APPENDIX D — MFLS STATUS ASSESSMENT

CURRENT STATUS ASSESSMENT AND UFA FREEBOARD CALCULATION

Frequency analysis was used to 1) assess the current status of all three MFLs, and 2) determine Upper Floridan aquifer (UFA) freeboard/deficit for all three MFLs for Sylvan Lake. The following sections describe the two analyses.

Current Status Assessment

Current status was assessed for all three minimum levels developed for Sylvan Lake (see *MFLs Determination* section of the main report for details on minimum levels) by performing frequency analysis of the lake levels under the current-pumping condition. The development of current-pumping condition lake levels is described in Appendix B. The frequency of each minimum level was determined based on the allowable probability of exceedance (flooding) events (FH) or non-exceedance (drying) events (FL and MA) calculated using annual series data. The following describes the frequency analysis method and results for assessing each of the three MFLs developed for Sylvan Lake.

Status assessment for FH

Calculating the probability of exceedance of the FH involved the following three steps:

1. Determine the annual maximum elevation continuously exceeded for the specified duration (30 days) for each water year. The water year for flooding events is from June 1 to May 31.
2. Rank annual maximums from step 1 in descending order.
3. Use Weibull plotting position formula to calculate the probability of exceedance.

$$P(S \geq \hat{S}_m) = \frac{m}{n+1}$$

where $P(S \geq \hat{S}_m)$ = probability of S equaling or exceeding $\hat{S}_m$

m = rank of event

n = number of water years

Under the current-pumping condition, the FH flooding event (40.2 feet, duration of 30 days) has a probability of 27% (3.7-year return interval) compared to a probability of 19% (5.2-year return interval) under the MFLs condition. At the MFLs return-interval (5.2 years) the current-pumping elevation is approximately 40.6 ft NAVD88. Based on the current-pumping elevation and return interval, the FH is considered met under current conditions (Figure 1), with a lake freeboard of 0.4 ft (Table 1); see below for UFA freeboard calculation (Table 2).

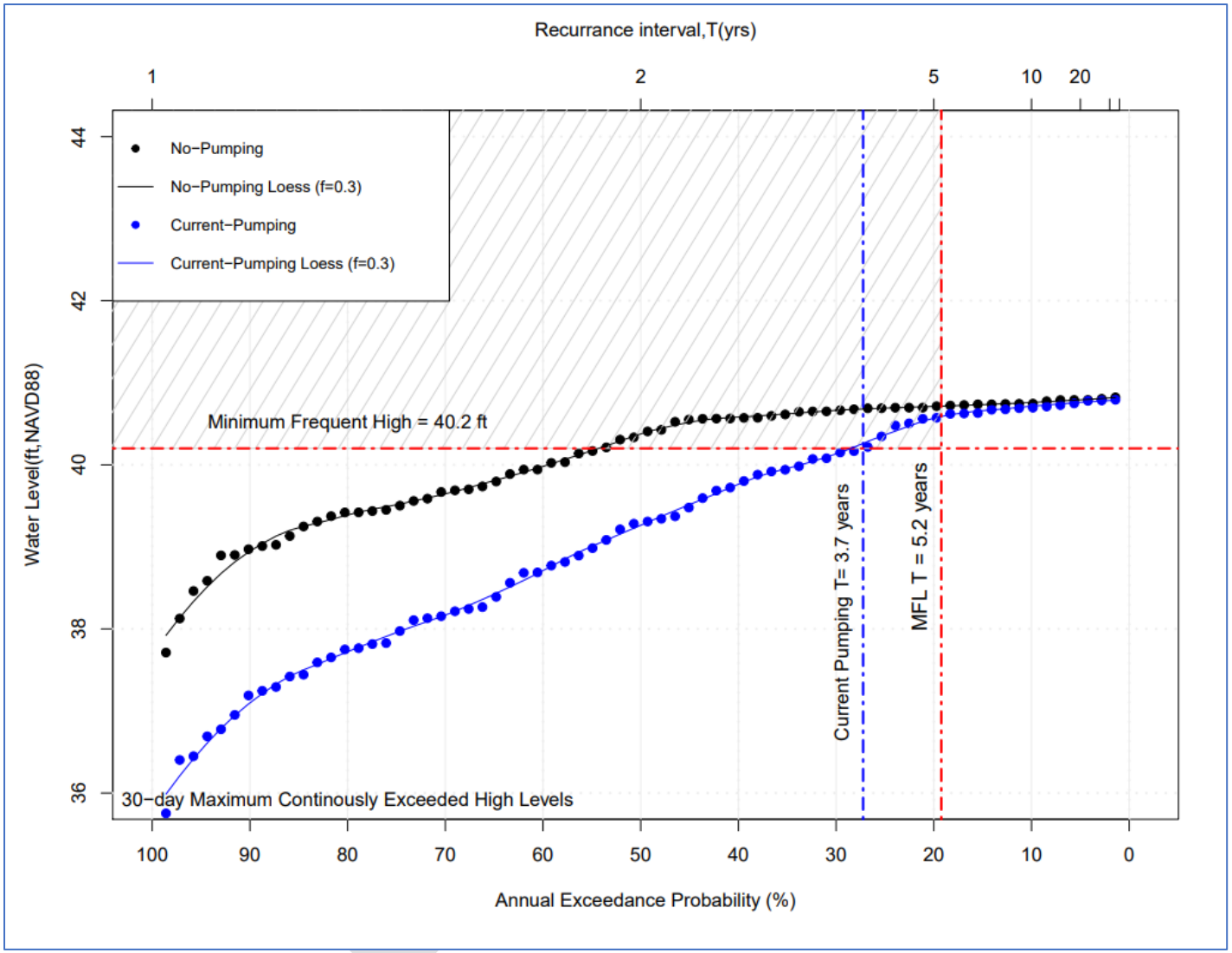

Figure 1. Exceedance probability (bottom axis) and return interval (top axis) of the FH for current-pumping condition (blue dots) and no-pumping condition (black dots) versus MFLs condition (red vertical and horizontal lines). The data plotted represent the minimum elevation continuously exceeded for 30 days, for each year in the period of record under the current-pumping condition. The horizontal and vertical red lines represent the minimum magnitude (lake level) and return interval, respectively. The blue vertical line represents the current-pumping condition frequency and return interval.

Status assessment for MA

Calculating the probability of non-exceedance of the MA involved the following three steps:

1. Determine the annual minimum average elevation not exceeded for the specified duration (180 days) for each water year. The water year for a non-exceedance event is October 1 to September 30.
2. Rank annual minimum averages from step 1 in descending order.
3. Use Weibull plotting position formula to calculate the probability of non-exceedance.

$$P(S< \hat{S}_m) = 1 - \left(\frac{m}{n+1} \right)$$

where $P(S \geq \hat{S}_m)$ = probability of S not exceeding $\hat{S}_m$

m = rank of event

n = number of water years

Under the current-pumping condition, the MA drying event (37.9 feet, duration of 180 days) has a probability of 52.6% (1.9-year return interval) compared to a probability of 58.6% (1.7-year return interval) under the MFLs condition. The MFLs condition allows for 5 more drying events per 100 years than what occurs under the current-pumping condition.

The current-pumping condition elevation is 38.5 ft (NAVD88). When compared to the MFLs elevation of 37.9, this results in a lake level freeboard of 0.6 feet (Table 1). See below for UFA freeboard (Table 2). Therefore, the MA is achieved under current-pumping conditions (Figure 2).

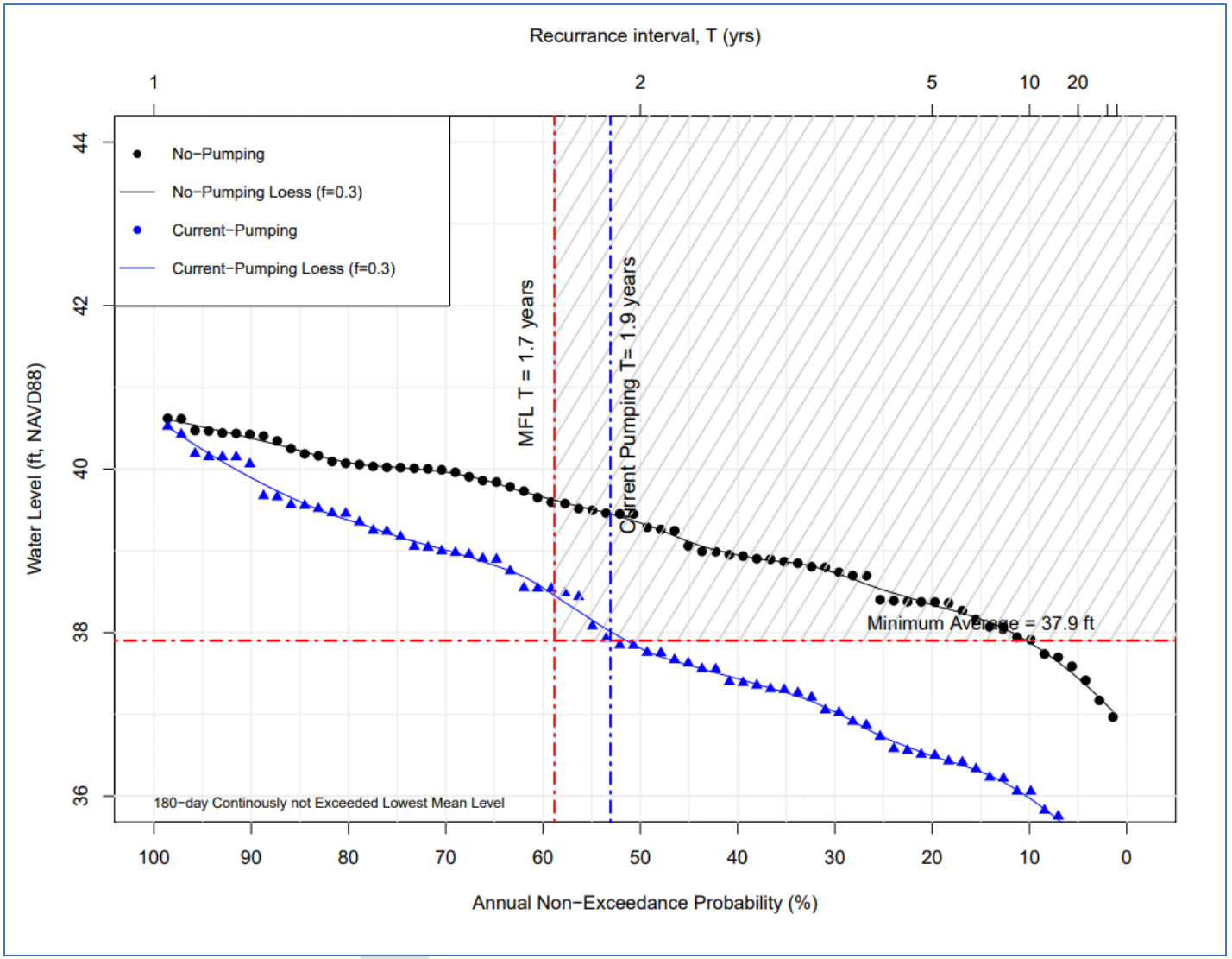

Figure 2. Non-exceedance probability (bottom axis) and return interval (top axis) of the MA for current-pumping condition (blue dots) and no-pumping condition (black dots) versus MFLs condition (red vertical and horizontal lines). The data plotted in blue triangles represent the maximum value for a mean lake level for a duration of 180-days, for each year in the period of record under current-pumping conditions. The horizontal and vertical red lines represent the minimum magnitude (lake level) and return interval, respectively. The blue vertical line represents the current-pumping condition frequency and return interval.

Status assessment for FL

Calculating the probability of non-exceedance of the FL involved the following three steps:

1. Determine the annual minimum elevation continuously not exceeded for the specified duration (120 days) for each water year. The water year for a non-exceedance event is October 1 to September 30.
2. Rank annual minimums from step 1 in descending order.
3. Use Weibull plotting position formula to calculate the probability of non-exceedance.

$$P(S< \hat{S}_m) = 1 - \left(\frac{m}{n+1} \right)$$

where $P(S \geq \hat{S}_m)$ = probability of S not exceeding $\hat{S}_m$

m = rank of event

n = number of water years

Under the current-pumping condition, the FL drying event (35.7 feet, duration of 120 days) has a probability of 4.3% (23.5-year return interval) compared to a probability of 11.8% (8.5-year return interval) under the MFLs condition.

The current-pumping condition elevation is 36.0 ft (NAVD88). When compared to the MFLs elevation of 35.7, this results in a lake level freeboard of 0.3 feet (Table 1). See below for UFA freeboard (Table 2). Therefore, the FL is achieved under current-pumping conditions (Figure 3).

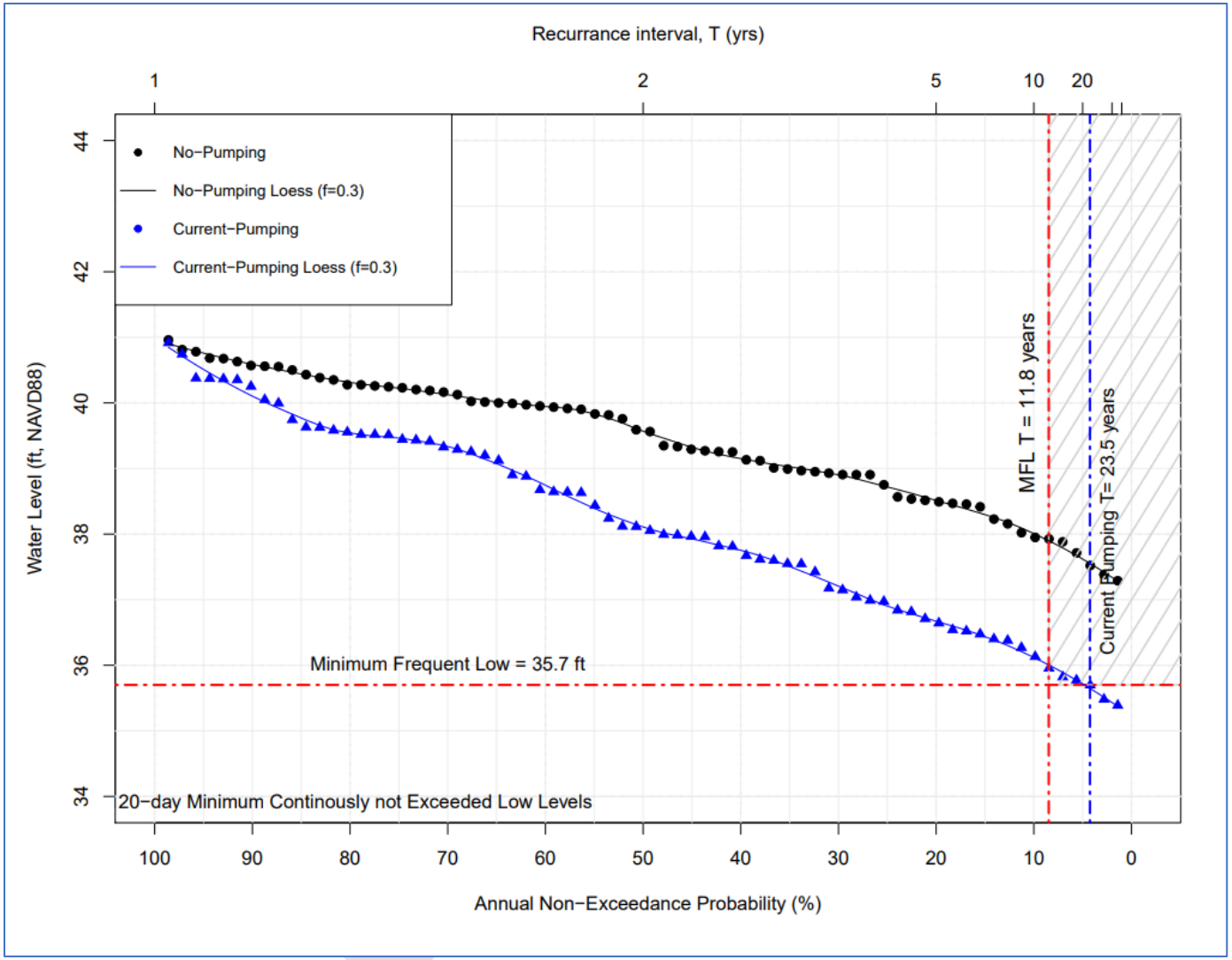

Figure 3. Non-exceedance probability (bottom axis) and return interval (top axis) of the FL for current-pumping condition (blue dots) and no-pumping condition (black dots) versus MFLs condition (red vertical and horizontal lines). The data plotted represent the maximum lake level not exceeded continuously for 120 days, for each year in the period of record under the current-pumping condition. The horizontal and vertical red lines represent the minimum magnitude (lake level) and return interval, respectively. The blue vertical line represents the current-pumping condition frequency and return interval.

Table 1. Frequency of MFLs events under MFLs condition and current-pumping condition for Sylvan Lake, Seminole County, Florida

MFLs	Environmental Criteria	Frequency of the MFLs event (years per 100-years)		Difference in number of events between current-pumping and MFLs conditions	Lake Freeboard (ft)
		MFLs Condition	Current-pumping condition		
Frequent High (FH)	Transitional shrub communities; Fish and wildlife habitat	19.3	27.0	7.7	0.4
Minimum Average (MA)	Organic soils; Seasonally flooded wetland habitat	58.6	52.6	6.0	0.6
Frequent Low (FL)	Shallow and deep marsh habitat	11.8	4.3	7.5	0.3

* lake freeboard considered zero, for reasons stated in text above, despite non-zero difference in number of events between current-pumping and MFLs conditions.

UFA Freeboard/Deficit Calculation

Frequency analysis is also used to determine whether there is water available for withdrawal (freeboard) from the UFA or whether water is needed to recover the UFA (deficit). Freeboard is defined as a UFA reduction (ft) that is allowable before an MFL is no longer achieved. Deficit is defined as the amount of water needed to recover an MFL that is not being achieved. For a lake MFL, aquifer deficit is expressed as the amount of recovery needed (in feet) in the UFA.

Freeboard or deficit calculation involves the following steps:

1. UFA elevations (i.e., water levels at an UFA well) in the surface water model are increased or decreased by small increments (depending on Weibull plot results);

2. The surface water model is run iteratively after each change to UFA elevations, to simulate a new lake stage time series;

3. Frequency analysis and Weibull plot creation is repeated;

4. Steps 1 through 3 are repeated until MFL is just met;

5. The amount of water added (or subtracted) to UFA elevation represents the amount of water available for consumptive use (i.e., freeboard), or amount of water needed to be recovered (i.e, deficit).

Each of the three Sylvan Lake MFLs have lake freeboards greater than zero, and therefore UFA freeboard analyses were performed for each level. The FH, MA and FL have lake freeboards of 0.4 ft, 0.6 ft and 0.3 ft, respectively. For each of the three MFLs, the current-pumping UFA and lake level timeseries were iteratively decreased using the surface water model until the event frequency just met the recommended minimum frequency, following the steps described above. This iterative modeling and frequency analysis process resulted in UFA freeboards for the FH, MA and FL of 1.8 ft, 0.6 ft and 0.5 ft, respectively (Table 2). Therefore, the FL is the most constraining MFL with a UFA freeboard of 0.5 ft.

Table 2. MFLs criteria including MFL and Current-pumping condition return intervals and UFA freeboard/deficit for Sylvan Lake, Seminole County, Florida

MFLs	Environmental Criteria	Minimum Level Components				Lake Freeboard (ft)	UFA Freeboard (ft)
		Level (ft NAVD88)	Duration (days)	MFL Condition Return Interval (years)	Current-pumping Condition Return Interval (years)		
Frequent High (FH)	Transitional shrub communities; Fish and wildlife habitat	40.2	30	5.2	3.7	0.4	1.8
Minimum Average (MA)	Organic soils	37.9	180	1.7	1.9	0.6	0.6
Frequent Low (FL)	Shallow and deep marsh communities / associated wildlife values	35.7	120	11.8	23.5	0.3	0.5

Future/Projected Status

The status assessment for Sylvan Lake shows that all three metrics have freeboard in the UFA (i.e., do not have a deficit), and therefore this water body is not in recovery (Table 2). If the MFLs are currently being achieved but are projected to not be achieved within the 20-year planning horizon, then a waterbody is in "prevention," and a prevention strategy must be developed concurrently with the MFLs. Whether MFLs are being achieved within the planning horizon is determined by comparing the UFA freeboard of the most constraining environmental criterion to the amount of projected UFA drawdown at the planning horizon.

Water withdrawal information used to assess future status was based on water supply planning projections for the planning horizon (i.e., not current CUP allocations). The projected UFA drawdown at the 20-year planning horizon (2040) was estimated for Sylvan Lake using the East Central Florida Transient Expanded (ECFTX) groundwater model. Assuming all future pumping is equal to projected 2040 water demand, the predicted UFA drawdown is 0.65 feet.

Under current-pumping conditions, all three Sylvan Lake MFLs are met, and the most constraining (FH and FL) have a UFA freeboard of 0.50 ft. However, the additional 0.65 ft of drawdown at the planning horizon creates a projected UFA deficit of 0.15 ft. Therefore, Sylvan Lake is in prevention, and a prevention strategy must be developed concurrently with the MFLs to ensure that the projected UFA deficit does not occur.