Technical Publication SJ2015-1

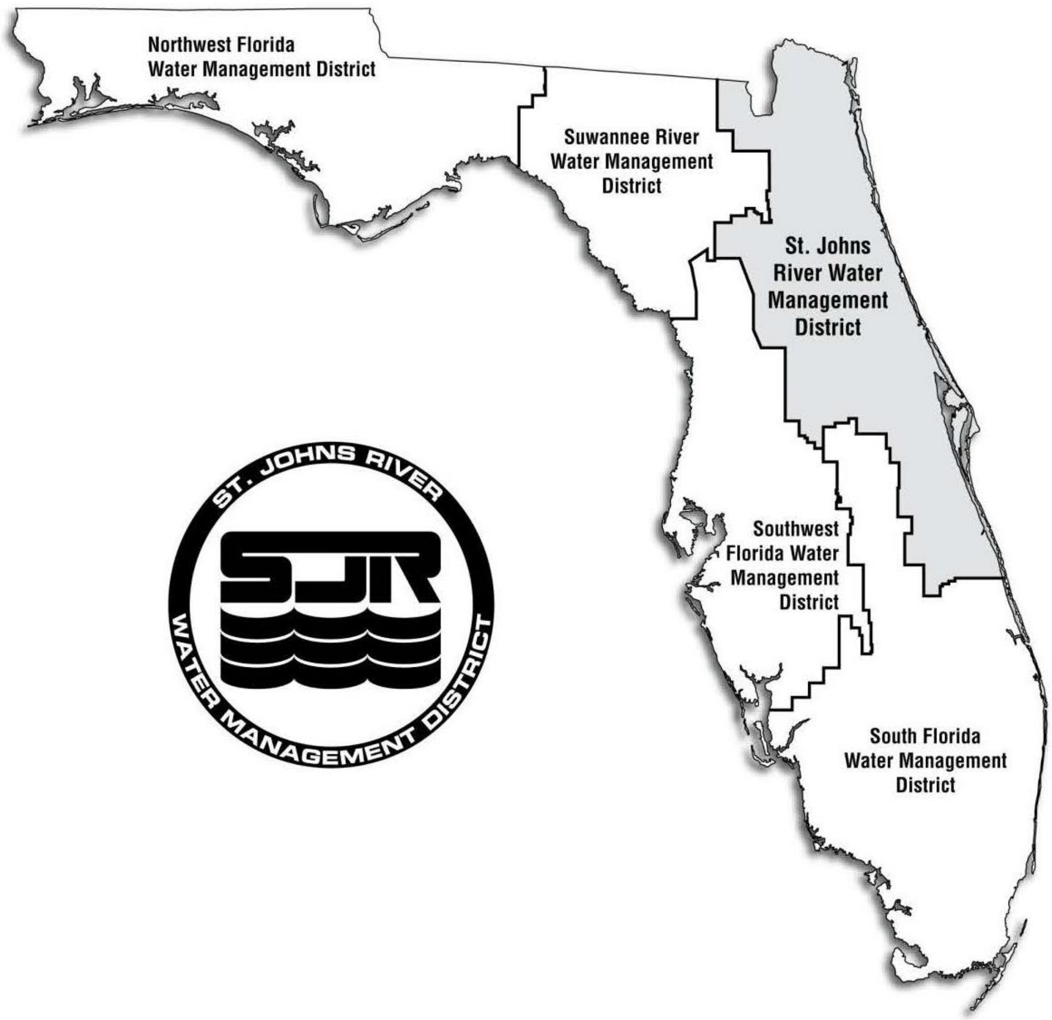
MINIMUM LEVELS REEVALUATION: LAKE MELROSE
PUTNAM COUNTY, FLORIDA

By

Jane W. Mace

St. Johns River Water Management District
Palatka, Florida

2015



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Scientific Reference Center
St. Johns River Water Management District
4049 Reid Street/P.O. Box 1429
Palatka, FL 32178-1429 (32177 for street deliveries)
(386) 329-4500

EXECUTIVE SUMMARY

This report describes the St. Johns River Water Management District's (SJRWMD) minimum flows and levels (MFLs) reevaluation for Lake Melrose in Putnam County. The SJRWMD Governing Board adopted MFLs for Lake Melrose on November 4, 1998 (Chapter 40C-8, *Florida Administrative Code* [*F.A.C.*] 2002. MFLs are to be reviewed periodically and revised as needed (Section 373.0421(3), *Florida Statutes* [*F.S.*]).

Lake Melrose was selected for reevaluation because a water budget model and frequency analysis of the stage data showed that the hydrologic conditions defined by the adopted MFLs were not being achieved under 2003 land use and water use conditions. A water budget model for Lake Melrose was not available in 1998 when the Lake Melrose MFLs were adopted. This reevaluation is necessary to ensure that the minimum levels adopted in 1998 are based on the most up-to-date criteria and specific indicators of protection before any remedial action (e.g., development of a recovery strategy, permit denial). This reevaluation has resulted in the recommendation to modify the adopted MFLs for Lake Melrose (Table ES–1) based on current SJRWMD MFLs determination methodology. The new recommended MFLs are being met, but there is no additional water available for consumptive use at or near Lake Melrose.

SJRWMD's MFLs program, which is implemented based on the requirements of Sections 373.042 and 373.0421, *F.S.*, establishes MFLs for lakes, streams and rivers, wetlands, springs, and groundwater aquifers. SJRWMD expresses MFLs in multiple flows or levels that define a minimum hydrologic regime that beyond which further withdrawals would be significantly harmful to the water resources or the ecology of the area (Section 373.042(1), *F.S.*).

The recommended minimum levels for Lake Melrose in Putnam County, Florida (Table ES–1), are intended to support the protection of aquatic and wetland ecosystems from significant ecological harm caused by the consumptive use of water. In addition, MFLs provide technical support to SJRWMD's regional water supply planning process (Section 373.0361, *F.S.*), the consumptive use permitting program (Chapter 40C-2, *F.A.C.*), and the environmental resource permitting program (Chapter 40C-44, *F.A.C.*).

SJRWMD reviewed the 10 environmental values identified in Rule 62-40.473, *F.A.C.*, and determined for Lake Melrose that the environmental value "fish and wildlife habitats and the passage of fish" was the most restrictive environmental value to the further development of consumptive uses of surface and/or regional groundwater. Hence, the Lake Melrose MFLs were developed primarily to protect this environmental value. Based on a qualitative assessment, SJRWMD believes the recommended MFLs developed primarily for the protection of significant harm to "fish and wildlife habitats and the passage of fish" will protect all other relevant environmental values for Lake Melrose.

MFLs take into account the ability of wetlands and aquatic communities to adjust to changes in the return intervals of high and low water events. Therefore, MFLs allow for an acceptable level of hydrologic change relative to existing hydrologic conditions. When the use of water resources shifts the hydrologic conditions below that defined by the MFLs, significant ecological harm is expected to occur. As it applies to wetland and aquatic communities, significant harm is a function of changes in the frequencies and durations of water level and/or flow events, causing impairment of ecological structures and functions.

The SJRWMD multiple MFLs methodology was used to determine the recommended minimum lake levels presented here. MFLs determinations are based on evaluations of topographic, soils, and vegetation data collected within plant communities associated with the water body and with information collected from other aquatic ecosystems and scientific literature.

To simplify comparing the adopted with the recommended reevaluated MFLs for Lake Melrose, the 1929 datum elevations are shown in Table ES–1 for both the adopted and recommended MFLs along with the 1988 datum elevations. Thus, based on the 1929 datum, the recommended reevaluation minimum frequent high level for Lake Melrose is 0.5 ft below the adopted minimum frequent high (FH) because a different FH level criterion was used. The adopted FH level at Lake Melrose corresponds to the average elevation of the mixed swamp at Transect 2 . The recommended, reevaluated FH level primary criterion equals the average ground elevation of the hardwood swamps at Transects 1 and 2 surveyed in 2011.

The recommended, reevaluated minimum average (MA) level for Lake Melrose equals the adopted MA level, because a similar MA level criterion was used. The adopted MA level for Lake Melrose is equal to a 0.25-foot (ft) drawdown below the average ground elevation of the lower hardwood swamp at Transect 1. The recommended, reevaluated MA level equals a 0.3-ft drawdown of the soil water table from the average soil surface elevation of the deep (>8 inch [in.] thick) organic soils at the shrub swamps and hardwood swamps observed in 2011 at Transects 1 and 2. The 0.3-ft drawdown criterion is commonly used to determine a MA level where deep (≥8 in. thick) organic soils are identified. Soil sampling with a professional soil scientist did occur in 2011 at Lake Melrose and did not occur in 1997 when the original MFL fieldwork occurred.

The recommended, reevaluated minimum frequent low (FL) level for Lake Melrose is 0.9 ft higher than the adopted FL because a different FL level criterion was used. The adopted FL level for Lake Melrose equals a 20 in. drawdown from the average ground elevation surveyed in the maple swamp at Transect 1. The primary reevaluated FL level criterion for Lake Melrose is a 10-in. drawdown of the organic soils water table from the average ground surface elevation of the deep (≥8 in. thick) organic soils observed at Transects 1 and 2, stations 80–920 and 90–340, respectively, in 2011.

The hydrologic model for Lake Melrose was calibrated for 2003 conditions. These conditions included recent land use information and groundwater levels consistent with 2003 regional water use. Based on hydrologic model results, SJRWMD concludes that the recommended MFLs for Lake Melrose are being met under 2003 conditions.

This reevaluation has resulted in the recommendation to modify the adopted MFLs for Lake Melrose based on current SJRWMD MFLs determination methodology (Table ES–1). The results presented in this report are preliminary and will not become effective until the recommended MFLs are adopted by the SJRWMD Governing Board.

The recommended minimum levels presented in this report were subjected to independent scientific peer review (Section 373.042(4)(a), F.S.). The findings of the peer review and SJRWMD's resolution of those findings are presented in Appendix B.

Table ES–1. Adopted and recommended, reevaluated minimum surface water levels for Lake Melrose, Putnam County

	Adopted		Recommended			
Levels	Elevation (ft NGVD)*	Hydroperiod Categories	Elevation (ft NGVD)	Elevation (ft NAVD)	Duration (days)	Return Interval (years)
Minimum frequent high	105.2	Seasonally flooded	104.7	103.6	30	3
Minimum average	104.2	Typically saturated	104.2	103.1	180	1.7
Minimum frequent low	102.8	Semipermanently flooded	103.7	102.6	120	10

*ft NGVD = feet National Geodetic Vertical Datum 1929; ft NAVD = feet North American Vertical Datum 1988

Note: The recommended, reevaluated minimum levels for Lake Melrose were determined using ground elevations based on a 1988 datum, differing from the adopted MFLs which were determined using a 1929 datum. This datum shift has occurred at SJRWMD to increase the accuracy of the ground elevation data. The amount of datum shift is location dependent and at Lake Melrose results in a decrease in the numeric elevation values of -1.1 ft.

Note: These recommended levels for Lake Melrose (Table ES-1) were adopted on November 25, 2014, by the SJRWMD Governing Board.

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ACRONYMS AND ABBREVIATIONS

cm	centimeter
CUPs	Consumptive use permits
dbh	Diameter at breast height
DO	Dissolved oxygen
F.A.C.	*Florida Administrative Code*
F.S.	*Florida Statutes*
FAC	Facultative
FACW	Facultative Wet
FH	Minimum frequent high
FL	Minimum frequent low
FM	Floating marsh
ft	Foot, feet
FWDM	Florida Wetlands Delineation Manual
GIS	Geographic information system
GPS	Global Positioning System
HS	Hardwood swamp
IH	Minimum infrequent high
IL	Minimum infrequent low
in.	inch
MA	Minimum average
MFLs	Minimum flows and levels
mi	mile
mV	millivolt
NAVD	North American Vertical Datum 1988
NGVD	National Geodetic Vertical Datum 1929
NRC	National Research Council
NRCS	Natural Resources Conservation Service
OBL	Obligate
Redox	Oxidation-reduction
SCS	Soil Conservation Service
SJRWMD	St. Johns River Water Management District
SR	State Road
SS	Shrub swamp
SSURGO	Soil Survey Geographic database
SWIDS	Surface water inundation/dewatering signatures
TRANS	Transitional area
UPL	Upland
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

INTRODUCTION

This report describes the St. Johns River Water Management District's (SJRWMD) minimum flows and levels (MFLs) reevaluation for Lake Melrose in Putnam County, Florida. The SJRWMD Governing Board adopted MFLs for Lake Melrose on November 4, 1998 (Chapter 40C-8, *Florida Administrative Code* [*F.A.C.*]; Appendix A). MFLs are to be reviewed periodically and revised as needed (Section 373.0421(3), *Florida Statutes* [*F.S.*]). Use of a subsequently completed hydrologic model for Lake Melrose (CDM 2005) indicated that the adopted MFLs were not being met under 2003 land use and water use conditions. Consequently, a reevaluation of the adopted Lake Melrose MFLs was performed. This document describes that reevaluation.

The minimum levels recommended for Lake Melrose are intended to support the protection of the water resources or ecology from significant ecological harm caused by the consumptive use of water. In addition, MFLs provide technical support to SJRWMD's regional water supply planning process (Section 373.0361, *F.S.*), the consumptive use permitting program (Chapter 40C-2, *Florida Administrative Code* [*F.A.C.*]), and the environmental resource permitting program (Chapter 40C-4, *F.A.C.*).

The recommended minimum levels presented in this report were subjected to independent scientific peer review (Section 373.042(4)(a), F.S.). The findings of the peer review and SJRWMD's resolution of those findings are presented in Appendix B.

MFLS PROGRAM OVERVIEW

The SJRWMD MFLs program develops recommended MFLs for lakes, streams and rivers, wetlands, springs, and groundwater aquifers. A water budget can be developed for all of these system types (Mitsch and Gosselink 1993, 76). Such a budget is an accounting of precipitation, runoff (i.e., inflows and outflows), evaporation, transpiration, and groundwater volumes. The interactions of these hydrologic components, over time, results in changes to the volume of a surface water system (e.g., lake, wetland, or river). Such volume changes are often measured as stage (i.e., water levels) or flows that are ecological drivers of aquatic and wetland systems. Surface and groundwater withdrawals as well as structural alterations in the lake basin can affect the water budget and the ecology of these system types. Thus, these water withdrawals and alterations are the focus of water management decisions.

The SJRWMD MFLs program is subject to the provisions of Sections 373.042 and 373.0421, *F.S.*, and Chapter 40C-8, *F.A.C.* Based on the provisions of Rule 40C-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, or the environmental effects resulting from the reduction of long-term water levels and/or flows below MFLs, is prohibited by Section 373.042(1a)(1b), *F.S.* In addition, “MFLs 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.*).

MFLs designate an environmentally protective hydrologic regime (i.e., the hydrologic conditions that prevent significant harm) and identify levels and/or flows above which water may be available for use. MFLs typically define the frequency of high, intermediate, and low water events necessary to protect relevant water resource values criteria and indicators that prevent significant harm to upland, wetland, and aquatic habitats. Three MFLs are usually defined for each system—minimum frequent high (FH), minimum average (MA), and minimum frequent low (FL)—flows and/or water levels. If deemed necessary, the minimum infrequent high (IH) and/or minimum infrequent low (IL) flow and/or water level is also defined. Alternatively, an IH level and an IL level might be sufficient to protect sandhill type lakes that generally may lack static wetland communities because of a large range of water level fluctuations (Neubauer et al. 2008). (Lake Melrose is not a sandhill lake.) MFLs represent hydrologic statistics composed of three components: a magnitude (water level and/or flow), duration (days), and a frequency or return interval (years). Historically, SJRWMD synthesized the continuous duration and frequency components of the MFLs into seven discrete hydroperiod categories to facilitate MFLs determinations for lakes and wetlands (Rule 40C-8.021, *F.A.C.*). However, associated with reevaluations of established MFLs and MFLs for water bodies for which MFLs have not been previously developed, these hydroperiod categories are now being replaced with specific duration and return interval values.

A fundamental assumption of the MFLs program is that the ecology of a system (e.g., locations of wetland communities and the upland ecotone) is dependent upon hydrology. More specifically, stable plant communities are located where the numbers of flooding and dewatering events over a long period result in hydrologic conditions that allow populations of species of a given community to survive. Systems with stable wetland communities may have hydrologic regimes dominated by annual wet- and dry-season, flooding and dewatering events, respectively. However, stable wetland communities similar to those along the St. Johns River and wetland type lakes (e.g., Lake Dias in Volusia County) do not appear to exist on some lakes (e.g., sandhill type lakes) with very large ranges of fluctuation (e.g., Pebble Lake in Clay County has a 39.34 ft range of fluctuation). Extreme high and low water levels, possibly the result of multidecadal climatic cycles (Enfield et al. 2001; Kelly and Gore 2008), result in hydrologic conditions that are too wet and too dry to support stable, seasonally flooded wetland communities. Wetland species that occur at such sandhill lakes tend to move up and down slope depending on the phases of multidecadal climatic cycles.

Figure 1 illustrates a continuum of lake types between the binary wetland and sandhill lake classes. The continuum from wet/dry season to multidecadal cycle dominated hydrologies might be the cause of the continuum of lake types. Different types of MFLs may be determined for lakes along the continuum because a variety of MFLs criteria may exist at a given lake.

MFLs take into account the ability of the upland ecotone, wetlands, and aquatic communities to adjust to changes in the return intervals of high and low water events. Therefore, MFLs may allow for an acceptable level of change to occur relative to the existing hydrologic conditions (gray-shaded area, Figure 2). However, when impacts to the water resources shift the hydrologic conditions below that defined by the MFLs, significant ecological harm may occur (red-hatched area, Figure 2).

As it applies to upland ecotone, wetland, and aquatic communities, significant harm is a function of changes in the frequencies of water level and/or flow events of defined magnitude and duration, causing impairment or loss of ecological structures (e.g., downhill shift in plant communities caused by water withdrawals) and functions (e.g., insufficient fish habitat caused by water withdrawals).

Surface water and groundwater computer simulation models are used to evaluate existing and/or proposed consumptive uses and structural alterations and the likelihood they might cause significant harm. Actual or projected instances where water levels fall below established MFLs require the SJRWMD 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(3), *F.S.*).

FACTORS TO BE CONSIDERED WHEN DETERMINING MFLS

According to Rule 62-40.473, *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, nonconsumptive uses, and environmental values associated with coastal, estuarine, riverine, spring, aquatic, and wetlands ecology, including:

1. Recreation in and on the water (Rule 62.40.473(1)(a), *F.A.C.*)
2. Fish and wildlife habitats and the passage of fish (Rule 62.40.473(1)(b), *F.A.C.*)
3. Estuarine resources (Rule 62.40.473(1)(c), *F.A.C.*)
4. Transfer of detrital material (Rule 62.40.473(1)(d), *F.A.C.*)
5. Maintenance of freshwater storage and supply (Rule 62.40.473(1)(e), *F.A.C.*)
6. Aesthetic and scenic attributes (Rule 62.40.473(1)(f), *F.A.C.*)
7. Filtration and absorption of nutrients and other pollutants (Rule 62.40.473(1)(g), *F.A.C.*)
8. Sediment loads (Rule 62.40.473(1)(h), *F.A.C.*)

9. Water quality (Rule 62.40.473(1)(i), *F.A.C.*)
10. Navigation (Rule 62.40.473(1)(j), *F.A.C.*)

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.

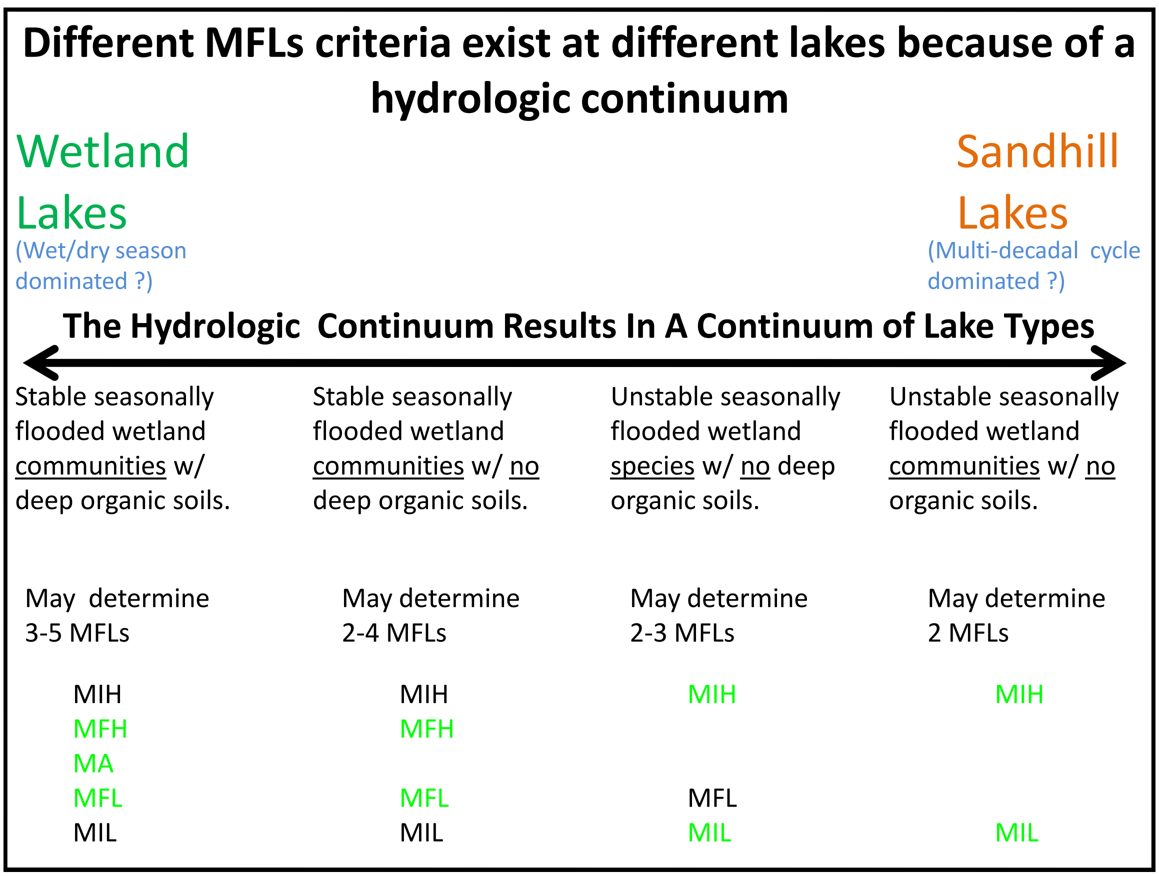
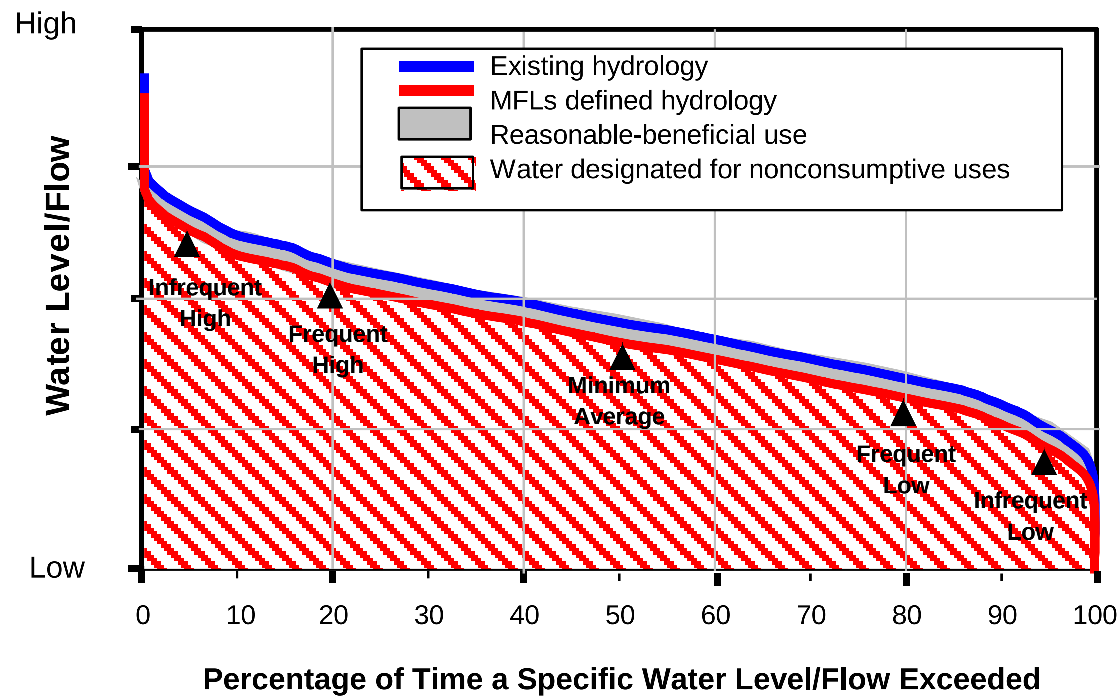


Figure 1. The hydrologic continuum

Note: Light green colored MFLs (e.g., FH) show those MFLs typically determined for a system while black colored MFLs show those that might also be determined



The existing hydrology curve represents the current lake or river stage or flow regime. The MFLs defined hydrology curve represents the new lake or river stage or flow regime, which provides for the reasonable-beneficial use of water (gray shaded area).

Figure 2. Hypothetical percentage exceedence curves for existing and minimum flows and levels (MFLs) defined hydrologic conditions

LAKE MELROSE GENERAL INFORMATION

Lake Melrose is located in Putnam County, approximately 1 mile (mi) south of the intersection of State Road (SR) 26 and SR 21 in Melrose (Figures 3 and 4). Lake Melrose resides within the Perched Lakes and Prairies Physiographic Division of the Central Lakes District, which consists of flatwoods and river swamps in the lower areas with sandhill type vegetation occurring on the low hills (Brooks 1981). Recharge to the Floridan aquifer around Lake Melrose is moderate (4–8 inches [in.] per year) to high (8–12 in. per year) (Boniol et al. 2004; Figure 5). Land use surrounding Lake Melrose is classified as agriculture, upland, water and wetland (Figure 6).

No consumptive use permits (CUPs) authorize the use of surface water withdrawal from Lake Melrose.

LAKE MELROSE MORPHOMETRY AND HYDROLOGY

Lake Melrose covers approximately 100 acres when the stage equals 106.9 ft National American Vertical Datum (NAVD), according to the U.S. Geological Survey (USGS) Melrose quadrangle map (1:24,000 scale). Lake Melrose has a simple morphology comprised of one pool with an average bottom elevation of 95.1 ft NAVD and a minimum bottom elevation of 92.8 ft NAVD as surveyed on June 13, 2012. Lake Melrose drains into Mill Creek. Mill Creek flows into Ross Lake, which is connected to Goose Lake. These lakes are located in the Etonia Creek subbasin, which drains to the northeast into the Lower St. Johns River Basin.

Surface water level data (Figure 7) for Lake Melrose was collected daily between May 16, 1991, and February 3, 2004, and weekly from 2004 to May 19, 2014. At the time of this MFLs reevaluation (during the period of record of 1991 to 2014) the lake level fluctuated between 101.5 ft and 106.6 ft NAVD (range 5.1 ft), with median and average levels equal to 102.9 and 103.0 ft NAVD, respectively (see Figure 7). Lake Melrose stage is very stable with typical stage fluctuation less than 1 ft (between 102.6 and 103.4 ft NAVD) (Figure 8). Lake Melrose experienced a recorded low stage during 2011, but lake levels increased due to rainfall in 2012. Rainfall data collected at a nearby site (station 70103367; SJRWMD rainfall gauge) indicated that rainfall was below average for the past 5 years—2011 was equal to 28.9 in. whereas the average annual rainfall is 51 in.

Lake Melrose was recently classified as a perched ridge lake with a low range of fluctuation, low leakage, and high surface outfall (Epting et al. 2008). Figure 7 illustrates the stage data for Lake Melrose, including the low range of stage fluctuation. Additional hydrologic information on Lake Melrose, with a description of the hydrologic model analyses, the Lake Melrose watershed, surficial and intermediate groundwater movement, and MFLs compliance is located in the Lake Melrose modeling report (CDM 2005).

LAKE MELROSE WETLANDS

SJRWMD geographic information system (GIS) wetland coverage (Figure 9) illustrates the wetland communities mapped adjacent to Lake Melrose. The three transects surveyed in 2011 at Lake Melrose traversed areas delineated as deep marsh, Hydric Hammock, and uplands vegetation communities. Detailed wetland community descriptions contained herein vary from those mapped due to map scale and are presented in Results and Discussion below for the three transects located at Lake Melrose.

LAKE MELROSE SOILS

Lake hydrology is related to the development of hydric soils. Hydric soils are defined as soils that form under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil (Soil Survey Staff 2003). Certain characteristics are used to indicate wet ecosystems, such as accumulation of muck (Histosol, histic epipedon) or the presence of reduced sulfur odor (rotten egg odor). Other hydric soil indicators are routinely used to delineate the extent of wetlands, which implies they form at the hydric/nonhydric soil edge (sandy oxidation-reduction [redox], stripped matrix, and dark surface) (Carlisle and Hurt 2000). The hydric soil indicators identified at Lake Melrose are listed below as observed along the hydrologic gradient from dark surface and polyvalue below surface at the higher elevations, followed by mucky mineral and muck presence as the elevation decreases, and grading to a thick accumulation of muck (histic epipedon and histosol) and hydrogen sulfide as the ground elevation drops and the hydroperiod increases.

Dark surface—A layer 4 inches thick starting with the upper 6 inches of the soil surface with a matrix value of 3 or less and a chroma of 1 or less. At least 70 percent of the visible soil particles must be masked with organic material. The matrix color of the layer directly below the dark layer must have the same colors as those described above or any color that has chroma of 2 or less (NRCS 2010 citation at end of this section).

Polyvalue below surface—A layer with a matrix value of 3 or less and chroma of 1 or less starting within 6 inches of the soil surface. At least 70 percent of the visible soil particles must be masked with organic material. Directly below this layer, 5 percent or more of the soil volume has a matrix value of 3 or less and chroma of 1 or less, and the remainder of the soil volume has a matrix value of 4 or more and a chroma of 1 or less to a depth of 12 inches or to the spodic horizon, whichever is less (NRCS 2010 citation at end of this section).

Mucky mineral—A layer of mucky modified mineral soil material 2 inches or more thick starting within 6 inches of the soil surface (NRCS 2010 citation at end of this section)**.**

Muck Presence—A layer of muck of any thickness that occurs within the upper 6 in. of the soil surface and contains a color value of 3 or less and chroma 1 or less. (Soil Survey Staff 2003). Muck presence has a seasonal high saturation at the surface or inundation above the soil surface (Carlisle and Hurt 2000).

Histic Epipedon—A surface organic layer that is 8 to 16 in. thick. The required organic carbon content in the histic epipedon is dependent on clay content (Soil Survey Staff 2003). Histic epipedons have a seasonal high saturation at the surface or inundation above the soil surface (Carlisle and Hurt 2000).

Histosol—A soil that has organic soil material in more than half of the 32 in. or that are of any thickness if overlying rock (Soil Survey Staff 2003). Histosols have a seasonal high saturation at the surface or inundation above the soil surface (Carlisle and Hurt 2000).

Hydrogen sulfide—A hydrogen sulfide odor within 12 inches of the soil surface (NRCS 2010 citation at end of this section).

Hydric soils (Samsula muck, Terra Ceia muck, Placid fine sand depressional, and Placid-Pompano sand frequently flooded) were mapped at the shoreline of Lake Melrose (Figure 10; USDA, SSURGO database). Robert Freese, SJRWMD soil scientist, performed soil sampling at Lake Melrose in 2011–2012. Hydric soils, with extensive areas of organic soil, were identified at each transect. The field soil sampling results were integral to the MFLs determinations. Transect-specific field soil sample descriptions are presented in Results and Discussion below.

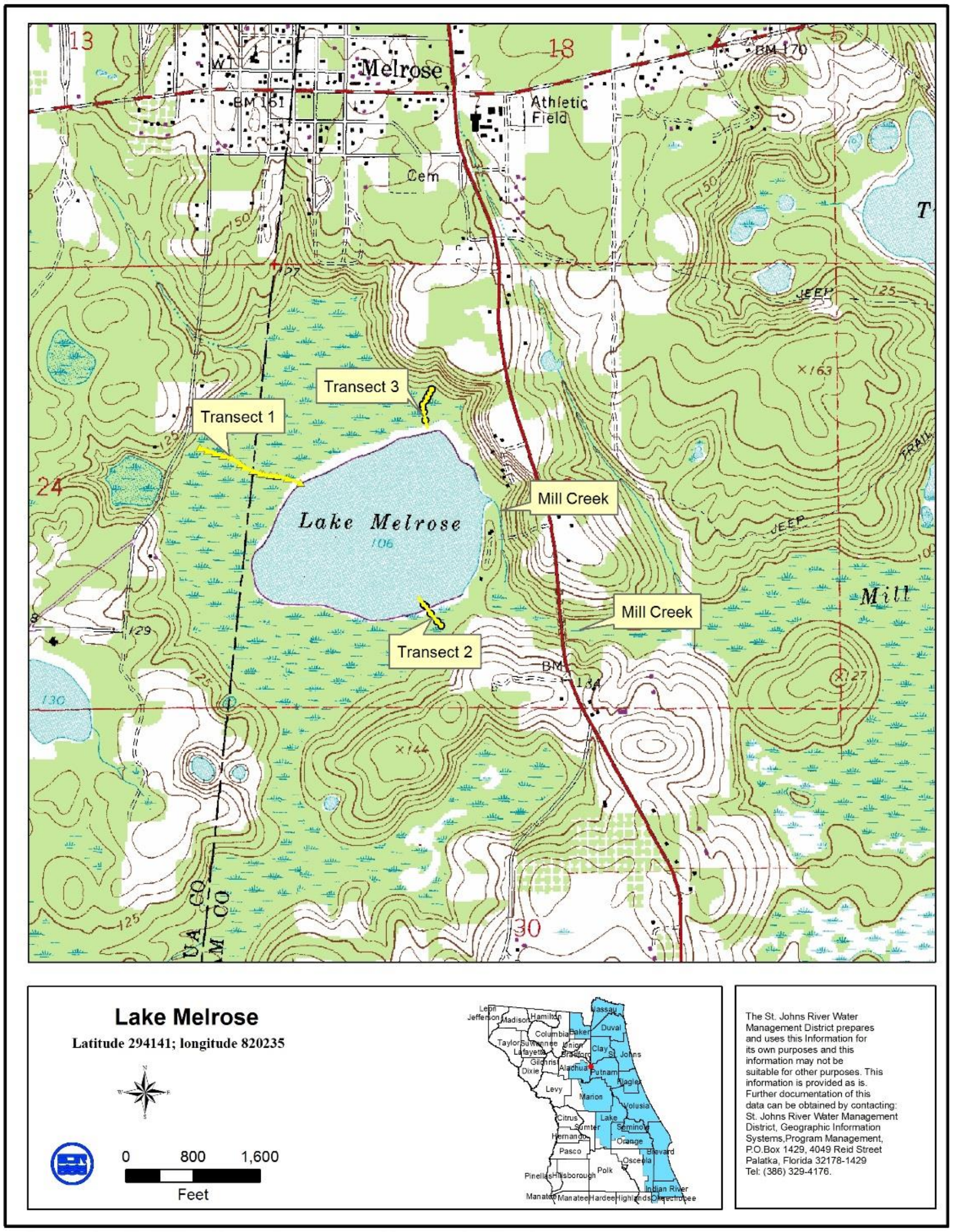


Figure 3. Lake Melrose, Putnam County, Florida

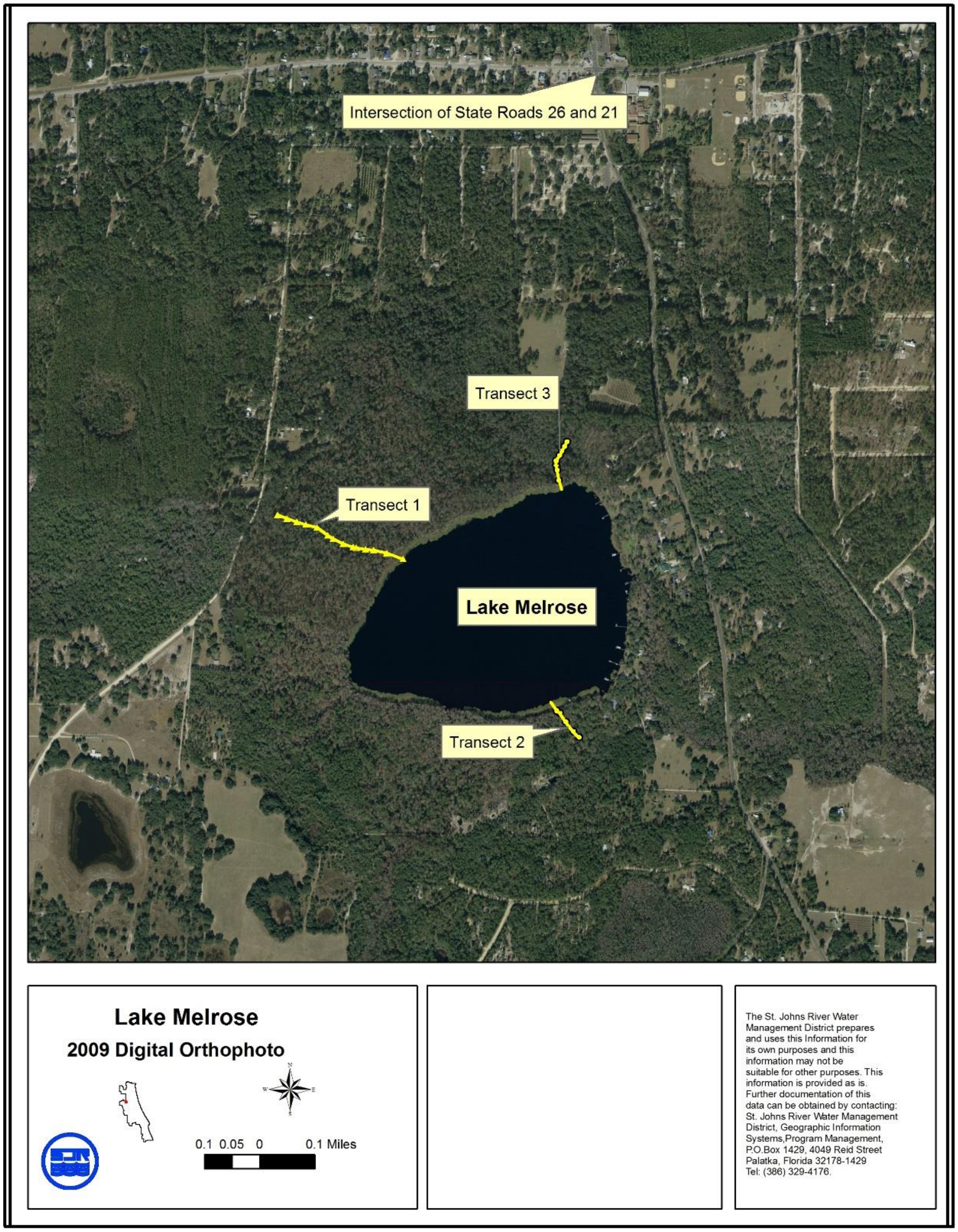


Figure 4. Transect locations at Lake Melrose

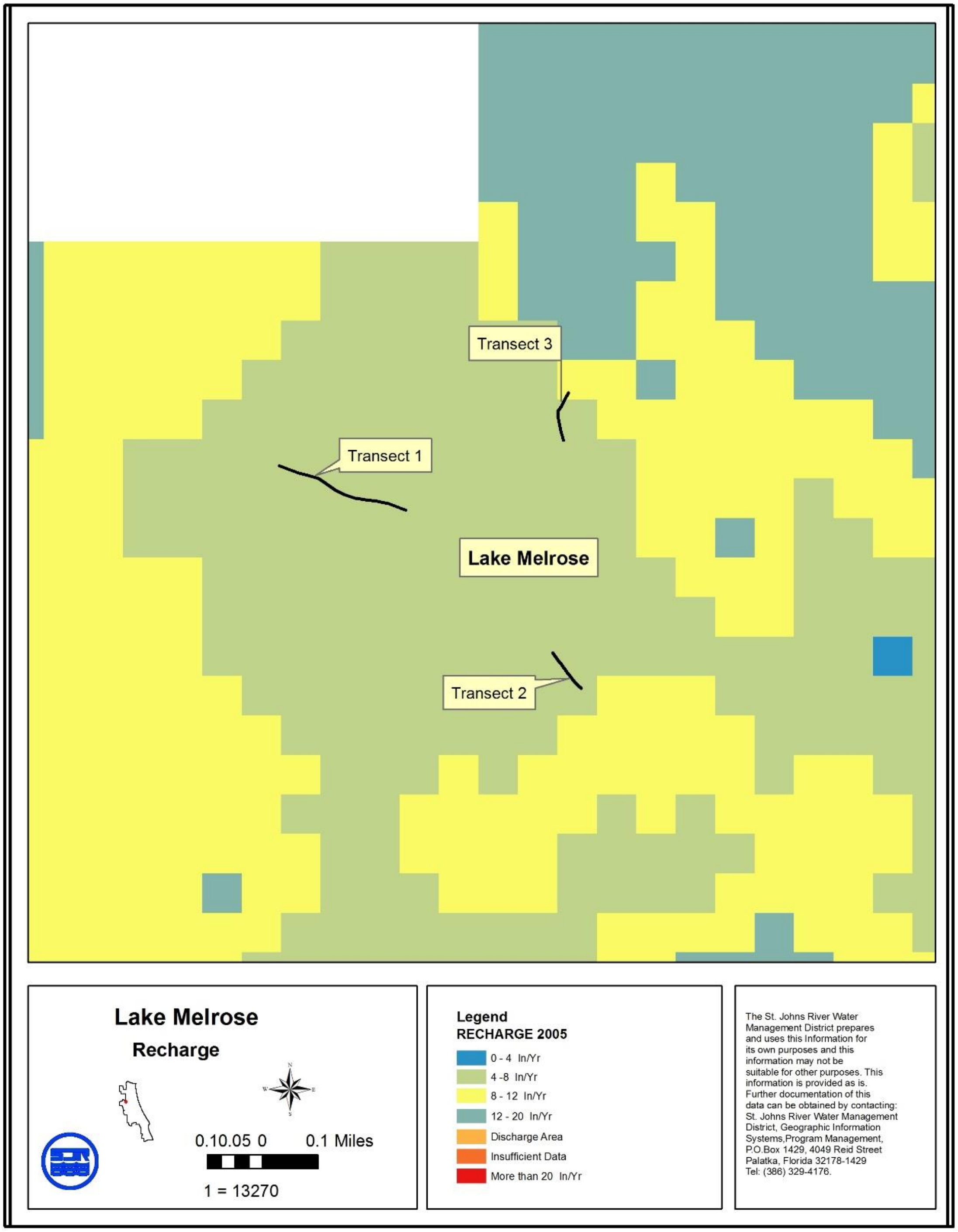


Figure 5. Recharge to the Floridan aquifer for Lake Melrose

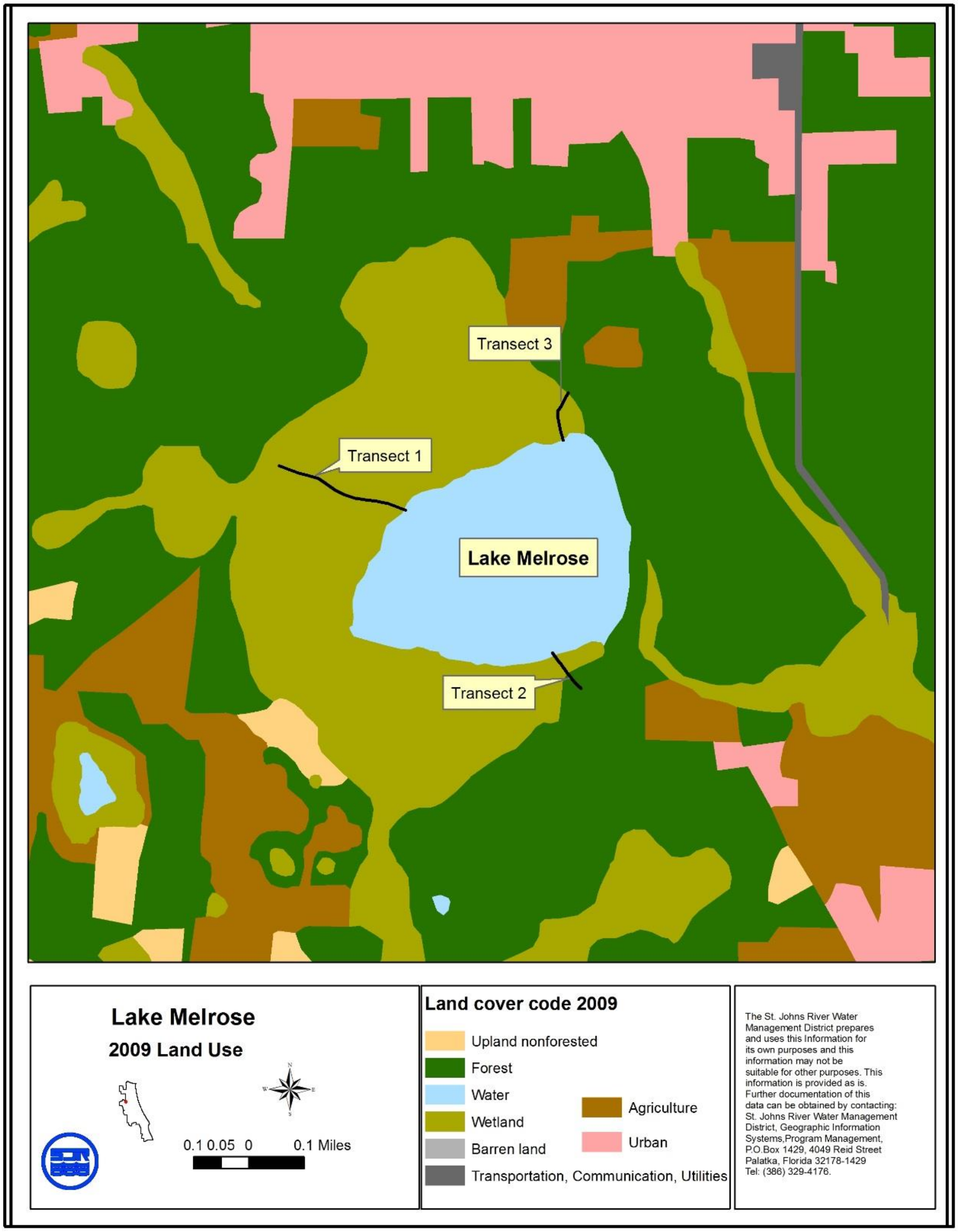


Figure 6. Land use for Lake Melrose 2004

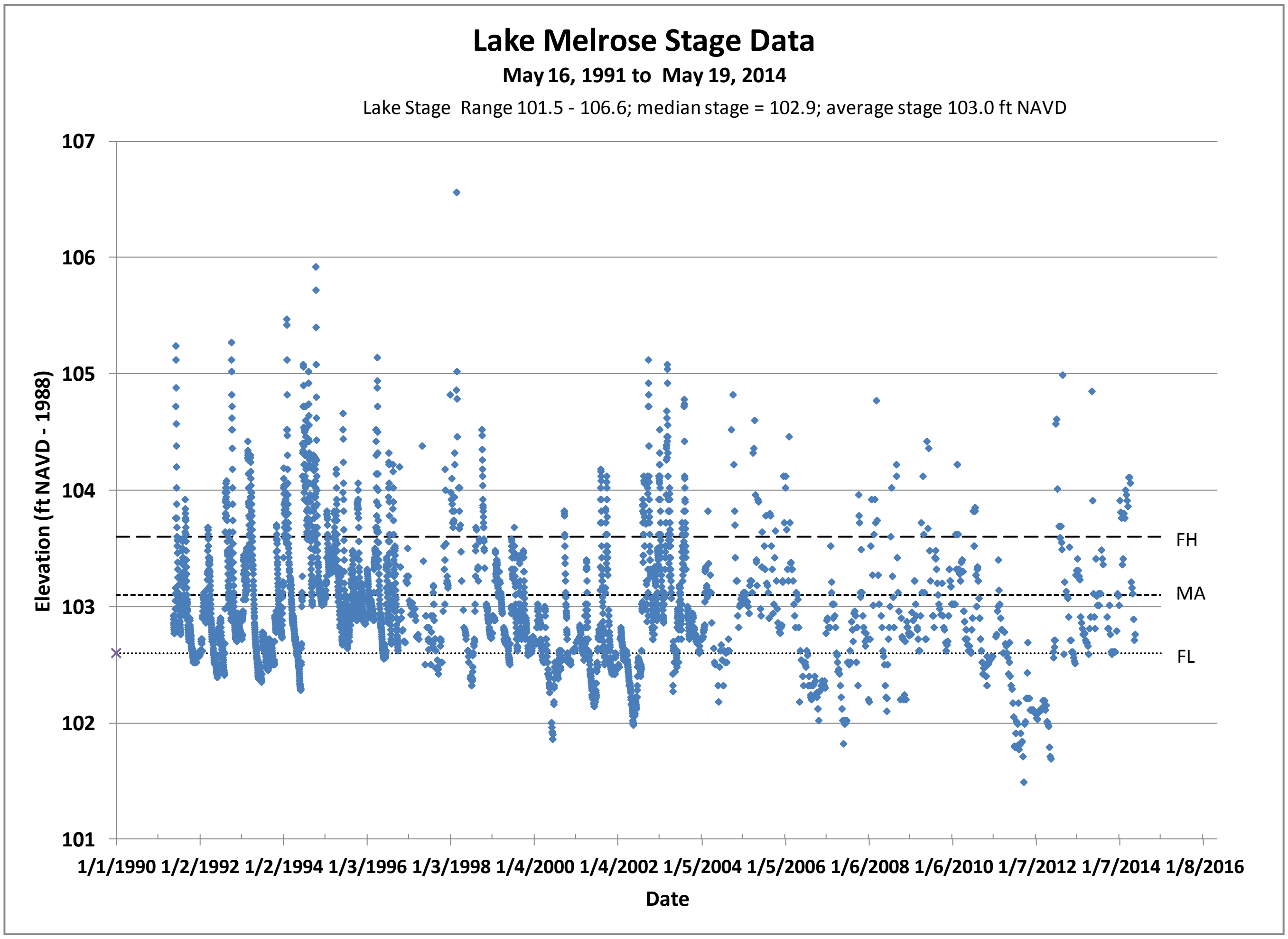


Figure 7. Stage data from May 1991 to May 2014 for Lake Melrose

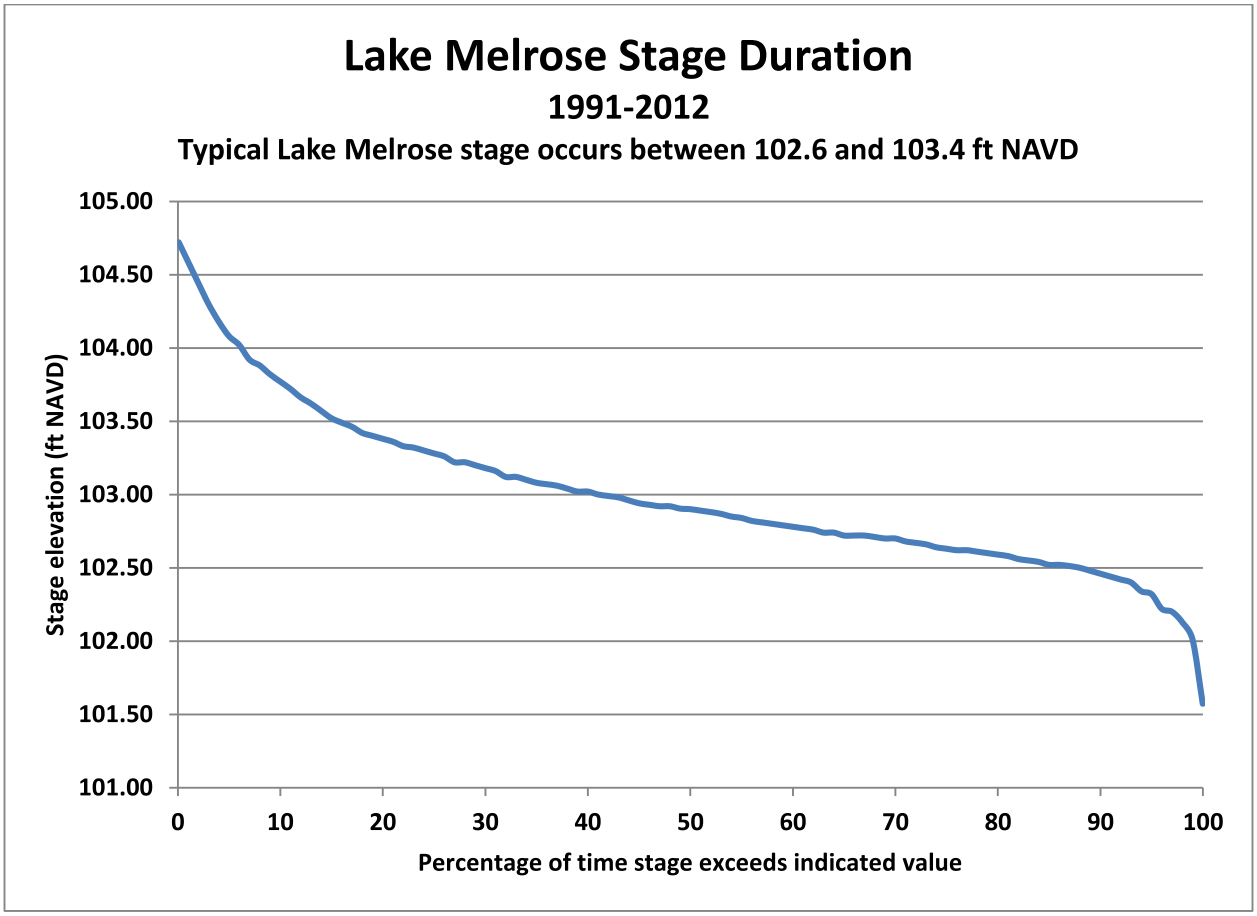


Figure 8. Stage duration curve for Lake Melrose

Figure 9. Wetland vegetation map for Lake Melrose

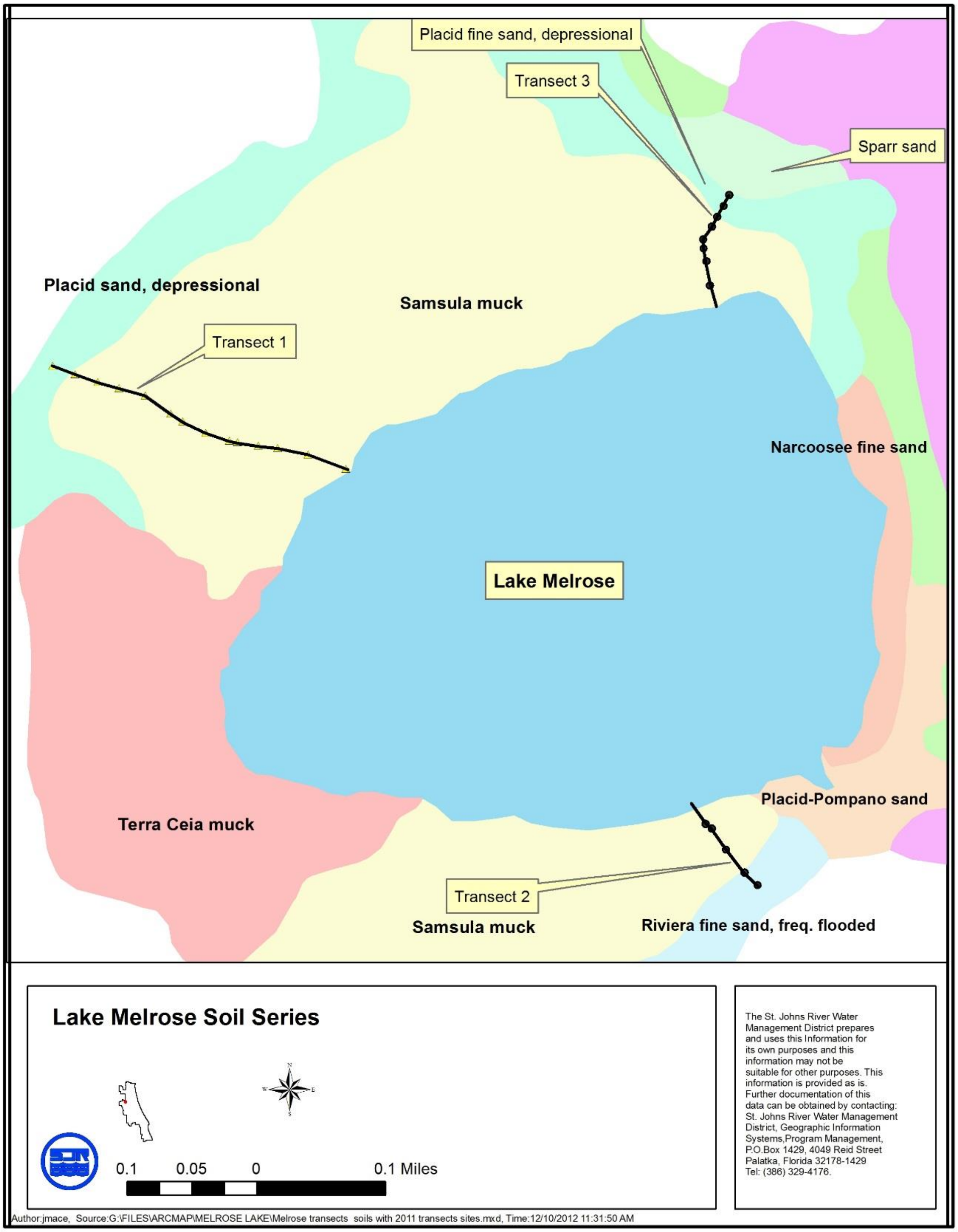


Figure 10. Soil series for Lake Melrose

METHODS

MFLs determinations incorporate biological and topographical information collected in the field with stage data, hydrologic and hydraulic models, wetlands, soils, and landownership data from GIS coverages, aerial photography, and scientific literature to generate an MFLs regime. MFLs methodology provides a process for incorporating these factors. This section describes the MFLs methodology and assumptions used in the MFLs determination process for Lake Melrose, including field procedures such as site selection, field data collection, and data analyses. Additional MFLs methodology descriptions can be found in SJRWMD's draft *Minimum Flows and Levels Methods Manual* (SJRWMD 2006, draft) and MFLs methods paper (Neubauer et al. 2008).

FIELD SITE SELECTION

Many factors are considered in the selection of field transect sites. Transects are fixed sample lines across a river, lake, or wetland floodplain. Transects usually extend from open water to uplands. Elevation, soils, and vegetation data are sampled along each transect to characterize the influence of surface water flooding on the distribution of soils and plant communities.

Field site selection begins with a site history survey and data search. The lead scientist compiled all pertinent information from SJRWMD library documents, project record files, the hydrologic database, and SJRWMD Division of Surveying Services files. The types of information include:

- On-site and regional vegetation surveys and maps
- Aerial photography (existing and historical)
- Remote sensing (e.g., vegetation, land use) and topographic maps
- Soil surveys, maps, and soil descriptions
- Hydrologic data (hydrographs and stage duration curves)
- Environmental, engineering, or hydrologic reports
- Topographic survey profiles
- Occurrence records of rare and endangered flora and fauna

The field investigation at Lake Melrose for the recommended minimum levels described in this document occurred in 2011 and 2012. All the previously identified types of information were considered in the selection of field transect sites at Lake Melrose, as well as the information obtained in Appendix A.

Data Analysis and Transect Site Identification

The compiled data were reviewed to familiarize the investigator with site characteristics, locate important basin features that needed to be evaluated, and assess prospective sampling locations. Copies of this information were organized and placed in archived files for future reference (SJRWMD 2006, draft).

Potential transect locations at Lake Melrose were initially identified from maps of wetlands, soils, topography, and landownership. Specific transect site selection goals included:

- Establishing transects at sites where multiple wetland communities of the most commonly occurring types were traversed
- Selecting multiple transect locations with common wetland communities among them
- Establishing transects that traverse unique wetland communities
- Establish transects at locations where earlier MFLs field data were collected

Transect characteristics were subsequently field-verified to ensure the particular locations contained representative wetland communities, hydric soils, and reasonable upland access. These goals help to ensure ecosystem protection of both commonly occurring and unique wetland ecosystems at Lake Melrose. Individual transect site selection criteria for the final transects are described in Results and Discussion below.

Field Data Collection

The field data collection procedure for determining MFLs involved collecting elevation, soils, and vegetation data along fixed lines, or transects, across a hydrologic gradient. Transects were established in areas where there are changes in vegetation and soils and the hydrologic gradient was marked (SJRWMD 2006, draft). The main purpose in using transects in these situations, where the change in vegetation and soils is clearly directional, was to describe maximum variations over the shortest distances in the minimum time (Kent and Coker 1992).

Site Survey

Once a transect was established at Lake Melrose, vegetation was trimmed to allow a line-of-sight along the length of the transect. A measuring tape was then laid out along the transect. Elevation measurements were surveyed at regular intervals on the ground along the length of the transect. At Lake Melrose, the elevation gradient decreased where the uplands transition to the hardwood swamps and the vegetation communities vary in extent at the three transects. Elevations were typically recorded at 10-ft intervals.

Additional elevations were measured including obvious elevation changes, vegetation community changes, and soil changes.

Latitude and longitude data were also collected using a global positioning system (GPS) receiver at selected points along the length of the transects. These data are used to create accurate maps of transect locations, locate specific features along the transects, and facilitate recovering transect locations in the future.

Vegetation Sampling Procedures

SJRWMD has wetland maps developed from aerial photography using a unique wetland vegetation classification system. SJRWMD's Wetland Vegetation Classification System (Kinser 1996, draft) was used to standardize the names of wetland plant communities sampled in MFLs fieldwork and in developing reports documenting the MFLs determination.

The spatial extent of plant communities or transition zones among plant communities was determined using reasonable scientific judgment. Reasonable scientific judgment involves the ability to collect and analyze information using technical knowledge, personal skills, and experience to serve as a basis for decision making (Gilbert et al. 1995). In this case, such judgment was based upon field observations of relative abundance of dominant plant species, occurrence and distribution of soils and hydric soil indicators, and changes in land slope or elevation along the hydrologic gradient. Plant communities and transition zones were delineated along a specialized line transect called a belt transect, which is a line with width (belt width). It is essentially a widening of the line transect to form a long, thin, rectangular plot divided into smaller sampling areas called quadrats that correspond to the spatial extent of plant communities or transitions between plant communities. The transect belt width will vary depending on the type of plant community to be sampled (SJRWMD 2006, draft). For example, a belt width of 10 ft (5 ft on each side of the transect line) may suffice for sampling herbaceous plant communities of a Floodplain Marsh. However, a belt width of 50 ft (25 ft on each side of the line) may be required to adequately represent a forested community (e.g., hardwood swamp) (Figure 11).

Plants were identified and the percent cover of plant species was estimated if they occurred within the established belt width for the plant community under evaluation (quadrat). Percent cover is defined as the vertical projection of the crown or shoot area of a plant to the ground surface, expressed as a percentage of the quadrat area.

Percent cover as a measure of plant distribution is often considered as being of greater ecological significance than density, largely because percent cover gives a better measure of plant biomass than the number of individuals. The canopies of the plants inside the quadrat will often overlap, so the total percent cover of plants in a single quadrat will frequently sum to more than 100% (SJRWMD 2006, draft). Percent cover was estimated visually using cover classes (ranges of percent cover). The cover class and percent cover ranges are a variant of the Daubenmire method (Mueller-Dombois and Ellenberg 1974) and summarized in SJRWMD's draft Minimum Flows and Levels Methods Manual (SJRWMD 2006, draft). Plant species, plant communities, and percent cover data were recorded on field vegetation data sheets. The data sheets are formatted to facilitate data collection in the field and for computer transcription.

Soil Sampling Procedures

The primary soil criteria considered in the MFLs determination are the presence and depth of organic soils, as well as the extent of hydric soils observed along the field transects (SJRWMD 2006, draft). The procedure to document hydric soils includes:

- Removing all loose leaf-matter, needles, bark, and other easily identified plant parts to expose the soil surface, digging a hole and describing the soil profile to a depth of at least 20 in., and, using the completed soil description, specifying which hydric soil indicators have been matched
- Performing deeper examination of the soil where field indicators are not easily seen within 20 in. of the surface (It is always recommended that soils be excavated and described as deep as necessary to make reliable interpretations and classification.)
- Paying particular attention to changes in microtopography over short distances, since small elevation changes may result in repetitive sequences of hydric/nonhydric soils and the delineation of individual areas of hydric and nonhydric soils may be difficult (Hurt et al. 1998)

At Lake Melrose, detailed soil profiles were observed at selected stations along each transect line. Soil profiles were described following standard Natural Resources Conservation Service (NRCS) procedures (USDA, SCS 1987). Each soil horizon (unique layer) was described with respect to texture, thickness, Munsell color (Kollmorgen Corp. 1992), structure, consistency, boundary, and presence of roots.

Soil sampling intervals varied along the Lake Melrose transects. The sampling interval was dependent upon on-site soil changes. Additional soil sampling procedures are documented in the (draft) Minimum Flows and Levels Methods Manual (SJRWMD 2006, draft).

The following soil features, if present at the Lake Melrose transects, were identified and the location was marked along the transect line so that soil surface elevations could also be determined for these features:

- Landward extent of hydric soils
- Landward extent of surface organics
- Landward extent of histic epipedon (surface organic horizon 8 to 16 in. thick)
- Landward extent of Histosols (≥16 in. thick surface organic horizon)
- Thickness of organic surface horizon

DATA ANALYSIS

The primary data analysis for information collected at Lake Melrose consisted of using a spreadsheet to perform basic statistical analyses on the surveyed elevation data. Vegetation and soils information collected along the transects were incorporated with the elevation data. Descriptive statistics were calculated for the elevations of the vegetation communities and specific hydric soil indicators. For example, the average soil surface elevation of a shallow marsh was calculated with the average surface elevation of deep organic soils within the shallow marsh.

Transect elevation data were also graphed to illustrate the elevation profile between the open water and upland community. The locations of vegetation communities along the transect with a list of dominant species, statistical results, and soils information are typically labeled on the graph. Specific transect elevation data from Lake Melrose are illustrated in Results and Discussion below.

CONSIDERATION OF ENVIRONMENTAL VALUES IDENTIFIED IN RULE 62-40.473, *FLORIDA ADMINISTRATIVE CODE (F.A.C.)*

In establishing MFLs for water bodies pursuant to Sections 373.042 and 373.0421, *F.S.*, SJRWMD identifies the environmental value or values most sensitive to long-term changes in the hydrology of each water body or watercourse. SJRWMD then typically defines the minimum number of flood events and maximum number of dewatering events that would still protect the most sensitive environmental value or values. For example, for water bodies or watercourses for which the most sensitive environmental value may be fish and wildlife habitat, recommended MFLs would reflect the number of flooding or dewatering events that allow for no net loss of wetlands and organic substrates. Protecting the most sensitive environmental value or values for each water body/watercourse provides the best opportunity to establish MFLs protective of all applicable environmental values identified in Rule 62-40.473, *F.A.C.*

SJRWMD uses the following working definitions when considering these 10 environmental values:

1. Recreation in and on the water—The active use of water resources and associated natural systems for personal activity and enjoyment. These legal water sports and

activities may include, but are not limited to, swimming, scuba diving, water skiing, boating, fishing, and hunting.

2. Fish and wildlife habitat and the passage of fish—Aquatic and wetland environments required by fish and wildlife, including endangered, endemic, listed, regionally rare, recreationally or commercially important, or keystone species; to live, grow, and migrate. These environments include hydrologic magnitudes, frequencies, and durations sufficient to support the life cycles of wetland and wetland dependent species.
3. Estuarine resources—Coastal systems and their associated natural resources that depend on the habitat where oceanic salt water meets freshwater. These highly productive aquatic systems have properties that usually fluctuate between those of marine and freshwater habitats.
4. Transfer of detrital material—The movement by surface water of loose organic material and associated biota.
5. Maintenance of freshwater storage and supply—The protection of an amount of freshwater supply for permitted users at the time of MFLs determinations.
6. Aesthetic and scenic attributes—Those features of a natural or modified waterscape usually associated with passive uses, such as bird-watching, sightseeing, hiking, photography, contemplation, painting, and other forms of relaxation that usually result in human emotional responses of well-being and contentment.
7. Filtration and absorption of nutrients and other pollutants—The reduction in concentration of nutrients and other pollutants through the process of filtration and absorption (i.e., removal of suspended and dissolved materials) as these substances move through the water column, soil or substrate, and associated organisms.
8. Sediment loads—The transport of inorganic material, suspended in water, which may settle or rise. These processes are often dependent on the volume and velocity of surface water moving through the system.
9. Water quality—The chemical and physical properties of the aqueous phase (i.e., water) of a water body (lentic) or a watercourse (lotic) not included in definition number 7 (i.e., nutrients and other pollutants).
10. Navigation—The safe passage of watercraft (e.g., boats and ships), which is dependent upon adequate water depth and channel width.

SJRWMD examined the 10 environmental values identified in Rule 62-40.473, *F.A.*C., through a matrix screening tool (Table 1) to determine the most restrictive environmental value. The screening process used field data collected at Lake Melrose, scientific literature, and expert opinion to evaluate and score each environmental value relative to

(1) level of risk of harm from water withdrawals; (2) importance of the criterion to the water body; and (3) legal constraints on the resource/water body (e.g., presence of endangered species, Outstanding Florida Water, state-owned lands). The environmental screening scores indicate which environmental values are relevant to Lake Melrose and which criterion MFLs development should be based on to afford protection to all other relevant environmental values. The screening process serves to focus the evaluation and to shape the types of analyses needed to complete the MFLs process.

Table 1. Minimum flows and levels decision matrix for Lake Melrose

Criterion	Level of Resource Risk[1]	Importance of Resource Value[2]	Resource Legal Constraints[3]	Screening Value[4]	Criterion Stage Related?[5]	Criterion Limiting?[6]
Recreation in and on the water	1	3	1	5	Y	N
Fish and wildlife habitats and passage of fish	3	3	1	7	Y	Y
Estuarine resources	0	0	NA	0	N	NA
Transfer of detrital material	2	2	1	5	Y	N
Maintenance of freshwater storage and supply	1	1	1	3	Y	N
Aesthetics and scenic attributes	1	2	1	4	Y	N
Filtration and absorption of nutrients and other pollutants	2	3	1	6	Y	N
Sediment loads	0	0	NA	0	N	NA
Water quality	2	3	1	6	Y	N
Navigation	1	1	1	3	Y	N

* Notes:

1. Evaluation of the level to which the resource is at risk. 0 = no risk; 1 = low risk, 2 = medium risk, 3 = high risk
2. Evaluation of importance of the criterion with respect to resource. 0 = no importance; 1 = low importance, 2 = medium importance, 3 = highly important
3. Legal constraints on resource, such as endangered species and Outstanding Florida Water. 1 = low, 2 = medium, 3 = high
4. Screening value = sum of columns 1, 2, and 3. Indicates overall importance of criterion to MFLs development.
5. Evaluation as to whether criterion is related to water level in resource. (Yes or No)
6. Evaluation as to whether criterion is potentially limiting for MFLs development. (Yes or No)

According to the screening criteria, the environmental value of "fish and wildlife habitats and the passage of fish" was determined to be the most limiting environmental value to the further development of consumptive uses of surface and/or regional groundwater and the primary criteria on which the Lake Melrose MFLs were developed (see Table 1).

CONSIDERATION OF BASIN ALTERATIONS IN ESTABLISHING MFLS

Based on the provisions of Section 373.0421(1)(a), *F.S.*, SJRWMD, when establishing MFLs, 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, SJRWMD cannot allow harm caused by withdrawals. To accomplish this, SJRWMD 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 the hydrology

SJRWMD develops hydrologic models, which address existing structural features, and uses these models to consider the effects these changes have had on the long-term hydrology of water bodies for which recommended MFLs are being developed.

SJRWMD considers that the existing hydrologic condition, which is used to calibrate and verify the models, reflects the changes and structural alterations that have occurred in addition to changes that are the result of groundwater and surface water withdrawals at the time of model development. This consideration may also apply to vegetation and soils conditions if the changes, structural alterations, and water withdrawals have been sufficient to affect vegetation and soils and have been in place for long enough 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 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 instantaneously to changes in hydrology that are sufficient to cause such change. SJRWMD typically develops recommended MFLs based on vegetation and soils conditions that exist at the time fieldwork is being performed to support the development of these recommended MFLs.

SJRWMD also provides for the collection and evaluation of additional data subsequent to the establishment of MFLs. SJRWMD uses this data collection and evaluation as the basis of determining if the MFLs are protecting the water resources or if the MFLs are appropriately set. If SJRWMD determines, based on modeling and this data collection and evaluation process, that MFLs have not been appropriately set, SJRWMD can establish revised MFLs.

If SJRWMD determines that recommended MFLs cannot be met under postchange hydrologic conditions due to existing structural alterations, SJRWMD may consider whether feasible structural or nonstructural changes, such as changes in the operating schedules of water control structures, can be accomplished such that the recommended MFLs can be met. In such cases, SJRWMD may identify a recovery strategy that includes feasible structural or nonstructural changes.

HYDROLOGIC MODELING FOR MFLS

Hydrologic modeling of the water body in question is an indispensable part of SJRWMD's MFLs method (SJRWMD 2006, draft; Neubauer et al. 2008). A hydrologic model for Lake Melrose was developed (CDM 2005). The hydrologic model was calibrated for 2003 hydrologic conditions. These conditions included the 2003 land use information and groundwater levels consistent with permitted 2003 regional water use.

MFLS COMPLIANCE ASSESSMENT

A hydrologic model for Lake Melrose was developed to assess whether compliance with MFLs is achieved under specific water use and land use conditions (CDM 2005). This hydrologic model was calibrated for 2003 conditions.

Any projected or planned hydrologic changes for Lake Melrose need to be assessed from the point of view of MFLs. In the case of Lake Melrose, the most likely significant changes will be caused by declines in the potentiometric surface of the Floridan aquifer caused by increased groundwater withdrawals. Therefore, before any increased withdrawals are permitted, the potential aquifer declines will be assessed with the regional groundwater model and then with the hydrologic model (CDM 2005). The declines determined by the groundwater model are superimposed on the updated conditions surface water model to determine MFLs compliance. A more detailed explanation of the use of this hydrologic model and the applicable SJRWMD regional groundwater flow model to assess whether water levels are likely to fall below MFLs under specific water use and land use conditions is presented in CDM 2005.

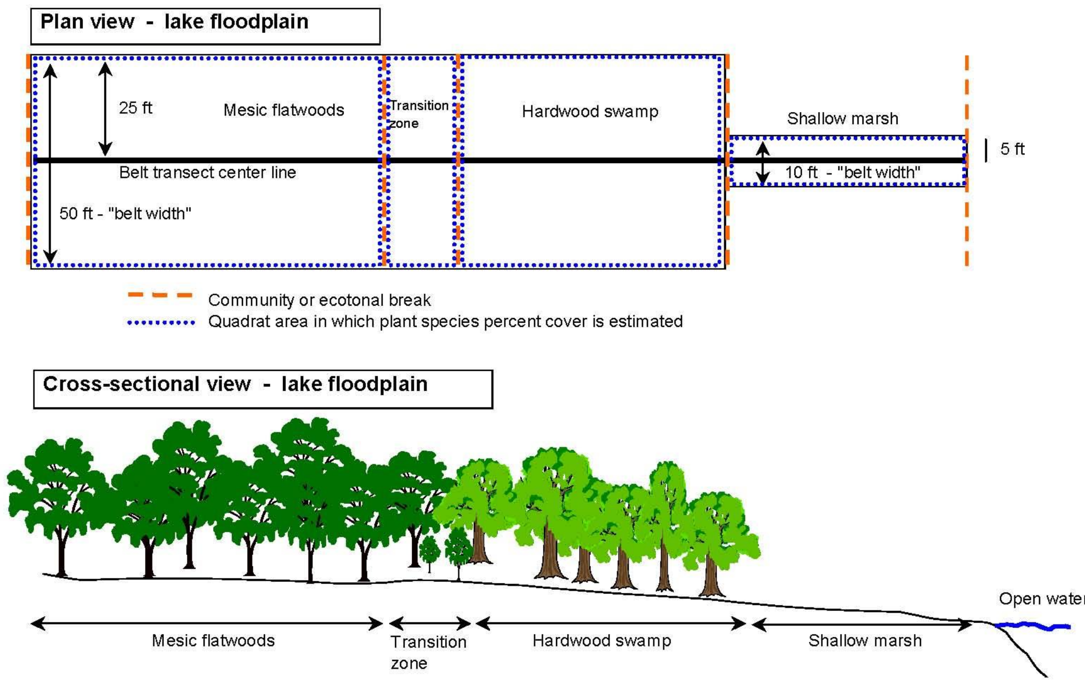


Figure 11. Example of belt transect through forested and herbaceous plant communities

RESULTS AND DISCUSSION

To reevaluate and recommend MFLs for Lake Melrose, elevation, soils, and vegetation field data were collected at three transect locations in 2011 and 2012. Additionally, data collected at Lake Melrose in 1997 for the adopted MFLs were reviewed. This section describes the Lake Melrose 2011–2012 transect site selection criteria, the data collected at each transect location, the primary level determination criteria, and the reevaluated MFLs determinations for Lake Melrose.

FIELD DATA TRANSECT 1

Transect 1 was located on the northwest shore of Lake Melrose (Table 2) to characterize the floating marsh, shrub swamp, and extensive hardwood swamp communities at this location (see Figures 4, 9, 12, and 13 and Tables 3 and 4).

Table 2. Location and fieldwork dates for Transect 1, Lake Melrose

Station	Latitude	Longitude	Location and Dates of Fieldwork
Station 0 (Waterward dock end)	29° 41' 48.33" N	-82° 02' 59.19" W	Northwest shore of Lake Melrose June-July 2011 and February 2012
Station 1300 (Transitional to Uplands)	29° 41' 52.38" N	-82° 03' 12.83" W	

Vegetation at Transect 1

Transect 1 began in a floating marsh (stations 0–50) at the waterward end of a dock, within 10 ft of the open water and traversed 1300 ft in a northwesterly direction through a shrub swamp (stations 50–140), two hardwood swamps (#1 at 140–920; #2 at 920–1210), and terminated within a transitional area (stations 1210–1300) immediately adjacent to a private residence (see Figures 4, 9, and 12; Tables 2 through 4). As mentioned previously, detailed wetland descriptions herein differ from the wetland map (Figure 9) due to map scale.

The floating marsh (stations 0–50) vegetation included abundant American cupscale (*Sacciolepis striata*) and pennywort (*Hydrocotyle umbellata)*; numerous smartweed (*Polygonum densiflorum*), alligator weed (*Alternanthera philoxeroides*), hairy primrose willow (*Ludwigia pilosa*), and pickerelweed (*Pontederia cordata*); and scattered water hyacinth (*Eichhornia crassipes*), Elliott's aster (*Symphyotrichum elliottii*), and climbing hemp vine (*Mikania scandens*).

Adjacent to the floating marsh, Transect 1 traversed a shrub swamp (stations 50–140). The vegetation in the lower elevations of the shrub swamp (stations 50–100) was also floating despite the vegetation's large size. Shrub swamp vegetation included codominant climbing hemp vine; numerous pickerelweed, red maple (*Acer rubrum*) saplings <20 ft tall, alligator weed, Virginia chain fern (*Woodwardia virginica*), Peruvian primrose willow (*Ludwigia peruviana*), pennywort, smartweed, dotted smartweed (*Polygonum punctatum*), and Elliott's aster; and scattered water hyacinth, bull tongue arrowhead (*Sagittaria lancifolia*), false nettle (*Boehmeria cylindrica*), hairy primrose willow, American cupscale, gallberry (*Ilex glabra*), dahoon holly (*Ilex cassine*),wax myrtle (*Myrica cerifera*), and buttonbush (*Cephalanthus occidentalis*).

Upslope from the shrub swamp, Transect 1 traversed hardwood swamp #1 (stations 140–920). Hardwood swamp #1 vegetation included abundant red maple, royal fern (*Osmunda regalis*), and cinnamon fern (*Osmunda cinnamomea*); numerous dahoon holly and blackberry (*Rubus* sp.); and scattered highbush blueberry (*Vaccinium corymbosum*), Virginia willow (*Itea virginica*), green arrow arum (*Peltandra virginica*), grape (*Vitus rotundifolia*), wax myrtle, and sweet bay (*Magnolia virginica*).

Adjacent to hardwood swamp #1, Transect 1 traversed hardwood swamp #2 (stations 920–1210). Comparing the vegetation composition and extent between hardwood swamps #1 and #2, there was a shift in abundance in hardwood swamp #2 with less red maple, more Virginia willow, more blackberry, more grape, and additional fern species. Specifically, hardwood swamp #2 vegetation included abundant Virginia willow and blackberry; numerous red maple, dahoon holly, cinnamon fern, and grape; and scattered high bush blueberry, green arrow arum, wax myrtle, royal fern, netted chain fern (*Woodwardia areolata*), hottentot fern (*Thelypteris interrupta*), fireweed (*Erechtites hieraciifolius*), and cat brier (*Smilax* sp.).

Adjacent to hardwood swamp #2, Transect 1 terminated in a transitional area (stations 1210–1300). Extending Transect #1 upslope from the transitional area would necessitate sampling immediately adjacent to a private residence where possible fill material associated with a sand road occurred. The transitional area vegetation included abundant grape; numerous red maple, sweetgum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), laurel oak (*Quercus laurifolia*), wax myrtle, cinnamon fern, and Virginia willow; and scattered dahoon holly, royal fern, netted chain fern, blackberry, hottentot fern, fireweed, cabbage palm (*Sabal palmetto*) saplings, and cat brier.

Additional plant species observed along Transect 1 at Lake Melrose are listed in Table 4.

Table 3. Elevation statistics for vegetation communities at Transect 1, Lake Melrose

Vegetation Community	Station Distance (ft)	Elevation (ft NAVD)*				**N
		Mean	Median	Minimum	Maximum	
Floating marsh	0–50	98.7	98.8	97.5	99.4	6
Shrub swamp	50–140	100.5	100.5	98.7	104.4	11
Hardwood swamp #1	140–920	103.7	103.6	103.2	104.4	79
Hardwood swamp #2	920–1210	104.5	104.6	103.8	105.2	30
Transitional	1210–1300	105.2	105.2	105.0	105.6	10
Deep organic soils (Histic epipedon or Histosol)	80–1280	103.8	103.8	98.7	105.3	122

* ft NAVD = feet North American Vertical Datum 1988

**N = the number of elevation readings surveyed in each vegetation or soil community

Table 4. Vegetation species list for Transect 1, Lake Melrose

Common Name	Scientific Name	FWDM Code[1]	Plant Communities[2] with Plant Species Cover Estimates[3]				
			FM	SS	HS#1	HS#2	TRANS
Alligator weed	*Alternanthera philoxeroides*	OBL	2	2			
American cupscale	*Sacciolepis striata*	OBL	1	3			
Blackberry	*Rubus* sp.	FAC		1	2	3	1
Bull tongue arrowhead	*Sagittaria lancifolia*	OBL		1			
Cabbage palm sapling	*Sabal palmetto*	FAC					1
Cat brier	*Smilax* sp.	FAC				1	1
Cinnamon fern	*Osmunda cinnamomea*	FACW			3	2	2
Dahoon holly	*Ilex cassine*	FACW		1	2	2	1
Dotted smartweed	*Polygonum punctatum*	OBL		2			
Elliott's aster	*Symphyotrichum elliottii*	OBL	1	2			
False nettle	*Boehmeria cylindrica*	OBL		1			
Fireweed	*Erechtites hieraciifolia*	FAC				1	1
Gallberry	*Ilex glabra*	FACW		0-1			
Grape	*Vitis rotundifolia*	UPL			1	2	3
Green arrow arum	*Peltandra virginica*	OBL			1	1	
Hairy primrose willow	*Ludwigia pilosa*	OBL	2	1			

Common Name	Scientific Name	FWDM Code[1]	Plant Communities[2] with Plant Species Cover Estimates[3]				
			FM	SS	HS#1	HS#2	TRANS
Climbing hemp vine	*Mikania scandens*	FAC	1	4			
Highbush blueberry	*Vaccinium corymbosum*	FACW			1	1	
Hottentot fern	*Thelypteris interrupta*	FACW				1	1
Laurel oak	*Quercus laurifolia*	FACW				0	2
Netted chain fern	*Woodwardia areolata*	OBL				1	1
Pennywort	*Hydrocotyle umbellata*	OBL	3	2			
Peruvian primrose willow	*Ludwigia peruviana*	OBL		2			
Pickerelweed	*Pontederia cordata*	OBL	2	2			
Red maple (ht <20')	*Acer rubrum*	FACW		2	3	2	2
Royal fern	*Osmunda regalis*	OBL		0	3	1	1
Slash pine	*Pinus elliottii*	FACW			0	0	
Smartweed	*Polygonum densiflorum*	OBL	2	2			
Sweet bay	*Magnolia virginiana*	OBL			1		
Sweetgum	*Liquidambar styraciflua*	FACW				0	2
Virginia chain fern	*Woodwardia virginica*	FACW		2			
Virginia willow	*Itea virginica*	OBL			1	3	2
Water hyacinth	*Eichhornia crassipes*	OBL	1	1			
Water oak	*Quercus nigra*	FACW				0	2
Wax myrtle	*Myrica cerifera*	FAC		1	1	1	2

1FWDM code indicator categories established in The Florida Wetlands Delineation Manual (Gilbert et al. 1995):

UPL = Upland plants that occur rarely in wetlands but occur almost always in uplands

FAC = Facultative plants with similar likelihood of occurring in both wetlands and uplands

FACW = Facultative wet plants that typically exhibit their maximum cover in areas subject to surface water flooding and/or soil saturation but may also occur in uplands

OBL = Obligate plants that are found or achieve their greatest abundance in an area, which is subject to surface water flooding and/or soil saturation; rarely uplands

2 Plant community abbreviations:

FM = Floating marsh (stations 0–50)

SS = Shrub swamp (stations 50–140)

HS#1 = Hardwood swamp #1 (stations 140–920)

HS #2 = Hardwood swamp #2 (stations 920–1210)

TRANS = Transitional area (stations 1210-1300)

3 Plant Species Cover Estimates: Areal extent of vegetation species along transect within given community where 0 = <1% (rare); 1 = 1–10% (scattered); 2 = 11–25% (numerous); 3 = 26–50% (abundant); 4 = 51–75% (codominant); 5 = greater than 75% (dominant)

Soils at Transect 1

Soils were mapped by the NRCS (see Figure 10) as Samsula muck from the lakeshore to approximately station 1210 at the ecotone of hardwood swamp #2 and the transitional zone and as Placid fine sand depressional from station 1210 to the end of Transect 1. Soils were sampled on July 27, 2011, by Robert Freese, professional soil scientist at the SJRWMD, (Table 5) and vary slightly from the SSURGO map (see Figure 10) delineation, presumably due to the map scale. Detailed soil sampling occurred at 9 locations along the transect and at 3 additional locations to identify hydric soil indicators in the shrub swamp community. Soil sampling did not occur in the floating marsh due to the difficulty in obtaining an accurate sample.

Soil sampling began in the shrub swamp at station 80. The vegetation at this station was floating and the soil sample consisted of a 12-in. deep, peat floating mat. Similarly, a 12-in. deep, peat root mat was observed at stations 90 and 100 overlying a thick muck layer of very low bulk density. At station 110, the vegetation was not floating, and the soil series was identified as Brighton. The Brighton series consists of very deep, very poorly drained, moderately rapid to rapidly permeable organic soils in depressions, freshwater marshes, and swamps in peninsular Florida. In natural settings the water table is above the surface for 4 to 6 months in most years. This ponding condition normally occurs during the summer rainy season (NRCS 2012).

Continuing upslope, soils sampled in hardwood swamp #1 (stations 150, 300, 500, 700, and 900) were identified as Hontoon muck. The Hontoon series consists of deep, very poorly drained, rapidly permeable organic soils formed in hydrophytic nonwoody plant remains. Runoff is very slow. These soils occur in freshwater swamps and marshes. The water table is at or above the surface of the soil except during extended dry periods (NRCS web page). Hontoon muck was also sampled across hardwood swamp #2 at stations 1100 and 1200 and within the transitional area at station 1290.

In summary, the soils observed at Transect 1 were organic with hydric soil indicators of hydrogen sulfide, histic epipedon, and Histosol. The hydric soil indicators emphasize the wet conditions typical adjacent to Lake Melrose. Organic soils, indicative of long-term soil saturation or inundation, were observed across all vegetation communities traversed at Transect 1 (see Tables 3 and 5). Additionally, groundwater discharge from the upland to the edge of the floodplain, typically occurring along the transitional vegetation community, may contribute to the anaerobic soil conditions within the transitional community at Transect 1 and promote organic soil development (Lindbo and Richardson 2001).

Table 5. Soil profile descriptions for Transect 1, Lake Melrose

Shrub Swamp
Station 80 (consolidated organic deposits below 20 in.)
Hydric indicator A4 (Hydrogen Sulfide), A1 (Histosol)
0–12 in. Peat (Fibric) slight H2S odor, floating root mat, m1-2 roots
12–20 ft water
Station 90
Hydric indicator A1 (Histosol), A4 (Hydrogen Sulfide)
0–12 in. Peat (Fibric) m1 roots (floating root mat), slight H2S odor
12–33 in. Muck (Sapric) 7.5YR 2.5/2 loose, fluid, very low bulk density
33–60 in. Mucky peat (He 7.5YR 2.5/3 relatively consolidated material
Station 100
Hydric indicator A1 (Histosol)
Oi; 0–12 in. Peat (Fibric) m1 roots (floating root mat)
W; 12–25 in. water with pockets of fluid, very low bulk density organic matter 7.5YR 2.5/2
Oe; 25–60 in. Mucky peat (Hemic) 7.5YR 2.5/3 relatively consolidated organic material
Station 110—Brighton muck with 8 in. standing water
Hydric indicator A1 (Histosol)
Oi; 0–10 in. Peat (Fibric) m1 roots; root mat
Oe1; 10–20 in. Mucky peat (Hemic) 7.5YR 2.5/1 very low bulk density
Oe2; 20–50 in. Mucky peat (Hemic) 5YR 2.5/2
Hardwood Swamp #1
Station 150—Hontoon muck
Hydric indicator A1 (Histosol)
Oe; 0–3 in. Mucky peat (Hemic) 7.5YR 2.5/2 m1 roots
Oa; 3–15 in. Muck (Sapric) 7.5YR 2.5/2 c1 roots
Oa; 15–60 in. Muck (Sapric) 7.5YR 2.5/1
Station 300—Hontoon muck
Hydric indicator A1 (Histosol)
Oe1; 0–3 in. Mucky peat (Hemic) 7.5YR 2.5/2 m1 roots
Oe2; 3–15 in. Mucky peat (Hemic) 7.5YR 2.5/2 20% rubbed fiber; f1 roots
Oa1; 15–35 in. Muck (Sapric) 10YR 2/1 f1 roots
Oa2; 35–60 in. Muck (Sapric) 7.5YR 2.5/2 c2 decomposed wood fragments

Station 500—Hontoon muck
Hydric indicator A1 (Histosol)
Oa1; 0–3 in. Muck (Sapric) 7.5YR 2.5/2 m1 roots
Oa2; 3–15 in. Muck (Sapric) 10YR 3/2 f1-2 roots
Oa3; 15–60 in. Muck (Sapric) 10YR 2/1 f1-2 roots; f2 partially decomposed wood fragments; f1 charcoal fragments
Station 700—Hontoon muck
Hydric indicator A1 (Histosol)
Oa1; 0–3 in. Muck (Sapric) 7.5YR 2.5/2 m1 roots
Oa2; 3–20 in. Muck (Sapric) 7.5YR 2.5/2 c1 roots
Oa3; 20–60 in. Muck (Sapric) 7.5YR 2.5/1 f1 roots
Station 900—Hontoon muck
Hydric indicator A1 (Histosol)
Oa1; 0–3 in. Muck (Sapric) 7.5YR 2.5/2 m1 roots
Oa2; 3–20 in. Muck (Sapric) 7.5YR 2.5/2 c1 roots
Oa3; 20–60 in. Muck (Sapric) 10YR 2/1 c3 partially decomposed wood fragments; f1 roots
Hardwood Swamp #2
Station 1100—Hontoon muck
Hydric indicator A1 (Histosol)
Oa; 0–60 in. Muck (Sapric) 10YR 2/1 c3 7.5YR 2.5/2 pockets; f1-2 roots
Station 1200—Hontoon muck (could not bore past woody material at 30 in.)
Hydric indicator A1 (Histosol)
Oa1; 0–25 in. Muck (Sapric) 10YR 2/1
Oa2; 25–30 in. Muck (Sapric) 10YR 2/1 80% soft wood fragments
Transition
Station 1290—Hontoon muck
Hydric indicator A1 (Histosol)
Oi; 0–12 in. Peat (Fibric) 7.5YR 3/2
Oa1; 12–30 in. Muck (Sapric) 10YR 2/1
Oa2; 30–56 in. Muck (Sapric) 10YR 2/2
C; 56–60 in. Sand (medium) 10YR 3/1 c1 10YR 5/1 pockets

FIELD DATA TRANSECT 2

Transect 2 was located on the south shore of Lake Melrose (Table 6) to characterize the floating marsh, shrub swamp, hardwood swamp, transitional, and upland communities at this location (see Figures 4, 9, 14, and 15). The ground elevation, soils, and vegetation at Transect 2 were sampled in 2011. As mentioned previously, detailed wetland descriptions herein differ from the wetland map (Figure 9) due to map scale.

Table 6. Location and fieldwork dates for Transect 2, Lake Melrose

Station	Latitude	Longitude	Location and Dates of Fieldwork
Station 0 (Uplands)	29° 41' 31.6" N	-82° 02' 39.1" W	South shore of Lake Melrose June and August 2011
Station 330 (Shrub Swamp)	29° 41' 34.1" N	-82° 02' 42.3" W	

Vegetation at Transect 2

Transect 2 began in an upland (stations 0–40) and traversed 464 ft in a northerly direction through a transitional area (stations 40–90), a hardwood swamp (stations 90–310), a shrub swamp (stations 310–350), and terminated at the waterward edge of a floating marsh (stations 350–464) (see Figures 4, 9, 14, and 15; Tables 6 through 8). This transect was surveyed on June 23, 2011.

The upland (stations 0–40) vegetation included abundant sand live oak and laurel oak saplings; numerous mature sand live oak (*Quercus geminata*) and scattered wild olive (*Cartrema americanus*), fetterbush (*Lyonia lucida*), bracken fern (*Pteridium aquilinum*), and mature laurel oak.

Downslope from the uplands, the transitional area (stations 40–90) vegetation included abundant fetterbush and grape; laurel and water oak saplings <6 ft tall, dahoon holly, highbush blueberry, sweetbay, and slash pine (*Pinus elliottii*) on tussocks; and scattered cinnamon fern, mature water oak, cat brier, mature laurel oak, and swamp bay (*Persea palustris*).

Downslope from the transitional area, Transect 2 traversed a hardwood swamp (stations 90–310). Hardwood swamp vegetation included codominant red maple; abundant Virginia chain fern (*Woodwardia virginica*); numerous cinnamon fern, slash pine on tussocks, sweetbay, highbush blueberry, and dahoon holly; and scattered fetterbush, grape, buttonbush, loblolly bay (*Gordonia lasianthus*), swamp gum (*Nyssa biflora*), royal fern, green arrow arum, giant gallberry (*Ilex coriacea*), wax myrtle, and swamp bay.

Downslope from the hardwood swamp, Transect 2 traversed a shrub swamp (stations 310–350). Shrub swamp vegetation included abundant wax myrtle, buttonbush, and red maple saplings less than 20 ft tall; numerous Carolina willow (*Salix caroliniana*), Virginia chain fern, and cinnamon fern; with scattered dahoon holly saplings, highbush blueberry, royal fern, swamp gum (<4 in. diameter at breast height [dbh]), and giant gallberry on tussocks.

Downslope from the shrub swamp, Transect 2 traversed a floating marsh, terminating at the open water of Lake Melrose. Ground elevations were obtained by pushing the survey rod through the floating mat until a firm surface was reached. Floating marsh vegetation included dominant climbing hemp vine; abundant dotted smartweed and pennywort; numerous maidencane (*Panicum hemitomon*) and buttonbush; and scattered Carolina willow, wax myrtle, Virginia chain fern, cinnamon fern, and red maple saplings (< 2 in. dbh).

Additional plant species observed along Transect 2 at Lake Melrose are listed in Table 8.

Table 7. Elevation statistics for vegetation communities at Transect 2, Lake Melrose

Vegetation Community	Station Distance (ft)	Elevation (ft NAVD)*				**N
		Mean	Median	Minimum	Maximum	
Uplands	0–40	106.7	106.6	105.9	107.6	5
Transition	40–90	105.0	105.0	104.0	105.9	6
Hardwood swamp	90–310	103.6	103.7	102.7	104.0	23
Shrub swamp	310–350	101.5	101.9	100.3	102.7	5
Floating marsh	350-464	98.0	98.0	96.0	100.3	13
Deep organic soils (Histic epipedon or Histosol)	90-340	103.4	103.6	100.4	104.0	26

* ft NAVD = feet North American Vertical Datum 1988

**N = the number of elevation readings surveyed in each vegetation or soil community

Table 8. Vegetation species list for Transect 2, Lake Melrose

Common Name	Scientific Name	FWDM Code[1]	Plant Communities[2] With Plant Species Cover Estimates[3]				
			UPL	TRANS	HS	SS	FM
Bracken fern	*Pteridium aquilinum*	FACU	1				
Buttonbush	*Cephalanthus occidentalis*	OBL			1	3	2
Carolina willow	*Salix caroliniana*	OBL				2	1
Cat brier	*Smilax* sp.	FAC		1			
Cinnamon fern	*Osmunda cinnamomea*	FACW		1	2	2	1

Common Name	Scientific Name	FWDM Code[1]	Plant Communities[2] With Plant Species Cover Estimates[3]				
			UPL	TRANS	HS	SS	FM
Dahoon holly	*Ilex cassine*	FACW		2	2	1*	
Dotted smartweed	*Polygonum punctatum*	OBL					3
Fetterbush	*Lyonia lucida*	FACW	1	3	1		
Giant gallberry	*Ilex coriacea*	FACW			1	1	
Grape	*Vitis rotundifolia*	FAC		3	1		
Green arrow arum	*Peltandra virginica*	OBL			1		
Climbing hemp vine	*Mikania scandens*	FACW					5
Highbush blueberry	*Vaccinium corymbosum*	FACW		2	2	1	
Laurel oak	*Quercus laurifolia*	FACW	1	1			
Laurel oak sapling	*Quercus laurifolia*	FACW	3	2			
Loblolly bay	*Gordonia lasianthus*	FACW			1		
Maidencane	*Panicum hemitomon*	OBL					2
Pennywort	*Hydrocotyle umbellata*	FACW					3
Red maple	*Acer rubrum*	FACW			4	3*	1
Royal fern	*Osmunda regalis*	OBL			1	1	
Sand live oak	*Quercus geminata*	UPL	2				
Sand live oak sapling	*Quercus geminata*	UPL	3	2			
Slash pine	*Pinus elliottii*	FACW		2	2		
Swamp bay	*Persea palustris*	OBL		1	1		
Swamp gum	*Nyssa biflora*	OBL			1	1	
Sweetbay	*Magnolia virginiana*	OBL		2	2		
Virginia chain fern	*Woodwardia virginica*	FACW			3	2	1
Water oak	*Quercus nigra*	FACW		1			
Wax myrtle	*Myrica cerifera*	FAC			1	3	1
Wild olive	*Cartrema americanus*	FAC	1				

[1]FWDM code indicator categories established in *The Florida Wetlands Delineation Manual* (Gilbert et. al. 1995):
- UPL = Upland plants that occur rarely in wetlands but occur almost always in uplands
- FAC = Facultative plants with similar likelihood of occurring in both wetlands and uplands
- FACW = Facultative wet plants that typically exhibit their maximum cover in areas subject to surface water flooding and/or soil saturation but may also occur in uplands
- OBL = Obligate plants that are found or achieve their greatest abundance in an area, which is subject to surface water flooding and/or soil saturation; rarely uplands

[2] Plant community abbreviations:
- UPL = Uplands (stations 0–40)
- TRANS = Transition (stations 40–90)
- HS = Hardwood swamp (stations 90–310)
- SS = Shrub swamp (stations 310–350)
- FM = Floating marsh (stations 350-464)

[3]Plant Species Cover Estimates: Areal extent of vegetation species along transect within given community where 0 = <1% (rare); 1 = 1–10% (scattered); 2 = 11–25% (numerous); 3 = 26–50% (abundant); 4 = 51–75% (co-dominant); 5 = greater than 75% (dominant)

*saplings <20 ft tall

Soils at Transect 2

Soils were mapped by the NRCS (see Figure 10) as Riviera fine sand depressional in the uplands and transitional communities and as Samsula muck in the hardwood swamp and shrub swamp at Transect 2. Soils were sampled on August 24, 2011, by Robert Freese, professional soil scientist at the SJRWMD, and vary slightly from the SSURGO map (see Figure 10) delineation, presumably due to the map scale. Detailed soil sampling occurred at 7 locations along Transect 2 and at 5 additional locations to identify hydric soil indicators in the transitional community.

The hydric soil indicators identified at Transect 2 were polyvalue below surface (station 70) and mucky mineral (station 80) in the transition zone, histic epipedon at the transition–hardwood swamp ecotone (station 90), histic epipedon in the hardwood swamp (station 100), and Histosol across the remainder of the hardwood swamp, extending into the shrub swamp (Tables 7 and 9).

As mentioned previously, hydric soils are defined as soils that form under conditions of saturation, flooding, or ponding that occur long enough during the growing season to develop anaerobic conditions in the upper part of the soil (Soil Survey Staff 2003). Certain characteristics are used to indicate wet ecosystems such as accumulation of muck (Histosol, histic epipedon) or the presence of reduced sulfur odor (rotten egg odor). Other hydric soil indicators are routinely used to delineate the extent of wetlands, which implies they form at the hydric/nonhydric soil edge (sandy redox, stripped matrix, and dark surface) (Carlisle and Hurt 2000).

Soil sampling began at station 10 in the uplands community (stations 0–40) at Transect 2, where the soil series was identified as a nonhydric Immokalee sand. The Immokalee series consists of deep and very deep, poorly drained and very poorly drained soils that formed in sandy marine sediments. They occur on flatwoods and in depressions of peninsular Florida. During most years, the water table is at depths of 6 to 18 in. for 1 to 4 months, between depths of 18 to 36 in. for 2 to 10 months, and below 60 in. during the dry periods. Depressional areas are covered with standing water for 6 to 9 months or more in most years (NRCS 2012).

Traversing downslope into the transition community (stations 40–90), soils sampled at stations 50 and 60 were nonhydric and marked the landward extent of hydric soils. The hydric soil indicator polyvalue below surface was identified at station 70 and the hydric indicator mucky mineral was identified at station 80. At the transition–hardwood swamp ecotone (station 90), the hydric soil indicator was a histic epipedon.

Continuing downslope into the hardwood swamp (stations 90–310), the soil at station 100 was identified as the hydric Sanibel muck with the hydric soil indicator of histic epipedon. The Sanibel series consists of very poorly drained sandy soils with organic surfaces. They formed in rapidly permeable marine sediments. The soils occur on nearly level to depressional areas with slopes less than 2 percent. The Sanibel soil water table is at depths of less than 10 in. for 6 to 12 months during most years. Water is above the surface for 2 to 6 months during wet seasons (NRCS 2012).

Traversing across the hardwood swamp, Samsula muck was identified at station 200 with Hontoon muck at stations 290 and 310, both with the hydric soil indicator of Histosol (Table 9). The Samsula series consists of very deep, very poorly drained, rapidly permeable organic soils that formed in moderately thick beds of hydrophilic plant remains. These organic soils typically occur in swamps, poorly defined drainageways, and floodplains. The Samsula muck soil water table occurs at or above the soil surface except during extended dry periods (NRCS 2012).

Hontoon and Samsula mucks are differentiated by surface muck thickness. Samsula muck contains a muck surface of 16 to 51 in. thick whereas Hontoon muck contains a muck surface that is at least 52 in. thick (JEA 2002, draft). The Hontoon series consists of deep, very poorly drained, rapidly permeable organic soils formed in hydrophytic nonwoody plant remains. These soils occur in freshwater swamps and marshes. As with Samsula muck, the Hontoon muck soil water table is at or above the surface of the soil except during extended dry periods (NRCS 2012).

Brighton muck (station 320) and Ocoee muck (station 340) were identified within the shrub swamp (stations 310–350). Both soils have a Histosol hydric soil indicator. The Brighton and Ocoee series consists of very deep, very poorly drained, moderately rapid to rapidly permeable organic soils in depressions, freshwater marshes, and swamps in peninsular Florida. The Brighton soil water table is above the surface for 4 to 6 months in most years. This ponding condition normally occurs during the summer rainy season (NRCS 2012).

Soil sampling did not occur in the floating marsh (stations 350–464) due to the thick floating mat.

In summary, the soils observed at Transect 2 within the uplands were nonhydric, while hydric soils were observed in the transition, hardwood swamp, and shrub swamp vegetation communities. The hydric soil indicators ranged from polyvalue below surface and mucky mineral at the higher elevations to histic epipedon and Histosol as the elevation decreased across the hardwood swamp and shrub swamp. The hydric soil indicators emphasize the typical wet conditions adjacent to Lake Melrose. Additionally, groundwater discharge from the upland to the edge of the floodplain, typically occurring along the transitional vegetation community, may contribute to the anaerobic soil conditions within the transition community and hardwood swamp and promote organic soil development (Lindbo and Richardson 2001).

Table 9. Soil profile descriptions for Transect 2, Lake Melrose

Upland
Station 10—Immokalee sand
A1; 0–2 in. Sand (medium) 10YR 2/1 50% csg, c2-3 roots
A2; 2–5 in. Sand (medium) 10YR 3/1 20%csg, f1 roots
A3; 5–8 in. Sand (medium) 10YR 4/1 C1 10YR 5/1 splotches wi/ shp bnd, f1 roots
E1; 8–17 in. Sand (medium) 10YR 6/2 C1 10YR 5/1 faint, oval, splotches
E2; 17–35 in. Sand (medium) 10YR 7/2
E3; 35–42 in. Sand (medium) 10YR 5/2 m1 10YR 6/1 splotches
Bh; 42–60 in. Sand (medium) 7.5YR 2.5/2 c3 7.5YR 3/2, splotches
Transition
Station 50
0–3 in. Sand (medium) 10YR 2/2 m1 roots, 60% csg
3–6 in. Sand (medium) 10YR 2/1 50% csg, c1 roots
6–9 in. Sand (medium) 10YR 3/1 20% csg
9–14 in, Sand (medium) 10YR 4/1 f1 10YR 5/1 splotches w/ shp bnd
Station 60
0–4 in. Peat (Fibric) m1-2 roots
4–9 in. Sand (medium) 10YR 2/1 f1 roots, 60% csg
9–12 in. Sand (medium) 10YR 4/2 c3 10YR 3/1 splotches
Station 70
Hydric indicator S8 (Polyvalue Below Surface)
0–5 in. Peat (Fibric) m1-3 roots
5–7 in. Sand (medium) 10YR 2/1 80% csg
7–14 in. Sand (medium) 10YR 3/1 60% csg, f1 10YR 4/1 streaks
Station 80
Hydric indicator A7 (5 cm Mucky Mineral)
0–7 in. Peat (Fibric)
7–9 in. Mucky sand 10YR 2/1
Transition–Hardwood Swamp Ecotone
Station 90
Hydric indicator A2 (Histic Epipedon)
0–8 in. Muck (Sapric) 10YR 2/1
8–12 in. Sand (medium) 10YR 2/1

Hardwood Swamp
Station 100—Sanibel muck
Hydric indicator A2 (Histic Epipedon)
Oe; 0–2 in. Mucky peat (Hemic) 7.5YR 2.5/2 m1 roots
Oa1; 2–6 in. Muck (Sapric) 10YR 2/2 c2 roots
Oa2; 6–15 in. Muck (Sapric) 10YR 2/1
C1; 15–23 in. Sand (medium) 10YR 3/2 c11, 10YR 4/2 streaks
C2; 23–30 in. Sand (medium) 10YR 3/3
Station 200—Samsula muck
Hydric indicator A1 (Histosol)
Oa; 0–48 in. Muck (Sapric) 10YR 2/1 Thin ms strata throughout
C; 48–50 in. Sand (medium) 10YR 4/2
Station 290—Hontoon muck
Hydric indicator A1 (Histosol)
Oa1; 0–6 in. Muck (Sapric) 10YR 2/1 m1-2 roots
Oa2; 6–58 in. Muck (Sapric) 7.5YR 2.5/2 f3 roots
C; 58–60 in. Sand (medium) 7.5YR 3/3
Hardwood Swamp–Shrub Swamp Ecotone
Station 310—Hontoon muck
Hydric indicator A1 (Histosol)
Oe; 0–10 in. Mucky peat (Hemic) 7.5YR 2.5/2 c2 soft wood frags, m1 roots
Oa; 10–60 in. Muck (Sapric) 10YR 2/1 low bulk density
Shrub Swamp
Station 320—Brighton muck
Hydric indicator A1 (Histosol)
Oe1; 0–10 in. Mucky peat (Hemic) 7.5YR 2.5/2 m3 soft wood fragments, c1-2 roots
Oe2; 10–60 in. Mucky peat (Hemic) 7.5YR 2.5/1 very low bulk density
Station 340—Ocoee muck
Hydric indicator A1 (Histosol)
Oe; 0–50 in. Mucky peat (Hemic) 7.5YR 2.5/1 very low bulk density
C; 50–52 in. Sand (medium) 10YR 4/2

FIELD DATA TRANSECT 3

Transect 3 was located on the north shore of Lake Melrose (Table 10) to characterize the floating marsh, hardwood swamp, Baygall, and upland communities at this location (see Figures 4, 9, 16, and 17; Tables 11 through12). The ground elevation, soils, and vegetation at Transect 3 were sampled in 2011 and 2012. As mentioned previously, detailed wetland description herein differ from the wetland map (Figure 9) due to map scale.

Table 10. Location and fieldwork dates for Transect 3, Lake Melrose

Station	Latitude	Longitude	Location and Dates of Fieldwork
Station 0 (Uplands)	29° 41' 59.54" N	-82° 02' 41.52" W	North shore of Lake Melrose June and August 2011 February 2012
Station 400 (Hardwood Swamp)	29° 41' 55.99" N	-82° 02' 42.43" W	

Vegetation at Transect 3

Transect 3 began in an upland (stations 0–20) and traversed 489 ft in a southerly direction through transition area #1 (stations 20–90), a Baygall (stations 90–200), transition area #2 (stations 200–270), a hardwood swamp (270–445), open water of Lake Melrose (stations 445–460), and a floating marsh (stations 460–489). This transect terminated at station 489, which was the ecotone between the floating marsh and the open water of Lake Melrose when sampled on June 23, 2011. On June 13, 2012, the floating marsh was no longer present.

The upland (stations 0–20) vegetation included abundant coral ardisia (*Ardisia crenata*), saw palmetto (*Serenoa repens*), grape, and laurel oak; numerous beautyberry (*Callicarpa americana*), loblolly bay, southern magnolia (*Magnolia grandiflora*), and cinnamon fern; and scattered highbush blueberry.

Transition #1 (stations 20–90) contained a blend of upland and wetland vegetation. Vegetation included abundant coral ardisia and loblolly bay; numerous grape, blackberry, giant gallberry, sweetgum, and cinnamon fern; and scattered laurel oak, highbush blueberry, buttonbush, American elm, netted chain fern, and sweetbay.

Downslope from transition #1, Transect 3 traversed a Baygall vegetation community (stations 90–200). A Baygall vegetation community, as defined by the SJRWMD wetland map, is a forested wetland vegetation community dominated by one or more species of evergreen bay trees or, less commonly, dahoon holly, deciduous hardwoods, or pine. This community is typically located at the base of a sandy slope and maintained by downslope seepage. Soils in a Baygall are organic and nearly constantly saturated but infrequently flooded (Kinser 1996). Vegetation and soils sampled at stations 90–200 closely match the

SJRWMD Baygall community description. Baygall vegetation included codominant coral ardisia; abundant mature loblolly bay and swamp gum; numerous sweetbay and giant gallberry; and scattered dahoon holly, royal fern, netted chain fern, grape, blackberry, sweetgum, cinnamon fern, and highbush blueberry.

Downslope from the Baygall community, Transect 3 traversed the transition #2 area (stations 200–270). Notable vegetation characteristics differentiating it from the adjacent vegetation communities included a midcanopy thicket of giant gallberry and a scattered mature tree canopy. Specifically, vegetation included abundant giant gallberry; numerous coral ardisia, blackberry, grape, and red maple; scattered cinnamon fern, royal fern, sweetbay, dahoon holly, swamp gum, and loblolly bay.

Continuing downslope, the hardwood swamp (stations 270–445) vegetation included abundant red maple and royal fern; numerous dahoon holly and coral ardisia; and scattered loblolly bay, giant gallberry, sweetbay, netted chain fern, cinnamon fern, wax myrtle, nut rush (*Scleria* sp.), dead swamp gum, green arrow arum, and Virginia willow.

Downslope and adjacent to the hardwood swamp an area of open water (stations 445–460) and a floating marsh (stations 460–489) were traversed. Floating marsh vegetation (on June 23, 2011) included dominant Cuban bulrush (*Oxycaryum cubense*); numerous marsh pennywort; and scattered alligator weed, Carolina willow, smartweed, water hyacinth, dog fennel, and creeping primrose willow (*Ludwigia repens*). During monitoring on June 13, 2012, the floating marsh was not evident. It appeared that the floating marsh around much of Lake Melrose had been treated with herbicide with varying impact. At Transects 1 and 2, the floating marsh communities were still present on June 13, 2012, but had been severely reduced in extent and robustness. Additional plant species observed along Transect 3 at Lake Melrose are listed in Table 12.

Table 11. Elevation statistics for the vegetation communities at Transect 3, Lake Melrose

Vegetation Community	Station Distance (ft)	Elevation (ft NAVD)*				**N
		Mean	Median	Minimum	Maximum	
Uplands	0–20	112.7	112.8	111.3	114.0	3
Transition #1	20–90	108.2	107.6	106.4	111.3	8
Baygall	90–200	105.9	105.9	105.5	106.4	12
Transition #2	200–270	105.3	105.3	104.4	106.2	8
Hardwood swamp	270–445	104.3	104.4	102.8	104.8	19
Open water	445–460	101.8	101.6	101.2	102.8	4
Floating marsh	460-489	100.8	100.8	100.4	101.3	4
Deep organic soils (histic epipedon or Histosol)	70-470	104.7	104.7	101.0	106.6	43

*ft NAVD = feet North American Vertical Datum 1988

**N = the number of elevation readings surveyed in each vegetation or soil community

Table 12. Vegetation species list for Transect 3, Lake Melrose

Common Name	Scientific Name	FWDM Code[1]	Plant Communities[2] with Plant Species Cover Estimates[3]					
			UPL	TRANS#1	BAYGALL	TRANS#2	HS	FM
Alligator weed	*Alternanthera philoxeroides*	OBL						1
American elm	*Ulmus americana*	FACW		1				
Beautyberry	*Callicarpa americana*	UPL	2					
Blackberry	*Rubus* sp.	FAC		2	1	2		
Buttonbush	*Cephalanthus occidentalis*	OBL		1				
Carolina willow	*Salix caroliniana*	OBL						1
Cinnamon fern	*Osmunda cinnamomea*	FACW	2	2	1	1	1	
Coral ardisia	*Ardisia crenata*	FAC	3	3	4	2	2	
Creeping primrose willow	*Ludwigia repens*	OBL						1
Cuban bulrush	*Oxycaryum cubense*	OBL						5
Dahoon holly	*Ilex cassine*	FACW			1	1	2	
Dog fennel	*Eupatorium capillifolium*	FAC						1
Giant gallberry	*Ilex coriacea*	FACW		2	2	3	1	
Grape	*Vitis rotundifolia*	FAC	3	2	1	2		
Green arrow arum	*Peltandra virginica*	OBL					1	
Highbush blueberry	*Vaccinium corymbosum*	FACW	1	1	1		0	
Laurel oak	*Quercus laurifolia*	FACW	3	1				
Loblolly bay	*Gordonia lasianthus*	FACW	2	3	3	1	1	
Netted chain fern	*Woodwardia areolata*	OBL		1	1		1	
Nut rush	*Scleria* sp.	FACW					1	
Pennywort	*Hydrocotyle umbellata*	FACW						2
Red maple	*Acer rubrum*	FACW			0	2	3	
Royal fern	*Osmunda regalis*	OBL			1	1	3	
Saw palmetto	*Serenoa repens*	UPL	3					
Smartweed	*Polygonum densiflorum*	OBL						1

Common Name	Scientific Name	FWDM Code[1]	Plant Communities[2] with Plant Species Cover Estimates[3]					
			UPL	TRANS#1	BAYGALL	TRANS#2	HS	FM
Southern magnolia	*Magnolia grandiflora*	UPL	2					
Swamp bay	*Persea palustris*	OBL					0	
Swamp gum	*Nyssa biflora*	OBL			3	1		
Swamp gum–DEAD	*Nyssa biflora*	OBL					1	
Sweetbay	*Magnolia virginiana*	OBL		1	2	1	1	
Sweetgum	*Liquidambar styraciflua*	FACW		2	1			
Virginia willow	*Itea virginica*	OBL					1	
Water hyacinth	*Eichhornia crassipes*	OBL						1
Water oak	*Quercus nigra*	FACW					0	
Wax myrtle	*Myrica cerifera*	FAC					1	

[1]FWDM code indicator categories established in *The Florida Wetlands Delineation Manual* (Gilbert et. al. 1995):

UPL = Upland plants that occur rarely in wetlands but occur almost always in uplands
FAC = Facultative plants with similar likelihood of occurring in both wetlands and uplands
FACW = Facultative wet plants that typically exhibit their maximum cover in areas subject to surface water flooding and/or soil saturation but may also occur in uplands
OBL = Obligate plants that are found or achieve their greatest abundance in an area, which is subject to surface water flooding and/or soil saturation; rarely uplands

[2] Plant community abbreviations:

UPL = uplands (stations 0–20)
TRANS#1 = transition #1 (stations 20–90)
BAYGALL = Baygall (stations 90–200)
TRANS #2 = transition #2 (stations 200–270)
HS = hardwood swamp (stations 270-445)
FM = floating marsh (stations 460-489)

[3]Plant Species Cover Estimates: Areal extent of vegetation species along transect within given community where 0 = <1% (rare); 1 = 1–10% (scattered); 2 = 11–25% (numerous); 3 = 26–50% (abundant); 4 = 51–75% (codominant); 5 = greater than 75% (dominant)

Soils at Transect 3

At Transect 3 the soils were mapped by the NRCS (see Figure 10) as Sparr sand in the uplands and Placid fine sand depressional in transition #1. From station 100 in the Baygall to the open water of Lake Melrose at Transect 3 the soils were mapped as Samsula muck. Soils were sampled on August 24, 2011, and February 8, 2012, by Robert Freese, professional soil scientist at the SJRWMD, and vary slightly from the SSURGO map (see Figure 10) delineation, presumably due to the map scale. Detailed soil sampling occurred at 7 locations along Transect 3 and at 5additional locations to identify hydric soil indicators and/or depth of muck.

The hydric soil indicators identified at Transect 3 were dark surface, mucky mineral, muck presence, and histic epipedon in the transition #1 community as the elevation decreased, respectively. The hydric soil indicator from station 120 in the Baygall, across transition #2, the hardwood swamp, and into the floating marsh was a Histosol (Table 13).

Soil sampling at Transect 3 began at station 10 in the uplands vegetation community (stations 0–20) where soil series was identified as Zolfo sand, a nonhydric soil. The Zolfo series consists of very deep, somewhat poorly drained soils that formed in thick beds of sandy marine deposits. During most years, the Zolfo soil water table is at a depth of 24 to 40 in. for 2 to 6 months and within depths of 60 in. for more than 9 months. It is at depths of 10 to 24 in. for up to 2 weeks in some years (NRCS 2012).

Traversing downslope into the transition #1 community (stations 20–90), soils sampled at stations 50, 60, 70, and 80 were hydric and marked the landward extent of hydric and organic soils:

- Station 50 hydric soil indicator: dark surface
- Station 60 hydric soil indicators: mucky mineral and muck presence
- Station 70 hydric soil indicator: histic epipedon
- Station 80 hydric soil indicator: histic epipedon

Samsula muck soil series was identified at station 80, near the transition #1 and Baygall vegetation community ecotone.

Hontoon muck (station 120) and Samsula muck (station 170) were identified in the Baygall vegetation community (stations 90–200). As mentioned previously, the Hontoon series consists of deep, very poorly drained, rapidly permeable organic soils formed in hydrophytic non-woody plant remains. These soils occur in fresh water swamps and marshes. As with Samsula soil, the Hontoon soil water table is at or above the surface of the soil except during extended dry periods (NRCS 2012; *https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HONTOON.html*).

Hontoon and Samsula mucks are differentiated by surface muck thickness. Samsula muck contains a muck surface of 16 to 51 in. thick, whereas Hontoon muck contains a muck surface that is at least 52 in. thick (JEA 2002).

At stations 300 and 400 in the hardwood swamp (stations 270–445), Hontoon muck was identified with an unnamed Histosol at station 440.

Brighton muck was identified at station 470 in the floating marsh (stations 460–489) As mentioned previously the Brighton series consists of very deep, very poorly drained, moderately rapid to rapidly permeable organic soils in depressions, freshwater marshes, and swamps in peninsular Florida. In natural settings the water table is above the surface for 4 to 6 months in most years. This ponding condition normally occurs during the summer rainy season (NRCS 2012; *https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BRIGHTON.html*).

In summary, the soils observed at Transect 3 within the uplands were nonhydric, while hydric soils were observed in the transition #1, Baygall, hardwood swamp, and floating marsh vegetation communities. The hydric soil indicators ranged from dark surface and muck presence at the higher elevations in the transition #1 community to histic epipedon and Histosol as the elevation decreased in the transition #1 community and across the Baygall, hardwood swamp, and floating marsh. The hydric soil indicators emphasize the typical wet conditions adjacent to Lake Melrose. Additionally, groundwater discharge from the upland to the edge of the floodplain, typically occurring along the transitional vegetation community, may contribute to the anaerobic soil conditions within the transition communities, the Baygall, and the hardwood swamp and promote organic soil development (Lindbo and Richardson 2001).

Table 13. Soil profile descriptions for Transect 3, Lake Melrose

Uplands
Station 10—Zolfo sand
A1; 0–1 in. Sand (medium) 10YR 3/1 30% csg, m1-2 roots
A2; 1–6 in. Sand (medium) 10YR 4/1 f2 roots
E1; 6–11 in. Sand (medium) 10YR 5/2 f2 roots
E2; 11–21 in. Sand (medium) 10YR 6/3
E3; 21–30 in. Sand (medium) 10YR 7/2
E4; 30–43 in. Sand (medium) 10YR 7/1
E5; 43–55 in. Sand (medium) 10YR 6/2
Bh; 55–60 in. Sand (medium) 10YR 3/2
Transition #1
Station 50
Hydric Indicator S7 (Dark Surface)
0–4 in. Sand (medium) 10YR 2/1 70% csg, c1 roots
4–9 in. Sand (medium) 10YR 3/1 30% csg
9–12 in. Sand (medium) 10YR 4/2 c2, 10YR 5/2 pockets
Station 60
Hydric Indicator A8 (Muck Presence), A7 (5 cm Mucky Mineral)
0–3 in. Muck (Sapric) 7.5YR 2.5/2 mi roots
3–6 in. Mucky sand 10YR 2.1 f1 roots
6–10 in. Sand (medium) 10YR 2/1
10–15 in. Sand (medium) 10YR 3/1
Station 70—start A2 (histic epipedon)
Hydric Indicator A2 (Histic Epipedon)
0–8 in. Muck (Sapric) 10YR 2/1
8–10 in. Mucky sand 10YR 2/1
Station 80—Samsula muck
Hydric Indicator A2 (Histic Epipedon)
Oa1; 0–4 in. Muck (Sapric) 10YR 2/1 m1 roots
Oa2; 4–15 in. Muck (Sapric) 10YR 2/1 f1 roots
C1; 15–18 in. Mucky sand 10YR 2/1
C2; 18–30 in. Sand (medium) 10YR 3/2

Baygall
Station 120—Hontoon muck
Hydric Indicator A1 (Histosol)
Oa1; 0–10 in. Muck (Sapric) 10YR 2/1 m1-3 roots
Oa2; 10–35 in. Muck (Sapric) 10YR 2/1 f3 roots
Oa3; 35–51 in. Muck (Sapric) 10YR 2/1
Station 140
Hydric Indicator A2 (Histic Epipedon), probably A1 (Histosol)
0–8 in. Muck (Sapric) 10YR 2/1 m1-4 roots, might have deeper muck, stopped by roots
Station 170—Samsula muck
Hydric Indicator A1 (Histosol)
Oa1; 0–6 in. Muck (Sapric) 10YR 2/1 m1 roots
Oa2; 6–49 in. Muck (Sapric) 10YR 2/1 c3 soft wood fragments
C; 49–51 in. Sand (medium) 10YR 3/1
Hardwood Swamp
Station 300—Hontoon muck
Hydric Indicator A1 Histosol
Oa;1 0–8 in. Muck (Sapric) 10YR 2/1 m1 roots
Oa2; 8–30 in. Muck (Sapric) 10YR 2/1 f1-2 roots
Oa3; 30–60 in. Muck (Sapric) 10YR 2/1 c3 wood fragments; f3 roots
Station 400—Hontoon muck
Hydric Indicator A1 (Histosol)
Oe; 0–20 in. Mucky peat (Hemic) 7.5YR 2.5/2 m2-4 roots
Oa; 20–55 in. Muck (Sapric) 10YR 2/1 low bulk density; m2-4 roots
C; 55–56 in. Sand (medium) 10YR 3/1
Station 440
Hydric indicator A1 (Histosol)
0–6 in. Muck (Sapric) 10YR 2/1 m1 roots
6–12 in. Muck (Sapric) 10YR 2/1 c1 roots
12–45 in. Muck (Sapric) 10YR 2/1 f3 roots
45–60 in. Mucky peat (Hemic) 7.5YR 2.5/2
Floating Marsh
Station 470
Hydric indicator A1 (Histosol)
0–10 in. Muck (Sapric) 10YR 2/1 Floating mat; m1 roots
10–60 in. Muck (Hemic) 7.5YR 2.5/2 c3 roots; soft wood fragment

STRUCTURAL ALTERATIONS AND OTHER CHANGES

No significant structural alterations exist in the Lake Melrose Basin (Robison 2011, draft). Minor alterations include a culvert connecting Lake Melrose to Mills Creek (see Figure 3).

RELEVANT ENVIRONMENTAL VALUES IDENTIFIED IN RULE 62-40.473, *FLORIDA ADMINISTRATIVE CODE (F.A.C.)*

Based on screening analysis (see Table 1), the following environmental values (Rule 62-40.473, *F.A.C.*) were determined to be relevant to identify the limiting conditions for MFLs development for Lake Melrose:

1. Recreation in and on the water
2. Fish and wildlife habitats and the passage of fish
3. Transfer of detrital material
4. Maintenance of freshwater storage and supply
5. Aesthetic and scenic attributes
6. Filtration and absorption of nutrients and other pollutants
7. Water quality
8. Navigation

The following environmental values were determined not relevant to identifying the limiting conditions for MFLs development for Lake Melrose:

- Estuarine resources. This environmental value is not relevant because the Lower St. Johns River estuary is far downstream from Lake Melrose (the lake is landlocked and has no surface water connection to any estuarine resources).
- Sediment loads. This environmental value is not relevant to establishing MFLs for Lake Melrose. Transport of inorganic materials as bed load is considered relevant only in flowing systems, where riverine fluvial dynamics are critical to the maintenance of geomorphic features (i.e., bed forms and the floodplain) and their associated ecological communities. These functions are not operating in lake systems. Lakes serve as sinks instead of sources of sediment load.

The environmental value “fish and wildlife habitats and the passage of fish” was determined to be the most limiting environmental value to the further development of consumptive uses of surface and/or regional groundwater and is the primary criterion on which the Lake Melrose MFLs were developed.

MINIMUM LEVELS DETERMINATION CRITERIA

Recommended, reevaluated minimum levels for Lake Melrose are based on the concept that if the essential characteristics of the natural flooding and drying regime are maintained, then the basic structure and functions of the environmental system will be maintained. Each recommended minimum level is based primarily on elevation, soil, and vegetation community data collected in the Lake Melrose floodplain. The elevations of the wetland communities can be associated with the long-term lake stage record, where durations and frequencies of flooding and drying are known. These wetland community elevations can be applied toward the development of recommended minimum levels. The standardized procedures for setting each level, using the best available information as described in detail in the draft *Minimum Flows and Levels Methods Manual* (SJRWMD 2006, draft) and the MFLs method paper (Neubauer et al. 2008), were followed as the basis of developing the recommended minimum levels for Lake Melrose. Minimum level criteria vary depending on the level being determined and the type of wetlands adjacent to the water body. For example, an FH, MA, and FL might be determined for a system with stable, seasonally flooded wetland communities and deep (>8 in.) organic soils, like Lake Melrose.

The primary FH criterion typically equals the average elevation of a wetland community that experiences flooding approximately 20% of the time based on the scientific literature and hydrologic data. Additional FH criteria may include the maximum elevation of a vegetation community that floods frequently and/or the elevation equal to the landward extent of the hydric soils or the landward extent of a shallow (depth < 8 in.) surface organic soil. The FH level should maintain the seasonal flooding regime. Seasonal high water flows or levels occur in natural systems with unaltered hydrology that provide for out-of-bank flooding of the wetlands adjacent to the main stem of a river or lake at a duration and return interval sufficient to support important ecological processes (Hill et al. 1991). Levels equal to the FH level should occur for at least 30 continuous days in the growing season at least every 2 to 3 years, on average. Aquatic biota relies on inundation of the floodplain for habitat and the exchange of nutrients and organic matter (McArthur 1989). Flooding of wetlands and upland fringes redistributes and concentrates organic particulates across the floodplain (Junk et al. 1989).

At Lake Melrose, the primary recommended FH level criterion equaled the average of the hardwood swamp ground elevations at Transects 1 (stations 140–920) and 2 (stations 90–310) as surveyed in 2011. This level will ensure inundation of at least half of these hardwood swamps and thus prevent a shift of upland vegetation into the hardwood swamps. In addition, soil sampling indicated consistent deep organic soils across the hardwood swamps at Transects 1 and 2. These organic soil depths indicate that frequent and prolonged saturation or inundation is typical within the hardwood swamps at Transects 1and 2.

The MA level represents the surface water level necessary over a long period to maintain the integrity of hydric soils and wetland plant communities. This level is considered the minimum that must be sustained for extended periods to maintain floodplain organic soils. The MA level determination criteria typically focus on soil characteristics when extensive Histosols or histic epipedon are sampled. Low water levels for extended periods cause oxidation of organic soils, ultimately resulting in soil subsidence. Consequently, due to the extensive deep organic soils identified at Lake Melrose, the primary MA level criterion for Lake Melrose equaled a 0.3-ft soil water table drawdown from the average soil surface elevation of the deep organic soils observed in the hardwood swamps and shrub swamps at Lake Melrose Transects 1 (stations 80–920) and 2 (stations 90–340). Deep organic soils are Histosols (surface organic horizon ≥16-in. thick)) or soils with histic epipedon (surface organic horizon 8 to 16-in. thick). Deep organic soils are indicative of long-term soil saturation or inundation. The 0.3-ft drawdown will ensure saturated soil conditions, thereby preventing soil oxidation in the deep organic soils observed at Lake Melrose.

This MA level criterion (0.3 ft below mean surface elevation of deep organic soils) has been used to protect muck soils in other MFLs determinations where extensive organic soils were sampled and was developed for Everglades peat soils (Stephens 1974). Studies of marshes in the Upper St. Johns River Basin (Brooks and Lowe 1984; Hall 1987) determined that this 0.3-ft depth corresponds to a water level exceeded approximately 60% of the time. Studies of the Wekiva River system found this hydrologic condition can also be expressed as the low stage, occurring, on average, every 1 to 2 years, with a duration of less than or equal to 180 days (Hupalo et al. 1994).

When the Lake Melrose stage equals the MA level, soil saturation at the average elevation of the deep organic soils sampled in the hardwood swamps and shrub swamps will impede the invasion of upland plant species into these wetlands and prevent organic soil oxidation. Meanwhile, shallow inundation at the lower elevations of the shrub swamps will provide aquatic refugia for numerous small fish, amphibians, and small reptiles. Also, the shallow water depths are ideal for wading bird foraging. Wading birds can only forage in relatively shallow water. Great egrets need water depths of less than 10 in., and the small herons need depths of less than 6 in. Declining water levels cause fish to be concentrated in isolated pools throughout the shrub swamps and birds effectively exploit these concentrations (Bancroft et al. 1990).

FL level criteria also typically focus on soil characteristics if extensive Histosols or histic epipedon were sampled. If deep (≥8 in. thick) continuous surface organic soils occur, the FL level is based on a soil water table drawdown of 10 to 30-in. from the average surface elevation of the deep organic soils. This drawdown criterion was based on the best available supporting information from the literature, including the soil surveys for Volusia and Brevard counties (USDA, SCS 1980; and USDA, SCS 1974, respectively), which describe typical drought organic soils water table depths at 10 to 30 in. below the soil surface. In addition, water table depths that described seasonally flooded marsh systems' average minimum dry season water table depth of 15.6 to 26.2 in. with an average hydroperiod of 255 ±11.1 days (ESE 1991).

The primary reevaluated FL level criterion for Lake Melrose was a 10-in. soil water table drawdown from the average soil surface elevation of the deep organic soils observed in 2011 at Transects 1 and 2 (stations 80–920 and 90–340, respectively) at Lake Melrose. Hontoon, Samsula, and Sanibel mucks were the common deep organic soils sampled at Lake Melrose, and the typical dry season water table levels as described by the NRCS were notably high/wet (NRCS 2012). Additionally, Lake Melrose stage is markedly stable with typical water level fluctuations of less than 1.0 ft. Consequently, the recommended FL level criterion of a 10-in. soil water table drawdown, rather than a 20 or 30 in. drawdown, was appropriate.

MINIMUM LEVELS REEVALUATION FOR LAKE MELROSE

Minimum Frequent High (FH) Level

FH is defined as "…. a chronically high surface water level with an associated frequency and duration that allows for inundation of the floodplain at a depth and duration sufficient to maintain wetland functions" (Rule 40C-8.021(8), *F.A.C.*).

The goal/criterion of protection for the recommended FH level for Lake Melrose (103.6 ft NAVD, 30-day duration, 3-year return interval) is focused on the most sensitive environmental value, "fish and wildlife habitats and the passage of fish" (see Table 1). This environmental value can be addressed through maintaining the location of the ecotone between the hardwood swamps and the transitional wetland communities located at higher elevations of the floodplain. The FH level serves to prevent a permanent downhill shift in these communities and a consequent loss in the areal extent of hardwood swamp. That is, withdrawals should not cause a net downhill shift of uplands, resulting in a loss of lake area. The location of the upland ecotone and the adjacent transitional zone is maintained by frequent flooding events at a ground elevation that must be continuously exceeded for a sufficient duration to kill upland plant species that grow downslope during periods of low water levels.

The general indicator of protection is that the gradient of wetland communities across the lake floodplain be saturated or inundated frequently enough to maintain the wetland species composition, vegetative structure, and associated ecological functions associated with the seasonally flooded wetland communities. This corresponds to a continuous high water level event typically associated with extended periods of normal or above-normal rainfall.

The specific indicator of protection is a high water level that corresponds to the average ground elevation of hardwood swamp #1 at Transect 1 and the hardwood swamp at Transect 2 (103.6 ft NAVD) (Table 14). This elevation provides saturation in transitional wetland communities and hardwood swamps located at higher floodplain elevations and complete inundation at the lower elevations of hardwood swamps and all other lower elevation wetland communities at Lake Melrose.

The recommended FH level for Lake Melrose represents a high-water event with a sufficient period of soil saturation or inundation that recurs often enough to maintain the species composition and vegetative structural development of the seasonally flooded wetland communities and the characteristics and ecological functions of the hydric soils in the Lake Melrose floodplain.

Table 14. Hardwood swamp and soils statistics for Lake Melrose transects

Vegetation Community	Transect No.	Station Distance (ft)	Elevation (ft NAVD)		
			Average	Median	Minimum
Hardwood swamp #1	1	140–920	103.7	103.6	103.2
Hardwood swamp	2	90–310	103.6	103.7	102.7
Hardwood swamp #1 and Hardwood swamp	1 and 2	140–920 90–310	103.6	103.6	102.7
Hardwood swamps #1 and #2	1	140–1210	103.9	103.8	103.2
Hardwood swamp	3	270–445	104.3	104.4	102.8
Hardwood swamp #2	1	920–1210	104.5	104.6	103.8
Deep organic soils	1	80–1280	103.8	103.8	98.7
Deep organic soils	2	90–340	103.4	103.6	100.4
All hardwood swamps	1-3		103.9	103.8	102.7
All deep organic soils	1-3		103.9	103.9	98.7

Rationale for Criteria and Indicators of Protection

Magnitude Component

The FH level was calculated by taking the average ground elevation of hardwood swamp #1 at Transect 1 and the hardwood swamp at Transect 2 (see Table 14). The rationale for the specific indicator of protection for the FH level at Lake Melrose is based on studies indicating that hardwood swamps are typically seasonally flooded (Mitsch and Gosselink 2000; Ewel 1990; Monk 1968). The following sections discuss the major ecological functions provided by the recommended FH elevation component of 103.6 ft NAVD. The discussion is organized according to the following major topic areas:

- Maintenance of Hardwood Swamp Vegetation Composition and Structure
- Maintenance of Fish and Wildlife Habitat

Maintenance of Hardwood Swamp Vegetation Composition and Structure. The inundation of the Lake Melrose hardwood swamp communities to an elevation of 103.6 ft NAVD will promote inundation and/or saturation conditions sufficient to support hydrophytic (i.e., obligate, facultative wet, and facultative) plant species within the Lake Melrose hardwood swamps and adjacent wetlands. An appropriate normal high water level is also necessary to conserve the nature and ecological functions (e.g., denitrification) of the hydric soils within the floodplain wetland communities (Hill et al. 1991).

Swamps are naturally subjected to high water table levels, soil saturation, and periodic and/or continuous flooding at various times of the year. The relative duration and level of flooding plays a key and often critical role in the occurrence and growth rate of tree species and other plants from seed germination, early seedling growth and survival, and later tree growth. The resulting anaerobic soil condition within the wetland communities favors hydrophytic vegetation, tolerant of longer periods of soil saturation and flooding, and mortality of young upland (flood-intolerant) plant species that may have become established during low water events (CH2M HILL 2005). Seedlings of different species exhibit different levels or tolerance to soil saturation or shallow flooding. Water tupelo (*Nyssa aquatica*), ash (*Fraxinus* sp.), and willow are very tolerant while oaks, American elm (*Ulmus americana*), sweetgum, and hackberry (*Celtis occidentalis*) are intolerant (Hosner and Boyce 1962; McAlpine 1961). These flood tolerant characteristics in seedlings are often the factor determining occurrence of a given species at a given site.

Soil inundation sets in motion a variety of physical, chemical, and biological processes that alter the capacity of soils to support plant growth (Gill 1970). Soil inundation/saturation induced physiological dysfunctions in plants include the depletion of soil oxygen in the roots, which eventually shuts down respiration in root cells. As respiration ceases, water and ion uptake is inhibited by changing membrane permeabilities in the root cells, affecting movement of both water and ions, and by reducing the amount of energy available for membrane transport, affecting primarily ion movement (Wharton et al. 1982). The inability of flood-intolerant species to absorb and use water and nutrients leads to foliar water deficits, stomatal closure, and reduced gas exchange. Consequently, transpiration and photosynthesis rates are slowed, cellular synthesis requiring unavailable nutrients is curtailed, and overall plant growth is impeded. The plants literally die of dehydration in standing water (Wharton et al. 1982).

Major soil chemical changes due to wetland inundation/saturation include decrease in or depletion of oxygen, accumulation of carbon dioxide, increased solubility of mineral substances, reduction of iron and manganese, and anaerobic decomposition of organic matter (Ponnamperuma 1972, 1984). In addition, many potential toxic compounds accumulate in flooded soils. Some of these compounds (e.g., sulfides, carbon dioxide, soluble iron, and manganese) are produced in waterlogged soils (Kozlowski 1997). Other compounds (e.g., ethanol, acetaldehyde, and cyanogenic compounds) are produced by roots (Rowe and Catlin 1971). Observations suggest that mature, vigorous individuals suffer less flooding damage than either seedlings or over-mature specimens of the same species. Species differ remarkably in their resistance to flooding (Gill 1970).

The hardwood swamps at Lake Melrose are extensive, mature wetland communities located downslope from a transition community. Obligate and facultative wet plants (Tables 4, 8, and 12) were prevalent within these transects. Frequent flooding to the average elevation of hardwood swamp #1 at Transect 1 (stations 140–920; 103.7 ft NAVD) and the hardwood swamp in Transect 2 (stations 90–310; 103.6 ft NAVD) should maintain the organic soils and plant community structure and composition if flooding occurs for at least 30 continuous days in the growing season with a return interval of at least every 3 years, as provided by the recommended FH level of 103.6 ft NAVD.

<u>Maintenance of Fish and Wildlife Habitat</u>. The inundation of the Lake Melrose hardwood swamp and shrub swamp communities to an elevation of 103.6 ft NAVD greatly expands the aquatic habitat, providing sufficient water depths for fish and other aquatic organisms to feed and spawn on the lake floodplain. Surface water connections to the floodplain are important to animal productivity and fecundity (Bain 1990; Poff et al. 1997). The life cycles of many fish are related to seasonal water level fluctuations, particularly the annual flood pattern (Guillory 1979). The floodplain provides feeding and spawning habitat (Guillory 1979; Ross and Baker 1983), refugia for juvenile fishes (Finger and Stewart 1987), and sources of food for many organisms (Brown et al. 1979; Wharton and Brinson 1979). Inundation periods encompassing peak spawning periods can potentially enhance fish diversity and production (Knight et al. 1991). Large areas of the floodplain are inundated when water levels increase, and the amount of vegetative structure available to aquatic organisms increases (Light et al. 1998). High primary and secondary productivity result because of nutrient pulses from floodwaters and the decomposition of dead litter and other inundated allochthonous materials (Crow and McDonald 1978; Wharton et al. 1982). The FH water level may be exceeded during wet years and may not occur during dry years; most aquatic fauna are adapted to year-to-year variation of the natural hydrologic regime. However, MFLs should result in defining the minimum number of flooding events and maximum number of dewatering events to safeguard this and other protection criteria.

Hardwood swamp #2 at Transect 1 and the hardwood swamp at Transect 3 were omitted from the elevation calculations to determine the FH level because both occur at higher elevations and likely receive significant groundwater seepage, which provides wet soil conditions with less frequent inundation from the Lake. These hardwood swamps, which extend to greater elevations and, in the case of hardwood swamp #2 at Transect 1, occur a considerable distance from the Lake, are typical of perched ridge lakes such as Lake Melrose and Lake Norris, which have low leakage to the aquifer, low inflow, and high surface water outflow (Epting et al. 2008). Additionally, groundwater discharge from the upland to the edge of the floodplain, which typically occurs along the transitional vegetation community, may contribute to the anaerobic soil conditions within the transitional community and higher hardwood swamp elevations, promote organic soil development, and maintain the hardwood swamp vegetation (Lindbo and Richardson 2001).

Additional considerations included in the FH level determination were that the recommended FH level of 103.6 ft NAVD is very similar to the average elevations of the deep organic soils sampled at Transect 1 (103.8 ft NAVD) and Transect 2 (103.4 ft NAVD) and the average of all hardwood swamp elevation points (103.9 ft NAVD) (see Table 14). Other elevations typically examined when determining the FH level include the landward extent of the hydric soils and the landward extent of organic soil. At Lake Melrose the landward extent of the hydric soil indicator of Histosol (organic soil) was observed in the transitional zone at station 1290 near the landward end of Transect 1 (elevation 105.5 ft NAVD; see Figure 12). Transect 1 terminated at station 1300 due to the close proximity of a residential dwelling and the possibility of fill material and/or sand deposition. At Transect 2 the landward extent of the hydric soil indicator histic epipedon, indicative of organic soil, was observed at station 90, which coincided with the transition—hardwood swamp ecotone (elevation 104.0 ft NAVD; see Figure 14). The hydric soil indicators observed across the hardwood swamps and upslope in the transition vegetation communities at Lake Melrose are indicators of frequent inundation and/or soil saturation.

Duration Component

The recommended FH level duration component (30-day continuous inundation) shows seasonally flooded hardwood swamps are inundated for 1 to 2 months during the growing season (Mitsch and Gosselink 1993). A 30-day continuous flooding event represents a sufficient period of soil saturation or inundation needed to protect the structure and functions of seasonally flooded wetland plant communities (Hill et al. 1991). The life cycles of many fishes are related to seasonal water level fluctuations, particularly annual flood patterns (Guillory 1979). Several months of flooding should be provided to ensure fish access to the floodplain and ensure nesting success (Knight et al. 1991). The 30-day flooding duration at the target elevation of 103.6 ft NAVD will result in lower hardwood swamp elevations experiencing longer flooding conditions. Therefore, the 30-day duration allows the majority of the floodplain habitat at Lake Melrose to be used by fish and other aquatic fauna to feed, reproduce, and/or use the available floodplain habitat for refuge.

In addition, the 30-day flooding duration is sufficient to cause the mortality of young upland plant species that have become established in the hardwood swamps during low water events, maintaining the hydrophytic structure and diversity (Ahlgren and Hansen

1957; Menges and Marks 2008). Research shows that abundant hypertrophied lenticels and adventitious roots develop in loblolly pine (*Pinus taeda*) and pond pine (*Pinus serotina*) after 30 continuous days of anaerobic conditions (Topa and McLeod 1986).

The 30-day flooding duration roughly corresponds to the durations of saturation that defines the upper boundaries of many wetlands. From a regulatory standpoint, the U.S. Army Corps of Engineers (USACE) uses durations of saturation between 5% and 12.5% of the growing season in most years as the standard in their wetland delineation manual (USACE 1987). Given the year-round growing season in Florida, this corresponds to durations of 18 to 46 days. However, the National Research Council (NRC 1995) has recommended a shorter duration hydroperiod to define wetland hydrology: saturation within 1 ft of the soil surface for a duration of 2 weeks (14 days) or more during the growing season in most years. This shorter duration hydroperiod may approximate the hydrology of the transitional wetland communities located upslope of the hardwood swamps along much of the Lake Melrose floodplain.

Return Interval Component

The FH event defines a high surface water level and/or flow that typically occurs during wet seasons with periods of normal or above-normal rainfall. These flooding events usually occur for short durations with relatively short return intervals between flooding events. The FH is typically associated with the seasonally flooded hydroperiod category (Rule 40C-8.021(17), *F.A.C.*) "…where surface water is present or the substrate is flooded for brief periods (up to several weeks) approximately every one to two years."

Based on results from a number of lakes in SJRWMD, FH level events are estimated to reoccur at least 1 in every 3 years for 30 or more consecutive days, on average. Modeling results for Lake Melrose (Figure 18; CDM 2005) indicate that the recommended FH level results in a change in the return interval of this wet season event from an event that currently occurs with allocated water use, on average, every 2.8 years (36 times in 100 years) to an event that would occur, on average, every 3 years (33 times in 100 years) while maintaining a 30-day duration at a stage of 103.6 ft NAVD.

The recommended FH return interval was supported by the current surface water dewatering and inundation signatures (SWIDS) analysis of 12 lakes with hardwood swamps in SJRWMD (Figure 19; unpublished data, method according to Neubauer et al. 2004; Neubauer et al. 2007, draft). The recommended duration (30 days) and return interval (once every 3 years) associated with the FH level at Lake Melrose allows flooding to occur at a similar frequency and duration to the hydrologic signature of the 12 lakes studied. This illustrates that application of the criterion allows for hydrologic change while maintaining a natural signature that is within thehydrologic range for the hardwood swamp communities and associated floodplain structures and functions specific to Lake Melrose.

The recommended return interval is expected to maintain the location of the ecotone between the hardwood swamps and the upland or transitional communities at higher elevations and is not expected to cause a permanent downhill shift of upslope communities (e.g., uplands and transitional). That is, withdrawals should not cause a net downhill shift of uplands and result in a loss of lake area.

Recommended Frequent High (FH) Level

The recommended FH level for Lake Melrose (103.6 ft NAVD) (Table 15) with an associated 30-day continuously exceeded (flooded) duration at a return interval of at least every 3 years (33 flooding events per century) defines an ecological threshold that is achieved under existing basin conditions (i.e., existing land use/land cover and regional groundwater withdrawals) and allows for a relatively small change in the existing condition. The location, structure, and functions of seasonally flooded wetland plant communities adjacent to Lake Melrose will be protected if these conditions occur.

Table 15. Primary criteria for adopted and recommended minimum frequent high (FH) levels

FH Levels	Elevation (ft NAVD) 1988 Datum	Hydroperiod Categories; Duration and Return Interval	Criteria
Adopted	104.1	Seasonally flooded	Corresponds to the average elevation of the mixed swamp at Transect 2 (Appendix A)
Recommended	103.6	30-day duration; 3-year return interval	Corresponds to the average elevation of hardwood swamp #1 at Transect 1 (stations 140–920) and the hardwood swamp at Transect 2 (stations 90–310)

Minimum Average (MA) Level

MA is defined as "…..the surface water level necessary over a long period to maintain the integrity of hydric soils and wetland plant communities" (Rule 40C-8.021(8), *F.A.C.*).

The goal/criterion of protection for the recommended MA level for Lake Melrose is to protect the deep organic soils (i.e., ≥8 in. thick organic layer within the top 32 in. of the soil) located in the hardwood swamps from oxidation and subsidence. The MA level approximates a typical lake stage (i.e., elevation component) that is slightly less than the long-term median stage. The MA level corresponds to a low water level event typically associated with the dry season of typical years.

The general indicator of protection for the MA level is that deep organic soils across the lake floodplain be saturated or inundated (i.e., shallow ponding) frequently enough to maintain soil structure and associated ecological functions, such as nutrient assimilation and denitrification. At the MA level, soils may be exposed during nonflooding periods of typical years, but the substrate usually remains saturated. The MA level corresponds to a water level that is expected to recur, on average, every 1 to 2 years for approximately 6 months during the dry season (Chapter 40C-8.021(15), *F.A.C.*).

The specific indicator of protection is a water level that equals a 0.3-ft water table drawdown from the average ground surface elevation of the deep organic soils surveyed in hardwood swamp #1 and shrub swamps Transects 1 (stations 80–920) and 2 (stations 90–340). As mentioned previously, deep organic soils are Histosols (>16 in. thick surface organic horizon) or soils with a histic epipedon (8–16 in. thick surface organic horizon). At the MA level, substrates may be exposed during non-flooding periods of typical years, but the substrate remains saturated and loss of organic soils is prevented. Achieving the specific indicator of protection at an appropriate duration and frequency should maintain hydrologic conditions that protect the deep organic soils within the seasonally flooded wetlands from oxidation and subsidence.

The recommended MA level for Lake Melrose is a low water level event at 103.1 ft NAVD with an associated 180-day mean nonexceedence (dewatered) duration at a return interval no more often than once every 1.7 years, on average. This ecological threshold represents a sufficient period of soil saturation or inundation that recurs often enough to maintain the structure and ecological functions of seasonally flooded organic soils.

Rationale for Criteria and Indicators of Protection

Magnitude Component

The recommended MA level was calculated by subtracting 0.3 ft from the average ground surface elevation of the deep organic soils. Wetlands soils play an important role in global biogeochemical cycles, particularly as reservoirs of carbon (Mitsch and Gosselink 1993). Of particular concern is the decomposition of soil organic matter (loss of soil carbon) that occurs when wetland soils are drained or sufficiently hydrologically altered, resulting in a lowered wetland surface elevations (i.e., subsidence). Soil subsidence is a function of two processes termed primary and secondary subsidence (Stephens 1984; Ewing and Vepraskas 2006). Primary subsidence results from loss of soil buoyancy provided by soil pore water. Once pore water leaves the soil, the support it provided to the overlying soil particles is lost. When air fills these pore spaces, the soil compacts under its own weight. Secondary subsidence is caused by the direct oxidation of the soil organic carbon to inorganic carbon, which may be lost to the atmosphere as carbon dioxide and methane emissions (Ewing and Vepraskas 2006; Parent et al. 1977). In addition, aerobic soil decomposition can also lead to the release of inorganic nutrients (e.g., nitrogen and phosphorus), metals, and toxic materials that might otherwise remain sequestered in the soil under flooded (anaerobic) conditions (Reddy and DeLaune 2008; Osborne et al. 2011).

Soil organic matter in wetlands provides long-term nutrient storage for plant growth. Accumulation of soil organic carbon is a function of the balance between primary productivity and decomposition. When wetland primary productivity exceeds decomposition and erosion rates, soil organic matter accumulates by the stratified buildup of partially decomposed plant remains (Reddy and DeLaune 2008). Soil organic matter produces dissolved organic carbon to support aquatic systems. It is also a source of exchange capacity for cations in soils, and the large surface area of organic colloids present in organic soils plays an important role in the bioavailability of various metals and toxins in wetlands (Reddy and DeLaune 2008).

An appropriate mean nonexceedence water level event is necessary to conserve the hydric nature and the ecological functions of the floodplain organic soils. The presence of deep organic soils (≥8 in. thick, histic epipedon and Histosols) are indicative of long-term soil saturation or inundation (Hurt and Vasilas 2010). Stephens (1974) reported that the oxidation and subsidence of Everglades peat soils occurred when the long-term average elevation of the water table was greater than 0.3 ft. below the soil surface. The 0.3-ft organic soil drawdown criterion is also supported by studies in organic soils in the Blue Cypress Water Management area in the Upper St. Johns River Basin (Reddy et al. 2006). Field and laboratory experiments suggested that the top 0.3 ft is the most reactive (i.e., labile) soil area with respect to microbial oxidation. Therefore, this layer of reactive soil is most susceptible to oxidation and requires protection (Reddy et al. 2006). Where deep organic soils are observed, a 0.3-ft organic soil water table drawdown criterion is typically employed when developing the MA level (Mace 2006, 2007).

An important factor to be considered in the protection of organic soils from oxidation is the action of the capillary fringe. The capillary fringe is the subsurface soil layer in which groundwater is wicked up from a water table by capillary action to fill pores in the soil, contributing to saturation of soils and anaerobic conditions above the water table elevation (Ponnamperuma 1972; Reddy et al. 2006). Soil scientists locate the capillary fringe by measuring the redox potentials in soils. Low redox potentials (200 to -400 millivolts [mV]) are associated with reduced, anaerobic submerged soils; aerobic soils have redox potentials of about 300 to 800 mV (Ponnamperuma 1972). Reddy et al. (2006) measured redox potentials *in situ* in organic soils of the upper St. Johns River marsh, as well as in soil cores subjected to lowered water tables in the laboratory. The capillary fringe extended +5 to +10 centimeters (cm; 0.2 to 0.3 ft) above the static water level. Deeper water table depths (e.g., -30 cm [-1 ft]) had the greatest rise (+10 cm [0.3 ft]) in the capillary fringe (Reddy et al. 2006). Thus, the action of the capillary fringe could significantly affect the rates of organic soil oxidation and, therefore, reduce the net oxidation during seasonal drawdowns (Reddy et al. 2006).

The recommended MA level of 103.1 ft NAVD at Lake Melrose provides saturated soil conditions across the majority of the lake floodplain where deep organic soils were sampled. Additionally, shallow ponding will occur in the shrub swamps, providing aquatic refugia for numerous small fish, amphibians, and small reptiles. Aquatic habitats connected to the open water of Lake Melrose are of crucial importance to fishes and invertebrates of the floodplain.

Similar to the FH hardwood swamp elevation criteria, the deep organic soils at Transect 3 and Transect 1 upslope of station 920 were excluded from the MA level calculations because both occur at higher elevations and likely receive significant groundwater seepage, which provides wet soil conditions with less frequent inundation from the Lake. Transect 1 also occurs a considerable distance from the lake. Additionally, groundwater discharge from the upland to the edge of the floodplain, which typically occurs along the transitional vegetation community, may contribute to the anaerobic soil conditions within the transitional community and higher hardwood swamp elevations, promote organic soil development, and maintain the organic soils and wetland vegetation (Lindbo and Richardson 2001).

Duration Component

The recommended 180-day mean nonexceedence duration is supported by the flooding and dewatering characteristics described by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Official Soil Series Descriptions website (NRCS 2012) for the organic soils identified in the Lake Melrose floodplain (i.e., Brighton, Sanibel, Samsula, Hontoon, and Ocoee [Freese 2012]). These organic soils typically have a water table at or above the soil surface for 6 to 9 months in most years, and the water table is seldom below a depth of 10 in. except during extended dry periods.

The hydrologic regime defined by the 180-day mean nonexceedence duration will typically allow for numerous, short duration alternating aerobic/anaerobic conditions of the organic soil surface elevation. Field and laboratory experiments in organic soils of the Upper St. Johns River Basin indicated that shorter duration dewatering (alternating aerobic and anaerobic conditions) events are less likely to result in oxidation of organic matter, probably due to the wicking action of the capillary fringe in these soils (Reddy et al. 2006). Additionally, wetland soils are a medium for denitrification, a process important in maintaining aquatic/wetland water quality. The denitrification process is most effective in wetlands that are subject to alternating aerobic and anaerobic conditions because the aerobic conditions allow conversion of ammonium to nitrate (nitrification), which is then subject to denitrification (Payne 1981; Reddy and DeLaune 2008).

The 180-day mean nonexceedence duration will also maintain wetland communities by a combination of inundation and dewatering. Studies of marshes in the Upper St. Johns River Basin (Brooks and Lowe 1984; Hall 1987) determined that the elevation corresponding to the 0.3 ft organic soil water table drawdown criterion had a hydroperiod of approximately 219 days. Studies of the Wekiva River system found this hydrologic condition can also be expressed as the low stage occurring on average every 2 years (i.e., 50 events per century) with a duration of less than or equal to 180 days (Hupalo et al. 1994).

In a baseline study from Water Conservation Area 3A of the Everglades, Zafke (1983) reported that sawgrass, a species that generally occurs on organic soils, tolerated annual durations of inundation ranging from 15% to 94% (approximately 55 to 343 days, respectively). Similarly, Sincock (1958) noted that sawgrass in the Upper St. Johns River Basin usually occurred where there was an annual duration of saturation of 45% (approximately 164 days). These data suggest that organic soils may form under widely ranging durations of saturation. The average of the annual range provided by Zafke (1983) is 54%, approximately equal to the 180-day annual duration specified for the MA level at Lake Melrose.

Return Interval Component

The MA event defines a low surface water level and/or flow that usually occurs during normal dry seasons. These dewatering events typically occur for long durations with short return intervals between dewatering events. Such low water events are important to protect deep muck soils from losses caused by oxidation and subsidence. The MA is usually associated with the typically saturated hydroperiod category defined below:

> …where for extended periods of the year the water level should saturate or inundate. This results in saturated substrates for periods of one-half year or more during non-flooding periods of typical years. Water levels causing inundation are expected to occur fifty to sixty per cent of the time over a long term period of record. This water level is expected to have a recurrence interval, on the average, of one or two years over a long term period of record (Rule 40C-8.021(18), *F.A.C.*).

The MA level approximates a typical lake stage that is slightly less than the long-term median stage while still protecting the wetland resources. Modeling results for Lake Melrose (Figure 20; CDM 2005) indicate that the recommended MA level results in a change in the return interval of this dry-season event from an event that currently occurs with allocated water use, on average, every 1.9 years (53 times in 100 years) to an event that would occur, on average, every 1.7 years (59 times in 100 years) while maintaining a 180-day duration at a stage of 103.1 ft NAVD.

The recommended MA level is supported by the current SWIDS analysis of the mean elevation of deep organic soils minus 0.3 ft (Neubauer et al. 2004; Neubauer et al. 2007, draft), which was completed at 21 unique locations. The distribution of hydrologic signatures for the annual average nonexceedence elevation for selected durations is summarized in Figure 21. At Lake Melrose, the mean elevation of the deep organic soils minus 0.3 ft has an annual average nonexceedence probability of 59% (return interval 1.7

years) for 180 days (see Figure 21). The 59% annual average nonexceedence probability occurs on the SWIDS graph in the “1st quartile”—the driest value for the 180-day duration—for the 21 deep organic soils analyzed (see Figure 21). This illustrates that application of the 0.3 ft drawdown criterion in organic soils allows for the maximum hydrologic change at Lake Melrose while preventing subsidence and oxidation of organic soil material.

The recommended MA return interval allows for some hydrologic change from the existing hydrologic conditions while maintaining a natural hydrologic signature that is within the hydrologic range for the mean elevation of deep organic soils that should protect organic soils at Lake Melrose from oxidation and subsidence. The return interval for the MA event is expected to protect organic substrates and/or the structure and functions of emergent wetland plant communities by causing dewatering but maintaining saturated conditions. The MA return interval is not expected to cause permanent loss of deep organic soils due to oxidation or subsidence in the floodplains at Lake Melrose.

Recommended Minimum Average (MA) Level

The recommended MA level for Lake Melrose is a low water level event at 103.1 ft NAVD (Table 16) with an associated 180-day mean nonexceedence (dewatered) duration at a return interval no more often than once every 1.7 years (i.e., 59 dewatering events per century), on average. This ecological threshold is achieved under existing basin conditions (i.e., existing land use/land cover and regional groundwater withdrawals) and allows for a relatively small change in the existing condition.

Table 16. Primary criteria for adopted and recommended minimum average (MA) levels

MA Levels	Elevation (ft NAVD) 1988 Datum	Hydroperiod Categories; Duration and Return Interval	Criteria
Adopted	103.1	Typically saturated	Equals a 0.25 ft drawdown from the mean elevation of the lowest portions of mixed swamp at Transect 1
Recommended	103.1	180-day duration; 1.7-year return interval	Equals a 0.3 ft drawdown from the mean elevation of deep organic soils in the shrub swamp and hardwood swamp #1 in Transect 1 (stations 80–920) and the hardwood swamp and shrub swamp in Transect 2 (stations 90–340)

Minimum Frequent Low (FL) Level

The FL level is defined as "…..a chronically low surface water level that generally occurs only during periods of reduced rainfall. This level is intended to prevent deleterious effects to the composition and structure of floodplain soils, the species composition and structure of floodplain and instream biotic communities, and the linkage of aquatic and floodplain food webs" (Rule 40C-8.021(11), *F.A.C.*).

The goal/criterion of protection for the recommended FL level for Lake Melrose (102.6 ft NAVD, 120-day duration, 10-year return interval) is to avoid excessive floodplain drawdown while simultaneously allowing seed germination and growth of wetland plants to a sufficient height to survive the next flood event. Other ecological benefits will be achieved, such as compaction of flocculent sediments; microbial breakdown of sediment/detritus with the concomitant release of nutrients and stimulation of primary productivity on the floodplain; and use of the floodplain by upland fauna. This FL level represents a low lake stage that generally occurs only during moderate droughts.

The general indicator of protection for the FL level is to prohibit excessive floodplain drawdown while providing a sufficient period of dewatering to allow wetland plant seeds and propagules to sprout and grow to sufficient heights to survive shallow flooding during subsequent normal, wet season periods. Such conditions will maintain the plant species composition, vegetative structure, and ecological functions associated with the seasonally flooded wetland plant communities.

The specific indicator of protection equals a 10-in. soil water table drawdown from the average soil surface elevation of the deep organic soils observed in 2011-12 at Lake Melrose Transects 1 and 2, stations 80–920 and 90–340, respectively. Hontoon, Samsula and Sanibel mucks were the common deep organic soils sampled at Lake Melrose. The typical dry season, organic soil water table levels for these soils were notably high and wet (NRCS 2012).

The recommended FL level for Lake Melrose should provide a sufficient period of soil dewatering to allow regeneration and maintenance of the floodplain's seasonally flooded wetland plant communities.

The recommended FL level results in a change in the return interval of this dry-season event from an event that currently occurs, on average, every 33 years (3 times in 100 years) to an event that would occur, on average, every 10 years (10 times in 100 years) while maintaining a 120-day duration at a stage of 102.6 ft NAVD (Figure 22). The recommended frequent low level event (stage at or below 102.6 ft NAVD for 120 consecutive days) has occurred twice during the 22-year period of data collection at Lake Melrose.

Rationale for Criteria and Indicators of Protection

Magnitude Component

The recommended FL elevation component of 102.6 ft NAVD was calculated by subtracting 10 in. (0.83 ft) from the average soil surface elevation of the deep organic soils observed in 2011–2012 at Transect 1 (stations 80–920) and Transect 2 (stations 90–340). Typically, where extensive organic soils occur, the FL level criterion is based on an average organic soil water table drawdown of 20 in. (1.67 ft). This is derived from the mean of the range of dry-season water tables (10–30 in.) reported for many organic soils occurring within SJRWMD (USDA, SCS 1974, 1980) and supported from studies of seasonally flooded wetlands (ESE 1991). However, due to the markedly stable hydrologic characteristics of Lake Melrose with typical water level fluctuations of less than 1.0 ft, the primary FL level criterion is a 10-in. (0.83-ft) dry season organic soils water table drawdown from the average ground surface elevation of the deep (≥8 in. thick) organic soils at Lake Melrose Transects 1 and 2, stations 80-920 and 90-340, respectively.

The 10-in. organic soil drawdown depth is derived from the drainage and permeability characteristics described by local county soil surveys (USDA, SCS 1974, 1980) and the USDA NRCS Official Soil Series Descriptions (NRCS 2012) for the organic soils identified in the Lake Melrose floodplain (Hontoon, Sanibel, and Samsula mucks; Freese 2012). Specific organic soil water table descriptions for common organic soils sampled at Lake Melrose follow: from *https://soilseries.sc.egov.usda.gov/OSD*

- Hontoon muck—The water table is at or above the surface of the soil except during extended dry periods.
- Sanibel muck—The water table is at depths of less than 10 in. for 6 to 12 months during most years. Water is above the surface for periods of 2 to 6 months during wet seasons.
- Samsula muck—The water table is at or above the surface of the soil except during extended dry periods.

Additional organic soil water table descriptions include:

> In Tomoka muck, the soil water table is within a depth of 10 in. from the soil surface for 9 to 12 months in most years, and water is frequently above the surface. In dry periods, it is between 10 in. and 30 in. below the soil surface. In Monteverde peat, the water table is within a depth of 10 in. from the soil surface for 9 to 12 months in most years, and water stands on the surface each year for more than 6 months. In dry seasons the water table is lower but seldom falls below a depth of 30 in. *Soil Survey of Brevard County, Florida* (SCS 1974)

> In Gator muck the water table is at or above the soil surface in spring, summer, and fall and is within 10 in. of the soil surface in winter. In Samsula muck, the water table is at or above the soil surface except during long dry periods. In Terra Ceia muck the water table is as much as 2 ft above the soil surface during the rainy season. It is at or above the surface for 6 to 9 months in most years and is seldom below a depth of 10 in. except during extended dry periods. *Soil Survey of Putnam County, Florida* (SCS 1980)

The recommended FL (102.6 ft NAVD) is slightly below the average of the minimum ground elevations (102.9 ft NAVD) of the hardwood swamps at Transects 1, 2, and 3, thereby allowing saturated soil conditions at the lowest hardwood swamp elevations for seed germination and sufficient growth of wetland plants to survive the next flood event.

The FL level typically results in dewatered wetlands. This dewatering is a natural consequence of drought and has ecological benefits. Drawdown conditions enable seeds of emergent wetland plants to germinate from the seed banks of the floodplain. Seeds of many wetland plant species require exposed soils in order to germinate (Van der Valk 1981). For example, cypress trees have rigorous hydrologic seed germination and seedling establishment requirements. Cypress seeds will not germinate under water and seedlings can be killed by submergence (Demaree 1932; Watson 1983; Ware 2003). Dewatering the floodplain at Lake Melrose for suitable durations maintains the composition of emergent plant species and increases plant diversity.

Low water levels also allow decomposition and/or the compaction of flocculent organic sediments. Aerobic microbial breakdown of the sediment begins with receding water levels, which results in a release of nutrients, thereby stimulating primary production. Normally, upon reflooding, conditions are improved for fish nesting and foraging since the wetland surface has consolidated, structural cover has increased, and forage resources (terrestrial and aquatic invertebrates) are abundant (Kushlan and Kushlan 1979; Merritt and Cummins 1984).

At the recommended FL level, shallow ponding will occur in the shrub swamps and floating marshes at Lake Melrose (see Figures 12, 14, and 16). Shallow ponding provides aquatic refugia for numerous small fish, amphibians, and small reptiles. Aquatic habitats, such as the shrub swamp and floating marshes connected to the open water of Lake Melrose are of crucial importance to fishes and invertebrates of the floodplain. Connected habitats provide shallow, quiet waters as refugia from the deep, rough waters (Light et al. 1998). In addition, shallow ponding in the floating marshes provides favorable water depths for wading bird foraging. Wading birds can only forage in relatively shallow water. Great egrets need water depths of less than 10 in. and the small herons need depths of less than 6 in. Dropping water levels cause fish to be concentrated in isolated pools throughout the marshes. Birds effectively feed upon these concentrations (Bancroft et al. 1990).

An additional consideration regarding the FL level at Lake Melrose include soil moisture in the mineral soils in the transitional and uplands vegetation communities traversed at Lake Melrose. Soil moisture is likely available to the vegetation at depths considerably closer to the soil surface than that predicted from the FL level due to groundwater seepage and the capillary fringe zone. A capillary fringe zone of varying thickness exists above the mineral soil water table, where the soil is nearly saturated and the water is absorbed by soil particles to a greater degree than below the water table. This capillary fringe zone contains various amounts of water depending on the pore size and the height of the soil above the water table (Richardson et al. 2001). Additionally, shallow groundwater seepage typically occurs in bayhead vegetation communities providing soil saturation to an elevation above the lake stage. Lindbo and Richardson (2001) described groundwater discharge from the upland to the edge of the floodplain often occurring along seepage slopes at the upper edge of the floodplain. Thus, groundwater seepage helps maintain the hydric soil characteristics in the transitional vegetation community when the lake stage occurs below this elevation.

Further consideration regarding the recommended FL level determination included maintaining the open water pool of Lake Melrose. Water depths taken approximately every 100 ft while canoeing from Transect 1 to Transect 2 determined the median lake bottom elevation equaled 94.8 ft NAVD with a minimum elevation of 92.8 ft NAVD. Thus typical water depths would equal approximately 7.8 ft when Lake Melrose equaled the FL stage of 102.6 ft NAVD.

Duration Component

The recommended 120-day continuously nonexceeded duration corresponds to the length of a normal dry season (i.e., mid-February through mid-June) that typically occurs from the end of winter rains until the beginning of the summer wet season. The 120-day duration provides sufficient periodic dewatering of seasonally flooded wetlands to allow seed germination of wetland plants that require saturated but not inundated substrates (Kushlan 1990). Further, this duration allows many wetland plants to grow tall enough to survive postdrought, higher water conditions (Ware 2003). Additionally, such low water events enable wading birds to feed over the entire floodplain and allow access to the floodplain resources by wildlife species that usually inhabit upland plant communities (Harris and Gosselink 1990).

The recommended FL event (i.e., 102.6 ft NGVD, 120-day continuous dewatering duration) is expected to provide a sufficient period of dewatering for regeneration of the hardwood swamp plant communities and maintain the structure and functions of seasonally flooded wetlands.

Return Interval Component

The FL level is predicted to occur, on average, approximately once every 5-10 years for a duration of several months (Rule 40C-8.021(15), *F.A.C.*). The recommended FL level for

Lake Melrose results in a change in the return interval of this dry-season event from an event that currently occurs, on average, every 33 years (3 times in 100 years) to an event that would occur, on average, every 10 years (10 times in 100 years) while maintaining a 120-day duration at a stage of 102.6 ft NAVD (see Figure 22).

The recommended FL return interval allows change from the existing hydrologic conditions while maintaining a natural signature that is within the range for floodplain water table fluctuations. The FL event return interval is expected to prevent excessive drawdown while providing a sufficient period of dewatering (i.e., exposure) of the floodplain soil surface to allow regeneration, growth, and maintenance of the wetland plant communities. Other ecological benefits will be achieved, such as compaction of flocculent sediments, microbial breakdown of sediment/detritus with the concomitant release of nutrients and stimulation of primary productivity, and use of the floodplain by upland flora and fauna. The FL return interval is not expected to cause a permanent downhill shift of upland plant communities or a permanent net loss of Lake Melrose wetland communities.

The recommended FL level event (stage at or below 102.6 ft NAVD for 120 consecutive days) has occurred twice during the 22-year period of data collection at Lake Melrose. Due to the marked stability of Lake Melrose water levels (see Figure 7), the recommended FL level is only 1.0 ft below the recommended FH level of 103.6 ft NAVD. When considerations regarding future possible water use from Lake Melrose occur, both the recommended FH and MA levels will allow very little water use before the lake experiences the recommended FL event.

Recommended Frequent Low (FL) Level

The recommended FL level for Lake Melrose is a low water level event at 102.6 ft NAVD with an associated 120-day continuously nonexceeded (dewatered) duration at a return interval no more often than once every 10 years (i.e., 10 dewatering events per century), on average (Table 17). This ecological threshold is achieved under existing basin conditions (i.e., existing land use/land cover and regional groundwater withdrawals) and allows a relatively small change in the existing condition (see Figure 22).

Table 17. Primary criteria for the adopted and recommended minimum frequent low (FL) levels at Lake Melrose

FL Level	Elevation (ft NAVD) 1988 Datum	Hydroperiod Categories; Duration and Return Interval	Criteria
Adopted	101.7	Semipermanently flooded	Corresponds to the average elevation of the maple swamp at Transect 1 (stations 16–110) minus 1.67 ft (20 in. drawdown in soil water table)
Recommended	102.6	120-day duration; 10-year return interval	Corresponds to a 10 in. soil water table drawdown from the average ground surface elevation where deep organic soils ($\geq$8 in. thick) were identified in the shrub swamp and hardwood swamp #1 at Transect 1 (stations 80–920) and the shrub swamp and hardwood swamp at Transect 2 (stations 90–340)

PROTECTION OF ENVIRONMENTAL VALUES IDENTIFIED IN RULE 62-40.473, *FLORIDA ADMINISTRATIVE CODE* (*F.A.C.*)

SJRWMD qualitatively assessed whether the recommended Lake Melrose MFLs (developed to protect the hardwood swamps and organic soils in the floodplain at Lake Melrose and ultimately the environmental value “fish and wildlife habitats and passage of fish”) were protective of all other relevant environmental values identified in Rule 62-40.473, *F.A.C*. The results of this assessment are listed in Table 18. SJRWMD concludes that the recommended MFLs will protect all relevant Rule 62-40.473, *F.A.C*., environmental values at Lake Melrose.

Table 18. Summary consideration for each environmental resource value, 62-40.473, *F.A.C.*

Environmental Value	
Recreation in and on the water	**Environmental Value Definition:** The active use of water resources and associated natural systems for personal activity and enjoyment
	Criterion of Protection Hydrologic regime characteristics (low stage events) associated with the water depth necessary to safely operate motorboats and allow water sports activities
	Discussion There is no public access to Lake Melrose. The most restrictive recreational use on Lake Melrose is the water depth necessary to launch and operate safely motor boats at Lake Melrose. Water depths taken approximately every 100 ft while canoeing from Transect 1 to Transect 2 determined the median lake bottom elevation equaled 94.8 ft NAVD with a minimum elevation of 92.8 ft NAVD. Thus typical water depths would equal approximately 7.8 ft when Lake Melrose equaled the FL stage of 102.6 ft NAVD.
	Do Recommended Minimum Flows and Levels Protect Environmental Value? Compliance with the recommended Minimum Frequent Low level provides for the protection of low water events necessary for the safe operation of motor boats for water sports activities in Lake Melrose. Therefore, "recreation in and on the water" is considered to be protected.
Fish and wildlife habitats and the passage of fish	**Environmental Value Definition:** Aquatic and wetland environments required by fish and wildlife, including endangered, endemic, listed, regionally rare, recreationally or commercially important, or keystone species; to live, grow, and migrate
	Criterion of Protection Hydrologic regime characteristics (high and low stage events) associated with conservation of the floodplain wetland vegetation composition, structure, and function for fish and wildlife habitats
	Discussion Fish and wildlife are dependent on local vegetation communities to provide food, cover, and/or nesting sites. Therefore, in order to protect fish and wildlife, it is necessary to protect their associated habitat (i.e., vegetation communities and soils). Water level fluctuations influence the colonization and survival of plants, thereby affecting the species composition and structure of plant communities (Schneider and Sharitz 1986; Kushlan 1990; Huffman 1980) The life cycles of many fishes are related to seasonal water level fluctuations, with flooded areas affecting productivity by providing feeding and spawning habitat and refugia for juveniles (Bain 1990; Poff et al. 1997; Guillory 1979; Ross and Baker 1983; Finger and Stewart 1987). Flooding events redistribute and concentrate organic particulates (Junk et al. 1989), while increasing aquatic vegetation structure as substrates for bacterial and fungal growth, affecting the aquatic faunal food chain (Cuffney 1988). Anaerobic soil conditions within the flooded wetland communities favor hydrophytic vegetation and eliminate upland plant species that have invaded during low water events (CH2M HILL 2005), while increasing vegetative structure available to aquatic organisms (Light et al. 1998). High water events allow the lateral movement of fish and other aquatic organisms between hydrologically connected lake lobes and lakes, as well as onto the floodplain to forage and reproduce. The increased spatial area and vegetation structure provide forage for juveniles and refugia from predators. Low water events allow for the decomposition and/or the compaction of flocculent organic sediments, improving habitat conditions for fish nesting and foraging (Kushlan and Kushlan 1979; Merritt and Cummins 1984). Shallow ponding provides aquatic refugia for fish, amphibians, and small reptiles, creating ideal depths for wading bird forage and concentration of resources in isolated pools (Bancroft et al. 1990; Kushlan 1990). Dewatering events increase the habitats and area available for use by terrestrial fauna, while enabling germination of wetland plant seeds (Kushlan 1990; Van der Valk 1981).

Table 18–*Continued*

Environmental Value	
	Do Recommended Minimum Flows and Levels Protect Environmental Value? One of the advantages of setting multiple MFLs is that the overall fluctuation range of the lake is largely protected. The recommended MFLs for Lake Melrose were primarily based on the protection of fish and wildlife habitats with a sufficient frequency and duration of high water (flooding) and low water (dewatering) events to prevent a down-slope shift in the location of floodplain wetlands (i.e., no net loss of wetlands). Fish and wildlife require access to these habitats and the terrestrial and aquatic passages between them under varying water levels for the continuance of their life cycle and various biological processes (e.g., foraging, reproduction, growth). Compliance with all three recommended MFLs provides for the protection of "fish and wildlife habitats and the passage of fish" for Lake Melrose. Therefore, this WRV is considered to be protected.
Estuarine resources	**Environmental Value Definition:** Coastal systems and their associated natural resources that depend on the habitat where oceanic salt water meets freshwater
	Criterion of Protection Not applicable
	Discussion Not applicable
	Do Recommended Minimum Flows and Levels Protect Environmental Value? Not applicable
Transfer of detrital material	**Environmental Value Definition:** The movement by surface water of loose organic material and associated biota
	Criterion of Protection Hydrologic regime characteristics (high and low stages) associated with depth and area of inundation necessary for adequate detrital transfer to the water column of the lake
	Discussion Detrital material is an important component of the food web in aquatic ecosystems (Mitsch and Gosselink 1993). The ecology of the floodplain and aquatic communities is dependent to a large extent on the events that deliver detrital material to the system. A significant portion of the detrital material transfer occurs during periods of high water events when accumulated detrital materials on the floodplain are detached from the land surface due to buoyancy or turbulence and moved by currents. Therefore, maintaining the hydrologic regime characteristics in the lake floodplain is essential to the supply and transport of detrital material.
	Do Recommended Minimum Flows and Levels Protect Environmental Value? Compliance with the recommended Minimum Frequent High level provides for the protection of flooding events necessary for the transfer of most detrital material in Lake Melrose. Therefore, the "transfer of detrital material" is considered to be protected.
Maintenance of freshwater storage and supply	**Environmental Value Definition:** The protection of an amount of freshwater supply for permitted users at the time of MFLs determination
	Criterion of Protection Protect existing permitted surface water and/or groundwater withdrawals
	Discussion Maintenance of freshwater storage and supply is assessed by including existing permitted surface and/or groundwater withdrawals in the initial MFLs compliance analysis. SJRWMD uses two modeling tools in this process. A regional groundwater flow model includes any permitted groundwater withdrawals. A lake water budget model includes permitted surface water withdrawals and accounts for the interaction between the lake and the regional groundwater system. Any projected or planned hydrologic changes for Lake Melrose would be assessed, from the point of view of MFLs compliance, on top of existing permitted withdrawals.

Table 18–*Continued*

Environmental Value	
	Do Recommended Minimum Flows and Levels Protect Environmental Value? Compliance with the recommended MFLs for Lake Melrose protects existing permitted water uses from impacts associated with potential future surface water and/or groundwater withdrawals because existing permitted surface and/or groundwater withdrawals are included in the initial MFLs compliance analysis. Therefore, "maintenance of freshwater storage and supply" is considered to be protected.
Aesthetic and scenic attributes	**Environmental Value Definition:** Those features of a natural or modified waterscape usually associated with passive uses such as bird watching, sightseeing, hiking, photography, contemplation, painting and other forms of relaxation, that usually result in human emotional responses of well-being and contentment
	Criterion of Protection Hydrologic regime characteristics (high and low stage events) associated with the preferred stage exceedence range associated with optimal scenic viewing and recreational use.
	Discussion Southwest Florida Water Management District (SWFWMD) conducted a survey to determine a representative group of lake users' perceptions regarding lake aesthetics and recreational use in relation to lake stage (Hoyer et al. 2006). The results suggested that lake users were willing to accept water level fluctuations between a stage exceedence of 20% to 90%. Outside of this range, lake users felt that lake aesthetics and/or recreational use were impaired.
	Do Recommended Minimum Flows and Levels Protect Environmental Value? One of the advantages of setting multiple MFLs is that the overall fluctuation range of the lake is largely protected. Compliance with all three recommended MFLs provides for the protection of "aesthetic & scenic attributes" for Lake Melrose.
Filtration and absorption of nutrients and other pollutants	**Environmental Value Definition:** The reduction in concentration of nutrients and other pollutants through the processes of filtration and absorption (i.e., removal of suspended and dissolved materials) as these substances move through the water column, soil or substrate, and associated organisms
	Criterion of Protection Hydrologic regime characteristics (high stage events) associated with depth and area of inundation necessary for adequate filtration and absorbing nutrients and other pollutants
	Discussion Wetlands serve important functions by filtering and absorbing nutrients from runoff (which typically contains nutrients at concentrations greater than the parent soil), serving as sinks for nutrients deposited from the drainage basin during periods of inundation, and allowing long-term nutrient removal through microbial action (Adams 1997; Boudreau et al. 2004; Labaree 1992). The ability of wetlands to perform these functions depends on cycles of flooding and drying as both anaerobic and aerobic processes are involved (Boudreau et al. 2004). Recognition of the importance of wetlands to the aquatic health of neighboring bodies of water has resulted in the creation or restoration of wetland areas throughout the country. The biogeochemical processing of dissolved constituents is controlled by complex interactions between the rate at which water flows through surface and subsurface flow paths and the rate at which dissolved constituents are processed by methods such as adsorption to sediments or uptake by microorganisms and vegetation (Phillips et al. 1993; Hamilton and Helsel 1995). The conceptual model relevant to the WRV assessment is that filtration and absorption occur in the pervious soils in the floodplain; hence, the frequency, duration, and return period of overbank flooding are the defining characteristics (Battelle 2004).
	Do Recommended Minimum Flows and Levels Protect Environmental Value? Compliance with the recommended Minimum Frequent High level provides for the protection of flooding events necessary for the "filtration and absorption of nutrients and other pollutants" in Lake Melrose. Therefore, "filtration and absorption of nutrients and other pollutants" is considered to be protected.

Table 18–*Continued*

Environmental Value	
Sediment loads	**Environmental Value Definition:** The transport of inorganic material, suspended in water, which may settle or rise; these processes are often dependent on the volume and velocity of surface water moving through the system
	Criterion of Protection Not applicable
	Discussion Not applicable
	Do Recommended Minimum Flows and Levels Protect Environmental Value? Not applicable
Water quality	**Environmental Value Definition:** The chemical and physical properties of the aqueous phase (i.e., water) of a water body (lentic) or a watercourse (lotic) not included in "filtration and absorption of nutrients and other pollutants"
	Criterion of Protection Hydrologic regime characteristics (high and low stage events) necessary to prevent excessive low dissolved oxygen (DO) events
	Discussion Algal blooms can occur naturally during dry seasons with moderate to severe droughts when water level conditions are low resulting in seasonally elevated water temperatures and elevated concentrations of nutrients. Similarly, algal blooms can occur naturally after the onset of rainy seasons when nutrient loading is high because of runoff from upland and dewatered wetland areas and flushing (e.g., residence time is high when flushing is low) from the lake is low (e.g., an isolated lake). Thus, natural algal blooms can occur following wet or dry season events when conditions for algal growth are favorable. More severe algal blooms can result in low DO concentrations that may negatively affect aquatic biota (e.g., fish kills). Water withdrawals can increase the number of low water events or decrease the number of high water events per century, on average, and affect the number of low DO events. The time needed for system recovery from natural and human caused low DO events is important to this WRV assessment. Water quality data are not available for Lake Melrose.
	Do Recommended Minimum Flows and Levels Protect Environmental Value? One of the advantages of setting multiple MFLs is that the overall fluctuation range of the lake is largely protected. Therefore, the compliance with all three recommended MFLs provides for the protection of "water quality" for Lake Melrose.
Navigation	**Environmental Value Definition:** The safe passage of watercraft (e.g., boats and ships), which is dependent on adequate water depth and channel width
	Criterion of Protection Minimum depth of water necessary for most motorboat safe operation
	Discussion Watercraft navigation in most lakes is closely tied to recreation and necessitates adequate draft depths and channel widths for safe boat operation between lake lobes.
	Do Recommended Minimum Flows and Levels Protect Environmental Value? One of the advantages of setting multiple MFLs is that the overall fluctuation range of the lake is largely protected. Therefore, the compliance with all three recommended MFLs provides for the protection of "navigation" for Lake Melrose. The lake does not support commercial boating, shipping, or barge traffic, nor does it have connectivity between lake lobes as a constraint. Passage by recreational vessels and canoes was considered under the "Recreation in and on the water" environmental value.

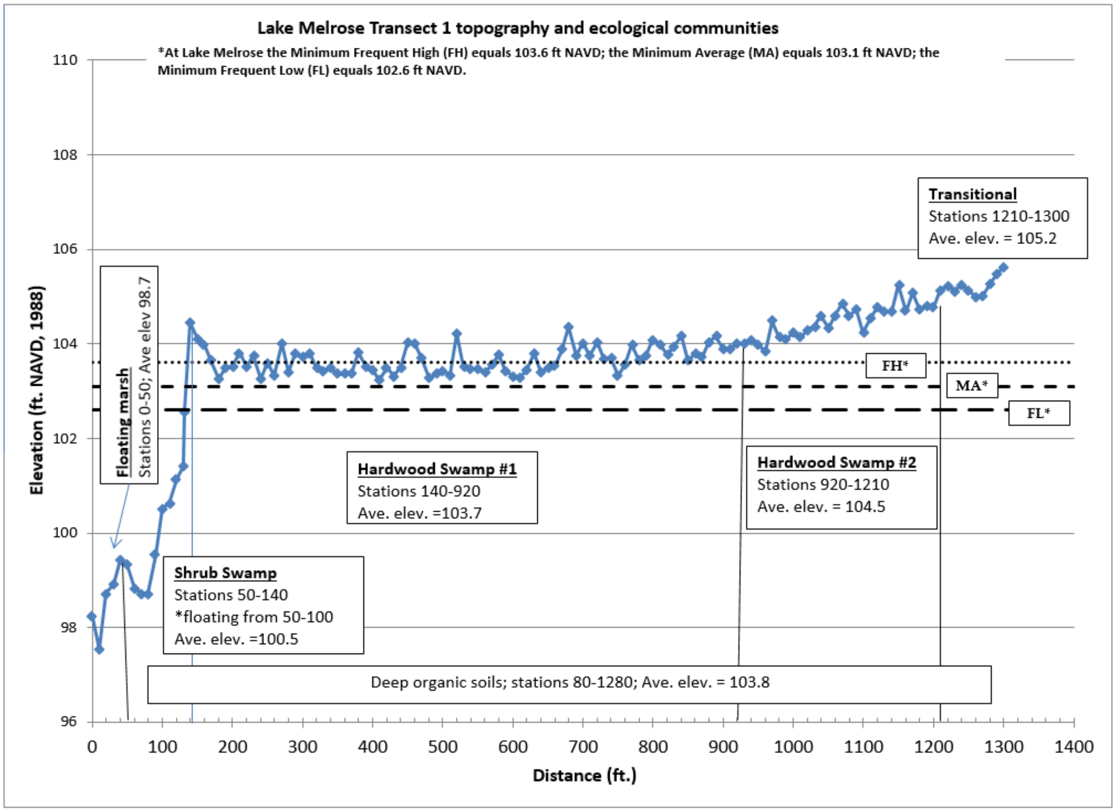


Figure 12. Topography and ecological communities at Transect 1, Lake Melrose

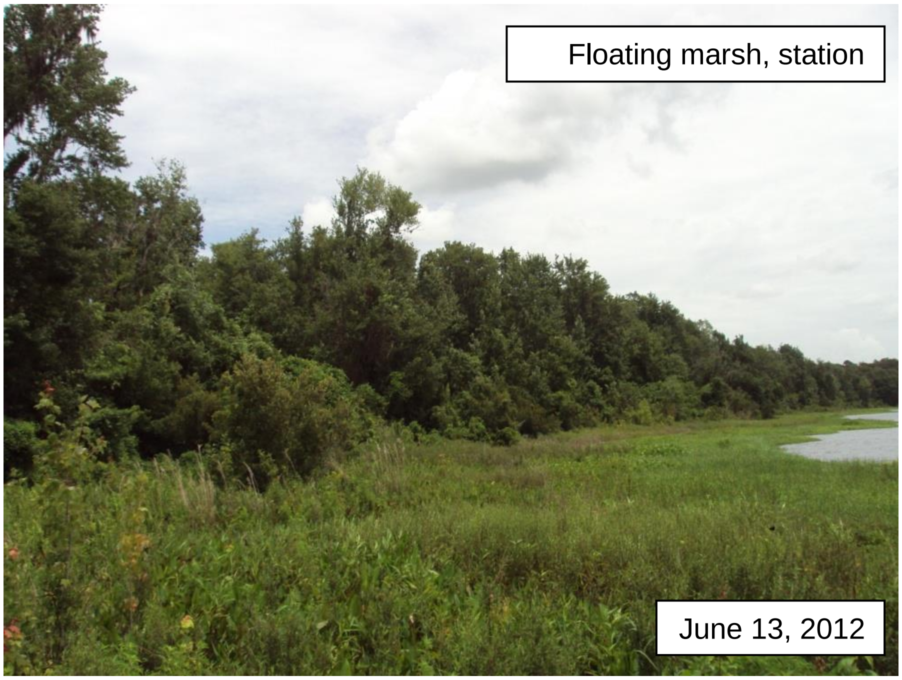


Figure 13. Site photographs of Transect 1 at Lake Melrose

Figure 13—*Continued*

Figure 13—*Continued*

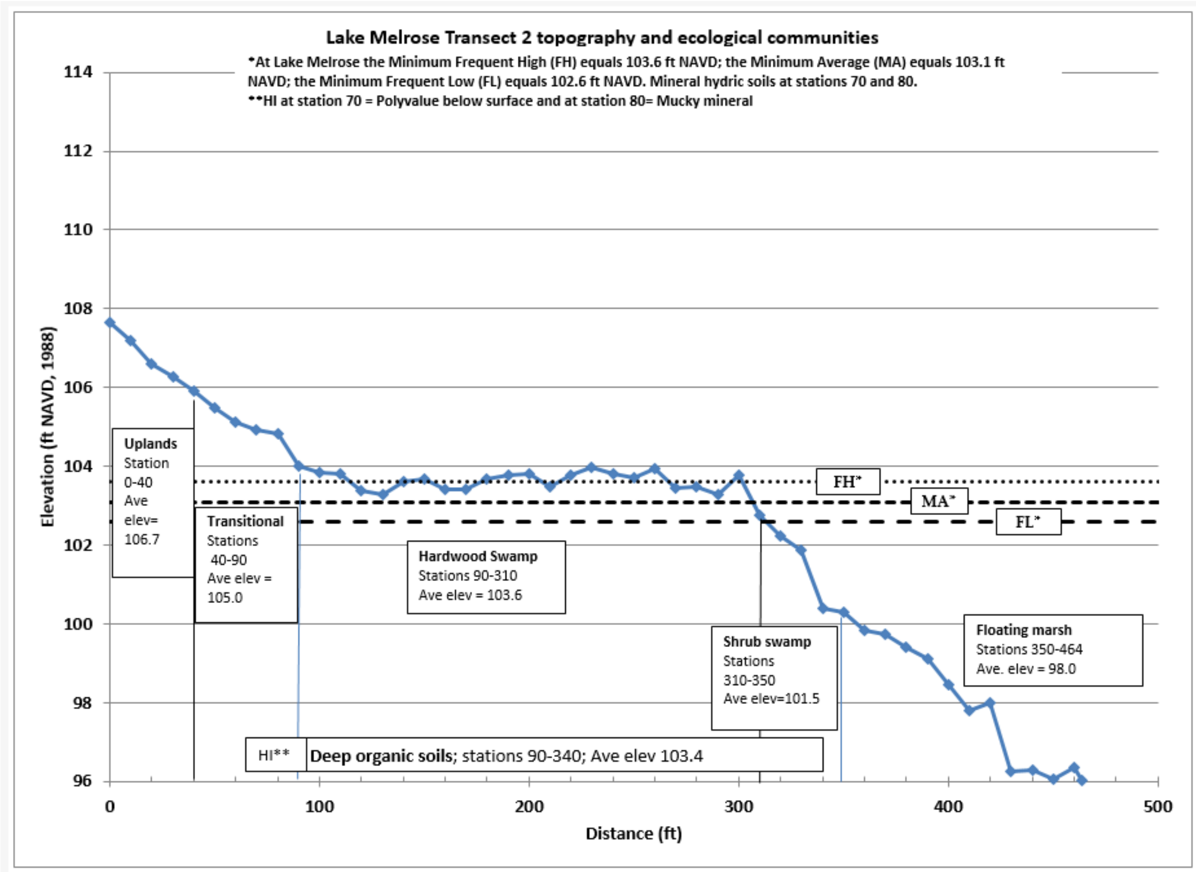


Figure 14. Topography and ecological communities for Transect 2, Lake Melrose

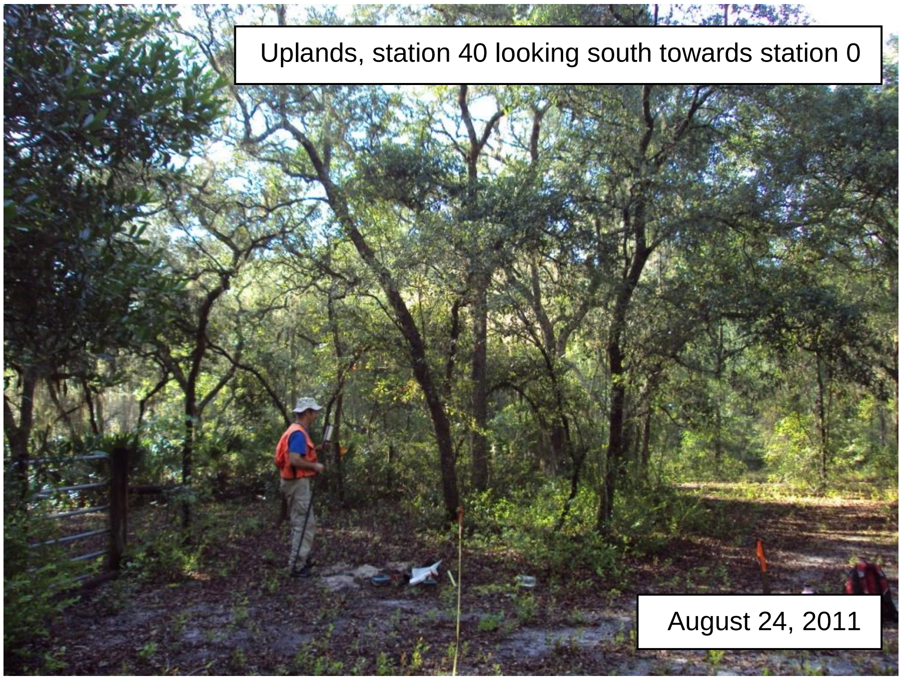


Figure 15. Site photographs of Transect 2 at Lake Melrose

Figure 15—*Continued*

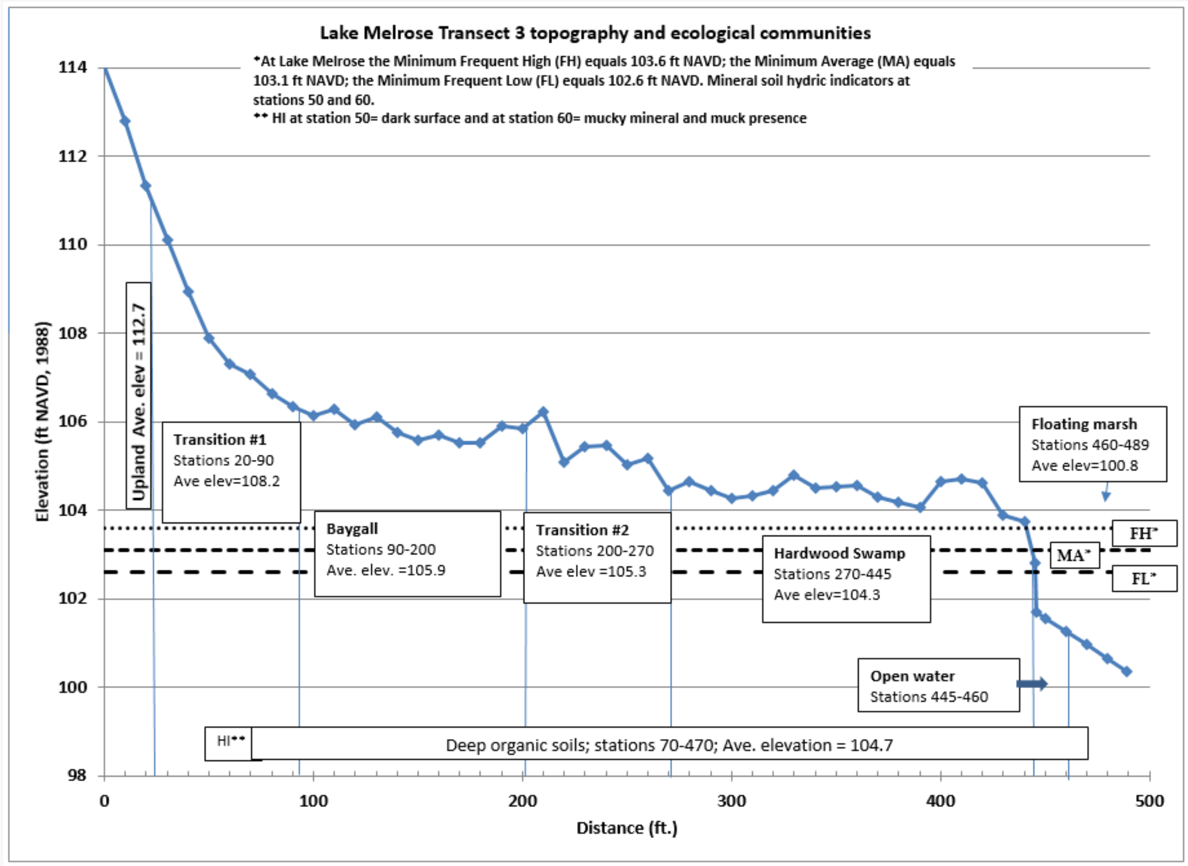


Figure 16. Topography and ecological communities for Transect 3, Lake Melrose

Figure 17. Site photographs of Transect 3 at Lake Melrose

Figure 17—*Continued*

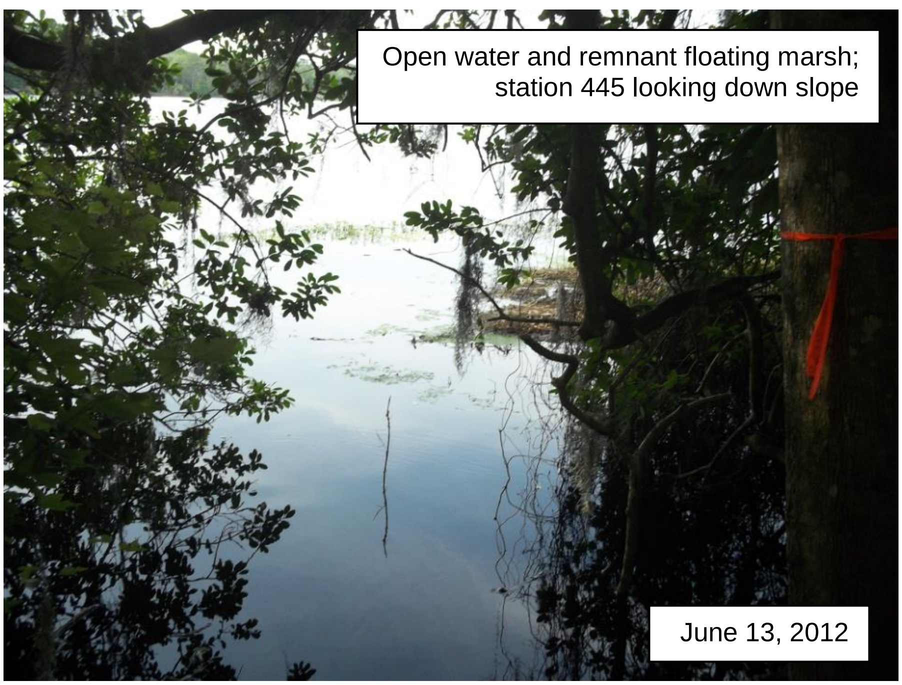


Figure 17—*Continued*

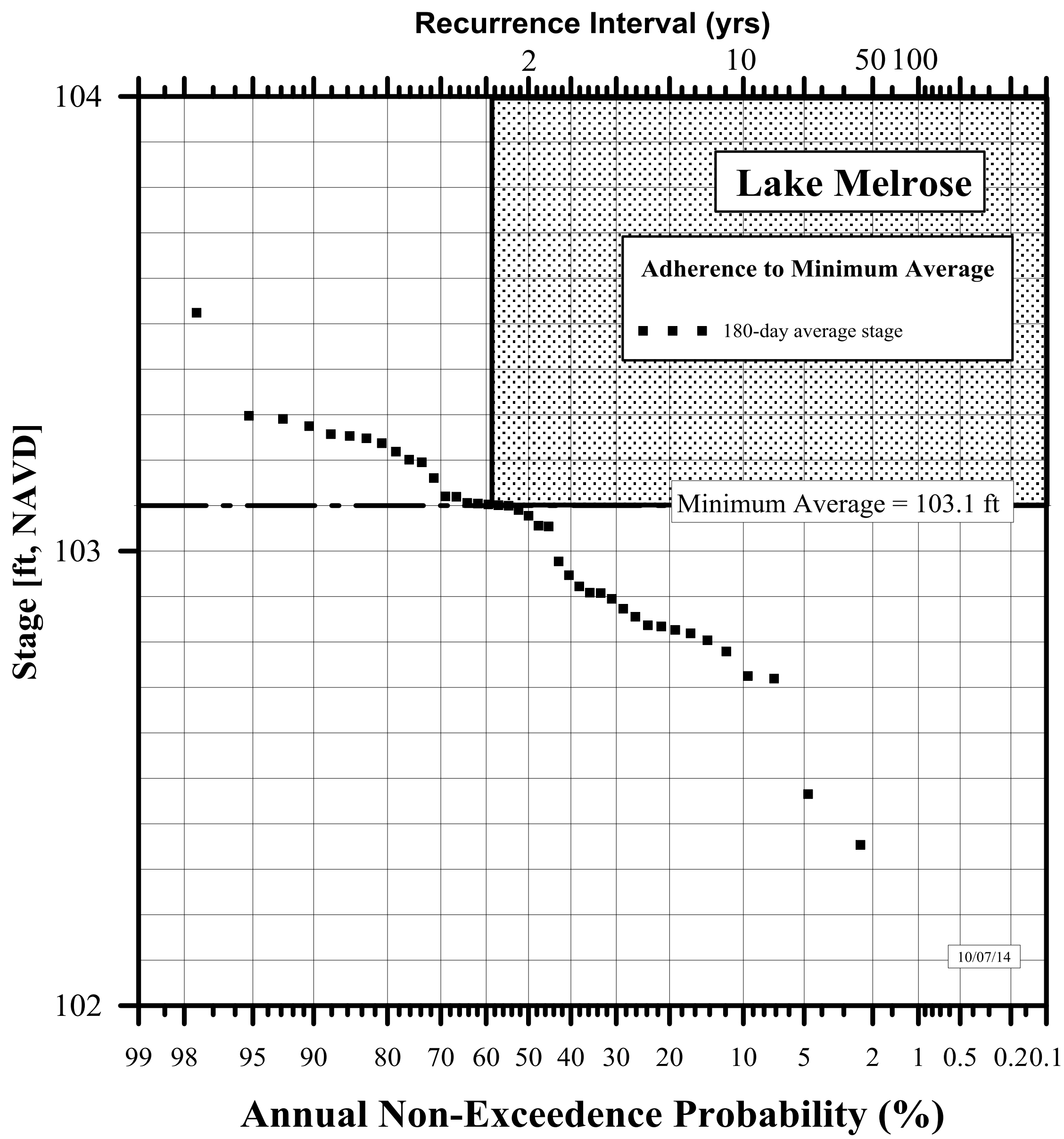


Figure 18. Modeled flood frequencies computed for elevations continuously wet for 30 days with the recommended frequent high (FH) level superimposed

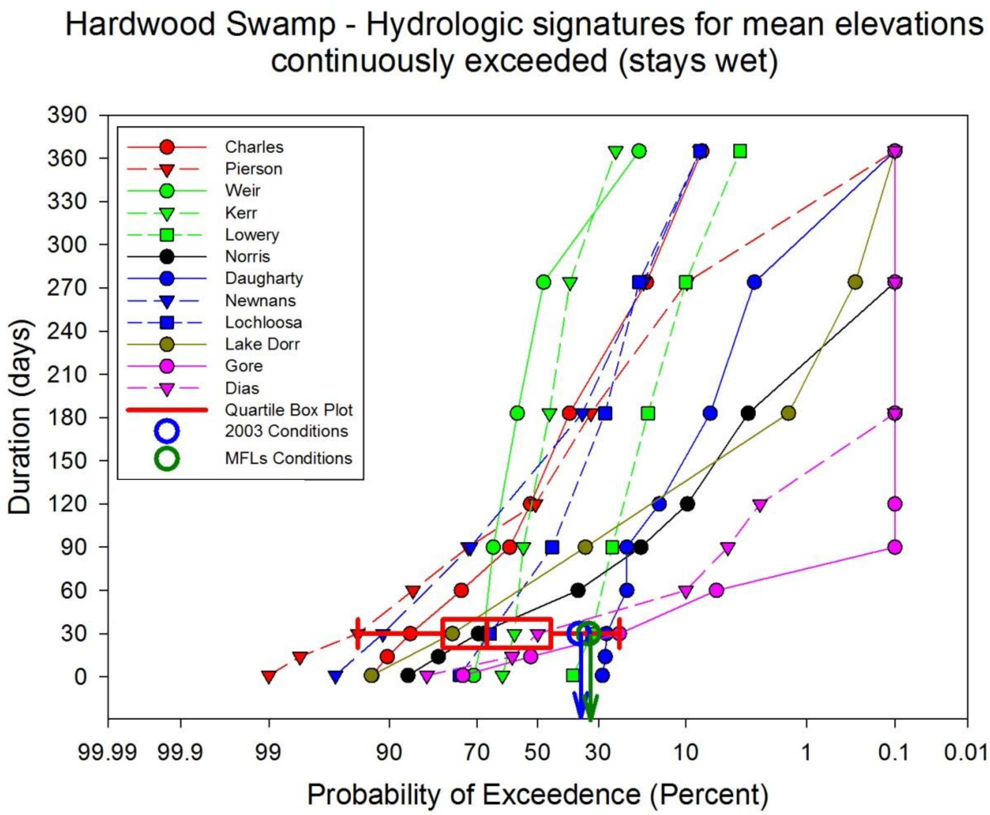


Figure 19. Surface water dewatering and inundation signatures (SWIDS) plot of the distribution of hydrologic signatures for the annual average exceedence elevation for selected durations of 12 lakes with hardwood swamps

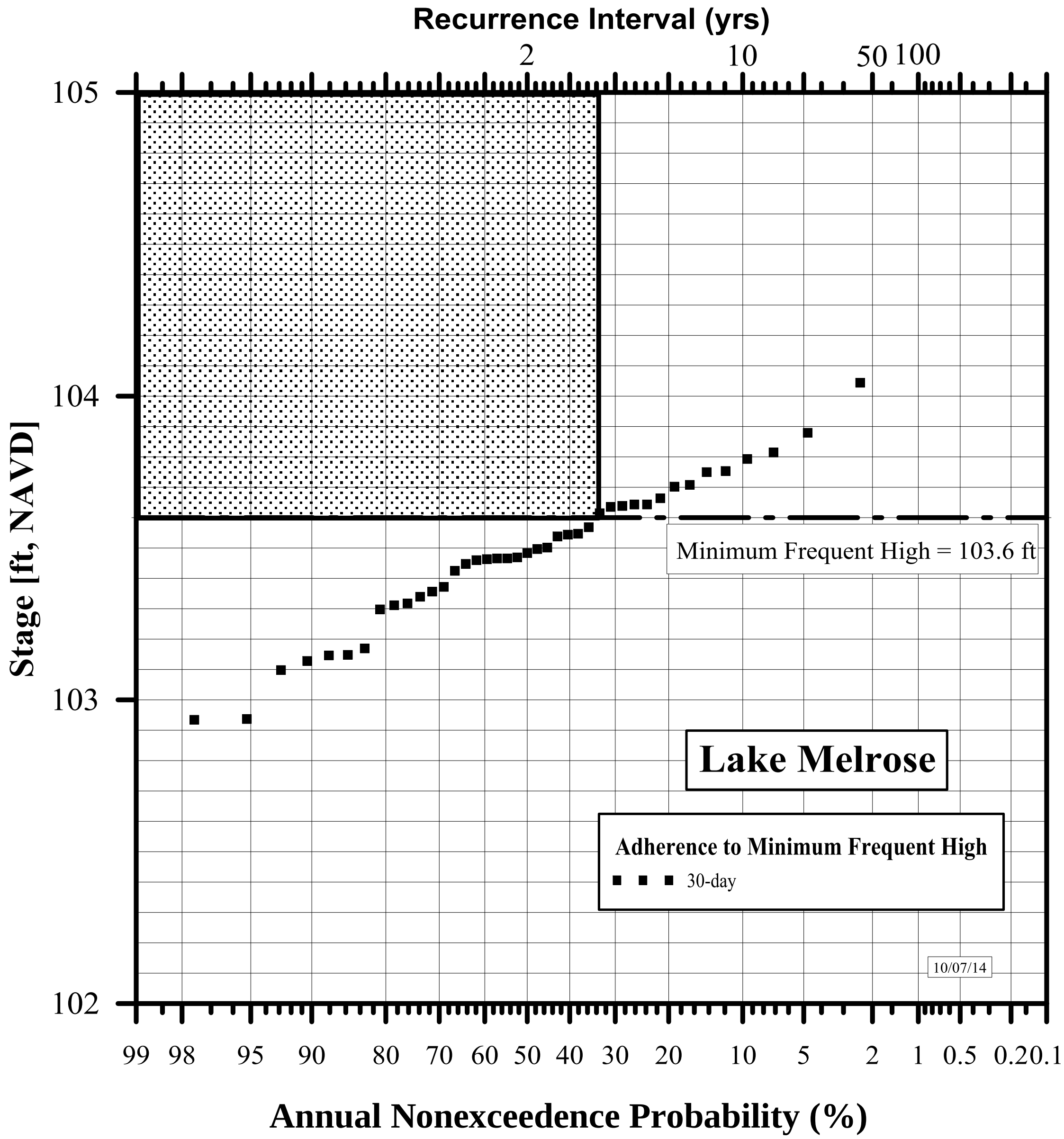


Figure 20. Modeled drought frequencies computed from model simulations of Lake Melrose for the minimum average (MA) level under existing conditions with the MA level superimposed

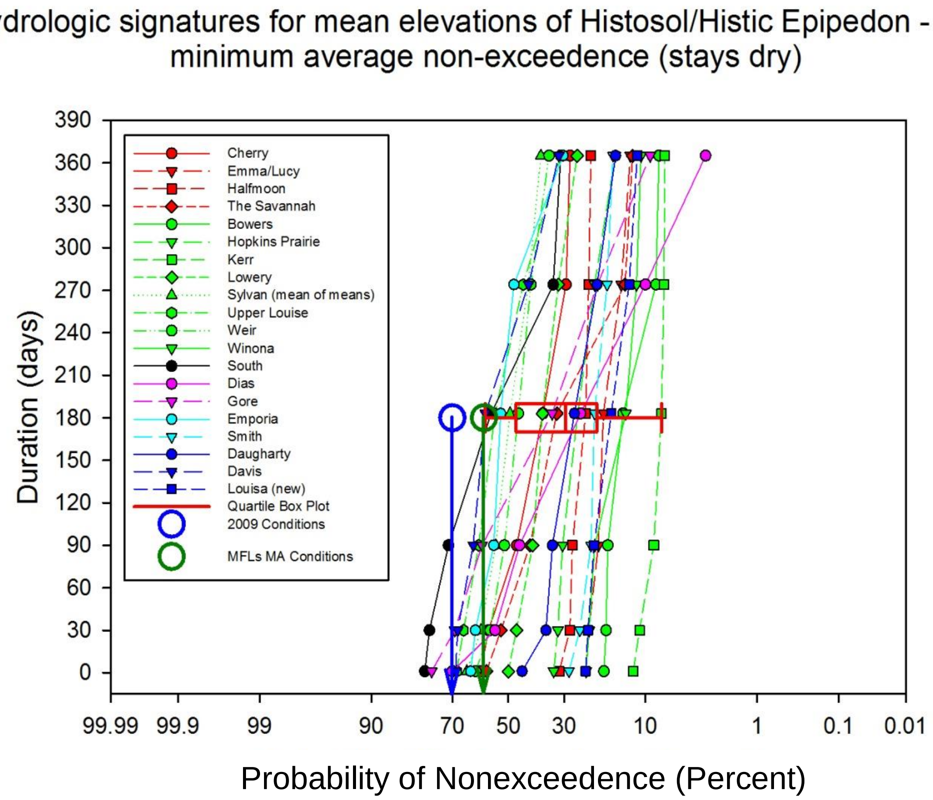


Figure 21. Surface water dewatering and inundation signatures (SWIDS) plot of the distribution of hydrologic signatures for the annual average nonexceedence elevation for selected durations at 21 lakes with deep organic soils

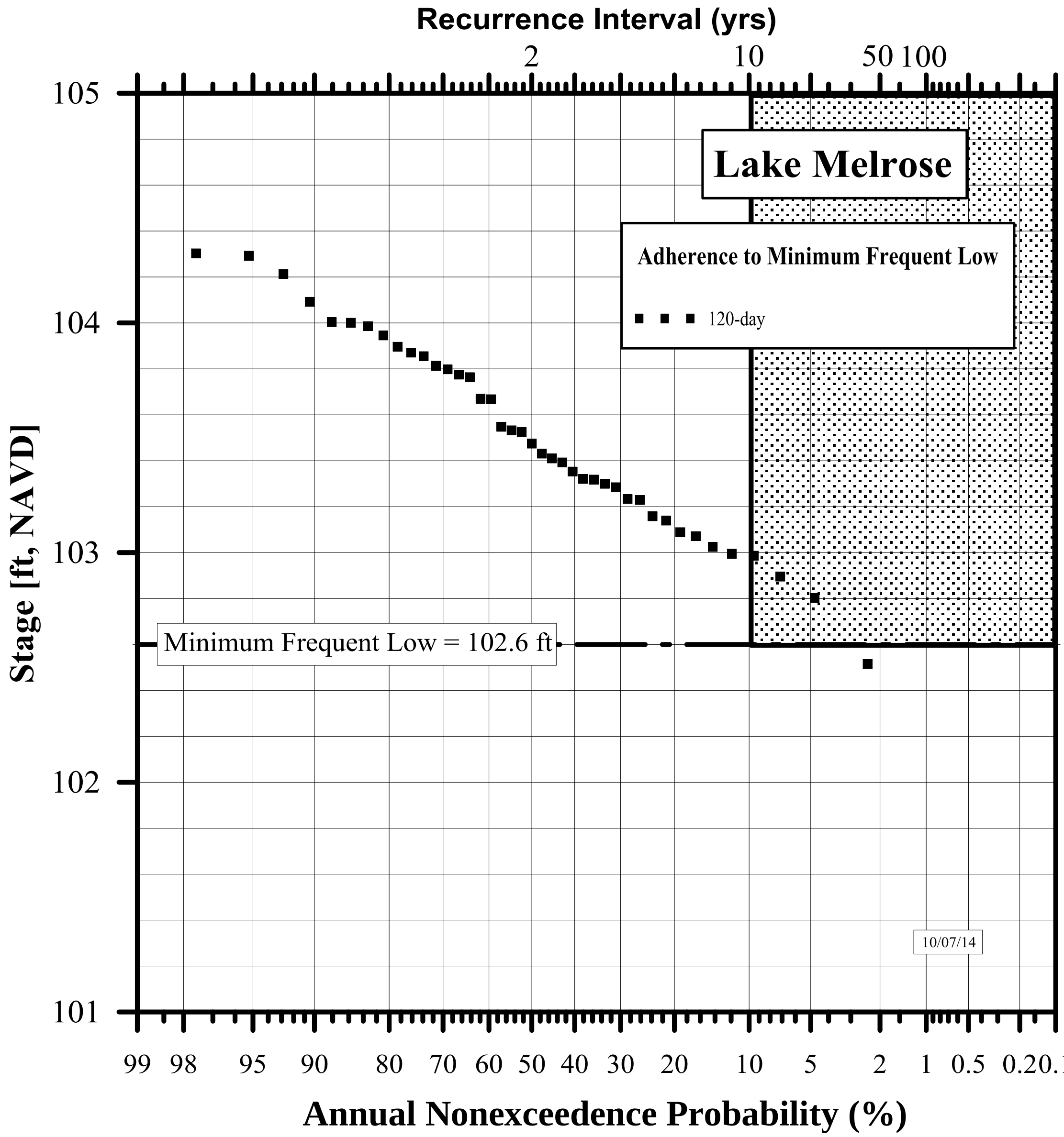


Figure 22. Modeled drought frequencies for Lake Melrose for the recommended frequent low (FL) level under existing conditions with the FL level superimposed

CONCLUSIONS AND RECOMMENDATIONS

The SJRWMD Governing Board adopted MFLs for Lake Melrose on November 4, 1998 (Chapter 40C-8, *F.A.C.*); Appendix A), before a hydrologic model was completed for Lake Melrose. MFLs are to be reviewed periodically and revised as needed (Section 373.0421(3), *F.S.*). Subsequent completion of a hydrologic model for Lake Melrose (CDM 2005) indicated that the adopted MFLs were not being met under 2003 modeled conditions. Consequently, a reevaluation of the adopted Lake Melrose MFLs was performed. This reevaluation has resulted in the recommendation to modify the adopted MFLs (Table 19) based on current SJRWMD MFLs determination methodology.

The hydrologic model for Lake Melrose was calibrated for 2003 conditions (CDM 2005). These conditions included the most recent land use information and groundwater levels consistent with 2003 regional water use. Based on hydrologic model results, SJRWMD concludes that the recommended MFLs for Lake Melrose are protected under 2003 conditions. To determine if changes in groundwater use allocations subsequent to 2003 would cause lake levels to fall below the recommended MFLs for Lake Melrose, the existing hydrologic model should be run using Floridan aquifer potentiometric level declines that reflect these changes in water use allocation.

The following conclusions and recommendations are drawn from the information presented in this document:

- Establishment and enforcement of the recommended, reevaluated minimum levels for Lake Melrose, as presented in this document, should adequately provide for the protection of the water resources or ecology of the area, which includes Lake Melrose and its associated floodplain, from significant harm as a result of consumptive uses of water. SJRWMD concludes that the recommended MFLs developed primarily for the protection of significant harm to “fish and wildlife habitats and the passage of fish” will protect all other relevant Rule 62-40.473, *F.A.C.*, environmental resource values (see Table 18).
- Periodic reassessments of these recommended, reevaluated minimum levels, based on monitoring data collected in the future, would better assure that these levels are providing the expected levels of protection of the water resources and ecology of the area. Monitoring data would include periodic vegetation and soil resampling, as well as hydrologic model updates with future stage and aquifer data.

The results presented in this report are preliminary and will not become effective until the recommended MFLs are adopted by SJRWMD Governing Board rule.

Table 19. Adopted and recommended, reevaluated minimum surface water levels for Lake Melrose (see Appendix A)

Level	Adopted		Recommended		
	Elevation (ft NGVD)	Hydroperiod Category	Elevation (ft NAVD)	Duration (days)	Return Interval (years)
Minimum Frequent High	105.2	Seasonally flooded	103.6	30	3
Minimum Average	104.2	Typically saturated	103.1	180	1.7
Minimum Frequent Low	102.8	Semiperman ently flooded	102.6	120	10

ft NGVD = feet National Geodetic Vertical Datum

ft NAVD = feet North American Vertical Datum

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APPENDIX A—LAKE MELROSE MEMORANDUM 1997

MEMORANDUM **F.O.R. 94-1514**

DATE: September 15, 1997

TO: Jeff Elledge, Director JE
Resource Management Department

THROUGH: Charles A. Padera, Director
Water Resources Department

For Edgar F. Lowe, Ph.D., Director
Environmental Sciences Division

Greeneville B. (Sonny) Hall, Ph.D., Technical Program Manager
Environmental Sciences Division

FROM: Clifford P. Neubauer, Ph.D., Supervising Environmental Specialist CPN
Environmental Sciences Division

RE: Recommended minimum Surface Water Levels determined for Lake Melrose, Putnam County, Project #01-43-00-5161-XXXX-10900

The purpose of this memorandum is to forward recommended minimum levels with associated hydroperiod categories (Table 1) determined for Lake Melrose to the Department of Resource Management. Lake Melrose was identified as a priority lake in the MF&L project plan. Field data for this memorandum were collected on August 5, 1997. A hydrologic water budget model is not available for Lake Melrose.

Table 1. Recommended minimum surface water levels for Lake Melrose. Terminology is defined in 40C-8021, F.A.C.; the category names and definitions are adapted from the water regime modifiers of Cowardin et. al., (1979).

MINIMUM LEVEL	ELEVATION (ft NGVD)	HYDROPERIOD CATEGORY
Minimum Frequent High Level	105.2	Seasonally Flooded
Minimum Average Level	104.2	Typically Saturated
Minimum Frequent Low Level	102.8	Semipermanently Flooded

INTRODUCTION

Lake Melrose is a 388 acre lake (@ stage=108 ft NGVD) which is located approximately 1 mile south of the intersection of State Road 26 and State Road 21 in Melrose (Fig. 1). Much of the above referenced acreage is likely wetlands because the open-water area of the lake was more recently calculated to be 98.4 acres with an additional 245 acres of hydric soils immediately adjacent to the open water area of Lake Melrose (as calculated from a GIS soils coverage).

Lake Melrose is a black-water system located in the Perched Lakes and Prairies (4a) Physiographic Division of the Central Lakes District and is immediately adjacent to the

Interlachen Sand Hills Division (4b) of the Central Lakes District. The Central Lake District is described as a region of active sink-hole development with internal drainage and is the principle recharge area of the Floridan aquifer (Brooks, 1982). The Perched Lakes and Prairies Division is not geologically typical of the Central Lake District. Miocene limestone has influenced the karst development and the surficial sand is more clayey. Flatwoods and river swamp vegetation are predominant in the lower portions with sand hill type vegetation occurring on the low hills. The maximum elevation is 186 ft with the lake and swamp elevations at about 140 ft. The Interlachen Sand Hills is located immediately to the east and has a direct hydraulic connection to the Floridan aquifer through thick sand and gravel deposits. Lakes in the Interlachen Sand Hills are at or only slightly above the potentiometric level in the limestone aquifer. The boundary between these two divisions appears to correspond with State Road 21 near Lake Melrose, generally, resulting in blackwater/wetland dominated lakes to the west and more clear-water sandhill type lakes to the east. Lake Melrose is located in a medium recharge zone (4-8 inches/year) and adjacent to higher recharge zones (8-12 inches/yr. and 12 or more inches/year) according to Boniol et al., (1993). Although, the regional nature of this map precludes accurate site specific references concerning actual recharge, Lake Melrose may not contribute significant recharge to the Floridan Aquifer because the lake has remained relatively stable during the drought of the early 1990's when extremely low water levels were recorded from nearby lakes (i.e. Lakes Brooklyn, Geneva, and Swan).

A relatively short hydrologic record (Fig. 2) exists from May 1991 to the present. Much of this record is from a period when most other lakes in the area have had low water level conditions. The maximum and minimum water levels for the period of record are: 106.87 (10/12/94) and 103.23 feet NGVD (6/1/94), respectively. The mean and median water levels for the period of record were 104.07 ft NGVD and 103.96 ft NGVD, respectively. A percent exceedence curve, which illustrates the percentage of time the lake stage was at/or above an elevation for this relatively short period of record is presented in Fig. 3.

The USGS (1:24,000 scale) quadrangle (Fig. 1) shows one surface water outflow near the east shore of Lake Melrose to Mill Creek. Water enters the lake via direct precipitation, seepage from the surrounding watershed, and may also inflow through wetlands located adjacent to Lake Melrose and from numerous small ponds and wetlands located within the drainage basin.

There are no permitted surface water withdrawals from Lake Melrose. However, three permitted groundwater water withdrawals (CUP's) exist within approximately 1 mile of the lake (Fig. 4, Pers. Comm. Mary McKinney, Res. Mgt. Dept.). The total maximum allocation for these permits is 661.5 MGY with no frost and freeze allocation.

<u>Soils</u>

Seven hydric soils (approximate total area = 282 acres) and two non-hydric soils were associated with Lake Melrose as delineated by the SCS (1985 and 1990, Fig 5). Two SCS classifications exist at Lake Melrose because the basin is bisected by the Putnam-Alachua Counties border. These soils are listed in Table 2 and the following descriptions are composites from the Alachua (SCS, 1985) and Putnam (SCS, 1990) Counties soil surveys.

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Table 2. Hydric soils associated with Lake Melrose

Putnam County	#	Alachua County	#
Samsula muck	27	Samsula muck	26
Terra Ceia muck, frequently flooded	26	Terra Ceia muck	63
Monteocha sand, depressional	62	Monteocha loamy sand	19
Placid fine sand, depressional	51	Placid fine sand, depressional	34
Surrency fine sand, depressional	51	Surrency sand	16
Riviera fine sand, frequently flooded	29		
Myakka fine sand, depressional	31		

Samsula muck is described as a nearly level, very poorly drained soil formed in moderately thick beds of hydrophytic, non-woody plant remains. The soil has a high water table at or on the surface for more than 6 months during most years. The water table is usually within 10-12 inches of the surface during normal dry periods. This soil is prone to oxidation when not saturated.

Terra Ceia muck, frequently flooded (Terra Ceia muck) is described as a nearly level, very poorly drained organic soil in freshwater marshes. The soil has a high water table that is at or above the surface during most of the year. The water level may drop below the surface during long, dry periods but is flooded during the rainy season. This soil is prone to oxidation and subsidence when not saturated.

Monteocha sand, depressional (Monteocha loamy sand) is described as a nearly flat, very poorly drained soil in wet ponds and shallow depressions in the flatwoods. The soil has a high water table that is 1-2 feet above the surface for more than 4 months and within 10 inches of the surface for more than 6 months during most years.

Placid fine sand, depressional is described as a nearly level, very poorly drained soil located in depressional areas on the flatwoods and sandy ridges. In most years, this soil has a high water table above the surface for more than 6 months. The water table is within 10 inches of the surface for 6 to 12 months of the year.

Surrency fine sand, depressional (Surrency sand) is described as a nearly level, poorly drained soil in ponds and depressional areas in the broad flatwoods and in areas of wet prairie on uplands. The soil has a water table that is within 10 inches of the surface for about 6 months or more during most years with water on or above the surface for 4-6 months during the growing season.

Riviera fine sand, frequently flooded is described as a nearly level and poorly drained soil in broad to narrow floodplains and drainage ways on the flatwoods and is also in a few upland areas. The soil is flooded for long periods during rainy seasons with a water table within 12 inches of the surface during dry periods.

Myakka fine sand, depressional is described as a nearly level very poorly drained soil found in depressional areas on the flatwoods and in a few places on the uplands. In most years, the soil has a high water table 1-2 feet above the surface for 6-9 months.

Wetland Vegetation-
The US Fish and Wildlife Service National Wetlands Inventory maps identified 10 classes of wetlands adjacent to Lake Melrose (Fig. 6). These classes are presented in Table 3.

Table 3. Classified wetlands mapped at Lake Melrose by the US Fish and Wildlife Service.

Wetland Id	Wetland Class/Hydroperiod Category
L1OWH	LACUSTRINE LIMNETIC OPEN WATER Permanently Flooded
PFO1A	PALUSTRINE FORESTED Broad-Leaved Deciduous Temporarily Flooded
PFO1C	PALUSTRINE FORESTED Broad-Leaved Deciduous Seasonally Flooded
PFO3/4B	PALUSTRINE FORESTED Broad-Leaved Evergreen/Needle-Leaved Evergreen Saturated
PFO4A	PALUSTRINE FORESTED Needle-Leaved Evergreen Temporarily Flooded
PFO4C	PALUSTRINE FORESTED Needle-Leaved Evergreen Seasonally Flooded
PFO6/4C	PALUSTRINE FORESTED Deciduous/Needle-Leaved Evergreen Seasonally Flooded
PFO6F	PALUSTRINE FORESTED Deciduous Semipermanently Flooded
PFO7/1B	PALUSTRINE FORESTED Evergreen/Broad-Leaved Deciduous Saturated
PSS3C	PALUSTRINE SCRUB-SHRUB Broad-Leaved Evergreen Seasonally Flooded

Transect #1 (Fig. 7)
Transect #1 was located on the west shore of Lake Melrose (Fig 1) and traversed a portion of a maple swamp. This community was dominated by red maple, royal fern and cinnamon fern with wax myrtle near the waterward end of transect and button bush, virginia chain fern, highbush blueberry, swamp bay, swamp blackgum, dahoon holly, virginia sweetspire, and slash pine. Wetlands were identified as Palustrine Forested Broad-leaved Deciduous Seasonally Flooded (PFO1C) by the USFWS Service. The mapped hydric soil was Terra Ceia muck, frequently flooded (Putnam Co. MUID#26; Terra Ceia muck, Alachua Co. MUID#63). Muck depths >2.8 ft were measured at stations 100, 200, 300, and 332 feet along the transect.

Transect #2 (Fig. 8)
Transect #2 was located on the northeast shore of Lake Melrose (Fig 2) and traversed a narrow littoral shrub marsh, mixed swamp, bay swamp and terminated in low flatwoods. The littoral shrub marsh zone was characterized by buttonbush, maidencane, lizards tail, virginia chain fern, and yelloweye-grass. The mixed swamp zone was characterized by swamp bay, bamboo-vine, red maple, wax myrtle, swamp blackgum, sweet gum, cinnamon fern, and virginia chain fern. The bay swamp zone was characterized by fetterbush, swamp bay, red maple, black oak, laurel oak, and muscadine grape.

Wetlands were identified as Palustrine Forested Broad-leaved Deciduous Seasonally Flooded (PFO1C) by the USFWS. The mapped hydric soils were Samsula muck (Putnam Co. MUID #27) and Placid fine sand, depressional (Putnam Co. MUID #5).

The minimum levels for Lake Melrose are based upon two elevation transects and spot elevations measured by a District surveyor (Lee Amon), vegetation and soils analysis by ES staff, information contained in the Alachua and Putnam County Soil Surveys (SCS, 1985 and 1990), and the US Fish and Wildlife National Wetland Inventory map. Table 4 contains elevations of reference features measured at Lake Melrose.

Table 4. Spot, maximum, mean, and minimum elevations measured at Lake Melrose. Elevations are in feet NGVD.

Location	Feature	Spot	Max	Mean	Min	N
Transect 2	Waterward Palmetto Line	108.4				
Transect 2	Bay swamp		108.4	107.2	105.9	10
Lake Shore	Top of Docks		107.4	106.9	106.2	8
Transect 2	Waterward mucky sand	106.2				
Transect 2	Landward muck soil	105.9				
Transect 1	Average top of royal fern tussock		106	105.8	105.7	3
Transect 2	Mixed swamp (8-60 ft)		105.9	105.2	104	10
Transect 1	Maple swamp (16-330 ft)		106.6	104.6	104	36
Transect 1	Seasonally flooded swamp (50-110&160-275)		104.7	104.5	104	20
Lake	Stage data for period of record 5/91-present		106.87	104.07	103.23	2002
Lake Shore	Lake bed at end of docks		101.6	100.5	99.3	8
Open Water	Soundings across Lake (SW to NE transect)	96.3	97.6	96.3	95.4	10

Common and scientific names of plants species observed along the transects are presented in Table 5. Three levels with corresponding hydroperiod categories are recommended. Short descriptions of the functions of each minimum level and the related data used in their determination are presented below.

MINIMUM FREQUENT HIGH LEVEL

The Minimum Frequent High level (105.2 ft NGVD), and the assigned hydroperiod category of Seasonally Flooded corresponds to the average elevation of the mixed swamp present at transect #2.

This minimum level results in frequent inundation/saturation of the mixed swamp and muck soils measured at transects 1 and 2. Saturated soil conditions are expected in the bay swamp (transect #2), protecting the structure of these communities and maintaining existing hydric soils. This minimum level also results in 0.6 ft of water over the average elevation of the mixed swamp at transect #1 (as calculated from all elevations between stations 16-330 ft). This elevation also results in water levels that are 0.6 ft lower than the average elevation of the top-of-tussocked royal ferns measured at transect #1 (mean elevation=105.8 ft NGVD). This recommended minimum level allows water levels of sufficient frequency and duration to: 1) inhibit the invasion of the mixed swamp and littoral zone by upland plant species and 2) allow fish and other aquatic species access to these wetland resources. This recommended minimum water level is also 1.7 feet below the maximum recorded water level (106.9 ft NGVD) for the period of record and 3.2 ft lower than the palmetto line at transect #2.

This minimum water level also corresponds to the approximately the 10th percentile of exceedence on the duration curve (Fig 5) developed from a short period of record. The period of record is considered to be relatively short and the duration curve may not be representative of long-term water levels of the lake because these data were collected during a period when other lakes in the area were also experiencing very low water levels. The presence of a dense palmetto line at 108.4 ft NGVD supports this hypothesis. Alternatively, the outfall elevation (hydraulic control) of the lake may have been lowered resulting in lake-level fluctuations that are lower than historic. The dock height elevations appear to support this hypothesis because the highest measured dock was at 107.4 ft NGVD. Additionally, aerial photography (Fig. 9) shows that woody species (maple swamp at transect #1) have been replacing herbaceous vegetation since the late 1930's. This transition from herbaceous to woody vegetation may be from a lowered hydraulic control or from generally lowered lake levels because of drier conditions during the past several decades. The change of herbaceous to woody wetlands adjacent to Lake Melrose does not appear be the result of logging and regrowth of the swamp (Ed Denton, pers. comm.). Computer modeling and continued monitoring of water levels and wetland vegetation will be necessary to determine if the apparent lowered range of lake fluctuation is the result of short-term local hydrologic condition of the lake and associated Floridan Aquifer or because of changes to the outfall elevation.

Additionally, this recommended minimum level allows for approximately 4.7 feet of water at the waterward end of the average of 8 measured docks and is approximately 1.7 foot below the average top of deck elevation of measured docks.

MINIMUM AVERAGE LEVEL

The Minimum Average level (104.2 ft NGVD), with the assigned hydroperiod category of Typically Saturated was calculated by subtracting a quarter foot from the mean elevation (Hall, 1987) of the lowest portion (50-110 ft and 160-260 ft) of the mixed swamp (transect #1, 104.49 ft NGVD - 0.25=104.24 ft NGVD). The entire length of the swamp zone was not used because the 0.25 ft depth criteria was developed and used in marsh systems which are generally considered to be inundated/saturated for longer periods and more frequently than swamps. Additionally, mature slash pine were present at higher elevations along transect 1; slash pine is not a typical swamp species, and therefore only portions of the transect that were characterized as seasonally flooded swamp were used for the calculation of this level.

This minimum average level results in the inundation or saturation of the mixed swamp and muck soils present at transect #1 and #2 and the inundation of the existing aquatic beds adjacent to the lake. This minimum level protects muck soils from oxidation while allowing for wetland plant seed germination on the exposed muck soils present at higher elevations along the transects. This water level also corresponds to approximately the 35-40th percentile of exceedence on the stage-duration curve (Fig. 4). One would expect this minimum level to correspond to the 50-60th percentile of exceedence a long-term record of water level. As discussed above, a short period of record collected during a period of low lake levels or a lowered hydraulic control may explain this discrepancy.

Additionally, this recommended minimum level allows for approximately 3.7 feet of water at the waterward end of the average of 8 measured docks and is approximately 2.7 feet below the average top of deck elevation of measured docks.

MINIMUM FREQUENT LOW LEVEL

The Minimum Frequent Low level (102.8 ft NGVD), with the assigned hydroperiod category of Semipermanently Flooded, corresponds to the average elevation of the seasonally flooded maple swamp at transect #1 (104.49 ft NGVD, as calculated from stations 16-110 ft and 160-275 ft)) minus 1.67 ft which reflects a 20 inch drawdown. A twenty inch reduction in the soil water table is considered reasonable for a moderate drought.

This minimum level allows for drawdown conditions in the muck soils present in the maple and mixed hardwood swamps (transects #1 and #2, respectively) while inundating the littoral zone adjacent to the lake. This drawdown will promote aerobic soil conditions which stimulate decomposition and promote seed germination, while protecting fish habitat during low water conditions. This water level is 0.4 ft lower than the minimum recorded water level from this system (Fig. 4). Increasing the range of fluctuation may be beneficial to fish populations of a system with a relatively narrow hydrologic range.

Additionally, this recommended minimum level allows for approximately 2.3 feet of water at the waterward end of the average of 8 measured docks and is approximately 4.1 feet below the average top of deck elevation of measured docks.

Please call me (ext. 4343), Jane Mace (ext. 4389) or Patty Valentine-Darby (ext. 2309) if you wish to discuss these minimum levels.

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CPN:bs

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attachments

c:	Kathryn Mennella	Hal Wilkening	Tommy Walters	Larry Battoe
	David Clapp	Ric Hupalo	Jane Mace	Larry Fayard
	Sandy McGee	Price Robison	Bob Freeman	MFL-REG Tech
	Patty Valentine-Darby			

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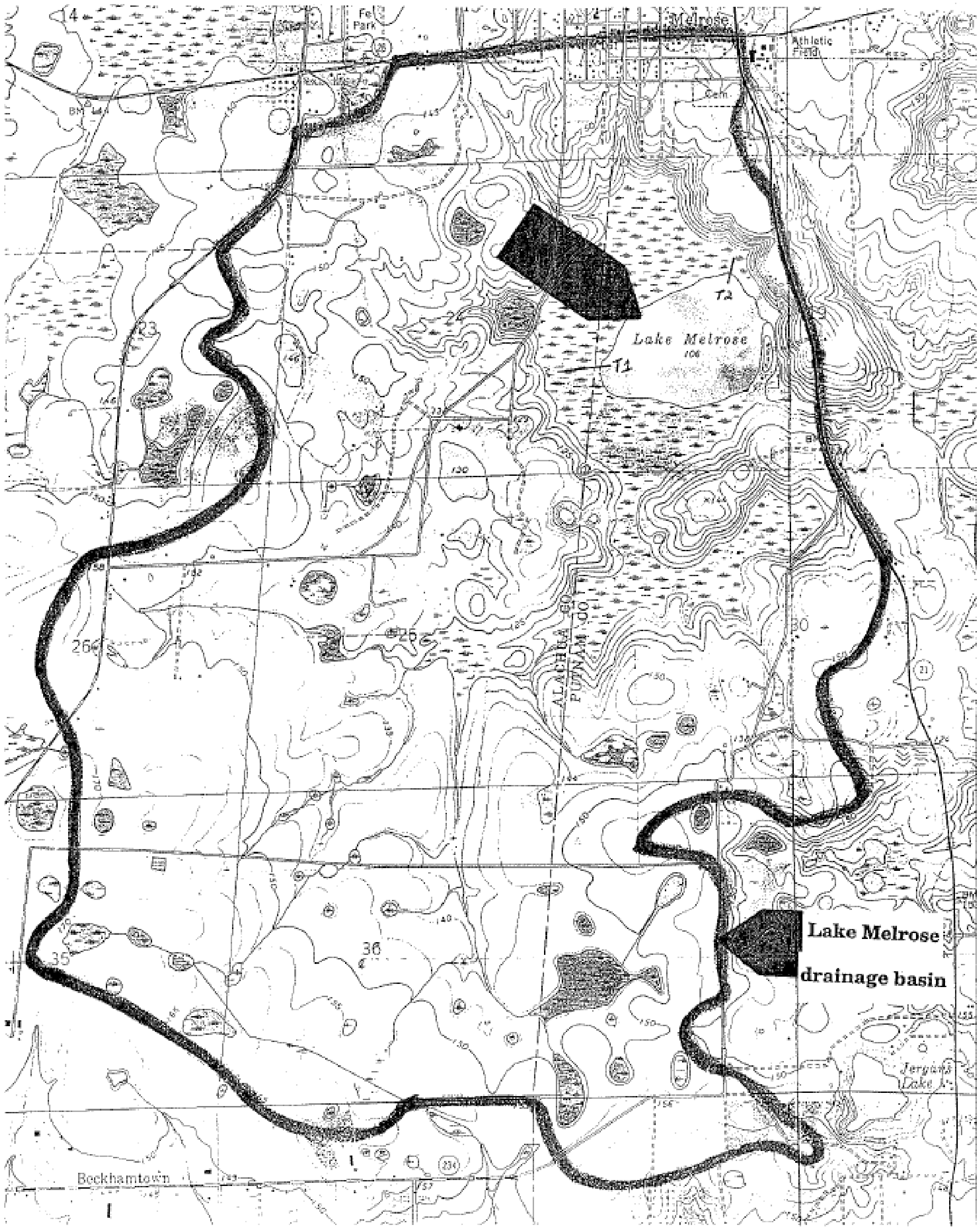
Table 5. Plant species, common names, with DEP and USACOE wetland classes found along transects #1 and #2.

SPECIES	COMMON NAME	DEP	USACOE
Acer rubrum	red maple	FACW	FAC
Blechnum surrulatum	sawfern blechnum	FACW	FACW+
Cephalanthus occidentalis	buttonbush	OBL	OBL
Crinum americanum	swamp-lily	OBL	OBL
Dryopteris ludoviciana	louisiana woodfern	FACW	FACW
Fraxinus caroliniana	water ash	OBL	OBL
Gordonia lasianthus	loblolly bay	FACW	FACW
Ilex cassine	dahoon holly	OBL	FACW
Itea virginica	virginia sweetspire	OBL	FACW+
Magnolia virginiana	sweetbay	OBL	FACW+
Myrica cerifera	wax myrtle	FAC	FAC+
Nyssa biflora	swamp blackgum	OBL	OBL
Nuphar luteum	spatter-dock	OBL	OBL
Osmunda cinnamomea	cinnamon fern	FACW	FACW+
Osmunda regalis	royal fern	OBL	OBL
Peltandra virginica	arrow-arum	OBL	OBL
Persea palustris	swamp bay	OBL	FACW
Pinus elliottii	slash pine	UPL	FACW
Quercus laurifolia	laurel oak	FACW	FACW
Saururus cernus	lizard tail	OBL	OBL
Serenoa repens	saw palmetto	UPL	UPL
Toxicodendron radicans	poison ivy	UPL	FAC
Ulmus americana	american elm	FACW	FACW
Vaccinium corymbosum	highbush blueberry	FACW	FACW
Vitis rotundifolia	muscadine grape	UPL	FAC
Woodwardia areolata	netted chain fern	OBL	OBL
Woodwardia virginica	virginia chain fern	FACW	OBL

Fig 1. Map indicating location of Lake Melrose, Putnam County. (from USGS 1:24000, Melrose quadrangle)



SJRWMD data)

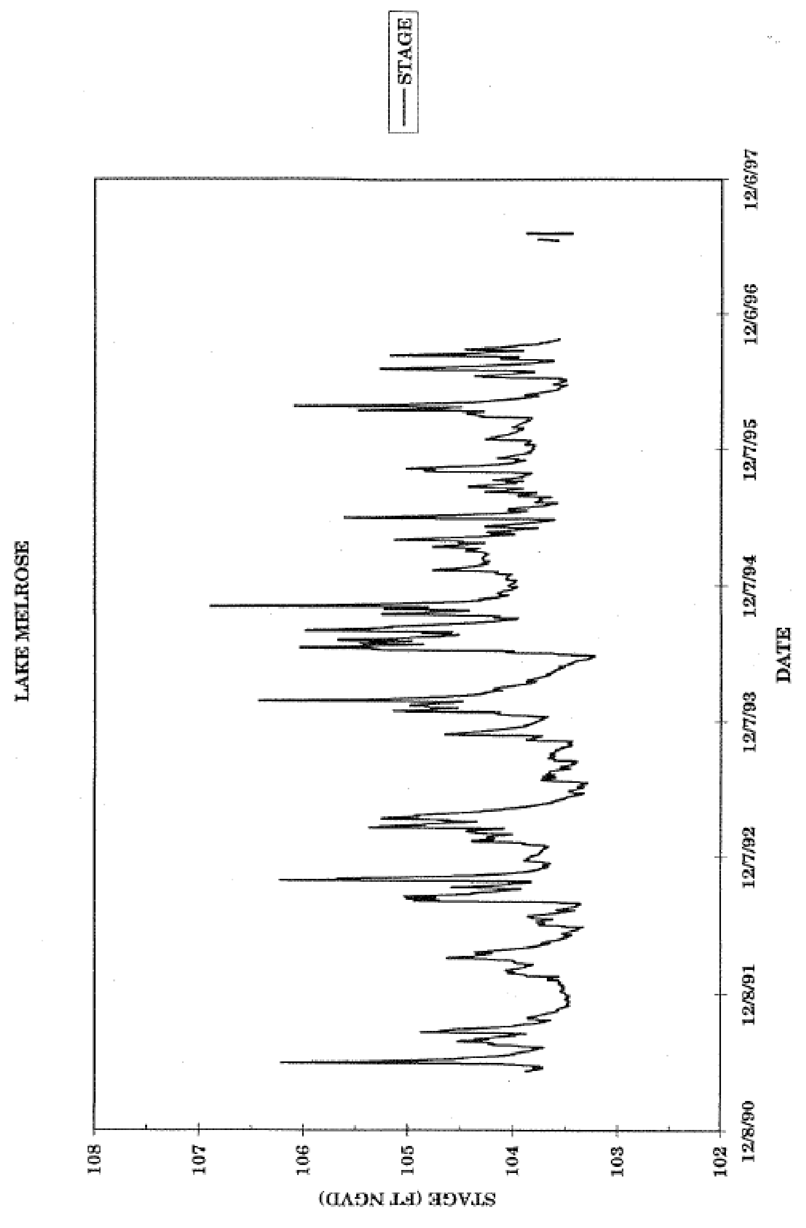

LAKE MELROSE
STAGE
STAGE (FT NGVD)
DATE
108
107
106
105
104
103
102
12/8/90
12/8/91
12/7/92
12/7/93
12/7/94
12/7/95
12/6/96
12/6/97

Fig 3. Percent exceedence curve for Lake Melrose, Putnam County (from SJRWMD data)

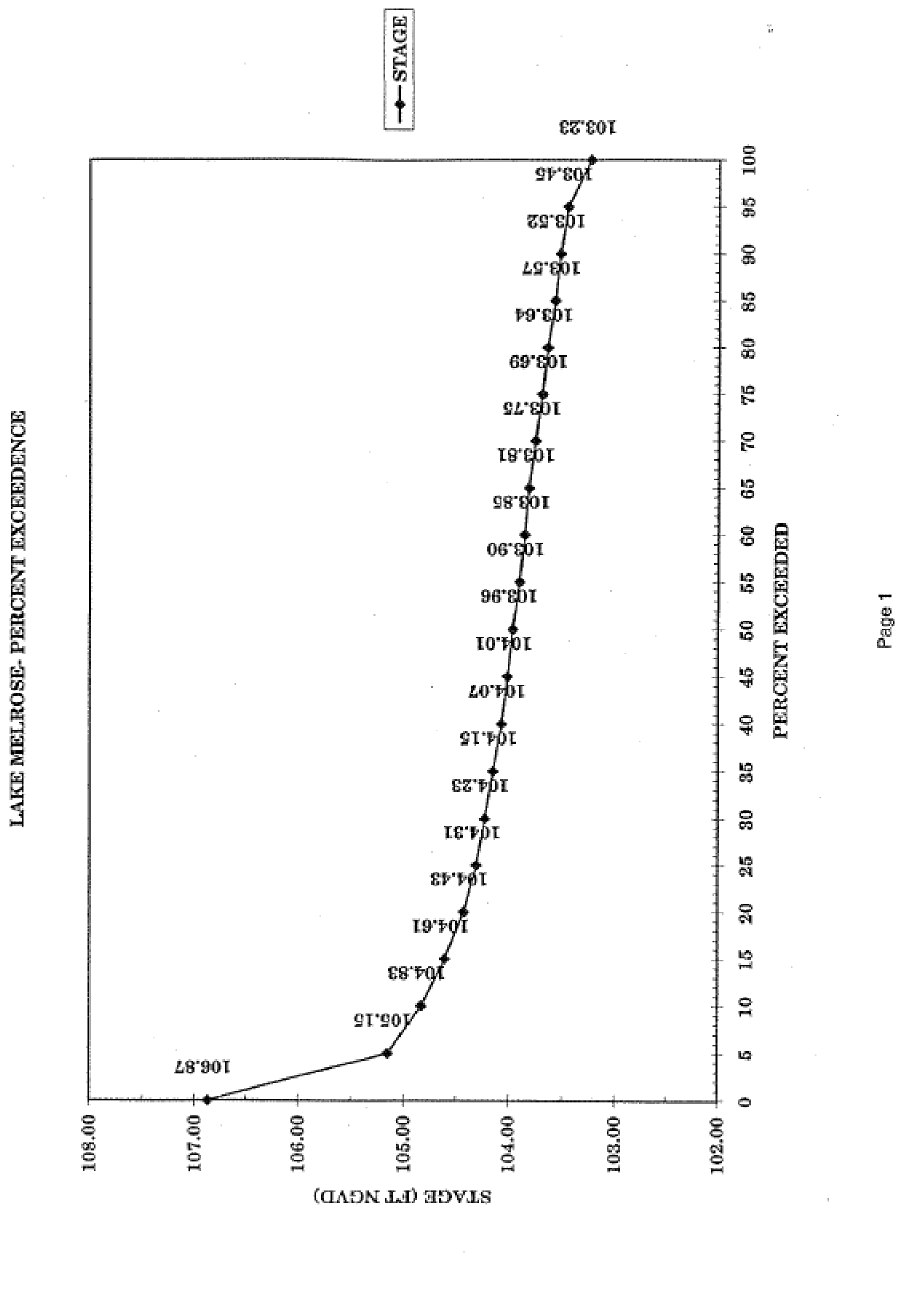


Fig 4. Water Mgt Permitted withdrawals near Lake Melrose, Putnam County (from SJRWMD files)

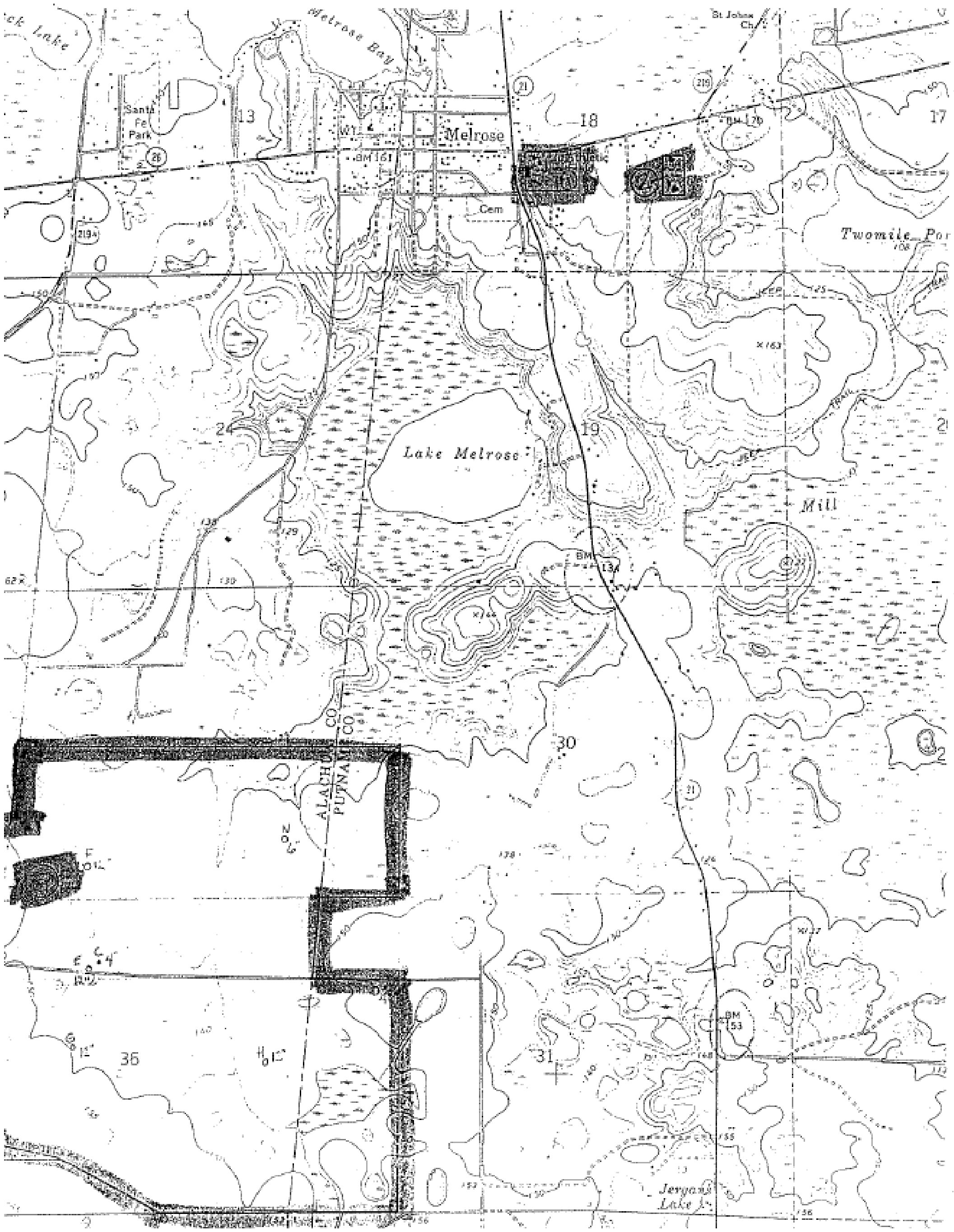


Fig 5. Soils map for Lake Melrose, Putnam County (from Alachua and Putnam Counties SCS maps.

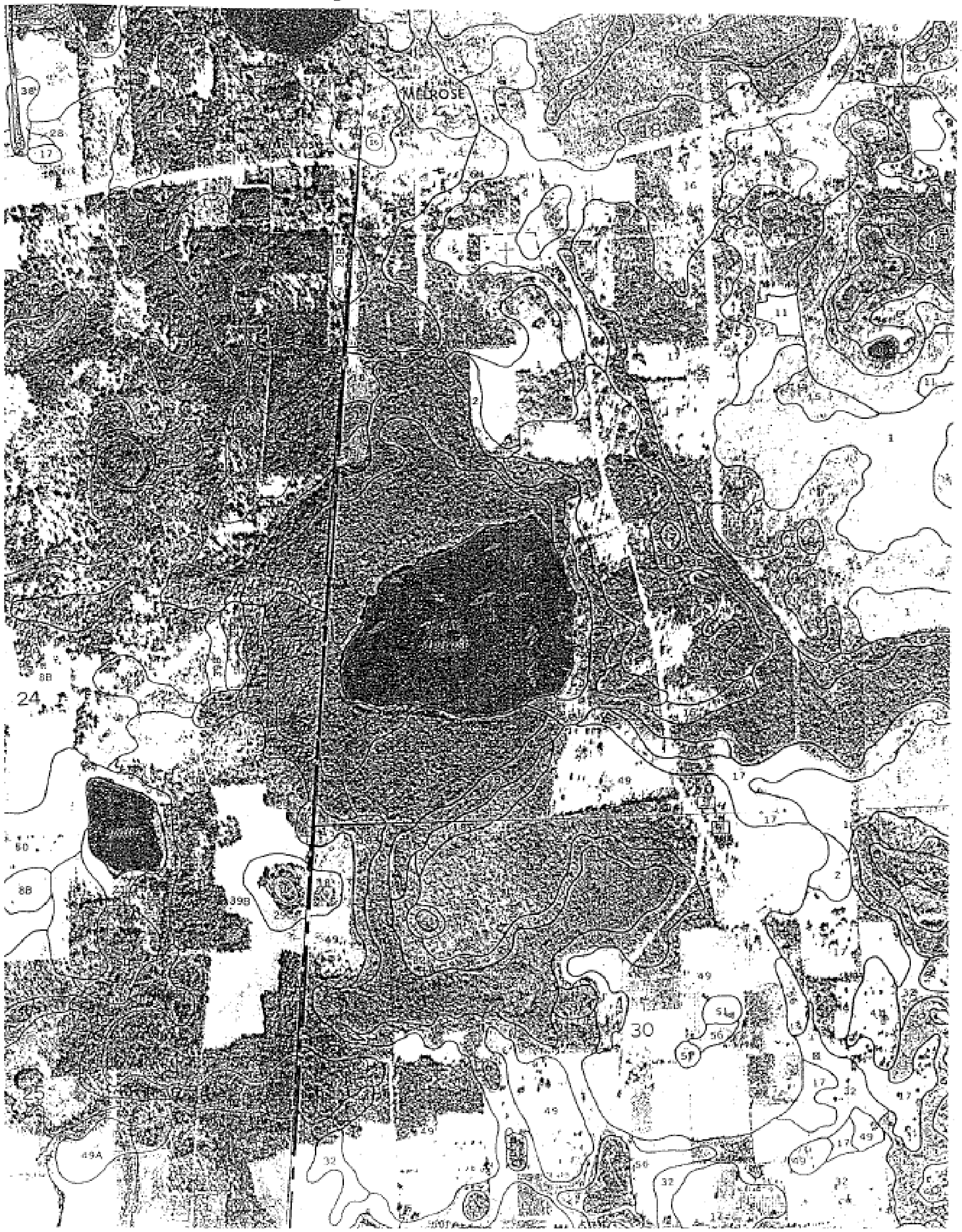


Fig 6. Classified wetlands near Lake Melrose, Putnam County (from US F&W wetland inventory maps, Melrose quadrangle).

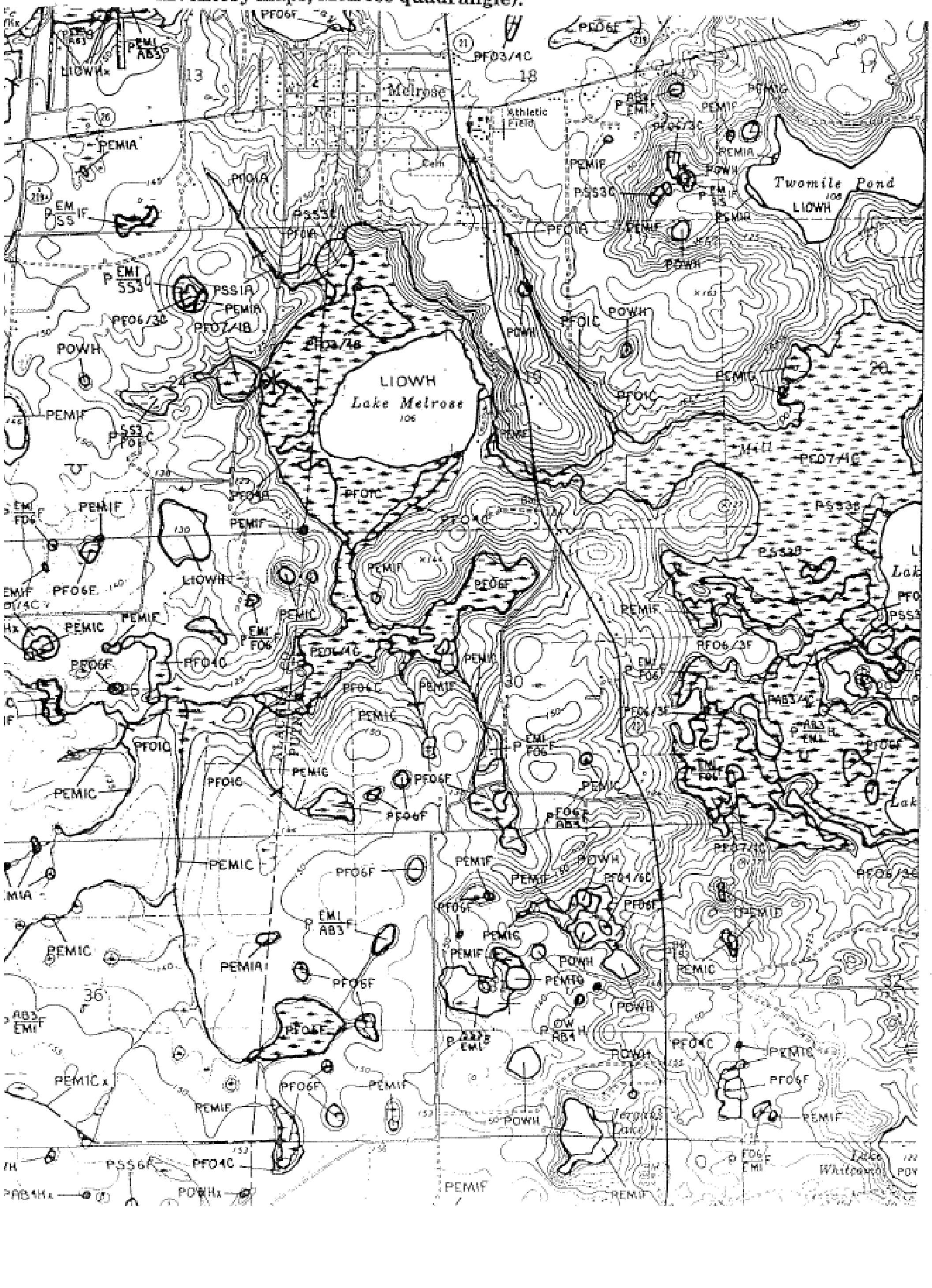


Fig 1. Elevation transect #1 from Lake Melrose, Putnam County

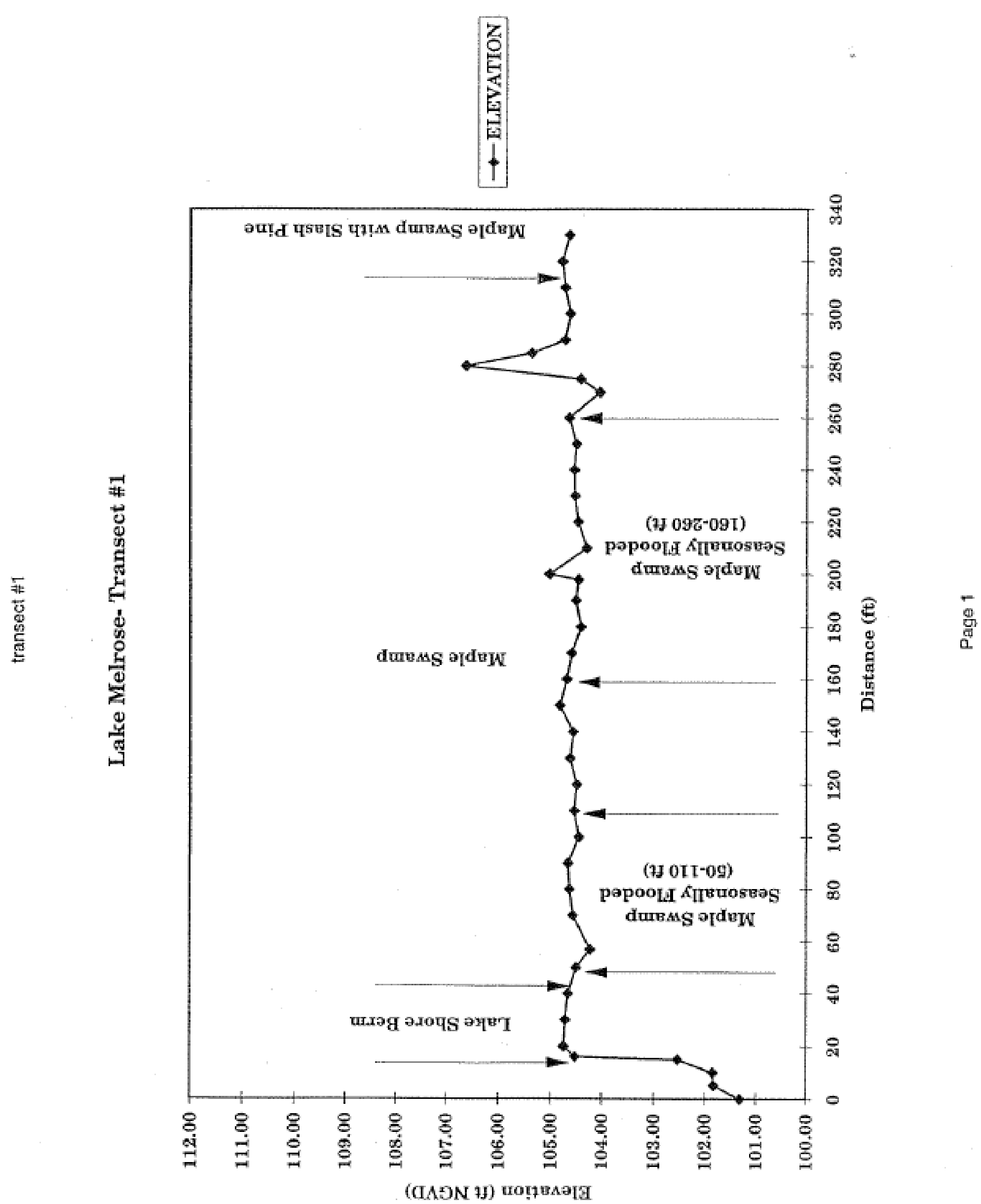


Fig 8. Elevation transect #2 from Lake Melrose, Putnam County.

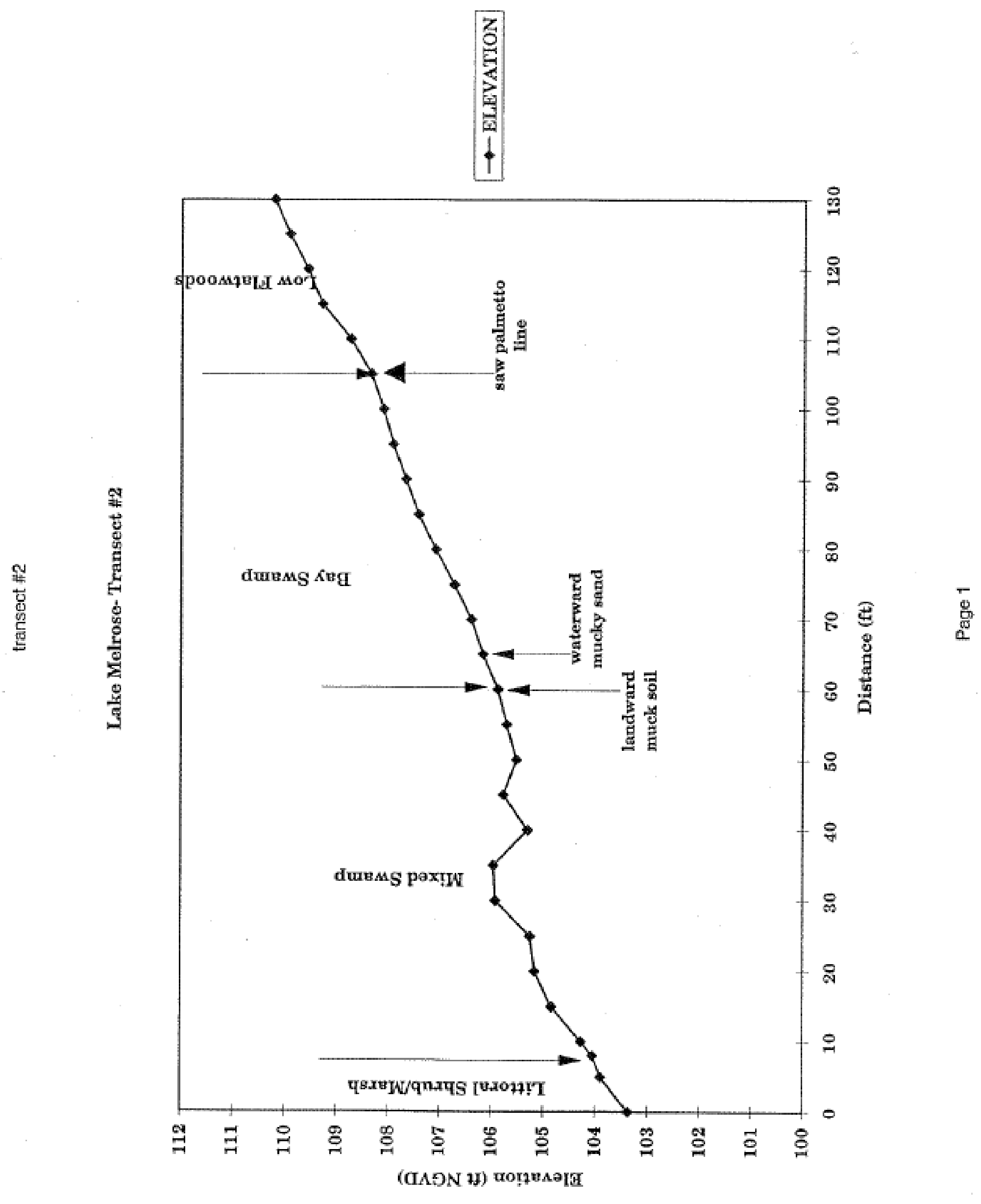
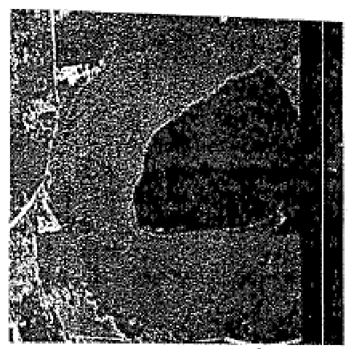


Fig 9. Aerial photographs from Lake Melrose, Putnam County. (Photo numbers: IT-10-65, CYZ-3C-58, PD 2806-18H-21, PD 3709-18-17, PD 3809-1-15, NAPP 6972-166)

IT-10-65 (12/21/37)

CYZ-3C-58 (1/31/43)

PD 2806-18H-21 (1/25/82)



PD 3709-18-17 (1/6/88)

PD 3809-1-15 (11/10/89)

NAPP 6972-166 (1/21/94)

APPENDIX B – PEER REVIEW COMMENTS AND RESOLUTION TABLE FOR LAKE MELROSE REEVALUATION

Lake Melrose, Putnam County
Peer Review Resolution Document by Jane Mace: Reviewers Bob Epting and Ivan Chou (ECT) and Lee Wilson (Lee Wilson and Associates)
February 12, 2013

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Epting	General Findings -	The reviewers conclude that the first-round review comments on the November 2012 draft document have been addressed by Ms. **Mace** in the January 2013 revision. The revisions noted in the resolution document (Attachment A) generally addressed the comments in the first-round review. ***Comment noted***
Epting	Supplemental Comment	Additional revision of the Executive Summary, as suggested in specific Comment No. 2, would be helpful in response to the general review comment that, “the report does not adequately state the objective reasons for the selection of Lake Melrose for reevaluation.”***Revised Executive Summary accordingly***
Epting	Supplemental Comment	The response to specific Comment No. 19 appears directed at the range of signatures (SWIDS) in Figures 19 and 20, when the comment was directed at the meaning of the annotation of cluster numbers, which are part of a lake classification. A simple explanation of the meaning of the term “cluster” in the context of lake classification would allow the reader to assess signatures with respect to lake classes. ***Agreed in final teleconference to remove the lake cluster information from Figures 19 and 20 to eliminate this complication. Figures 19 and 20 subsequently edited in final report.***
Epting	Supplemental Comment	The need for peer review comments to clarify common topics, e.g., the procedure for selecting water bodies for reevaluation, could be largely avoided if these topics where addressed in the MFLs methods manual and simply referenced in the MFL reports. This approach would ensure clarity and improve efficiency for staff and reviewers. ***Comment noted.***
Epting	Responses to General Findings	The report is logically organized into sections and subsections so that the reader can follow the presentation of the subjects. There are, however, some minor organization and presentation issues. There are inconsistent section references in the page headings. For example, the header beginning on page 8 is Introduction, the header on page 9 is Results and Discussion, followed later by MFLs Methodology, then again by Results and Discussion. ***Corrected the formatting of headers***.
Epting	Responses to General Findings	With respect to table and figure references, an aggregated list of figures and tables in the overview paragraph of a section is useful, but the reader would be better supported by the addition of specific references in the paragraphs that follow. Other than deep organic soils, the community profiles do not include annotation of the hydric soil indicators. ***Added soil HI notation onto Transects 2 and 3 charts. Transect 1 had deep organic soils to the upper end of the transect as shown on the graph.***

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Epting	Responses to General Findings	The text adequately describes the methods and quality assurance procedures, and statistical summaries of the 2011 environmental and hydrologic data are presented in tables and figures. There are, however, some deficiencies. The report does not adequately state the objective reasons for the selection of Lake Melrose for reevaluation. ***Edited the Executive Summary to more clearly state reason for reevaluation***.
Epting	Responses to General Findings	Split moving windows (SMW) analysis would be a useful comparison to the expert results; however, there is no mention of line-intercept vegetation sampling. ***SWMs are not being performed at most MFL sites due to cost benefit.***
Epting	Responses to General Findings	The transects from the 1997 field investigation are mentioned only twice, the results are not included in the data summaries and not considered in the reevaluation, either for support or exclusion. Because there is no long-term wetland monitoring program, the presentation of temporal changes in lake vegetation communities would be particularly relevant to the reevaluation. ***Did not discuss the 1997 transects because the exact location of them is unknown. Also, due to no public land at Lake Melrose, this is not preferable site for long-term monitoring.***
Epting	1.)Executive Summary page v, paragraph 1, line 3 "The SJRWMD Governing Board adopted (MFLs) for Lake Melrose… "	The acronym MFLs is previously defined, parentheses not required. ***Corrected***
Epting	2.) Executive Summary page v, paragraph 1, line 7 "A subsequently completed hydrologic model for Lake Melrose (CDM 2005) indicated that the adopted 1998 MFLs were not being met… "	Suggest preferencing this text with a statement such as, "Lake Melrose was selected for reevaluation based on the review criteria…" Comment also applies to the first paragraph of the introduction. ***Revised***
Epting	3.) Executive Summary page viii, last line "ft NGVD = feet National Geodetic Vertical Datum 1929; ft NAVD – feet North American Vertical Datum 1988 "	The annotation should be footnoted or included in the table legend.***Edited***
Epting	4.) Introduction page 4, paragraph 3, line 1 "A fundamental assumption of the MFLs program is that the ecology of a system (e.g., locations of wetland communities and the upland ecotone) is dependent upon hydrology."	Unclear why it is necessary to state this as an assumption. ***Stating basis of MFLs***
Epting	5.) Introduction page 5, paragraph 1, line 4 "…possibly the result of multi-decadal climatic cycles (Enfield et al. 2001)… "	Suggest also citing Kelly et al (2004) ***Added Kelly and Gore 2008***
Chou	6.) page 7, Figure 1	The title of the figure is a statement rather than a title. ***Edited the figure title***

Appendix B

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Epting	7.) Introduction page 9, paragraph 4, line 5 "Lake Melrose stage is very stable with typical stage fluctuation less than one foot…"	Unclear how the lake can be considered very stable based on the stage ranges in Figure 7. Consider recasting as "short-term fluctuations typically...", or "XX percent of time the stage is between Y1 and Y2," or "as compared to other sandhill lakes…" ***Figure 7 supports comment that Lake Melrose is very stable.***
Epting	8.) Methods, page 26, Figure 11	Recommend reformatting the figure in landscape. ***Rotated figure.***
Epting	9.) Methods, page 33, paragraph 3, line 5 "The hydrologic model was calibrated for 2003 hydrologic conditions."	Unclear why a 2011 reevaluation would be based on 2003 hydrologic conditions. Was 2011cumulative Floridan drawdown evaluated? ***Model performed by CDM with report finalized in 2005, thus data modeled up to 2003.***
Epting	10.) Results and Discussion, page 34, Table 2; page 49, Table 6; page 63, Table 10	Suggest combining these single row tables into a summary table in the overview section of the transect results. Also, the legend should identify Lake Melrose as the location of the transects. Longitude and latitude should include north, south, east, or west notation.***Edited tables; keeping them separate.***
Epting	11.) Results and Discussion, page 41, Table 3	The annotation should be included in a footnote, or in the figure legend. ***Edited.***
Epting	12.) Results and Discussion, page 47, Table 5	Table 5 should be formatted as a table or moved to an appendix. ***Formatted as table***
Epting	13.) Results and Discussion, page 54, .Table 7	The formatting of the columns is inconsistent, and the annotation requires footnoting. ***Formatted as table***
Epting	14.) Results and Discussion, page 61, Table 9	Table 9 should be formatted as a table or moved to an appendix. ***Formatted as table***
Chou	15.) Pages 70 through 72, Table 12	Note Nos. 2 (plant communities) and 3 (estimates) are not shown in the footnotes. The footnote convention should be consistent with Tables 4 and 8. Many abbreviations (e.g., OBL, HS, etc.) are not explained. ***Corrected***
Epting	16.) Results and Discussion, page 75, Table 13	Table 13 should be formatted as a table or moved to an appendix. ***Formatted.***
Epting	17.) Results and Discussion, page 79, paragraph 1, line 1 "The environmental value, "fish and wildlife habitats and the passage of fish," was determined to be the most limiting environmental value to the further development of consumptive uses of surface and/or regional ground water, and the primary criterion on which the Lake Melrose MFLs were developed."	Aside from the subjective evaluation of the ten water resources values (WRVs), the text should more fully develop the connection between the MFLs methodology and protection of fish and wildlife as the most sensitive environmental value. Table 18, or the derivation of Table 18, should be referenced to strengthen the statement. ***Added verbage to more strongly tie the MFLs to fish and wildlife WRV***
Epting	18.) Results and Discussion, page 87, Table 14	The table legend should identify Lake Melrose as the location for the transects. Provide reference to Figure 6 for transect location. ***Edited table title.***

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Epting	19.) Results and Discussion, page 89, Figure 19; page 93, Figure 20;	Neither the figure legend for Figure 19 nor the report text present the meaning of the term "cluster" or what bearing, if any, it has on the discussion of hydrologic signatures for wetland communities. ***SWIDS of vegetation communities provide a hydrologic range for each community, with a transition to a drier community on one side of the range and a transition to a wetter community on the other side. Thus not typically expressed as a "cluster".Also removed the "cluster" lake list from the figure for simplification.***
Epting	20.) Results and Discussion, page 90, Table 15	The table legend should identify Lake Mel-rose as the location for the transects. ***Edited to include Lake Melrose in title***
	21.) Results and Discussion, page 95, Table 16	The table legend should identify Lake Mel-rose as the location for the transects. ***Edited to include Lake Melrose in title***
Epting	22.) Results and Discussion, page 101, Table 17	The table legend should identify Lake Mel-rose as the location for the transects. ***Edited to include Lake Melrose in title***
Epting	23.)Results and Discussion, page 110, Table 19	The annotation should be footnoted or in-cluded in the figure legend. Placing NGVD and NAVD under the same header can be confusing. Recommend putting them in separate columns.***Simplified this table by stating new levels only in 1988 datum. This should also ensure new levels are not adopted in 1929 datum.***
Epting	24.) Literature Cited, page 111, Literature Cited	The titles of the references display a mix of fonts, where some are in italics and others are not, probably due to copying and pasting from another document. ***Reformatted***
Epting	25) Literature Cited, page 113, paragraph 1, line 1 "es. Florida Scientist 42(4):222–228."	Orphaned line of citation and not indented. ***Edited***
Wilson	Primary comment –Nov 14, 2012	1.) I continue to hold the opinion that the SJRWMD MFL program is scientifically sound and at the forefront of the application of ecological principles to protection of instream flows.
Wilson	Primary comment- Nov 14, 2012	2.)As I have come to expect, Dr. Mace has prepared a good report, for which my comments are mostly on minor technical points and editorial matters.

Appendix B

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Wilson	Specific comments - Nov 14, 2012	3.)It appears that the new MFLs are now met (assuming a repeat of historic climate) but there is no room for increased consumptive use of groundwater, even though the lake is perched. If this is correct, it perhaps should be stated. ***Added this sentence in second paragraph of exec summary. "The new recommended MFLs are now being met but there is no additional water available for consumptive use at or near Lake Melrose."***
Wilson	Specific comments - Nov 14, 2012	4.) Fonts and formats seem to vary throughout the document. This is a heads up to check that closely after the report has gone through the editing process. ***Most of this has been rectified and ultimately this will be taken care of by our document production staff.***
Wilson	Specific comments - Nov 14, 2012	5.) Page vi. I suggest the paragraph relating to NAVD and NGVD be condensed into a footnote to Table ES-1 and that no NGVD elevations be given in the main report. ***I deleted this paragraph and added a footnote as you suggested and stuck with NAVD for the remainder of the report.***
Wilson	Specific comments - Nov 14, 2012	6.) Figure 3 would benefit from a small-scale map showing the lake location within a larger area, such that most people would have a sense of where in Florida it lies. Or give coordinates so people can find it on Google Earth. ***I updated Figure 3 to include lat longs and also inserted a google map link to the report, immediately below Figure 3 title.***
Wilson	Specific comments - Nov 14, 2012	7.) There is a definite downward trend in the lake stage (Figure 7) which deserves mention in the text. If one considers the 2000s data representative of the future, then are MFLs really being met? Another way of thinking about this is that the left side of the stage duration curve (Figure 8) is biased by older data, and the right side is dominated by recent data. ***Added this - Lake Melrose experienced a recorded low stage during 2011 but has responded to rainfall in 2012. Rainfall data collected at a nearby site (70103367; SJRWMD rainfall gage) indicated below normal rainfall for the past five years with rainfall for 2011 equal to 28.9 inches where the average annual rainfall equals 51 inches. (http://www.sjrwmd.com/hydroconditionsreport/archive/).***

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Wilson	Specific comments - Nov 14, 2012	8.) Figure 9. Floating marsh is an important component of each transection, and a symbol for it is in the legend of this map, but there is no floating marsh shown on the map. ***The wetland map is great but not perfect thus delineated floating marsh as deep marsh. Also, the wetland map delineates the hardwood swamps as hydric hammock. I updated Figure 9 Also I added the comment in report … Detailed wetland community descriptions contained herein vary from those mapped due to map scale and are presented in the Results and Discussion section.***
Wilson	Specific comments - Nov 14, 2012	9.) Figure 9. There appear to be symbols on each transect; these should be identified in the legend or removed. This comment applies to several other figures. ***Corrected where needed***
Wilson	Specific comments - Nov 14, 2012	10.) Figure 10. Impossible to understand as now printed. ***Updated the soils figure and deleted unnecessary labels and made existing labels legible.***
Wilson	Specific comments - Nov 14, 2012	11.) Table 1. Not clear to me why navigation has a resource value of 3. Some of the other 3s on this chart seem worth a second look. ***Changed navigation resource value to a 1 as boating at Lake Melrose is protected under the Recreation value.***
Wilson	Specific comments - Nov 14, 2012	12.) Given the minimum alterations to this lake (p. 78) the section on consideration of alterations (p. 32) seems too long. A***gree but a lot of this section on pg 32 is background and modeling considerations, most of which is considered along the way to determining no major basin altercations, so choosing to leave this as is.***
Wilson	Specific comments - Nov 14, 2012	13.) Table 5, p. 47. This and the other transect soil tables are hard to follow because they look like text. I suggest a true table format with the left column being the location and the right column the indicator info. ***Formatted these into tables.***
Wilson	Specific comments - Nov 14, 2012	14.) P. 80. If levels equal the FH level occur at least 30 continuous days in the growing season at least every 2 to 3 days on average, does that match the statement that FH criterion typically relates to flooding approximately 20% of the time? ***Yes.***

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Wilson	Specific comments - Nov 14, 2012	15.) There is a consistent reference to basing MFLs on T1 and T2; later on we understand the higher levels at T3 may relate to seepage. Seems like this is an important component of the MFL evaluation that needs to be presented sooner. ***Bottomline is the elevations are out of sync at transect 3 with transects 1 and 2. Seepage is my hypothesis. Hardwood swamp vegetation appears drier but still qualifies as a HS at Tran3. The more this is discussed, the more gray our methodology appears, versus reality that wide range of hydrologic conditions may exist for a hardwood swamp. Thus, hardwood swamps are not all the same hydrologically or vegetatively/ecologically. In the case of Lake Melrose we emphasize Transects 1 and 2 due to higher quality HS and fact that these two sites have nearly identical elevations and lack the relatively steep topography at the upper end that occurs at Transect 3.***
Wilson	Specific comments - Nov 14, 2012	16.) The fact that there is so much relatively flat swamp around this lake is unusual and also deserves more emphasis. ***The wetlands are extensive at Lake Melrose. And, yes, a lot of wetlands at Lake Melrose compared to nearby sand hill lakes. However, just north of Lake Melrose at Lake Santa Fe extensive hardwood swamp exists, and to the south there are extensive wetlands at nearby Lake Winnot. Further south extensive wetlands are located at the Orange Creek basin lakes. Recent focus on the extremely different sand hill lakes may make Lake Melrose appear unique when it is not.***
Wilson	Specific comments - Nov 14, 2012	17.) P. 83. this entire section is good info. but reads as though it hasn't yet been subject to a rewrite that would present the information in a more organized fashion (i.e. big picture introduction and the individual components in labeled sub-sections). ***Completely reorganized this section where each level has an introduction section, followed by individual rationale sections for the magnitude, duration and return interval components.***
Wilson	Specific comments - Nov 14, 2012	18.) P. 86. If you really relied on SWIDs, I suggest more discussion. If not, delete? ***Did not rely on SWIDS but included the SWIDs info as proof that SWIDS were considered regarding Lake Melrose reevaluated MFLs.***

Peer Review Comments – November 14 and 16, 2012; January 17, 18, and 23, 2013		
Reviewer	**Text Reference**	**Peer Review Comments and resolution**
Wilson	Specific comments - Nov 14, 2012	19.) P. 88. Looking at this, and considering a potentially drier future, perhaps the MFH could be lowered a half foot or so? ***Our stance is that if/when we experience a drier future we will have to perform re-evaluations on many systems, including Lake Melrose*.**
Wilson	Specific comments - Nov 14, 2012	20.) Table 18. Regarding safe operation of motor boats, remind me why we used a canoe on the field trip! ***We used the canoe to facilitate access. No public boat ramp and the homeowner who is a volunteer staff gage reader allows us to access the lake via his yard but it's difficult to launch a motor boat in his yard due to negotiating the boat trailer thru the trees and yard art. There are approximately a dozen motor boats docked on Lake Melrose in the 10-18' boat size range.***
Wilson	Specific comments - Nov 14, 2012	21.) Table 18. Hard to evaluate water quality ranking when (if I recall correctly) there is no information ever given about water quality – at a minimum should indicate lack of current problems. ***Water quality data has not been collected at Lake Melrose. However, WQ is an important environmental resource for Lake Melrose. Lack of WQ data was added in Table 18 under the Discussion column for the WQ resource value.***
Wilson	General comment – January 18 2013 memo	First, I previously commented on the benefit of adding a small-scale location map to Figure 3, and offered the alternative of providing coordinates so people can find it on Google Earth. Dr. Mace did the latter, which satisfies that comment. However, after seeing the revised map, and considering how inset location maps have been so helpful in other reports, I suggest she also consider adding such a map to Figure 3. The recent change to Figure 3 of the Como Chain of Lakes report illustrates the idea. .***Added a small location map to Figure 3.***
Wilson	General comment – January 18 2013 memo	Second, regarding Table 1, I originally questioned why navigation has a resource value of 3. Dr. Mace indicated the rating reflected the value of the lake for recreational boating. I'd ask this be reconsidered, as there already is a separate rating in the table for recreation. In prior MFLs I recall only seeing a high rating of importance for navigation when a water level impacted boat passage along a river or between intermittently connected lakes. ***After further discussion changed navigations resource value to a 1 with the rationale being that navigation is protected under recreation, especially since there is not an issue of lake lobe connectivity at Lake Melrose.***