SJRWMD Initial Responses to Peer Review and Stakeholder Comments Regarding Draft MFLs for Johns Lake, Orange and Lake Counties, Florida

6/16/2025

Introduction

Independent scientific peer review was conducted for the draft Johns Lake MFLs report and appendices by Dr. Anthony Janicki, a Senior Principal Scientist with Environmental Science Associates (ESA) and Robert Burleson, a Senior Water Resources Engineer with Applied Technology Management (ATM), a Geosyntec Company. Peer review comments on environmental criteria, minimum levels, and hydrological data analyses were based on review of the following documents:

Blais, C. B., O. T. Leta, A. B. Sutherland, C.R. Shadik, S.L. Fox, and F. Gordu. 2025. Minimum Levels Determination for Johns Lake, Orange and Lake Counties, Florida. Draft Report. Bureau of Water Supply Planning, SJRWMD.

Appendix A: Topobathymetric DEM Development;

Appendix B: Hydrological Analyses;

Appendix C: Environmental Methods, Data, and Metrics;

Appendix D: MFLs Status Assessment; and

Appendix E: Water Resource Values (WRVs) Assessment

This preliminary resolution document provides St. Johns River Water Management District (SJRWMD) responses to peer reviewer comments of primary concern. These comments and questions were submitted by the peer reviewers on May 27, 2025, as part of a teleconference presentation on their initial review findings. While the focus of this document is responses to initial review comments, all peer review and stakeholder comments will be addressed in the final resolution document.

Peer Reviewer Comments / Recommendations:

Comment #1

Additional explanation needed related to the sudden change in simulated water levels around 1996 and prior as shown in Figure B-8.

Consider investigating the effect of the model over-prediction of Johns Lake water levels in the first half of the simulated time period on the environmental analysis.

SJRWMD Response:

As noted by the peer reviewers, the Johns Lake ICPR4 model overpredicts observed water levels during some periods, and especially from 1965-1990 (Figure 1). Despite the overprediction during that period, SJRWMD believes that the surface water model output is suitable for use in determining and assessing minimum levels at Johns Lake. This is because of the following:

1. The hydrological data used to determine and assess a given MFLs are meant to represent *future* conditions (climate and pumping influences), not the past;
2. Due to significant changes in the watershed (discussed below), the future condition of the lake is better represented by the model during the validation and calibration periods (post 1990) than the earlier part of the hydrological record;

The close relationship between simulated and observed water levels during the calibration and validation periods suggest that it is a suitable model for predicting the future state of the lake and watershed. It is worth noting that the Johns Lake surface water model was peer reviewed in 2022 and it was deemed appropriate for this MFLs (ATM 2022).

The following sections describe the reasons why the recent calibration period is a better predictor of the future state of Johns Lake. Further, the following information explains why the overprediction of the model during the period 1965 – 1990 is not a significant concern for determining the Johns Lake MFLs and freeboard.

1. Land Use / Land Cover Change

Johns Lake's watershed has changed significantly in recent years. Land use / land cover (LULC) was predominantly agricultural (primarily citrus groves) and natural until roughly 2002, but residential and commercial areas now comprise the vast majority of the watershed. Significant portions of the eastern half of the watershed were developed after 2002 and coincided with the construction of the beltway (SR 429) (Figures 2-8). This change in land use / land cover has come with a significant transformation from areas of high water infiltration to a large increase in impervious surface cover and directly connected imperviousness area (DCIA).

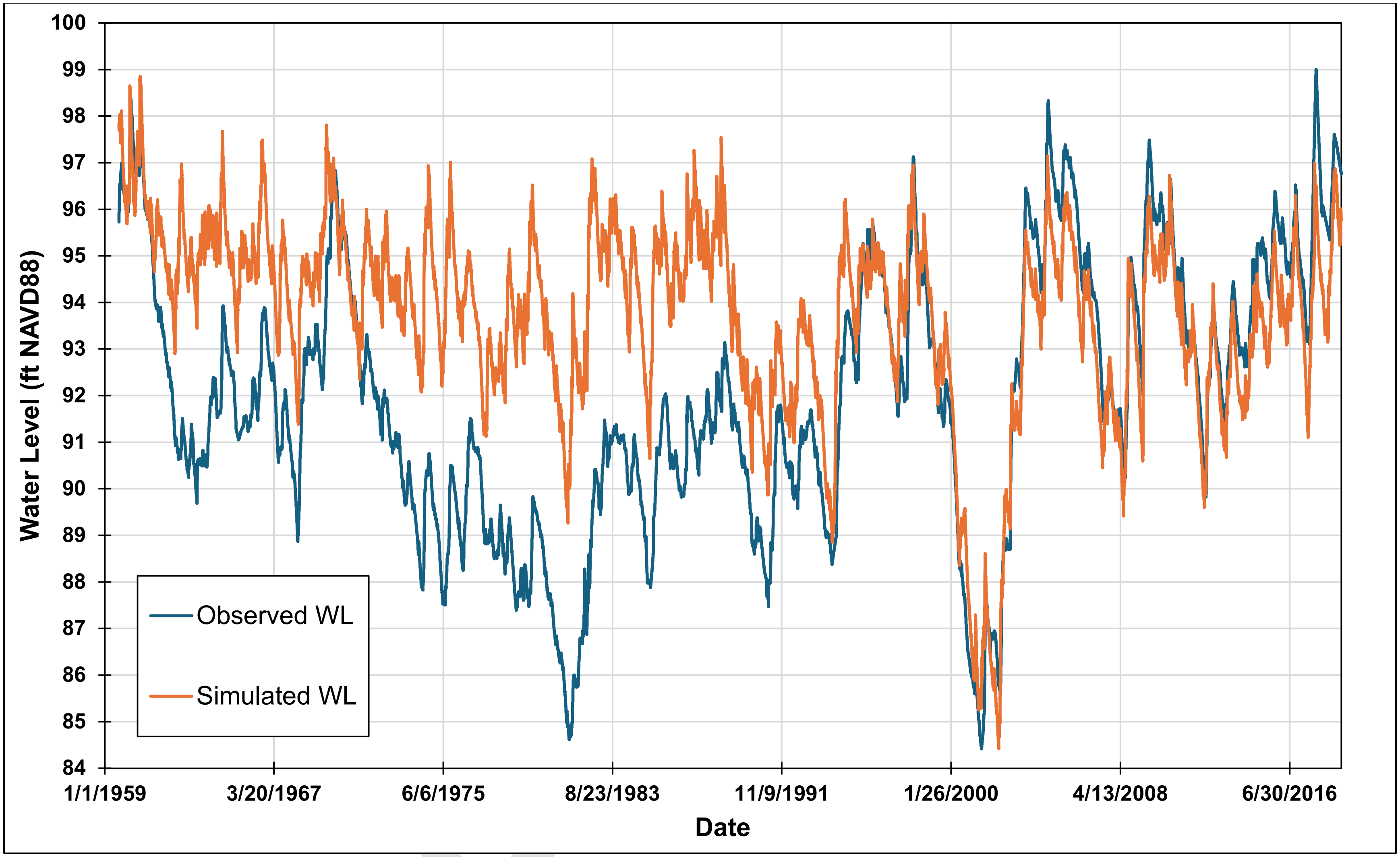

Figure 1: Observed and simulated water levels at Johns Lake from 9/7/1959 to 12/31/2018.

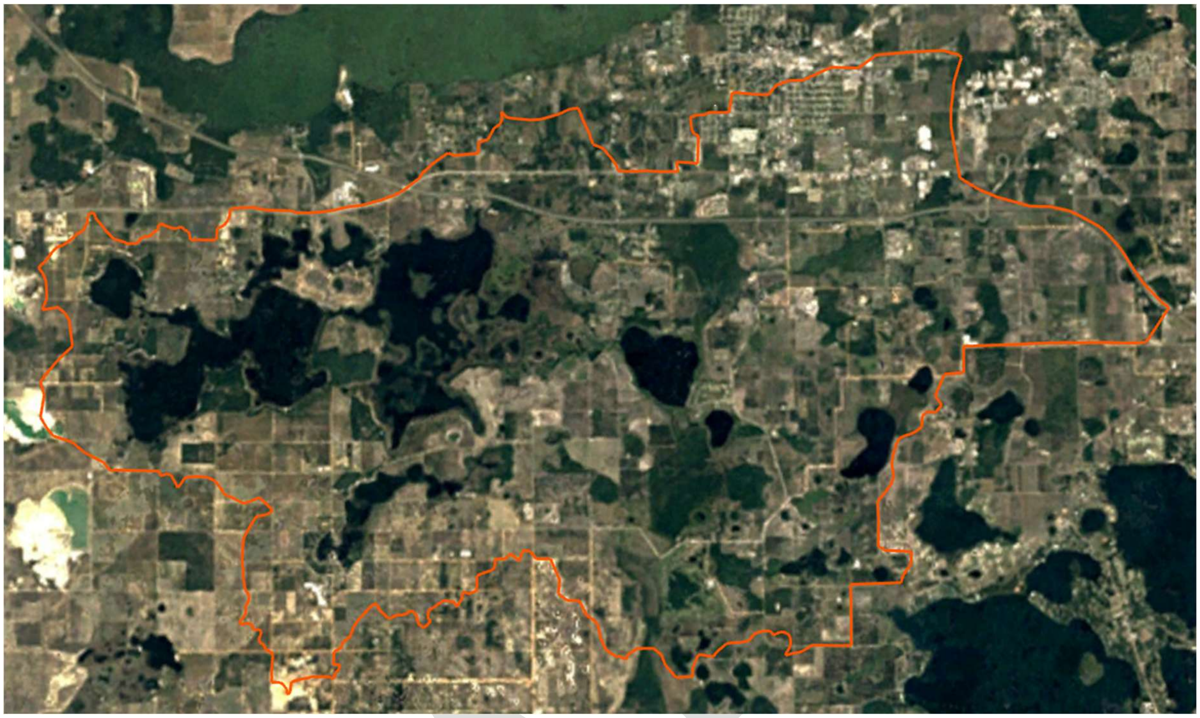

Figure 2: Johns Lake watershed on 12/30/1985.

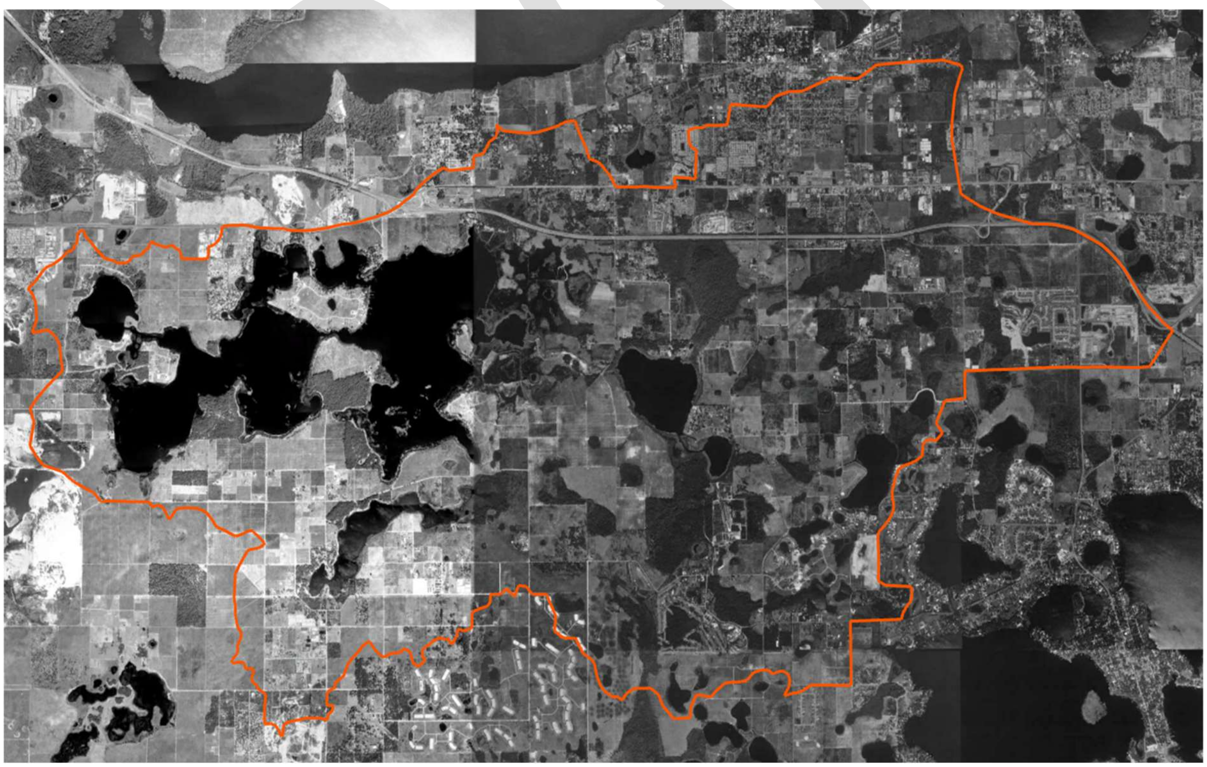

Figure 3: Johns Lake watershed on 2/4/1995.

Figure 4: Johns Lake watershed on 6/26/2003

Figure 5: Johns Lake watershed on 5//2010

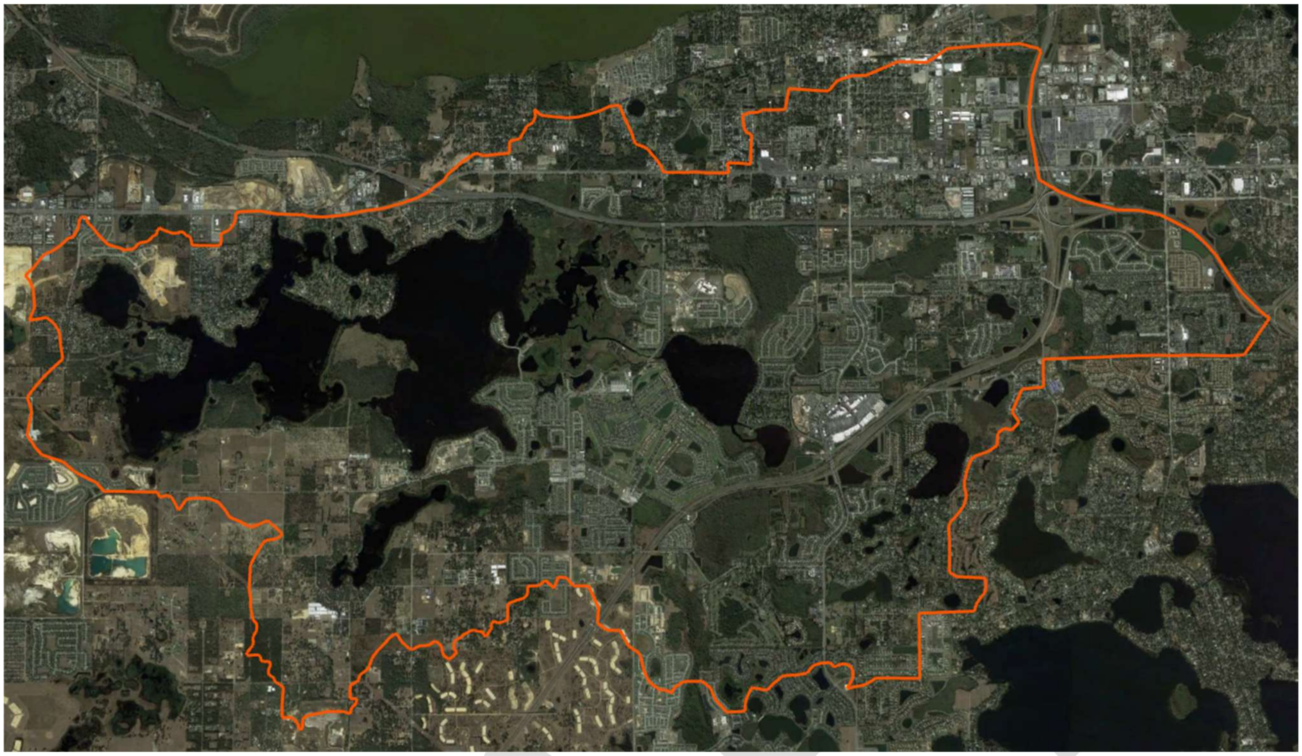

Figure 6: Johns Lake watershed on 1/3/2018

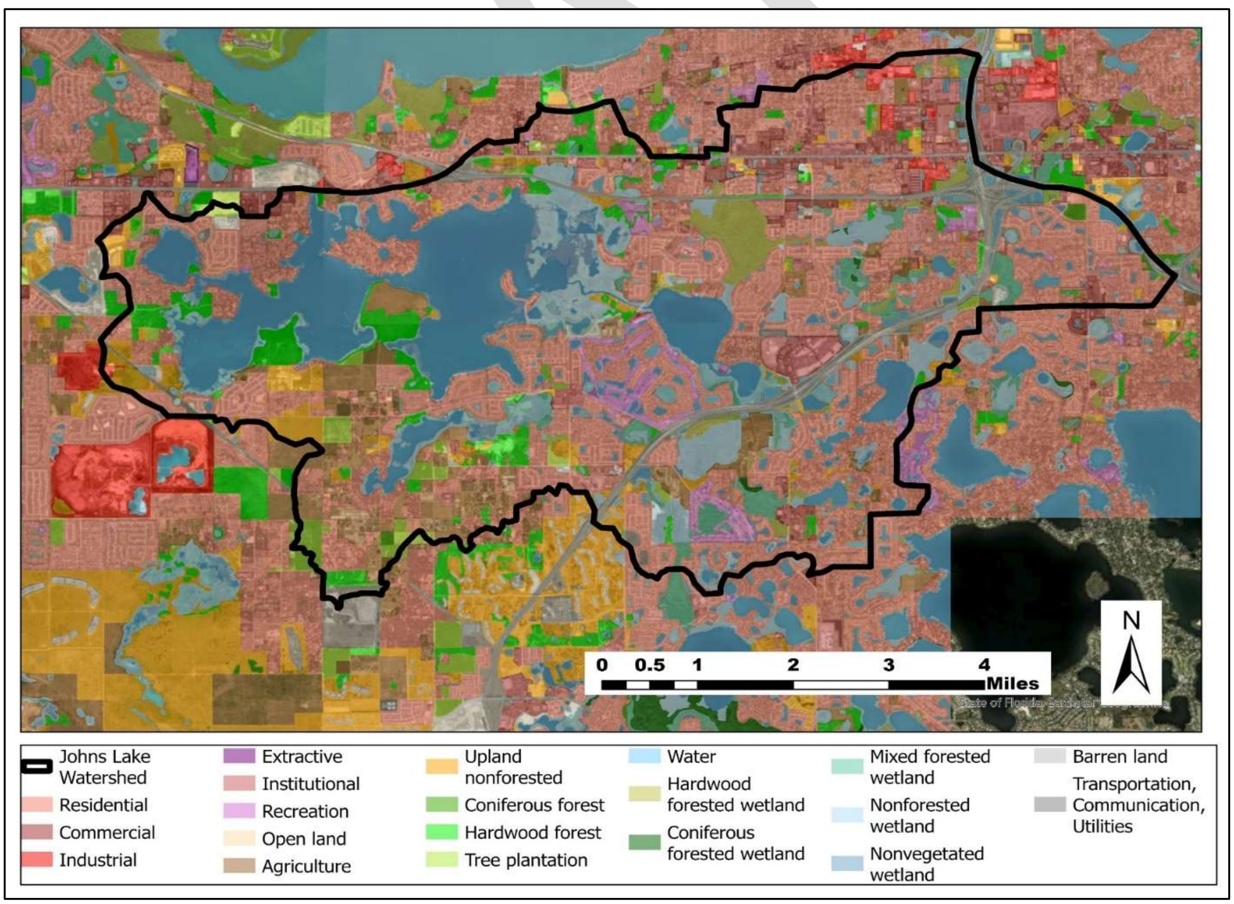

Figure 7: Land Use / Land Cover types in the Johns Lake watershed in 2020.

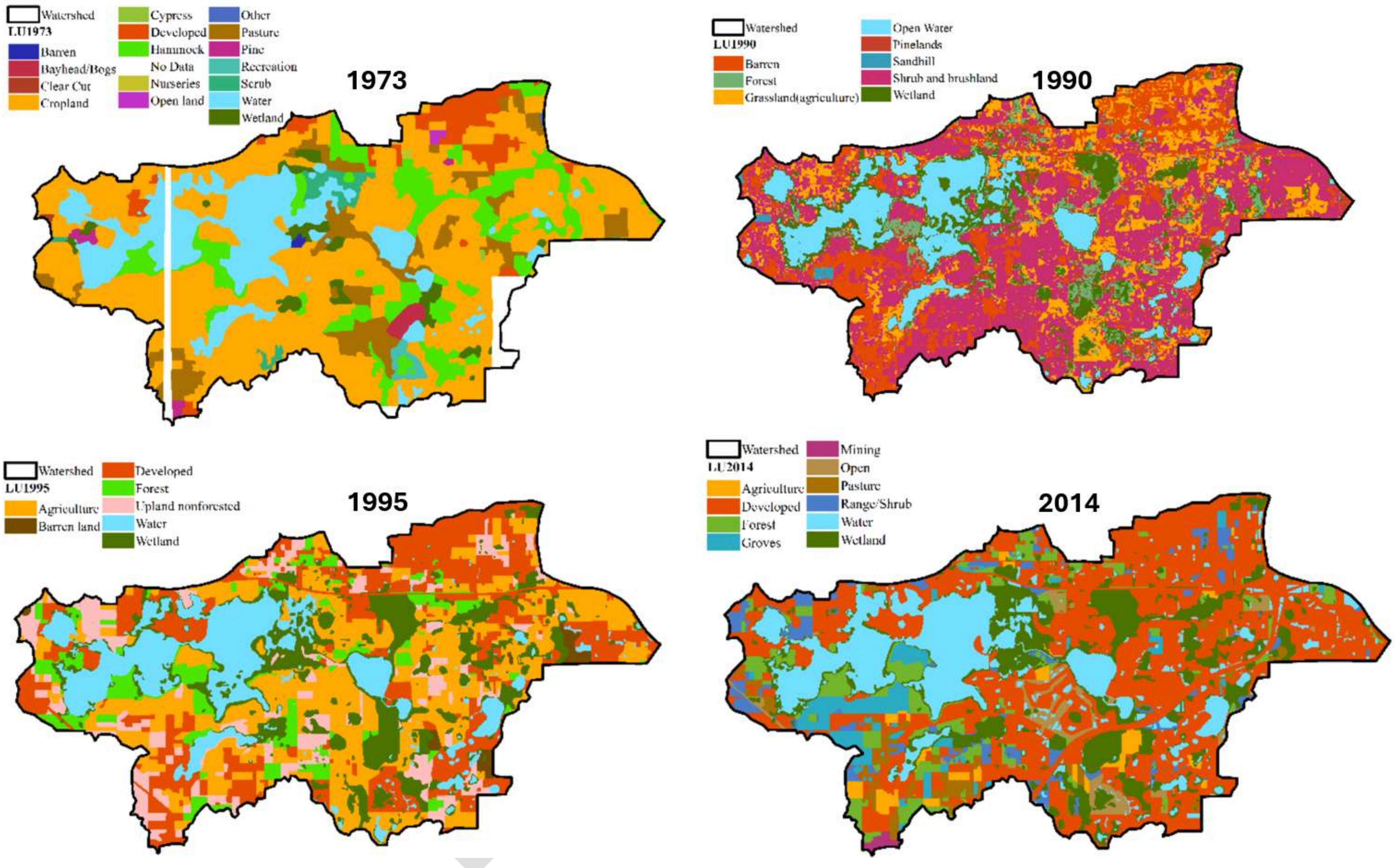

Figure 8: Land Use / Land Cover types in the Johns Lake watershed (1990, 1995, 1973, and 2014).

One hypothesis for the lower lake levels in the early period (1965 – 1990) relative to more recent higher levels, is that the pre-development watershed likely contributed higher amounts of rainfall to the Surficial Aquifer (SA) and Upper Floridan Aquifer (UFA) because of low impervious surface cover and high infiltration. The post-development state likely restricts groundwater recharge and increases the amount of rainfall entering Johns Lake as run-off, increasing lake levels. This could partially explain the recent sustained high-water levels at Johns Lake for the POR, compared to the pre-development period. This was tested during the model development phase. Leta et al. (2022) state,

"We found that more than 30% of the watershed's cropland has been converted to developed areas (low, medium, and high residential and commercial/ industrial areas) during the period from 1973 to 2014 (Attachment C-5). To reflect this change and assess its implication on simulated stages of Johns Lake, we changed the current condition imperviousness fractions, crop coefficient (kc), and initial rainfall abstraction values of low, medium, and high residential and industrial/commercial areas to the corresponding cropland properties. Assuming the cropland in the 1970s represented "Groves" land use, which is also proposed by SLT (2021), we set the current condition imperviousness, kc, and initial rainfall abstraction values of residential and commercial/industrial areas to the values used for "Groves". This conversion reduced the overestimated simulated stages before 1993, but consistently lowered the simulated stages during the post-development period (Figure C – 21; this is Figure 9 in this response document)." Additionally, the LULC change and reduction in infiltration and recharge into the UFA would likely result in changes in the hydrologic dynamicity and the relationship between the lake and UFA systems over time. For example, Leta et al (2022) documented that the correclation between observed lake levels of Johns Lake and UFA levels had been significantly changed over the POR.

These adjustments to the model did reduce the overprediction in the pre-development period, but led to consistent underprediction in the post-development period. Consequently, the comparison of the observed and simulated water levels for the pre-development period using the recent LULC data and calibrated model parameter values of the post-development period might not be appropriate. Due to this fact, and as stated above, the post-development period is a better representation of the current and future state of the lake. Therefore, it was decided to not use the adjustments to the simulated long-term water levels of Johns Lake.

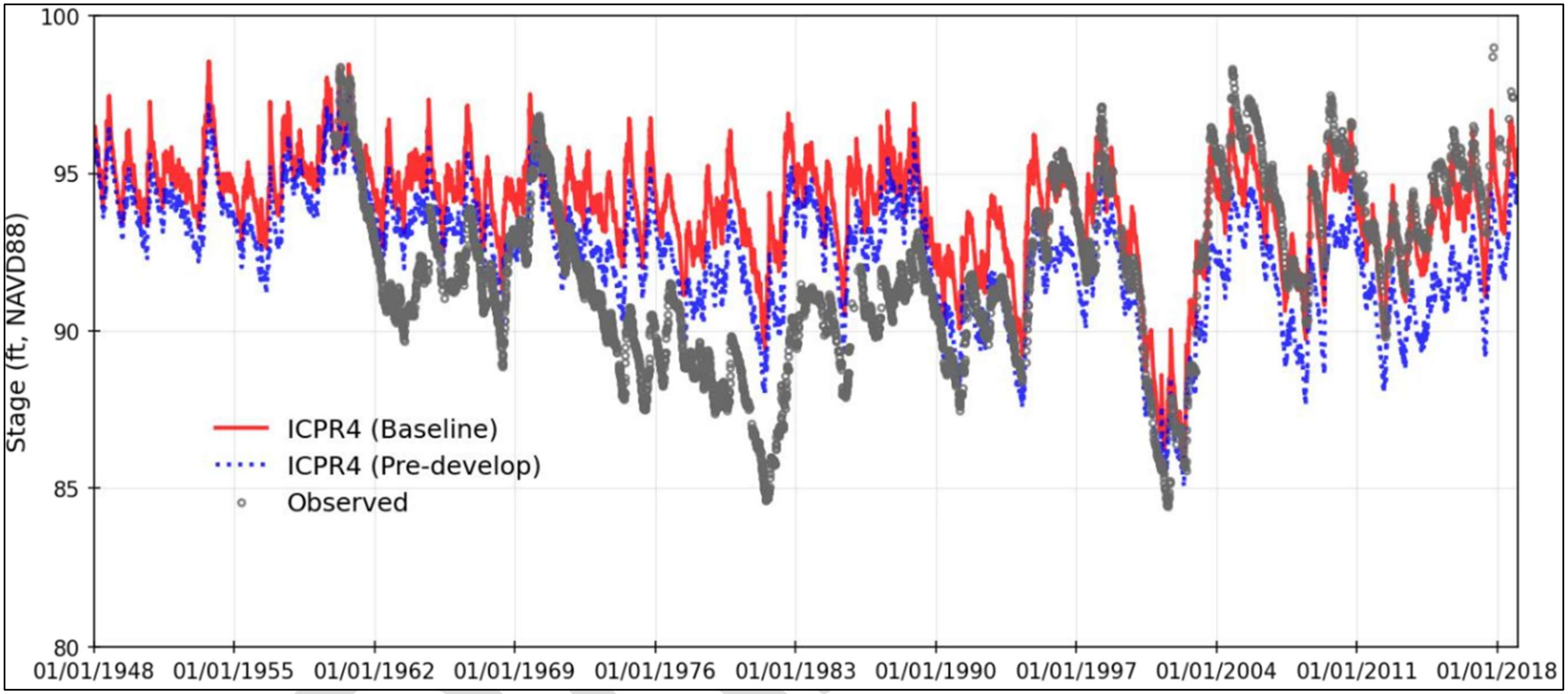

Figure 9: Adjustment to the ICPR4 model so that imperviousness, kc, and initial rainfall abstraction values of residential and commercial/industrial areas used the values for “Groves”.

2. Rapid Infiltration Basins (RIBs)

Another change in recent decades that is not reflected in the POR from 1965 – 1990, is possibly the presence of rapid infiltration basins (RIBs) in the Johns Lake watershed. Johns Lake is close to and downslope of numerous RIBs, with some located within the watershed boundary (Figure 10). The Water Conserv II RIBs have been operational since 1987 and on average, have received increased water for treatment over time (Figure 11). The Water Conserv II RIB capacity increased dramatically throughout the 1990s and has been as high as 25 million gallons per day (mgd) in recent years (City of Orlando 2023). This input of water may partially explain recent high-water levels and the oversimulation of water levels before the 1990s.

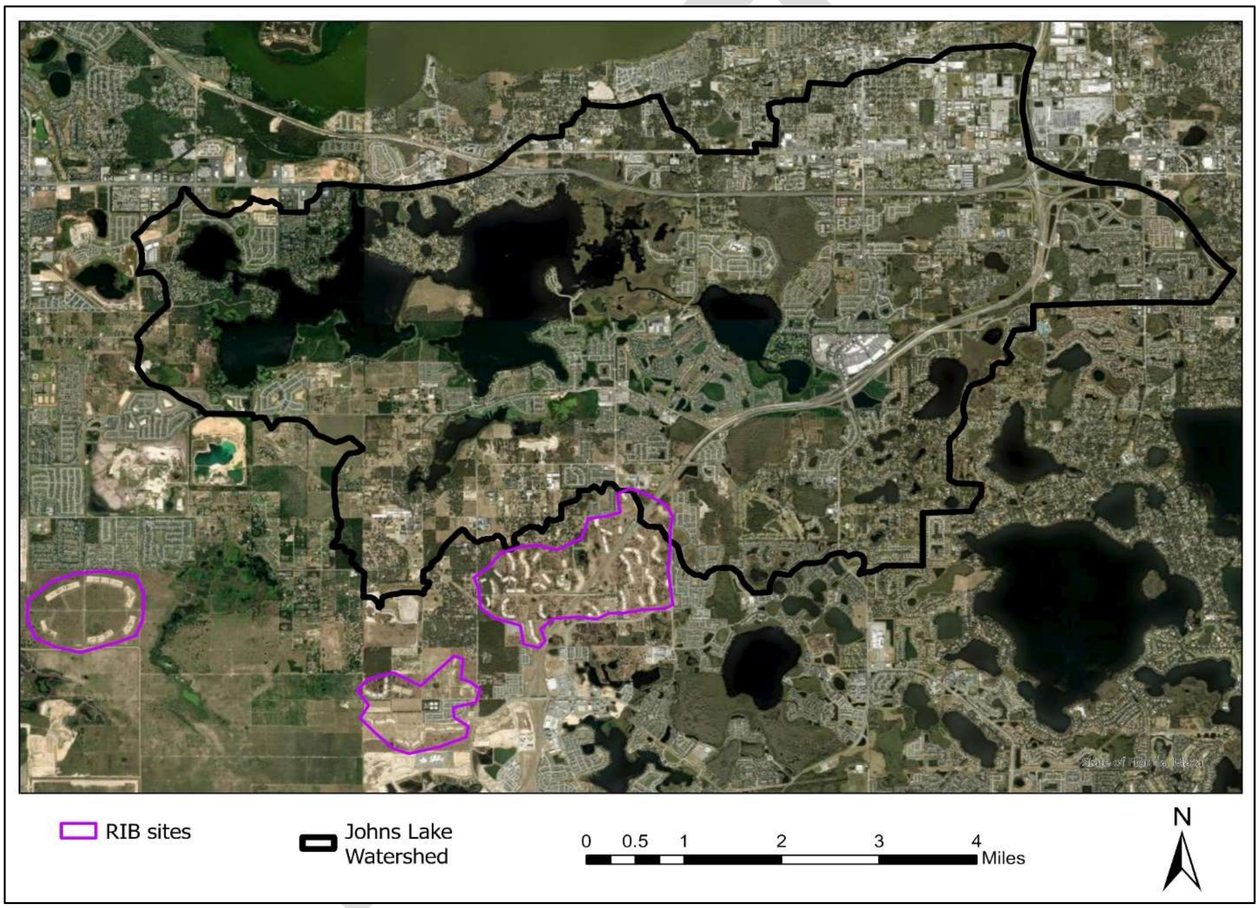

Figure 10: Water Conserv II RIBs and their proximity to the Johns Lake watershed.

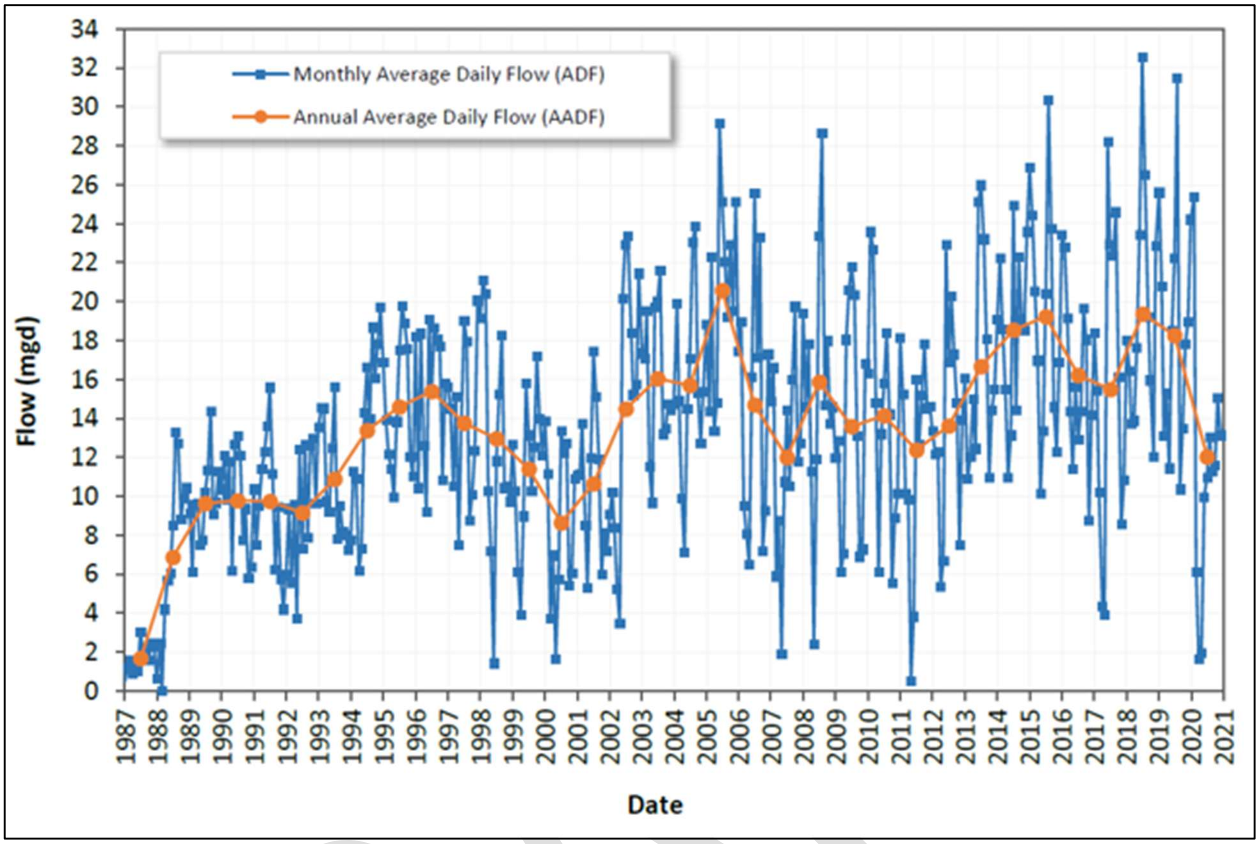

Figure 11: Historical flow to Water Conserv II RIBs

The exact impact of the RIBs on surface water levels at Johns Lake is unknown, but it is likely supplementing Johns Lake through increasing the nearby SA or UFA. The RIBs were receiving water during the validation and calibration periods of the model and may play a role in the overprediction in the pre-development period. The Water Conserv II project is planning to expand (Figure 12) and continue supplying the RIBs with reused water into the future. Though this may present a difficulty in modeling past water levels, it is likely to positively impact water levels at Johns Lake and the likelihood of the system meeting it's recommended minimum levels.

3. Changes to Motamassek Canal and the Outflow Sturcture

Motamassek Canal is the only surface water outflow from Johns Lake and was constructed sometime in the 1930's (MSCW 2003). It flows from the northeast corner of Johns Lake into Lake Apopka (Figure 13; Figure 14).

The canal flows through ten parcels, eight of which are privately owned. Maintenance has been sporadic and largely undocumented. In the canal, the controlling elevation for the lake is a concrete weir just north of SR-50, which was rebuilt in 1993. The controlling elevation is listed as 94.5 feet NAVD88 by CWR (2019); this elevation is used in the model for post-1993 simulation period. This elevation was also confirmed by district staff (Figure 15).

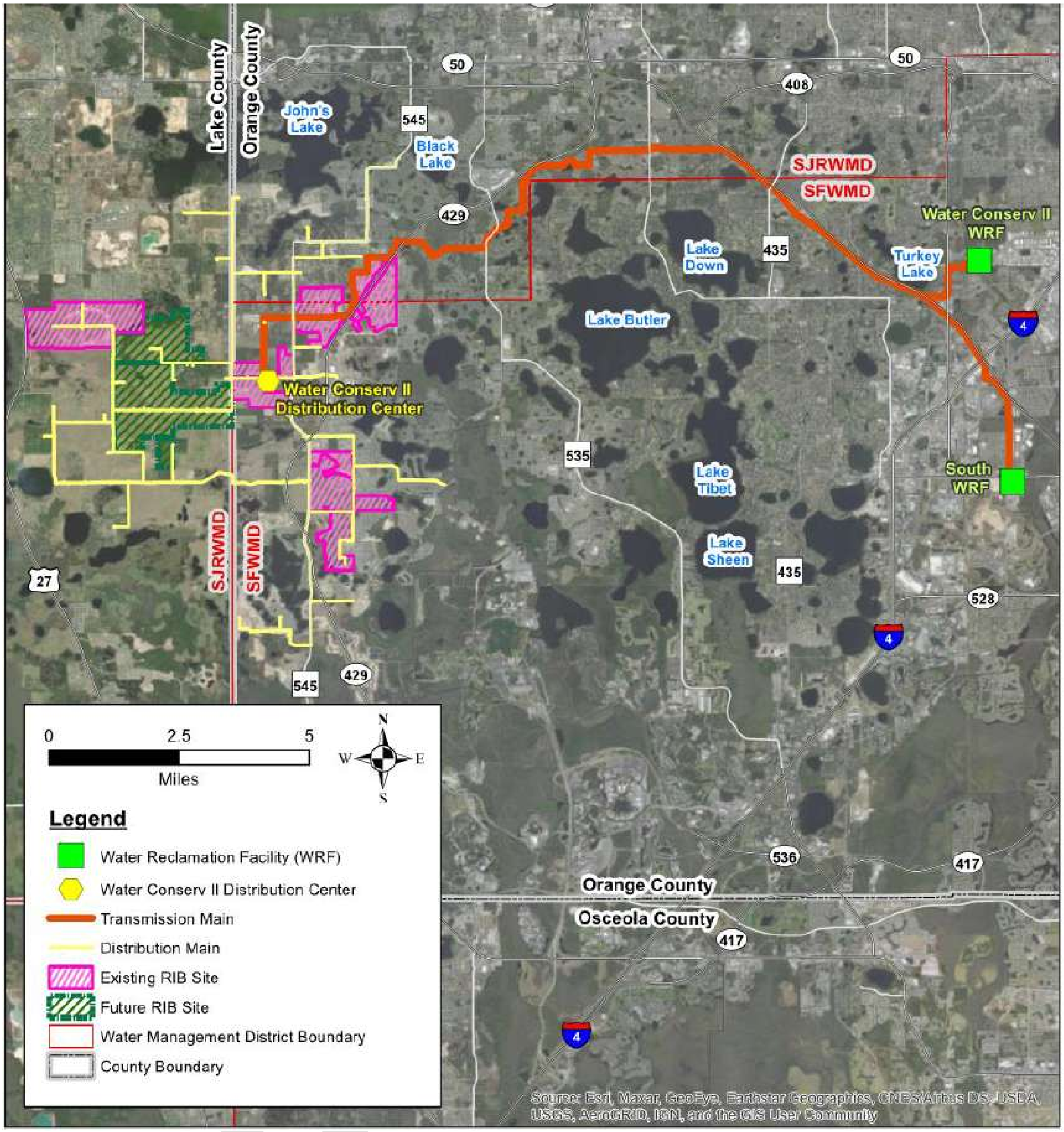

Figure 12: Existing and proposed future RIB sites in relation to Johns Lake

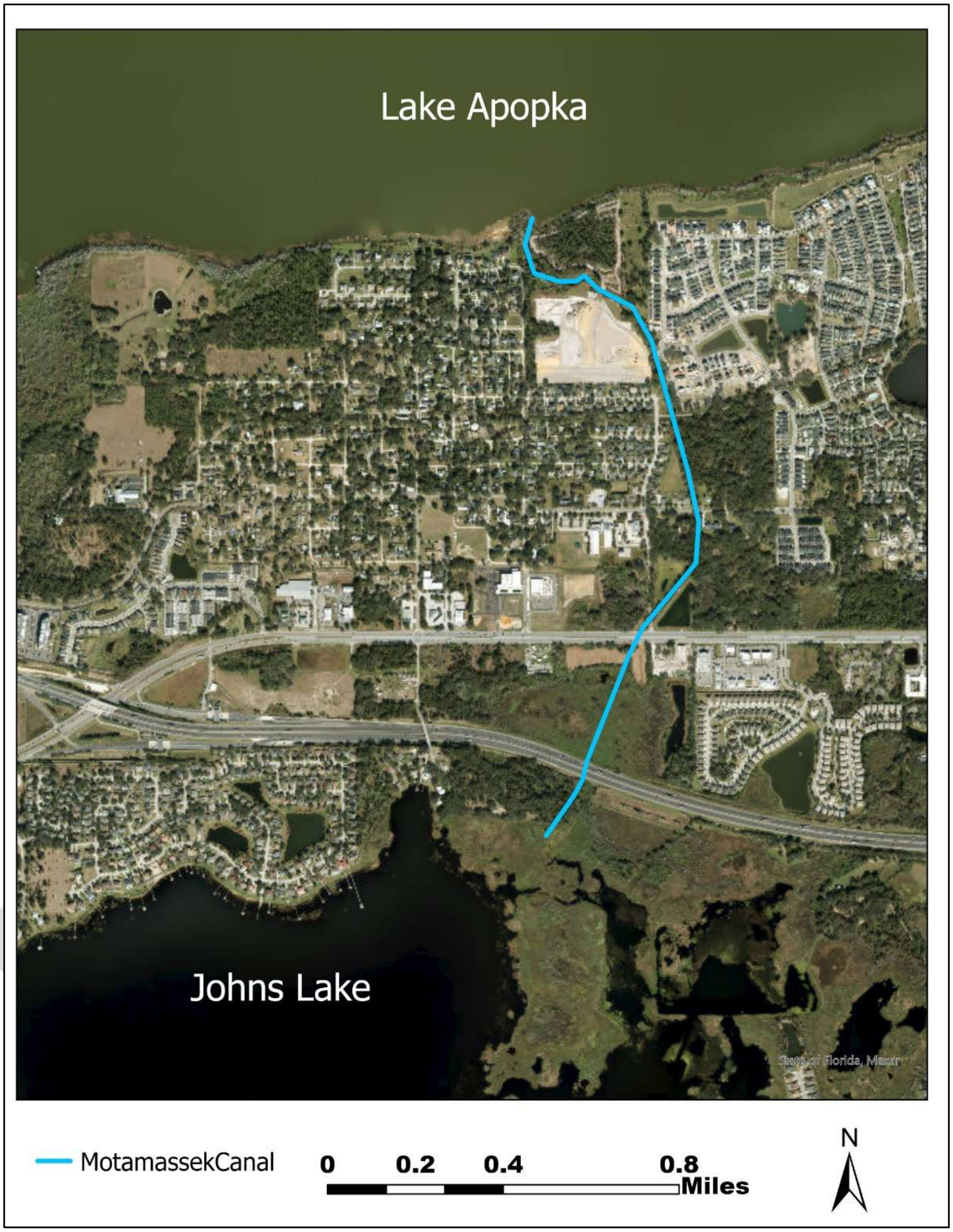

Figure 13: Motamassek Canal, which is the outflow path from Johns Lake into Lake Apopka

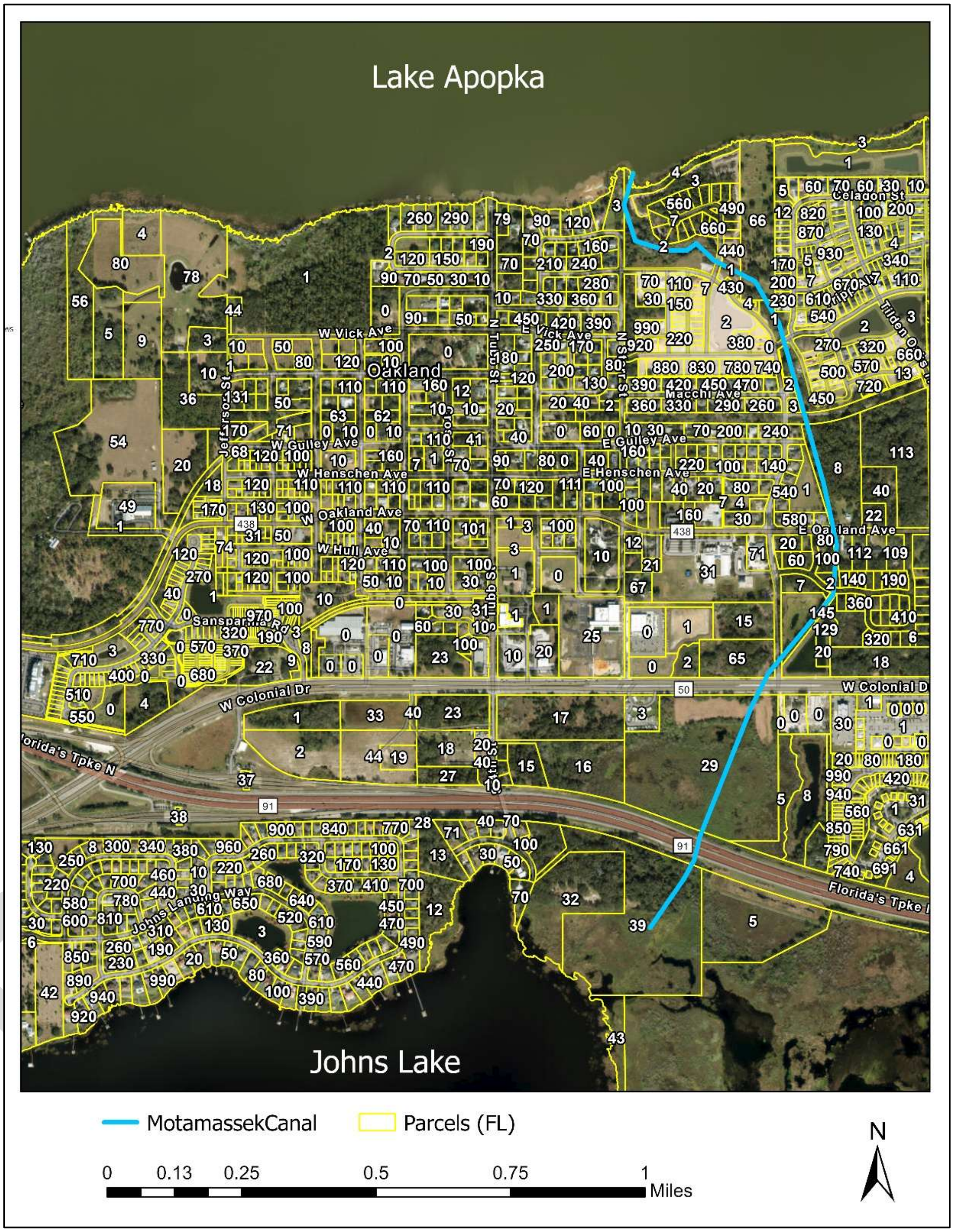

Figure 14: Motamassek Canal is split amongst ten parcels.

The exact elevation prior to the rebuild is unknown, but it was estimated to be 93.0 feet NAVD88 and used in the model for the pre-1993 simulation period. The increase in outfall elevation by a foot-and-a-half, is another possible explanation for the recent sustained observed higher water levels and relatively better model performance (Figure 16).

Figure 15: District staff confirmed the elevation of the control structure in Motamassek Canal.

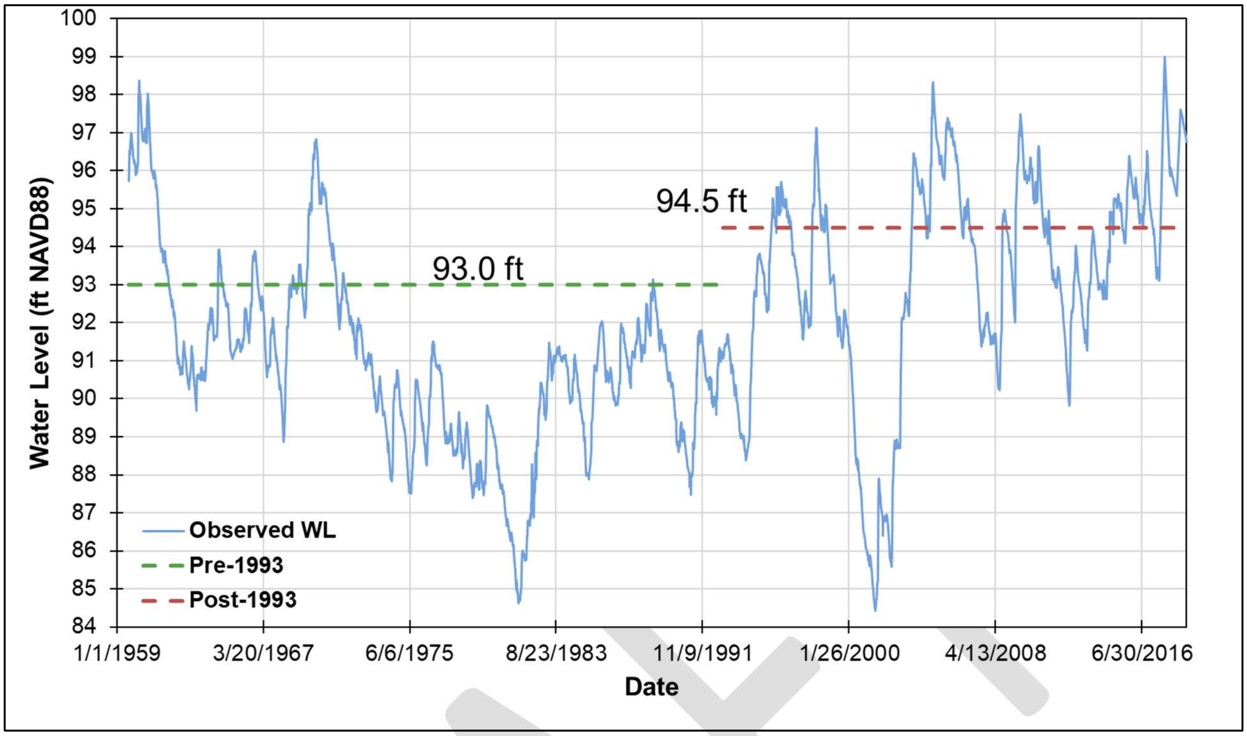

Figure 16: Controlling elevation of the outfall structure at Johns Lake, before and after 1993.

In summary, changes to the land use and land cover in the watershed, the impact of RIBs, and changes to the outflow canal and the structures that control the lake's water level all represent possible explanations for the model's overprediction. These recent and significant changes also explain why SJRWMD is recommending using the simulated data as the best predictor of future conditions in Johns Lake, despite the overprediction during the period 1965 – 1990.

While we understand the peer reviewers' concern with the model's overprediction of past water levels, we believe that the model's ability to forecast the future is more important for the evaluation of the recommended minimum levels.

Comment #2

Consider:

1. *Using the observed lake levels in the pre-development period to create a hybrid long-term lake level time series.*
2. *Apply no-pumping and current pumping adjustments to the hybrid time series.*
3. *Re-calculate statistics, including frequency statistics for duration, using the hybrid time series.*
4. *Re-evaluate No-pumping and current pumping frequency analysis for FH#1 and compare to MFL recurrence interval (1.6 years) determined from the SWIDS analysis.*
5. *Re-evaluate the open water area metric with the Hydroperiod Tool.*
6. *Re-determine available water for FH#1 and compare to open water metric freeboard (1.3ft) to determine if the open water metric is still the most constraining.*

SJRWMD Response:

To create the No- Pumping (NP) and Current Pumping (CP) conditions, a relationship between groundwater pumping and the UFA drawdown beneath the lake is developed using the ECFTX v2.0 model. In the MFLs analysis included in the report, this impact was applied to the ICPR4 simulated water-level time series (i.e., to create the simulated timeseries used for the MFLs assessment).

A “Delta-Observed NP” timeseries was created using pumping impact differences between the simulated NP condition and the simulated historical lake levels, and then adding this difference (or *delta*) to observed data. A Delta-Observed NP and Delta-Observed CP timeseries were created as follows:

1) A gap-filled observed lake level timeseries was created (observed data from SJRWMD gage 03840562 was filled using linear interpolation).
2) The ICPR4 model was used to create a simulated historical lake level timeseries.
3) The ICPR4 model was used to create a simulated NP condition lake level timeseries (using NP groundwater levels as model boundary condition).
4) The simulated historical levels were subtracted from the simulated NP levels to create the "NP delta".
5) The NP delta was added to the gap-filled observed lake level timeseries to create the "Delta-Observed NP" lake level timeseries.
6) The CP condition impact (i.e., same 2016-2020 impact used for the simulated CP timeseries) was subtracted from the Delta-Observed NP to create the Delta Observed CP lake level timeseries.

In addition to the NP and CP conditions, the same method was used to develop different drawdown scenarios. The MFL condition in the report (i.e., the most constraining condition) was based on CP plus an additional 1.3 feet of drawdown in the UFA. The difference from the CP and the CP-1.3 simulated conditions was subtracted from the Delta-Observed CP condition lake level timeseries to create the equivalent drawdown scenario (i.e., CP plus 1.3 ft of UFA drawdown) but with the observed data (Figure 17).

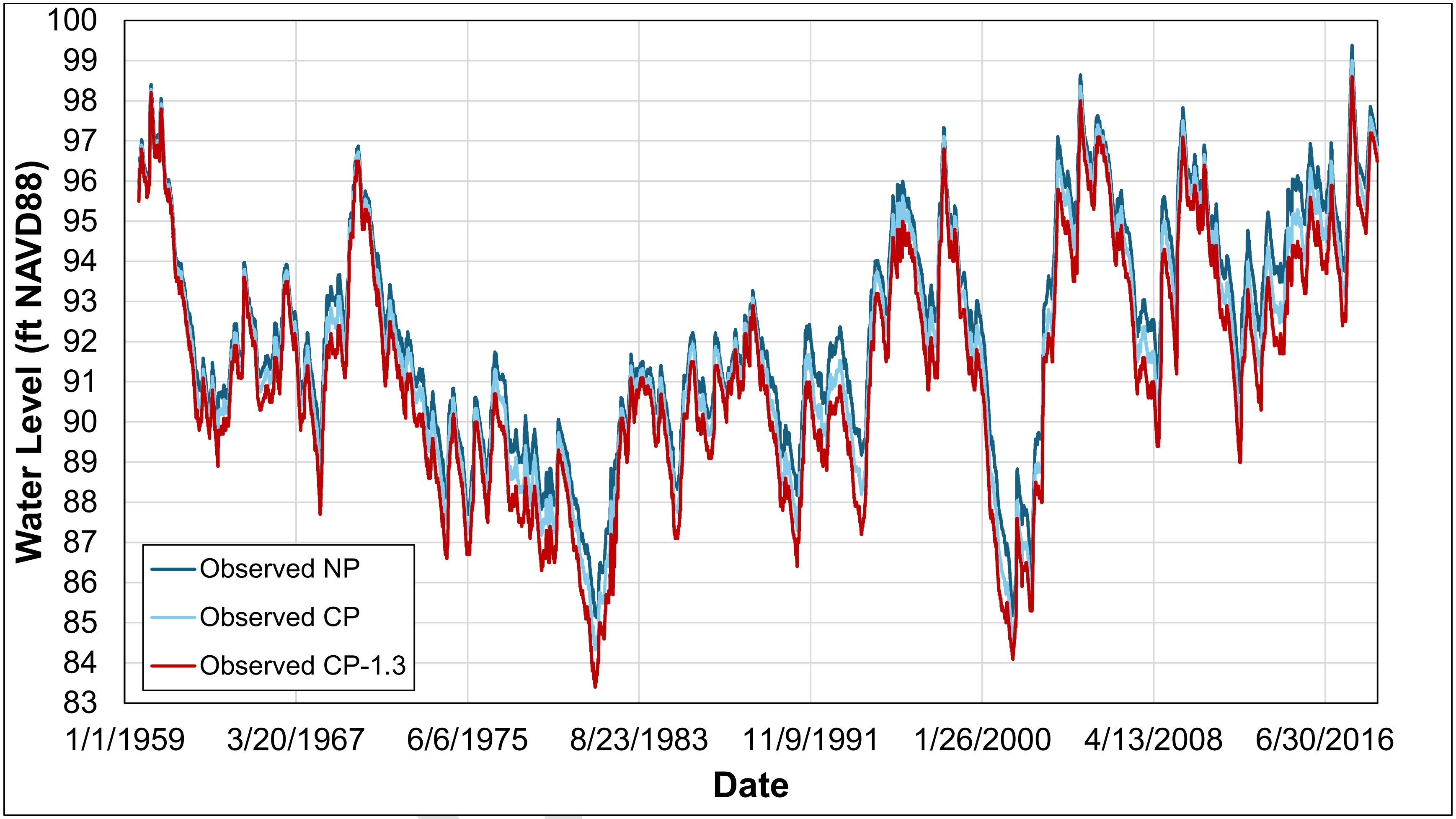

Figure 17: Three groundwater pumping scenarios, applied to gap-filled observed data for Johns Lake.

The three "delta timeseries" (i.e., Delta-Observed versions of the NP, CP and CP + 1.3 ft) were used to assess MFLs metrics using the same frequency analysis methods and criteria detailed in the report for Frequent High #1 (FH#1) (Figure 18; Table 1). With the Delta-Observed data, FH#1 did not meet the MFL, even under the NP condition. This would not have been considered a valid metric and would have been discarded if simulated data was not used. This result is due to the fact that recent higher water levels (ca. 1993-2023) have impacted the distribution of buttonbush at Johns Lake, increasing their average elevation. This is further evidence that the simulated data better reflects the current (and future) conditions and the hydroperiod required to protect the current distribution of plant communities at Johns Lake.

Due to the fact that the simulated data closely matched the observed water levels while the buttonbush community was establishing and the fact that those conditions are more likely to persist than the pre-development conditions, it is reasonable to use the simulated lake level data to assess FH#1.

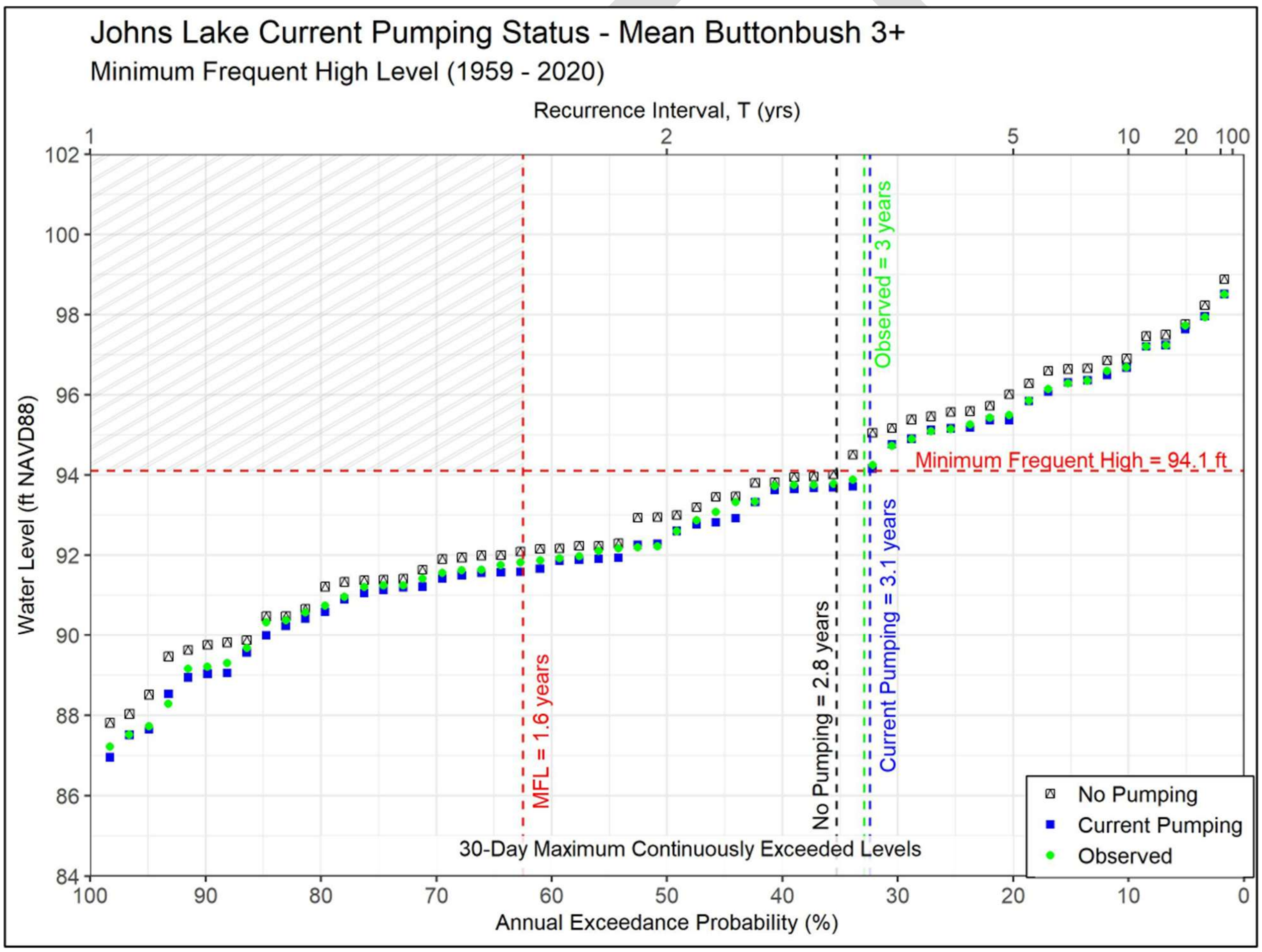

Figure 18: Weibull plot for FH#1 using the observed data and drawdown scenarios, instead of the simulated data.

The Delta-Observed data described above was also used to assess the most sensitive Hydroperiod Tool (HT) metric, the open water area ≥ 7 feet. The MFL condition (CP-1.3ft), on average, produced 19.1% less open water over time than the NP condition. This is above the impact threshold for this metric (a 15% reduction from the NP condition) but the larger *percent* change is due to a smaller NP condition area, not a greater total amount (i.e., acres) of change (Table 1).

Table 1: Simulated and observed data HT results for the open water metric

	Simulated Data	Delta-Observed Data
No-pumping (average acres)	1495.2	1022.6
CP -1.3 ft (average acres)	1275.4	827.6
Difference (NP - (CP-1.3ft))	219.8	195.0
Percent Change (%)	-14.7	-19.1

Comment #3

Need to discuss how you arrived at a 15-mile buffer zone when assessing groundwater pumping rate and UFA and Johns Lake drawdown impacts.

SJRWMD Response:

A technical memorandum was written by Hall et al. (2024) to explain why the 15-mile buffer was chosen. The 10, 15, and 20-mile buffers all had similarly strong relationships (i.e., high R^2 values) between pumping and impact (Figure 19), The 15-mile buffer was chosen because the Current Pumping (CP) impact from that regression was closest to the simulated ECFTXv2.0 result. Hall et al. state,

"To evaluate the performance of pumping-drawdown relationships for determining the most appropriate buffer to use for the final analysis, the impact from average 2016-2020 pumping in the model was calculated by inputting the average 2016-2020 pumping rate to each linear regression equation shown in Figures 4 through 6. The regression estimated impact was compared with the average 2016-2020 ECFTX v2.0 model simulated drawdown in the UFA beneath the lake. Table 1 includes the average 2016-2020 pumping rate and estimated impact from pumping drawdown relationships developed for each buffer area. At Johns Lake, the 15-mile buffer was deemed most appropriate for the final analysis due to its calculated regression CP impact being closest to the simulated ECFTX v2.0 impact."

Because the 15-mile buffer displayed a high R^2 value and closely simulated the ECFTXv2.0 impact, it was used to estimate the impact of groundwater pumping on the UFA near Johns Lake. It should also be noted that groundwater pumping across the whole ECFTXv2.0 model domain is considered when assessing pumping impacts at Johns Lake. These details and clarifications will be added to the MFLs report.

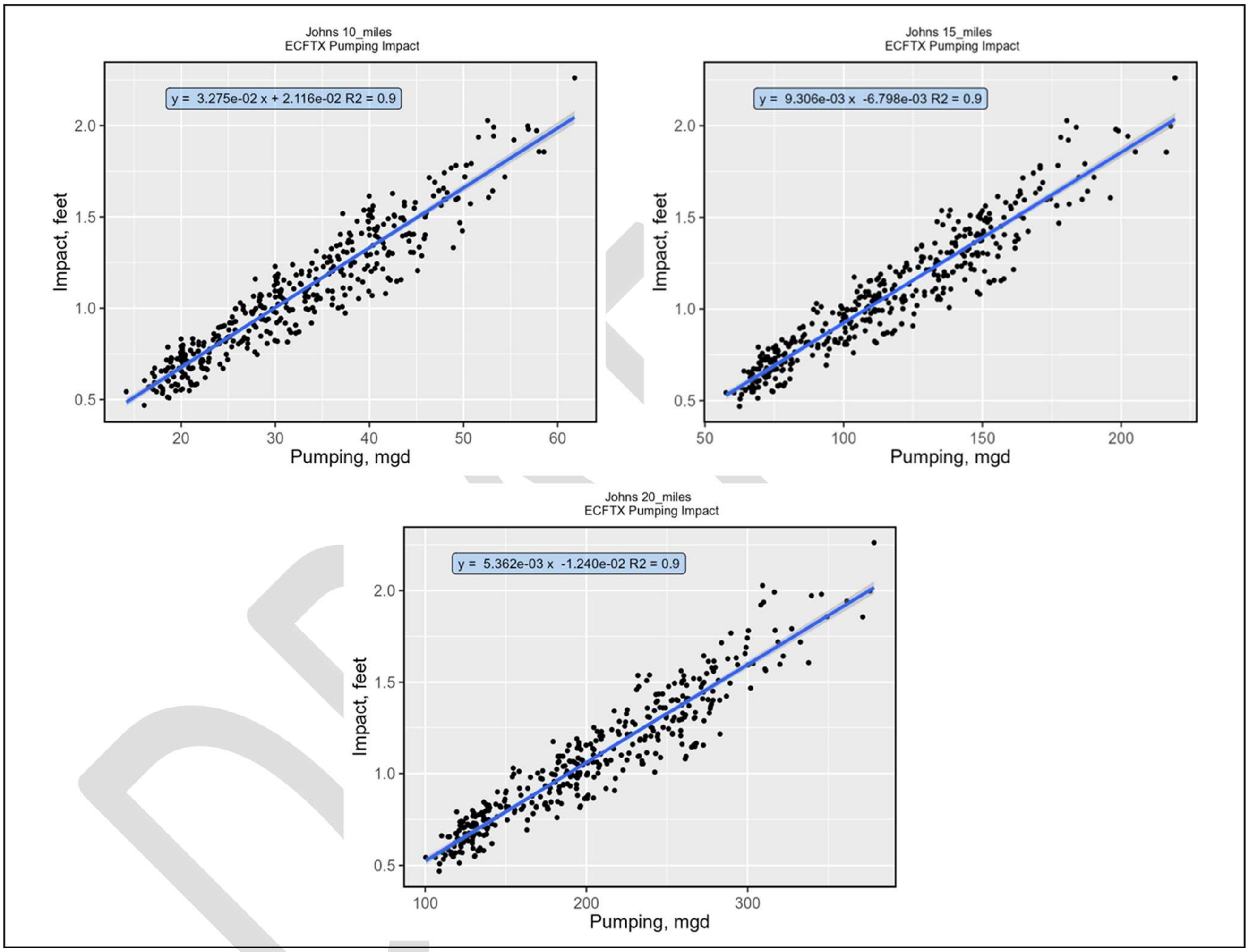

Figure 19: R^2 values for the relationship between pumping quantity (mgd) and impact (ft) on the UFA beneath Johns Lake using a 10, 15 and 20-mile buffer.

References

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