APPENDIX E — WATER RESOURCE VALUE (WRV) ASSESSMENT

WATER RESOURCE VALUES (WRVS) ASSESSMENT:

In establishing MFLs for water bodies pursuant to Section 373.042 and Section 373.0421, F.S., SJRWMD identifies the environmental value or values most sensitive to long-term changes in hydrology. 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 for which the most sensitive environmental value is the maintenance of organic soils, the recommended MFLs would provide the minimum hydrology necessary to ensure no net loss of organic matter due to oxidation or subsidence. Protecting the most sensitive environmental value or values for each water body ensures that all relevant Rule 62-40.473, F.A.C. environmental values are protected.

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 saltwater 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 purpose of this environmental value is to protect, from significant harm due to water withdrawal, an adequate amount of freshwater for non-consumptive uses and environmental values associated with coastal, estuarine, riverine, spring, aquatic, and wetlands ecology. This value encompasses all other environmental values identified in Rule 62-40.473 F.A.C.. Because the overall purpose of the MFL is protect environmental resources, and other non-consumptive beneficial uses while also providing for consumptive uses, this environmental value is considered protected if the remaining relevant values are protected.

6. Aesthetic and scenic attributes—Those features of a natural or modified waterscape usually associated with passive uses, such as birdwatching, sightseeing, hiking, photography, contemplation, painting and other forms of relaxation, that usually result in 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 upon 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.

Consideration of these values is meant to ensure that recommended MFLs protect the full range of water-related functions that provide beneficial use to humans and ecological communities. However, all 10 WRVs are typically not applicable to a specific priority water body because of the varying hydrologic characteristics (e.g., riverine vs. lake systems or the presence/absence of tidal influence). The suite of 10 WRVs listed above were divided into the following three groups based on relevance to Sylvan Lake and also based on whether they protect ecological versus non-ecological structure and function.

- Group 1: WRVs 3, 8 and 10
- Group 2: WRVs 2, 4, 5 and 7
- Group 3: WRVs 1, 6 and 9

Group 1: WRV3, WRV8 and WRV10

The three WRVs in Group 1 were determined not applicable and thus were not considered as part of this assessment:

WRV 3 – Estuarine resources:

This environmental value is not relevant because the lake is land-locked (except during extremely high flooding events) and generally has no surface water connection to any estuarine resources. Therefore, WRV-3 was not considered in this evaluation;

WRV8 – Sediment loads:

Transport of inorganic materials as bed load is considered relevant only in flowing systems, where riverine fluvial dynamics are critical to maintenance of geomorphic features (i.e. bed forms and the floodplain) and their associated ecological communities. Lakes serve as sinks instead of sources of sediment load, and therefore WRV-8 was not considered in this evaluation;

WRV10 – Navigation:

The primary navigation on Sylvan Lake is by recreational boaters. As such, this WRV is addressed under WRV1 (Recreation in and on the water).

Group 2: WRV2, WRV4, WRV5, and WRV7

The four WRVs in Group 2 are closely associated with and depend on the ecological functions and biochemical processes provided by the wetland communities surrounding Sylvan Lake. The event-based MFLs are designed to protect these important ecological functions and biochemical processes by protecting the resident wetland communities from significant harm. The three Sylvan Lake minimum levels (FH, MA and FL) were developed to ensure protection of the entire hydrologic regime and are based on the protection of 1) transitional shrub communities and associated wildlife habitat values; 2) organic soils and seasonally flooded wetland habitat; and 3) shallow and deep marsh habitats. The most constraining minimum levels are based on the protection of shrub wetlands, shallow marsh and deep marsh communities. These constraining event-based MFLs provide protection for each of the four WRVs in this group.

WRV 2 – Fish and wildlife habitat and the passage of fish:

WRV 2 is meant to ensure the consideration and protection of aquatic and wetland environments required by fish and wildlife, including endangered, endemic, listed, regionally rare, recreationally or commercially important, or keystone species. The recommended MFLs for Sylvan Lake are based on the protection of fish and wildlife habitats, providing a sufficient frequency of high water (flooding) events and preventing too many low water (drying) events to ensure existing wetland communities are maintained. These wetlands include extensive shallow and deep marsh habitats that provide important refuge habitat for small forage fish and juveniles of game fish that form the base of production for larger fish, birds and other wildlife. Shallow marshes provide important refugia and forage habitat for invertebrates, fish, mammals, birds, and other wildlife. Therefore, compliance with all three recommended MFLs (FH, MA and FL) provides for the protection of "fish and wildlife habitats and the passage of fish" for Sylvan Lake.

<u>MFLs Condition and Organic Soils Protection</u>

As described above, the recommended MFLs provide protection for wetlands structure and functions. The MFLs Condition, based on the FL, yield a minimum median and a minimum mean lake level that both equal 38.2 ft (NAVD88; Figure 1). An exceedance of

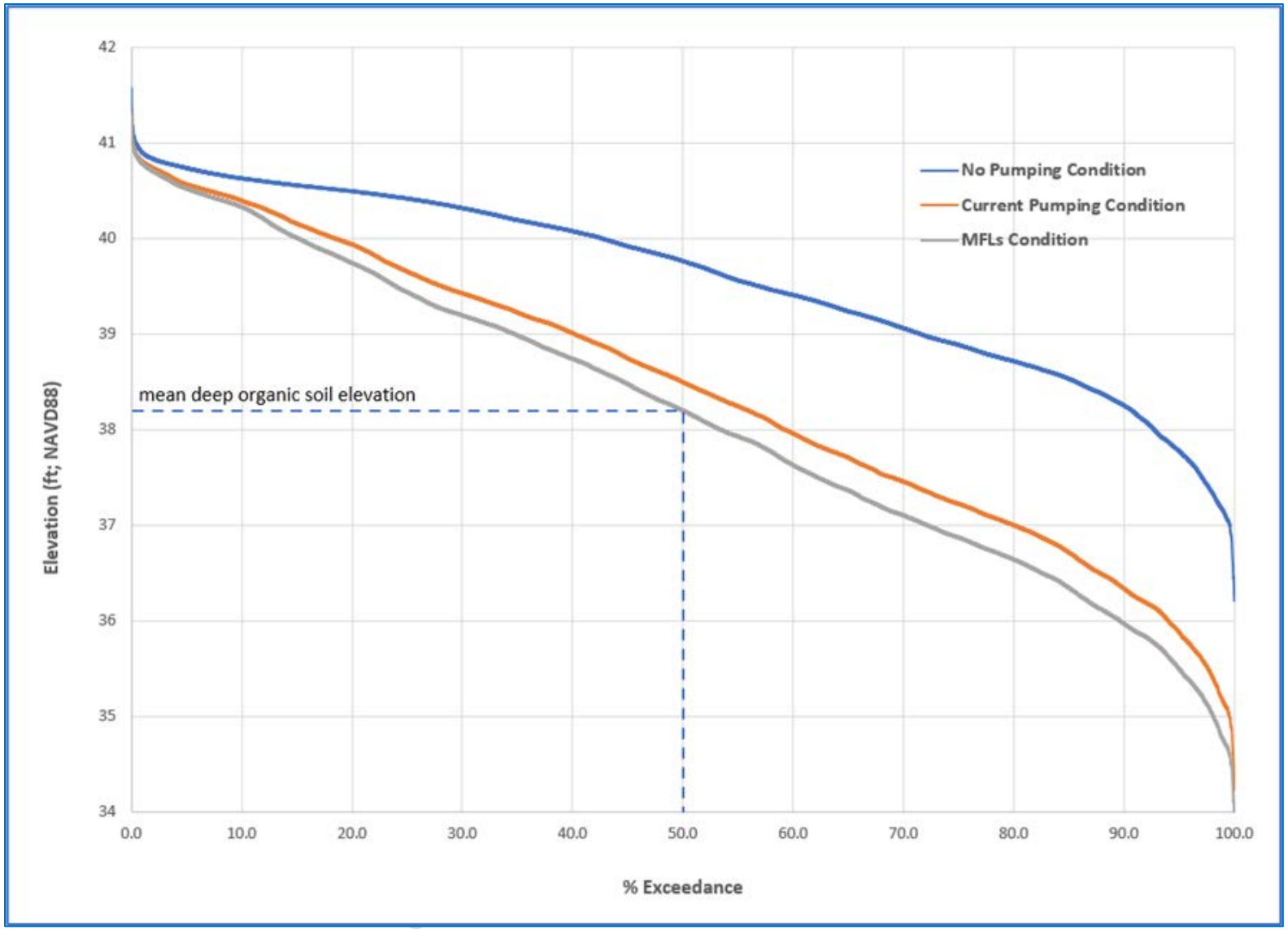

Figure 1. No-pumping condition, current-pumping condition and MFLs condition exceedance curves for Sylvan Lake, Seminole County, Florida. Also shown is the elevation and exceedance of the mean organic soils elevation for Sylvan Lake.

50% for a long-term minimum mean or median (i.e., central tendency) organic soils elevation (38.2 ft NAVD88) is supported by a recent University of Florida (UF) study on the relationship between organic soil stability and hydrology in the Upper St. Johns River Basin (Osborne et al., 2014). This study, by researchers in UF's Soil and Water Science Department, investigated the effect of water table drawdown on gaseous carbon emissions, which can lead to soil loss through oxidation and subsidence.

In general, higher water-tables reduce CO_2 emission (Komulainen et al., 1999) and subsidence (Wosten et al., 1997) in organic soils. Soil CO_2 flux is an indicator of soil oxidative processes and potentially soil subsidence (Reddy et al., 2006). Through both in situ (field-based) measurements and laboratory experiments Osborne et al. (2014) and Reddy et al. (2006) determined that water level drawdown below the soil surface leads to dramatic increases in carbon emissions.

Carbon dioxide flux observations, related to varying hydrology, indicates that in order to maintain quality, depth, and elevation of organic soils (i.e., prevent oxidation and/or subsidence), long-term minimum water table levels should be between 2 and 7 cm below the mean soil surface (Osborne et al., 2014, Reddy et al., 2006). At Sylvan Lake this maximum drawdown recommendation (7 cm from mean soil elevation; Osborne et al. 2014) yields a long-term mean water level of 38.0 ft (NAVD88). This is similar to the long-term mean (and median) water level provided by the MFLs condition. The recommended minimum water level for Sylvan Lake is slightly higher than the elevation suggested by this study and thus the latter supports the MFLs condition for Sylvan Lake, and the minimum levels (MA and FL) on which it is based.

WRV 4 – The transfer of detrital material:

WRV4 is meant to ensure consideration of the movement by water of loose organic material and debris and associated decomposing biota. Detrital material is an important component of aquatic food webs (Mitsch and Gosselink 2015). Wetland communities, such as transitional shrub swamp and shallow marsh, are importance sources of detrital material for the Sylvan Lake system. For this analysis, the transport of detritus is defined as the movement by water of loose organic material and debris and associated decomposing biota. The organic particles consist of decomposing vegetation, including leaves and wood, processed by microbes (e.g., bacteria and fungus). A significant portion of detrital transfer occurs during high-water events, when accumulated detrital materials in floodplain wetlands are moved to the aquatic system. The FH is based on providing a sufficient number of high-water (flooding) events to protect floodplain wetlands and associated wildlife habitat values. Maintaining sufficient high-water events will also ensure that detrital material, that has accumulated during drier periods, is transported to aquatic habitats downslope. Compliance with the recommended FH provides for the protection of flooding events necessary for the transfer of detrital material in Sylvan Lake. Therefore, the "transfer of detrital material" is considered to be protected by the MFLs condition.

WRV 7 – The filtration and absorption of nutrients and other pollutants:

WRV7 is meant to ensure consideration of nutrient and pollution filtration and absorption (i.e., the removal of suspended and dissolved materials as these substances move through the water column, soil, or substrate and associated organisms). Existing wetlands around Sylvan Lake include transitional shrub, and marsh communities, which provide for filtration and absorption of excess nutrients and other pollutants. The purpose of the FH and FL is to ensure the long-term maintenance of these wetland communities. Therefore, by protecting existing wetlands, the most constraining MFL also provides protection for WRV7.

WRV 5 – The maintenance of freshwater storage and supply:

The maintenance of freshwater storage and supply (WRV5) is also included in this group. The purpose of this environmental value is to protect, from significant harm due to water withdrawal, an adequate amount of freshwater for non-consumptive uses and environmental values associated with coastal, estuarine, riverine, spring, aquatic, and wetlands ecology. This environmental value encompasses all other environmental values identified in Rule 62-40.473 F.A.C. Because the overall purpose of the MFL is to protect environmental resources, and other non-consumptive beneficial uses while also providing for consumptive uses, this environmental value is considered protected if the remaining relevant values are protected.

Group 3: WRV1, WRV6, and WRV9

The three WRVs in Group 3 are closely related to lake area and depth, rather than conditions of the wetland vegetation communities in and around the lake. The determination of whether these WRVs are protected was based on whether there was significant harm (i.e., defined as 15% reduction) from the no-pumping condition to the MFL condition, for specific criteria evaluated for each WRV. The MFLs condition represents the minimum hydrologic regime necessary to protect all the minimum levels (i.e., it is based on the most constraining levels for Sylvan Lake).

An exceedance curve based on the MFLs condition timeseries was created and compared to the no-pumping condition exceedance curve to help assess whether WRVs in this group are protected (Figure 1). The MFLs condition and no-pumping exceedance curves were created using the respective daily lake level timeseries. The no-pumping condition time series was simulated using the Sylvan Lake HSPF model, with the no-pumping groundwater level time series as an input (see Appendix B). The MFL condition lake level time series was simulated by adjusting groundwater levels incrementally in the surface water model until the model produced a lake level time series that just meets the most constraining MFLs (FH and FL).

A significant harm threshold of 15% was used as the maximum allowable change, for a specific WRV, between the MFLs condition and the no-pumping condition. A threshold of 15% reduction in exceedance of critical elevations has been peer reviewed numerous times and has been the basis for numerous adopted MFLs within Florida (Munson and Delfino, 2007; Mouzon et al., 2018). The WRVs assessment results indicate that all three WRVs in

this group do not exceed the 15% reduction threshold and are therefore protected by the MFLs condition, as discussed below.

WRV 1 – Recreation in and on the water:

The purpose of this environmental value is to protect, from significant harm due to water withdrawal, the active use of water resources and associated natural systems for personal activity and enjoyment. Sylvan Lake supports various legal recreational activities. Popular recreational activities include boating, water skiing, and fishing. More than 30 private docks are located around the lake. Therefore, recreational boat access to the lake is used as the representative function to be protected by this WRV.

To determine whether this WRV is protected by the recommended MFLs, the frequency of exceedance of a critical elevation necessary for boats to access residential docks was compared between MFLs and no-pumping conditions. Exceedance of this critical elevation was evaluated to determine if there was a 15% reduction under the MFLs condition relative to the no-pumping condition.

Thirteen residential docks were surveyed around Sylvan Lake to determine the mean waterward piling (lake bottom) elevation (Figure 2). Most of the boats used for recreational activities on this lake are ≤ 20 ft in length (Figure 3). For boats of this size, the typical draft is approximately 2 ft. To account for the typical boat draft and ensure access at docks, 2 ft was added to the mean waterward lake bottom elevation for the 13 private docks surveyed. Based on this analysis, the average minimum boat access elevation for Sylvan Lake is 33.9 ft (Table 1).

Table 1. Average waterward (lake bottom) dock elevation and minimum boat accessible elevation in Sylvan Lake.

Average waterward (lake bottom) dock elevation (ft, NAVD88)	Draft for 20' boat (ft)	Minimum boat accessible elevation (ft, NAVD 88)
31.9	2	33.9

The comparison of exceedance of the boat access elevation indicates that there is no change between the MFLs and no-pumping conditions (Table 2). This is because the critical elevation (33.9 ft NAVD88) is lower than the lowest water level in the MFLs timeseries (i.e., this elevation is always exceeded; Figure 4). Based on these results, this environmental value is considered protected by the recommended minimum hydrologic regime (i.e., the MFLs condition).

Table 2. Minimum boat access elevation at docks, and the percent reduction in exceedance over the elevation comparing the no-pumping and MFLs conditions

	Minimum access elevation (ft, NAVD88)	Number of days per year that exceeds the min. access elevation (day/year)		Percent reduction in exceedance of boat access/passage elevations under MFLs condition relative to no-pumping condition (%)
		No-pumping	MFL	
Docks	33.9	365	365	0

WRV 6 – Aesthetics and scenic attributes:

The purpose of this environmental value is to protect, from significant harm due to water withdrawal, those features of a waterbody typically associated with passive uses, such as birdwatching, sightseeing, hiking, photography, contemplation, painting and other forms of relaxation.

Given the lack of statutory or other guidance, this WRV was evaluated based on the change to the area of open water at the median (P50) water level. Extent of open water (acres) at the P50 water level was compared between the no-pumping and MFLs condition.

The long-term median lake level is 39.8 ft and 38.2 ft for the no-pumping and MFLs condition, respectively. The lake stage-area relationship developed for the Sylvan Lake hydrologic model was used to determine the difference in surface area between these two elevations (Figure 5).

The P50 lake surface area under the MFLs condition is approximately 28 acres less than under the no-pumping condition. This corresponds to an approximate 10% reduction in area at the long-term median lake level (Table 4). This reduction in open water acreage is less than the 15% threshold and therefore this WRV is considered protected by the recommended minimum hydrologic regime.

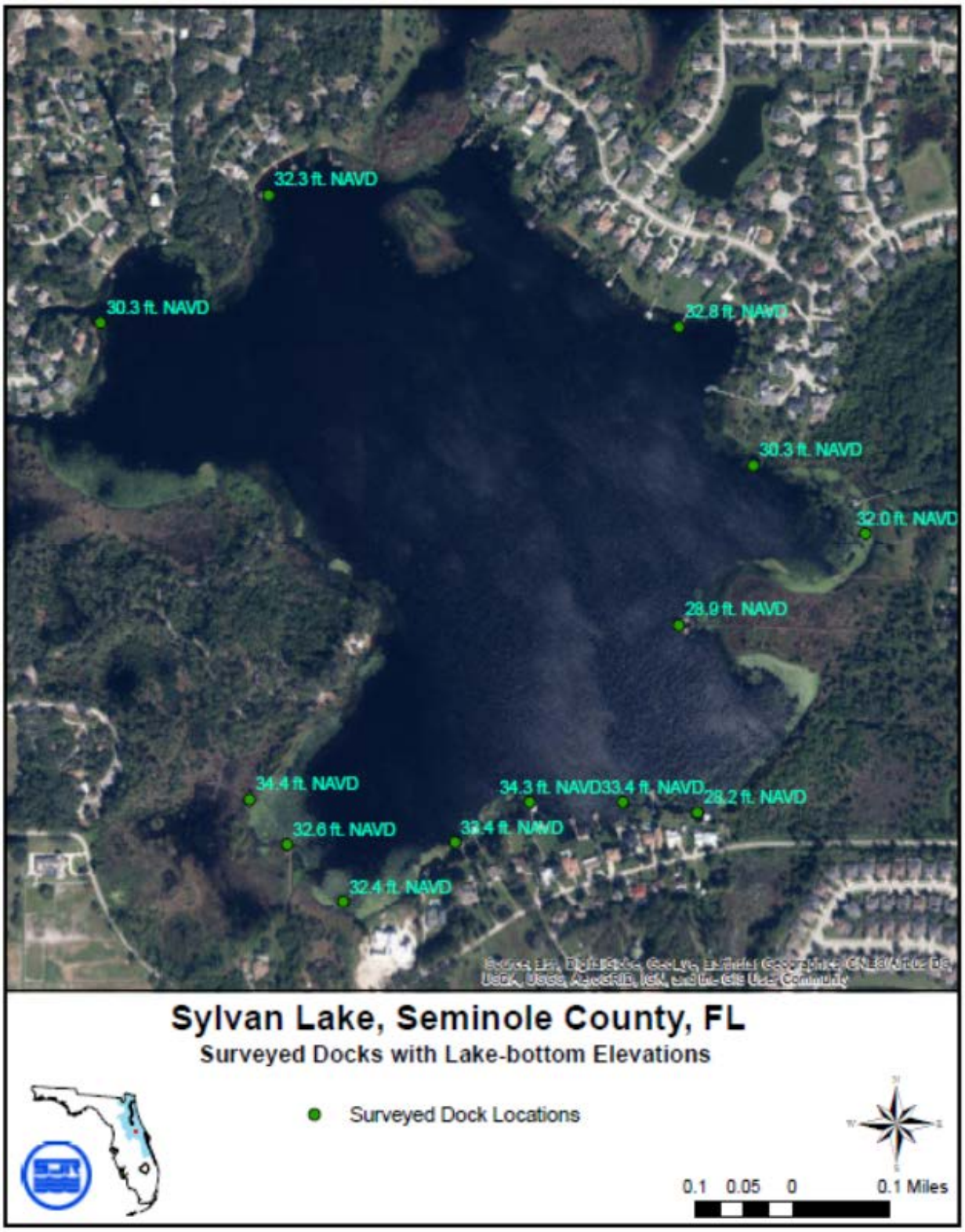

Figure 2. Location and waterward lake bottom elevation of 13 docks in Sylvan Lake, Seminole County, Florida

Figure 3. Typical docks and recreational boats in Sylvan Lake, Seminole County Florida.

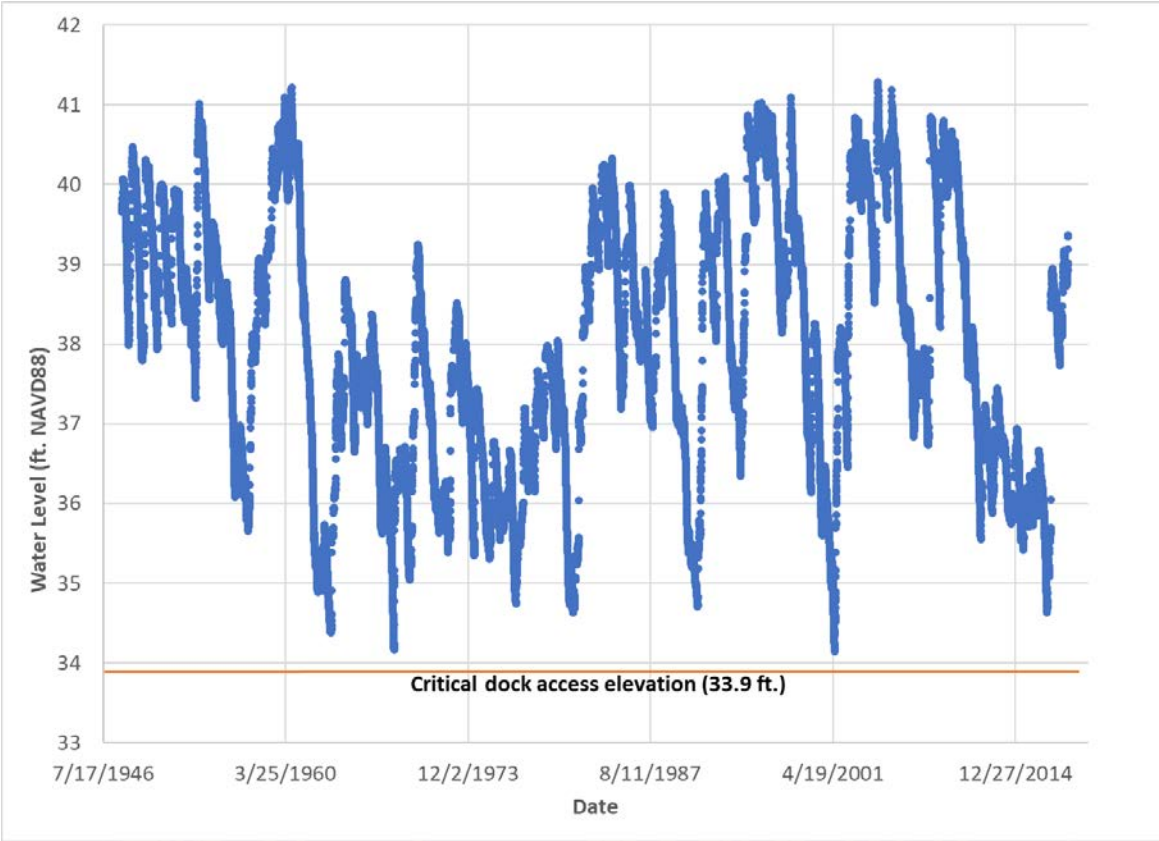

Figure 4. Water levels under MFLs condition and critical dock access elevation, for Sylvan Lake, Seminole County, Florida

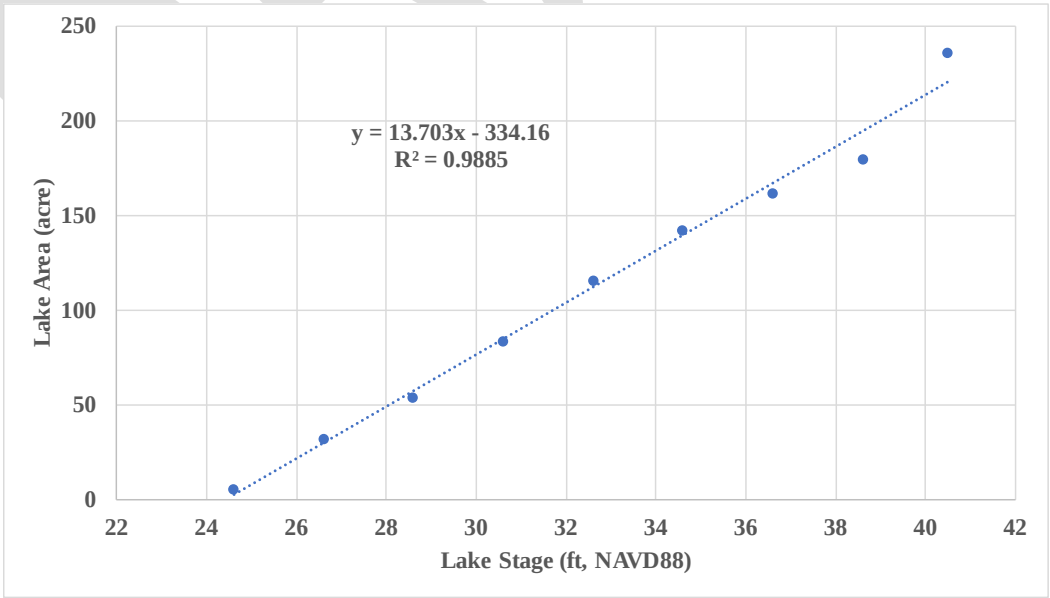

Figure 5. Relationship between lake level and surface area at Sylvan Lake (data from Appendix B. CDM Smith, 2017)

Table 1. Lake area at median stage elevation and percent change between the no-pumping and MFLs conditions

Hydrologic condition	Median stage (ft, NAVD)	Lake area at median stage (acres)	Area change between no-pumping and MFL at P50 (acres)	Percent change in lake area between no-pumping and MFLs conditions at P50 (%)
No-pumping	39.8	211	22	10%
MFL	38.2	189		

WRV 9 – Water quality:

The purpose of this environmental value is to protect, from significant harm due to water withdrawal, the ambient chemical and physical properties of a waterbody.

Sylvan Lake water quality is considered "good" based on state Trophic State Index (TSI) guidelines. TSI is an indicator of lake integrity, and is calculated using total phosphorus (TP), total nitrogen (TN) and chlorophyll-a (Chl-a) data, with values above 70 considered poor water quality, and values 60 or below considered good water quality (Friedemann and Hand, 1989). Sylvan Lake has a TSI value of 42.

Excess nutrients, such as nitrogen and phosphorus, in water bodies can cause a number of adverse ecological and human health effects. Long-term average annual geometric mean of all three primary water quality indicators (TP, TN and Chl-a) suggests that Sylvan Lake water quality is good. At Sylvan Lake, TP = 0.016 mg/L, TN = 0.807 mg/L, and Chl-a = 0.007 mg/L. These concentrations meet the numerical nutrient criteria FDEP sets for lakes with annual average geometric mean color greater than 40 PCU.

Total phosphorus and total nitrogen are negatively correlated with water level in many Florida lakes and lake around world (Kratzer and Brezonik, 1984; Nõges et al., 2003; Liu et al., 2016). At Sylvan Lake, however, lake levels show no correlation with TP and Chl-a (Figures 6 and 7), and TN is positively correlated with lake levels (Figure 8). This suggests that lake level reductions would not have a significant effect on TP and Chl-a concentrations and that lowering nitrogen concentration in Sylvan Lake would require lake level reduction. Based on these results, this WRV is considered protected under the recommended MFL hydrologic regime.

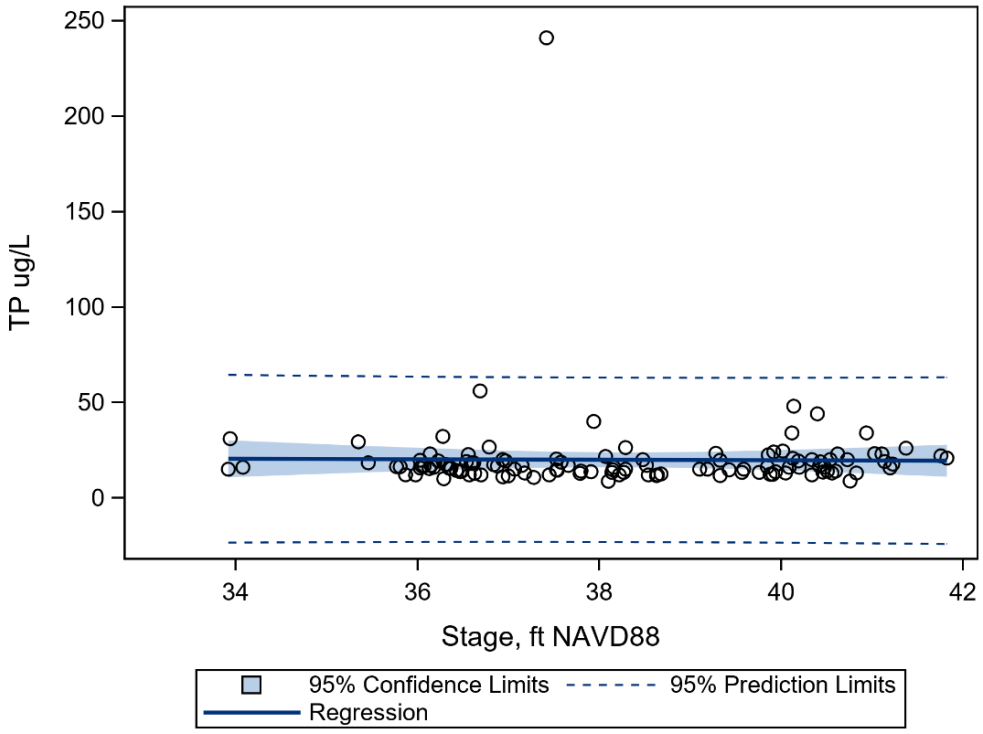

Figure 6. Regression between TP and Sylvan Lake stage

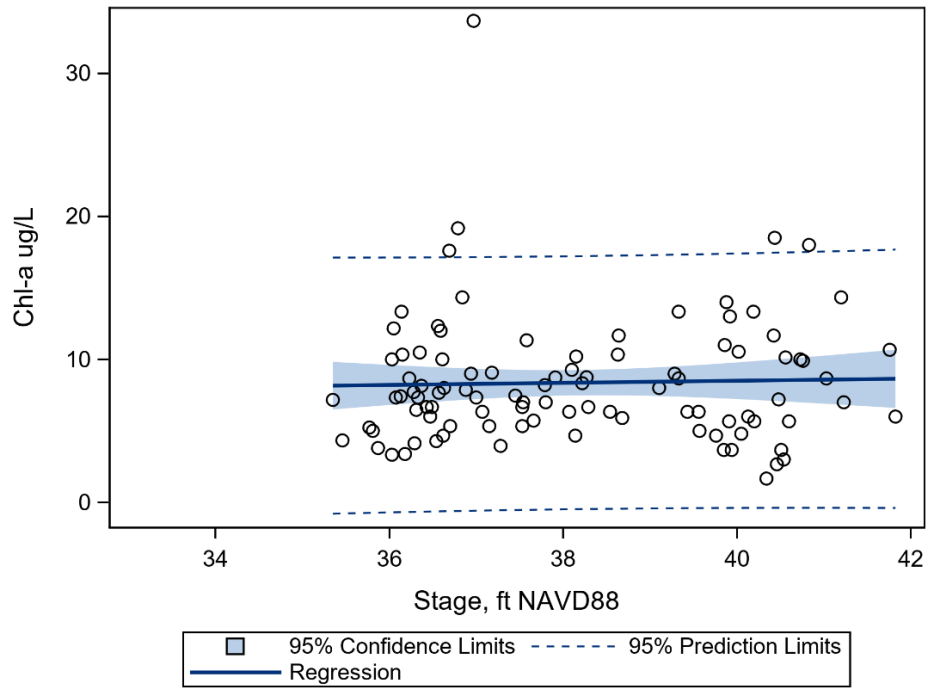

Figure 7. Regression between Chl-a and Sylvan Lake stage

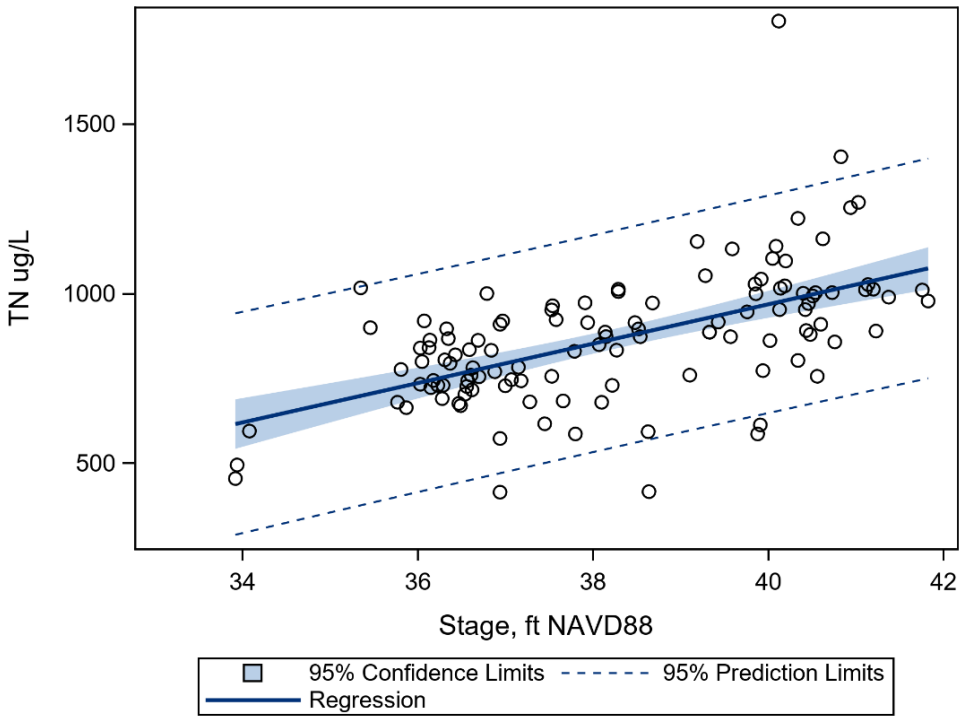

Figure 8. Regression between TN and Sylvan Lake stage

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