAVD88).

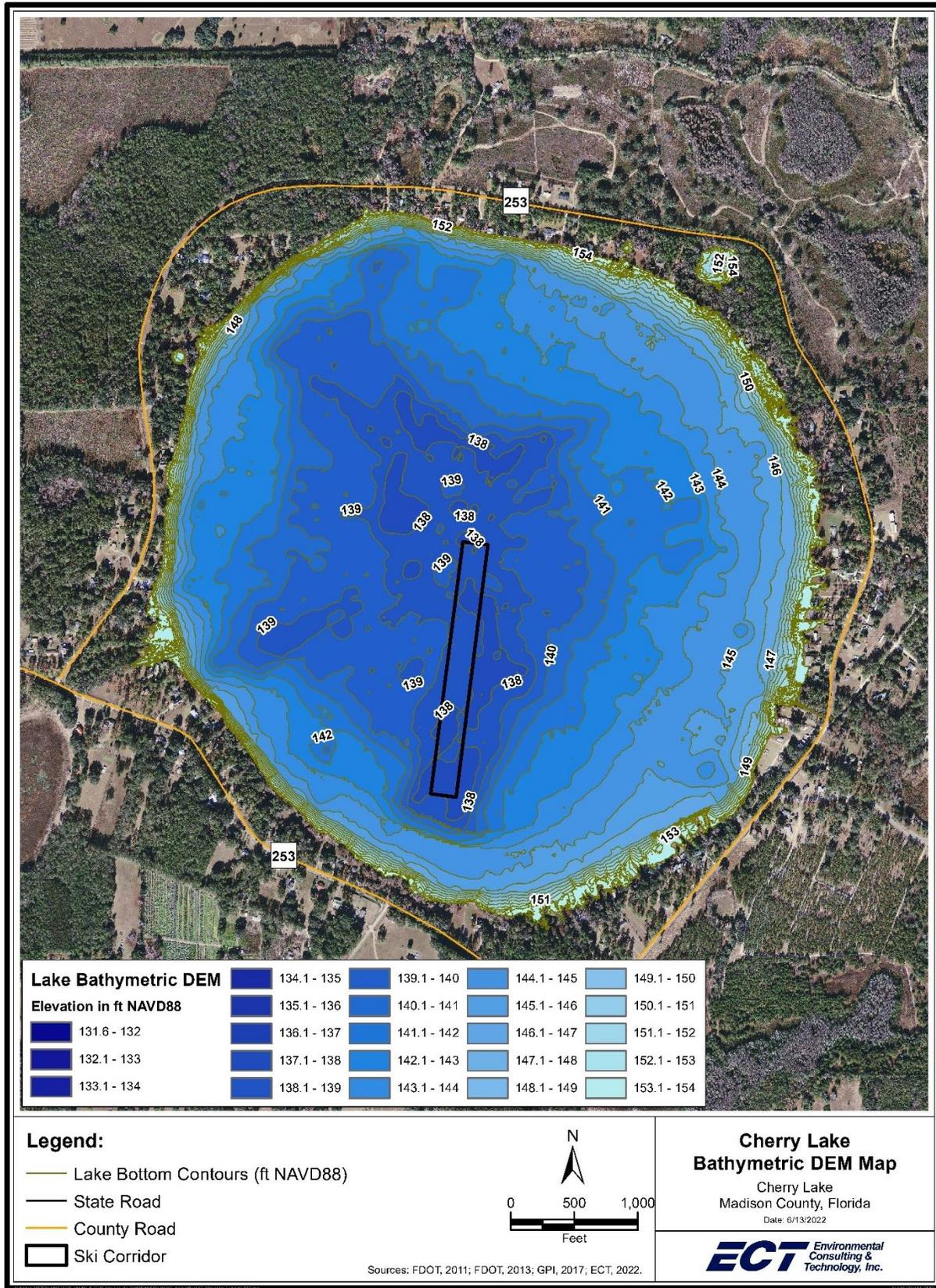


Figure D2. Cherry Lake bathymetric DEM map (elevation in ft NAVD88).

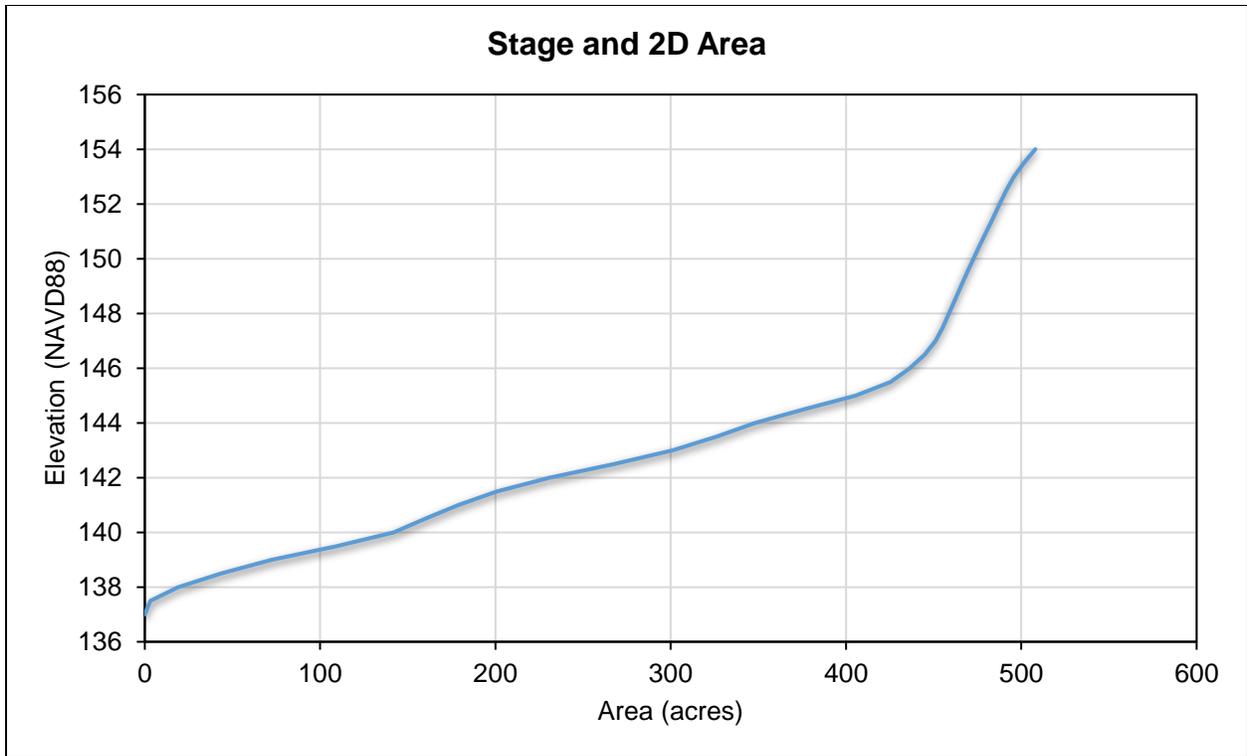


Figure D3. Lake stage to surface area (2D area) for Cherry Lake.

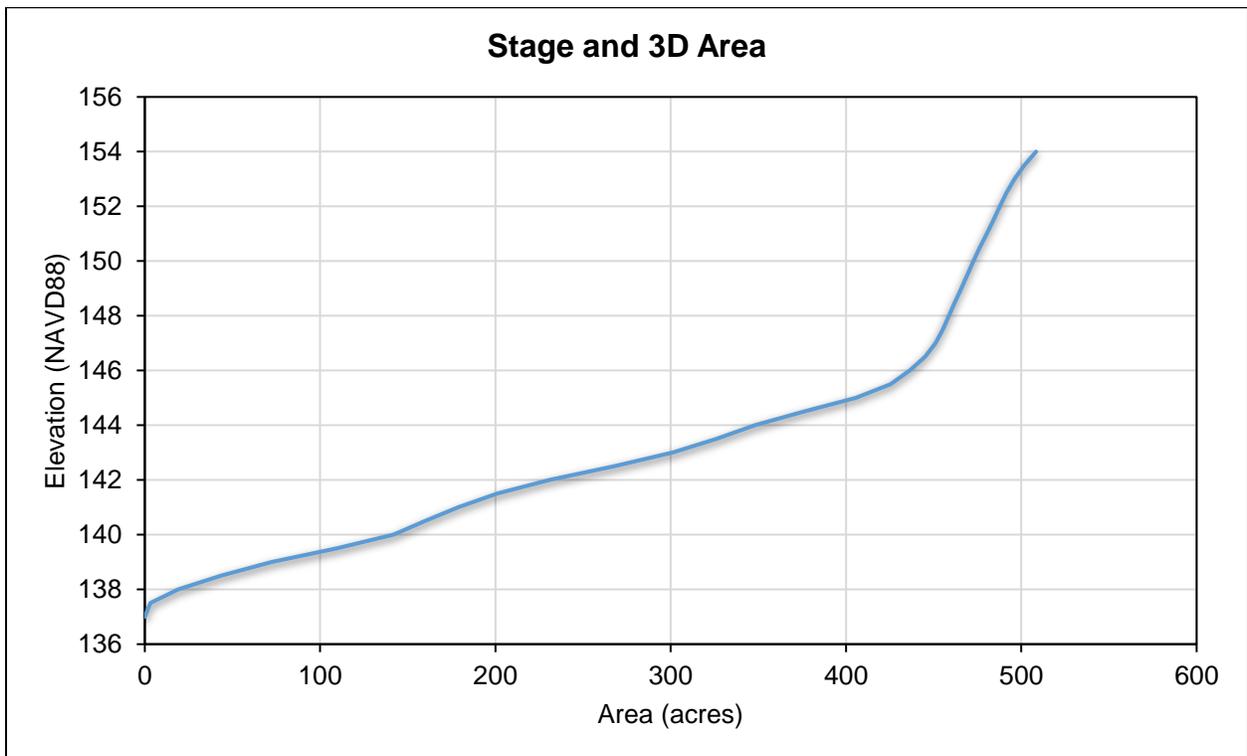


Figure D4. Lake stage to bottom area (3D area) for Cherry Lake.

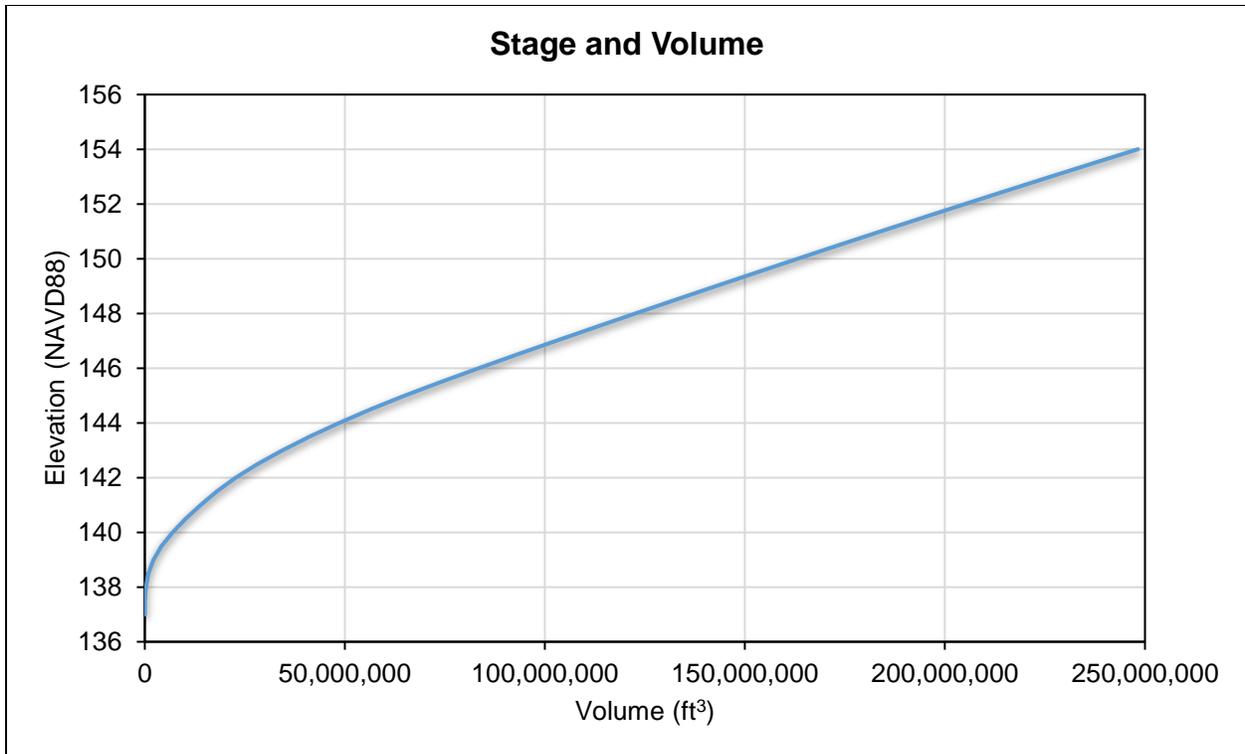


Figure D5. Lake stage to volume for Cherry Lake.

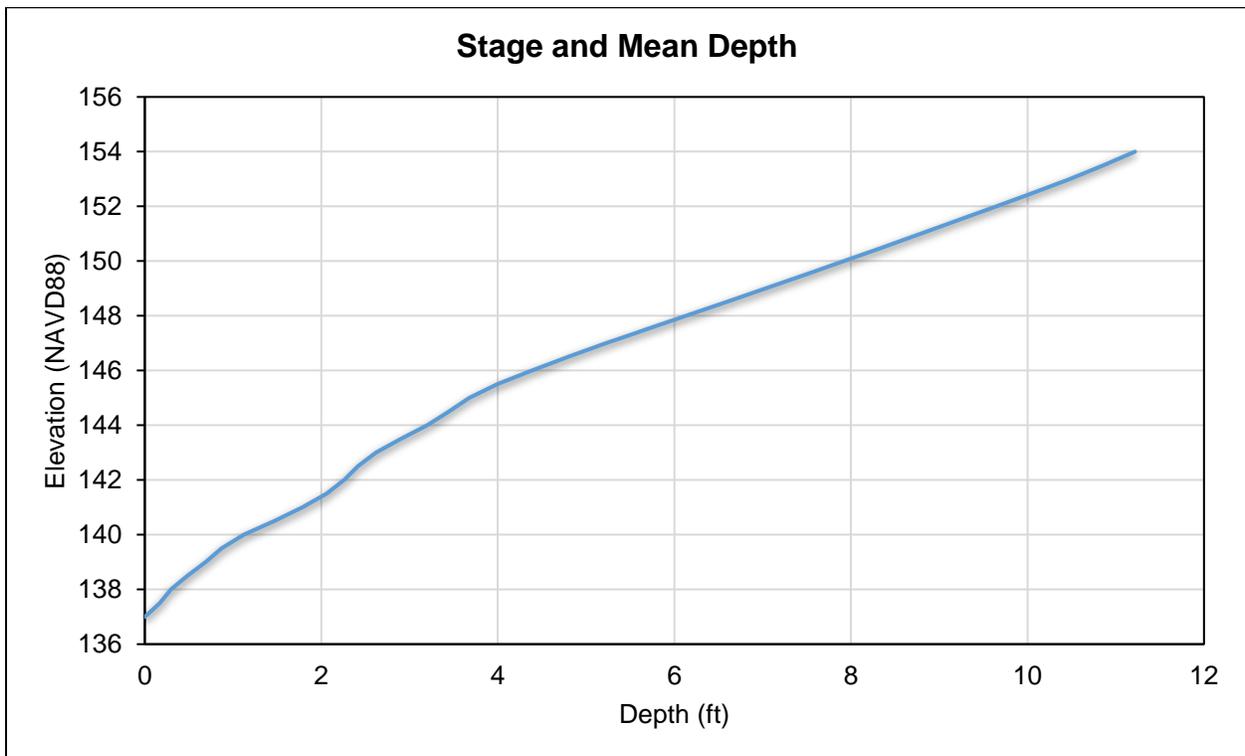


Figure D6. Lake stage to mean depth for Cherry Lake.

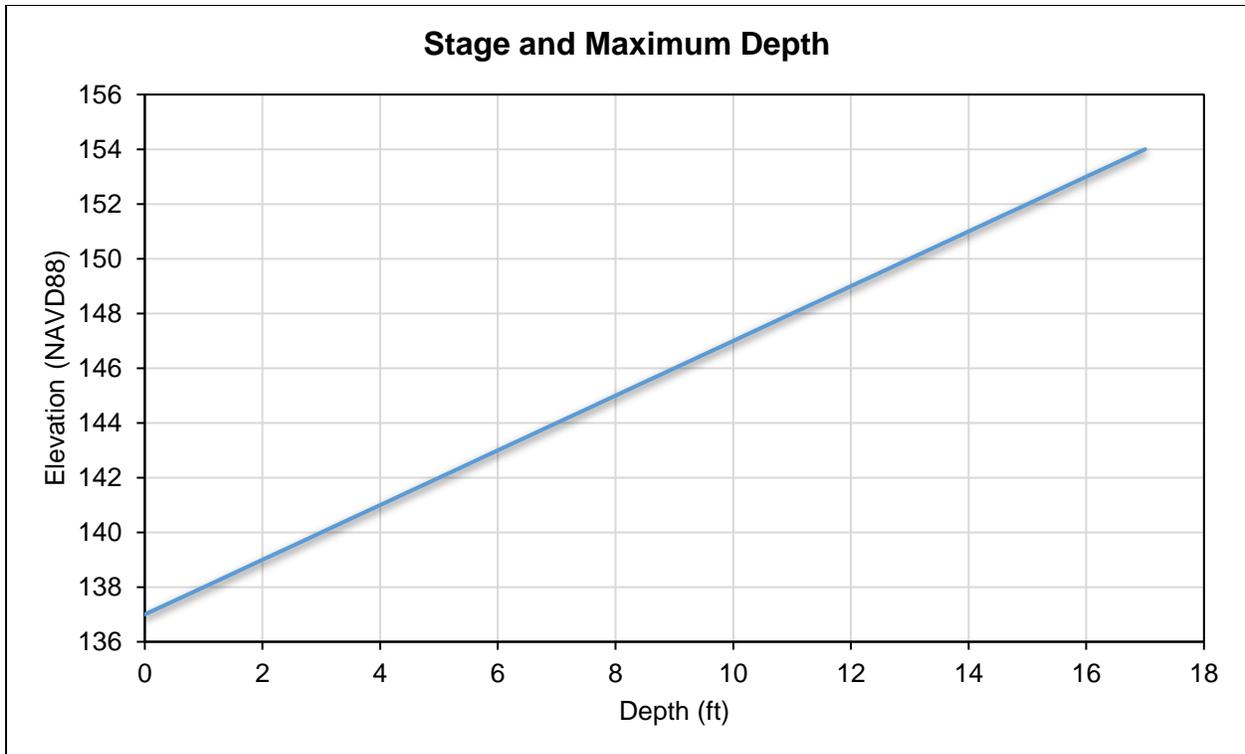


Figure D7. Lake stage to maximum depth for Cherry Lake.

## Significant Change Standards

The following sections summarize the supporting data and methodology utilized in the development of the seven significant change standards for Category 3 Lakes, including a Wetland Offset Standard, a Dock-Use Standard, an Aesthetics Standard, a Species Richness Standard, a Lake Mixing Standard, a Recreation/Ski Standard, and a Basin Connectivity Standard. Potential changes in the coverage of herbaceous wetland vegetation and submersed aquatic plants are also discussed below.

### Dock-Use Standard

The Dock-Use Standard was estimated by calculating the P10 of dock sediment elevations, then adding 2 feet to that and adding the absolute difference between the Historic P90 (HP90) and HP50 to get the final standard.

The P10 of the 127 surveyed dock sediment elevations was 147.34 ft NAVD88 (Figure D8). Using the Dock-Use Standard formula, it gives a final Dock-Use Standard of 150.58, 150.55, and 150.55 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively.

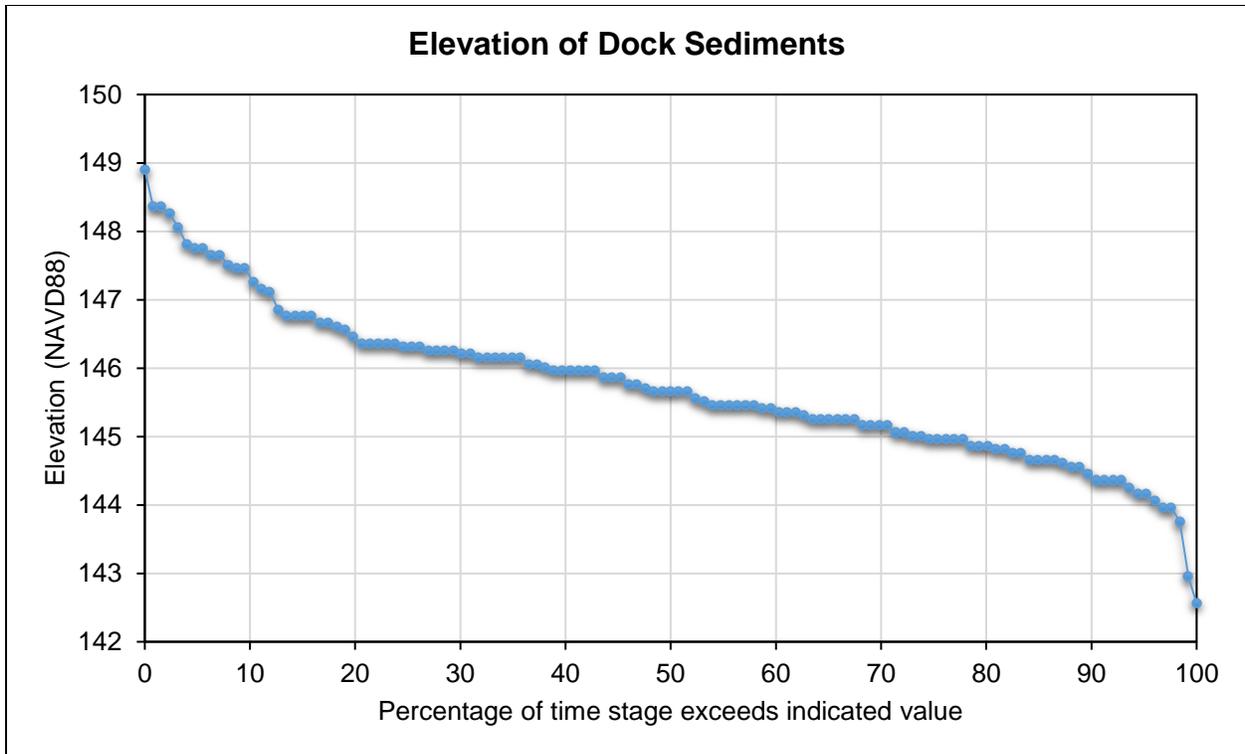


Figure D8. Elevation of dock sediments surveyed for Cherry Lake.

### Wetland Offset Standard

Based on an evaluation of the relationship of the Cypress Standard with the HP50 for hydrologically unimpacted cypress wetlands, the Wetland Offset Standard for Category 3 Lakes is established at an elevation 0.8 ft below the HP50 elevation (Hancock 2007).

The HP50 elevations were estimated at 150.52, 150.03, and 149.76 ft NAVD88 for the high, medium, and low Control Point scenarios, respectively. So, the Wetland Offset Standard elevations were established at 149.72, 149.23, and 148.96 ft NAVD88 for the high, medium, and low Control Point scenarios, respectively.

### Aesthetics Standard

The Aesthetic Standard elevations were established at the Historic P90 elevations, which were 149.28, 148.82, and 148.55 ft NAVD88 for the high, medium, and low Control Point scenarios, respectively.

### Lake Mixing Standard

We calculated the Lake Mixing Standard by calculating the dynamic ratio (Bachmann *et al.* 2000) at the HP50, then gradually lowering it to see when the ratio changes from either above 0.8 to below 0.8, or from below 0.8 to above 0.8. More detailed methods included the following:

1. Converted lake surface area (2D area in Table D1) from ft<sup>2</sup> to km<sup>2</sup>.
2. Mean depth in feet calculated as volume in ft<sup>3</sup>/2D area in ft<sup>2</sup>.
3. Converted mean depth in feet to meters.

4. Dynamic Ratio calculated as  $(\sqrt{\text{lake 2D area in km}^2}) / (\text{mean depth in meters})$ .
5. Repeated steps 1 through 4 for each elevation listed in Table D1 and any new elevations to have a Dynamic Ratio of 0.8, if needed.

The dynamic ratio calculation results for selected lake stages are listed in Table D2. Figure D9 illustrates the relationship of lake stage versus dynamic ratio for Cherry Lake. Based on the data listed in Table D2, the Lake Mixing Standard was established at an elevation of 147.36 ft NAVD88, for all the high, medium, and low Control Point scenarios.

Table D2. Lake Stage and Dynamic Ratio for Cherry Lake.

Elevation (ft NAVD88)	2D Area (ft <sup>2</sup> )	Volume (ft <sup>3</sup> )	Mean Depth (meter)	2D Area (km <sup>2</sup> )	Dynamic Ratio
146.0	19,004,230.65	83,399,311.90	1.34	1.77	0.99
146.5	19,382,315.52	92,997,666.97	1.46	1.80	0.92
147.0	19,650,572.28	102,764,354.78	1.59	1.83	0.85
147.36	19,777,831.27	109,872,014.06	1.69	1.84	0.80
147.5	19,827,320.88	112,636,103.79	1.73	1.84	0.78
148.0	19,980,357.00	122,588,184.21	1.87	1.86	0.73
148.5	20,131,771.70	132,616,381.71	2.01	1.87	0.68

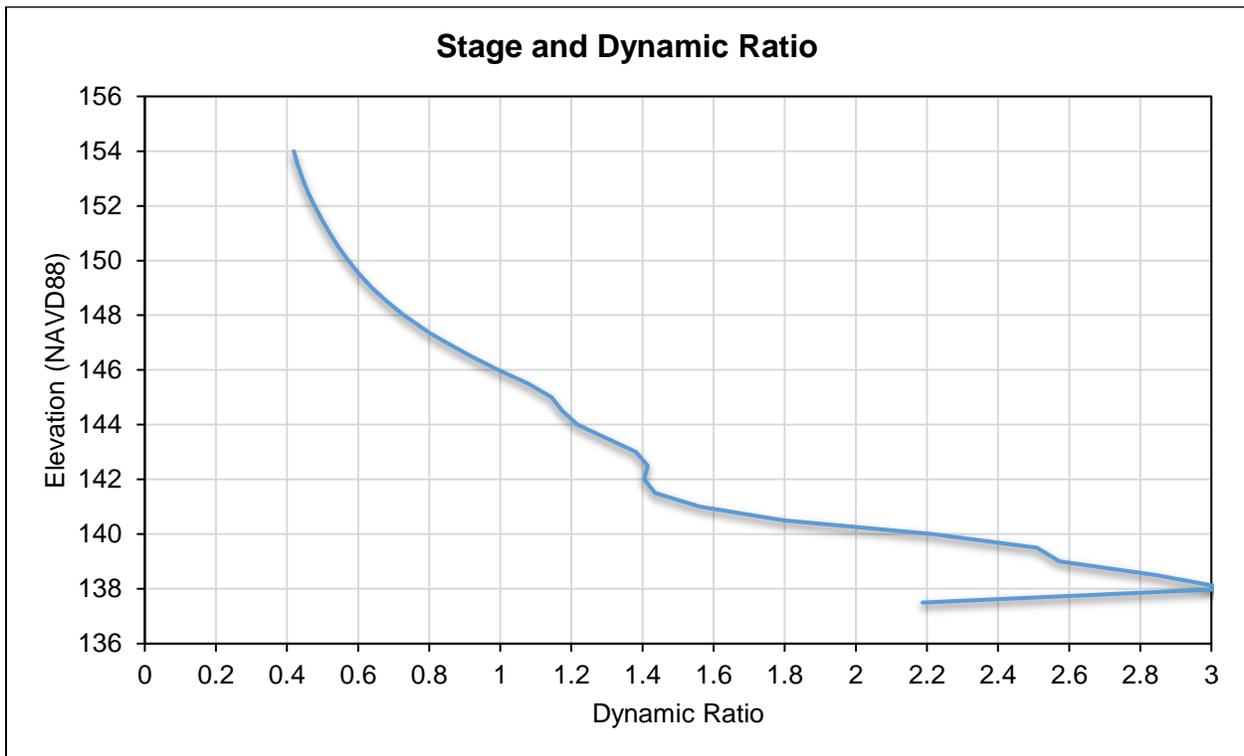


Figure D9. Lake stage to dynamic ratio for Cherry Lake.

### Species Richness Standard

The Species Richness Standard was estimated by identifying what drop in elevation from the HP50 water elevation will result in a 15% change in lake area. Preventing a loss of 15% of the area is expected to preserve the species richness (i.e., number) of birds utilizing the lake based on previous empirical research (Bachmann and Hoyer 1999, Emery *et al.* 2009). Based on the stage-area relationship (Table D1 and Figure D3), the lake surface areas at the HP50 elevations for the high, medium, and low Control Point scenarios (150.52, 150.03, and 149.76 ft NAVD88) were estimated at 476.5, 472.9, and 471.0 acres, respectively; and a 15% reduction in these areas results in areas of 405.0, 401.9, and 400.3 acres. By using linear interpolation method, the Species Richness Standard elevations were established at elevations of 144.99, 144.94, and 144.91 ft NAVD88, for the high, medium, and low Control Point scenarios, respectively.

### Recreation/Ski Standard

The Recreation/Ski Standard was estimated using a rectangular corridor that was 2,000 feet x 200 feet in size aligned with the deepest part of the lake (Figure D2). Using the Zonal Statistics tool in the Zonal toolset of the ArcGIS Spatial Analyst toolbox, the maximum elevation within the corridor was estimated at 139.07 ft NAVD88. Then, 5 feet and the difference of the HP90 and HP50 were added to establish the Recreation/Ski Standard elevations at 145.31, 145.28, and 145.28 ft NAVD88 for the high, medium, and low Control Point scenarios, respectively.

### Basin Connectivity Standard

A review of the morphology of the Cherry Lake basin (Figures 3-1 and D1) indicates that Cherry Lake is composed of one main basin with no navigable surface water connections to other waters, so no Basin Connectivity Standard was developed.

### Herbaceous Wetlands Information for Consideration

The herbaceous wetland information was evaluated by identifying the lake bottom area (3D area) less than 4 feet deep at the median water level (HP50), then plotting how that area changes with lowered depth.

As shown in Figure D10, a change in the median water level from the HP50 (150.52 ft NAVD88) to a lower level proposed here as the Minimum Lake Level (149.72 ft NAVD88) would be expected to result a 9.2-acre increase in the potential herbaceous coverage for the high Control Point scenario, a change in the median water level from the HP50 (150.03 ft NAVD88) to the MLL (149.68 ft NAVD88) would result a 5.0-acre increase in the potential herbaceous coverage for the medium Control Point scenario, and a change in the median water level from the HP50 (149.76ft NAVD88) to the MLL (149.68 ft NAVD88) would result a 1.2-acre increase in the potential herbaceous coverage for the low Control Point scenario. Based on the gradual slope of the function on the graph, even lower water levels would result in relatively large potential increases of herbaceous coverage relative to changing lake stage.

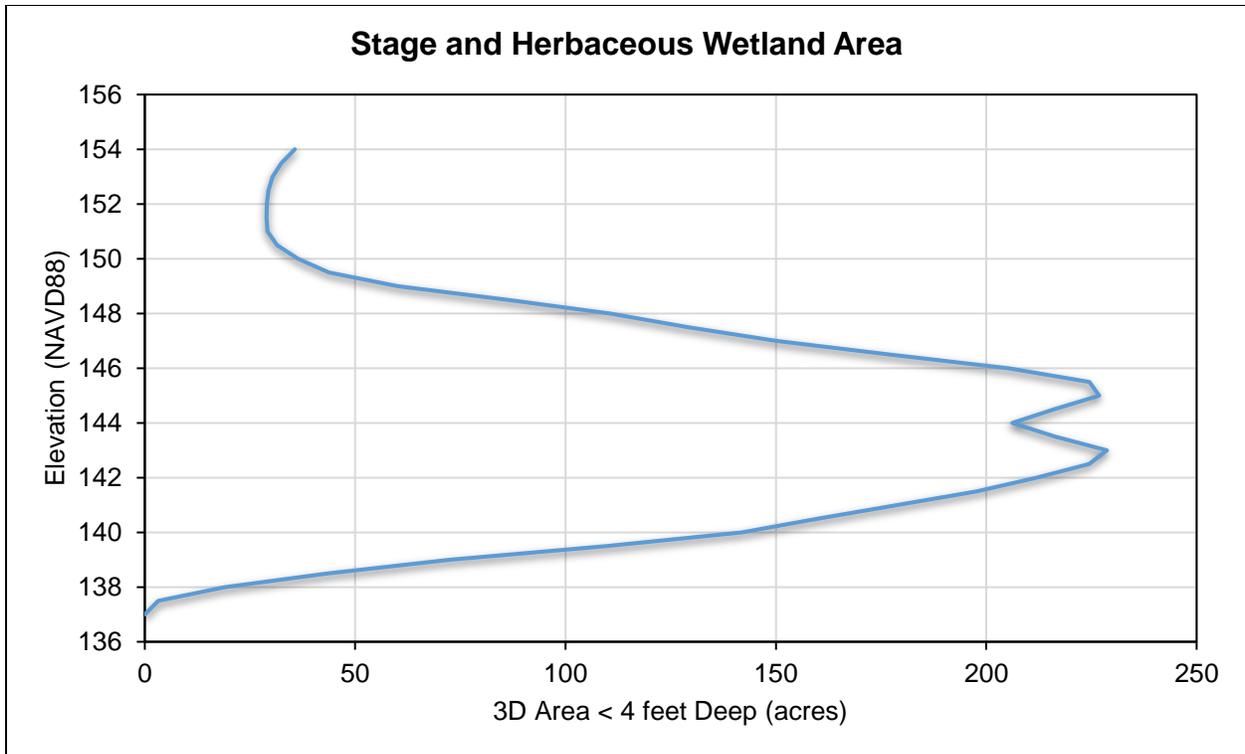


Figure D10. Lake stage to herbaceous wetland area for Cherry Lake.

### Submersed Aquatic Macrophyte Information for Consideration

Changes in lake stage associated with changes in area available for colonization by rooted submersed macrophytes are evaluated, based on water transparency values.

Secchi disk data for Cherry Lake was assembled by the District and provided to ECT, including the water quality data retrieved from the FDEP Watershed Information Network (WIN). The daily mean for each unique date (n=66) was used to estimate an overall mean Secchi disk depth of 2.31 meters (Figure D11). This value was used as a variable in the maximum depth of colonization (MDC) equation provided below (Caffrey 2006).

$$\text{Log}_{10}(\text{MDC}) = 0.66 * \text{log}_{10}(2.31) + 0.30 = 0.539984$$

$$\text{MDC} = 10^{0.539984} = 3.47 \text{ meters or } 11.38 \text{ feet}$$

For the lake bathymetry (Table D1 and Figure D7), we concluded that the estimated MDC value of 11.38 ft, say 11.5 ft, was not deep enough to support submersed aquatic vegetation (SAV) colonization for the entire lake bottom. As a result of SAV having the potential to grow within an MDC of 11.5 ft, the change in area that is available for SAV colonization is a function of lake stage versus lake bottom area (i.e., 3D area) less than 11.5 ft deep (Figure D12). A change from the HP50 to a lower level proposed here as the Minimum Lake Level would increase the submerged lake bottom areas by approximately 38.3, 14.9, and 3.3 acres, or 8.0%, 3.1%, and 0.7% of the total lake bottom areas at the HP50 of 476.6, 473.0, and 471.1 acres, for the high, medium, and low Control Point scenarios. It is interesting to note that decline in lake stage is not linearly related to an increase in area suitable for SAV colonization due to morphometry of the lake bottom.

As described in Appendix C, a SAV survey was recently conducted at Cherry Lake by University of South Florida (USF) in August 2017. A Secchi disk depth was taken near the center of the lake during the assessment on August 10 and 11, 2017. Both values were reported as being visible on bottom in 12.7 ft (3.87 meters) and 13.2 ft (4.02 meters) of water. Using the average Secchi disk depth of 3.95 meters assessed in August 2017 and the MDC equation above, the MDC value was estimated at 16.2 ft, which was deep enough to support SAV colonization for the entire lake bottom (Table D1 and Figure D7). As expected for a relatively shallow and clear water system (maximum depth of 14 ft and average Secchi disk depth of 3.95 meters at the time of the assessment), the SAV community covered the majority of the lake (98.27% of the lake surface area) during the time of assessment. If the Secchi disk depth is decreased, e.g., approximately 1.4 meters in the period of 2006 through 2008 (Figure D11), the Cherry Lake SAV community coverage could be reduced accordingly.

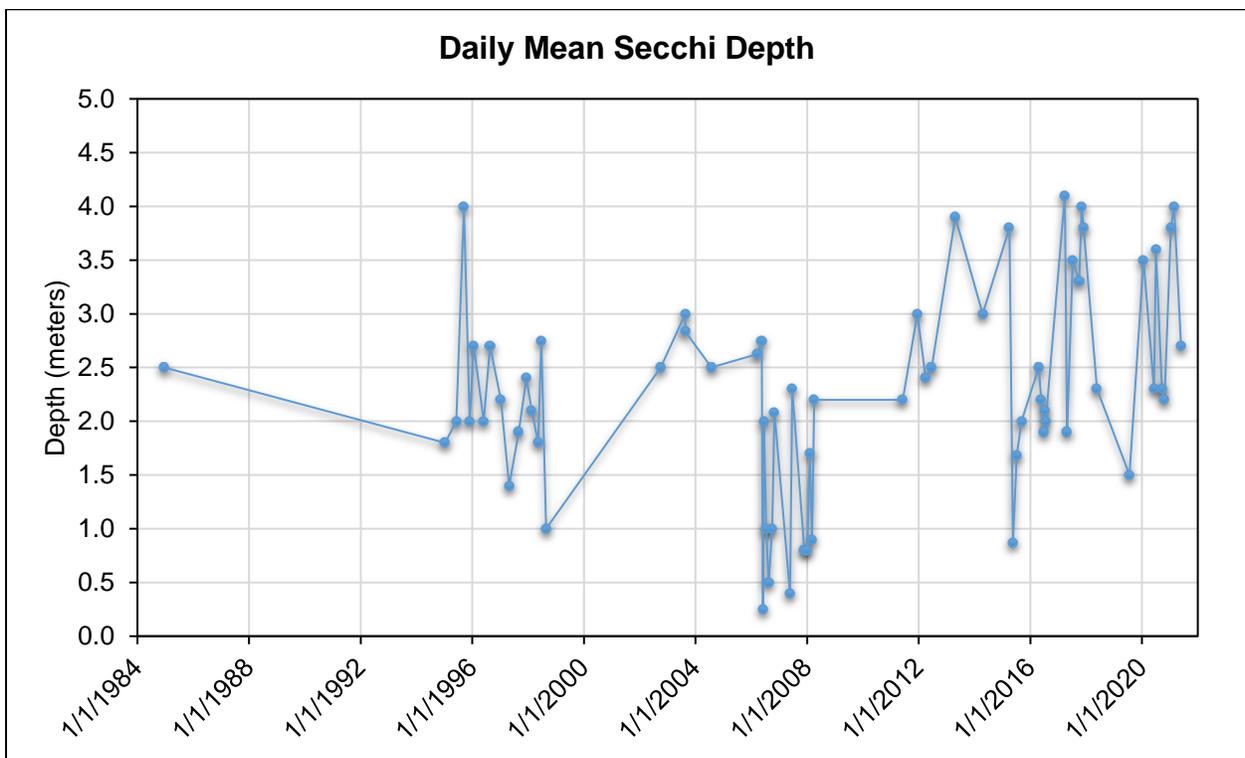


Figure D11. Mean daily Secchi disk depths for Cherry Lake.

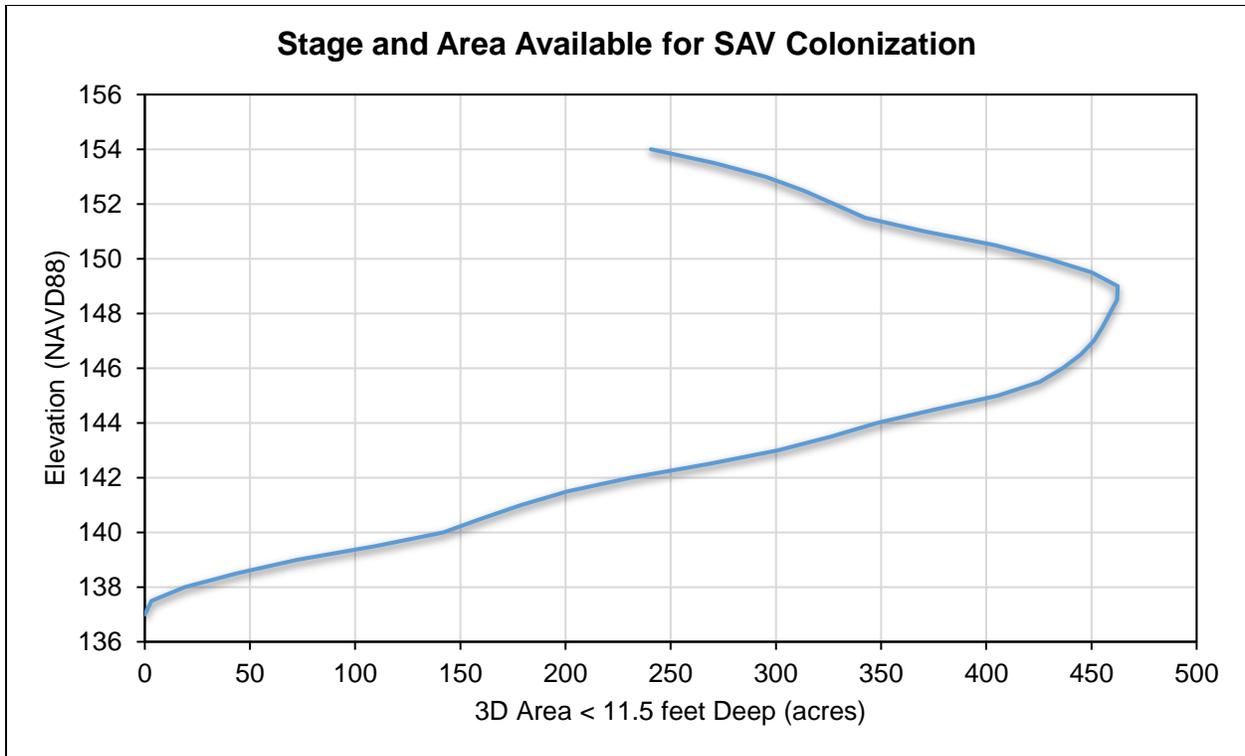


Figure D12. Lake stage to area available for SAV colonization for Cherry Lake.