St. Johns River Water Management District

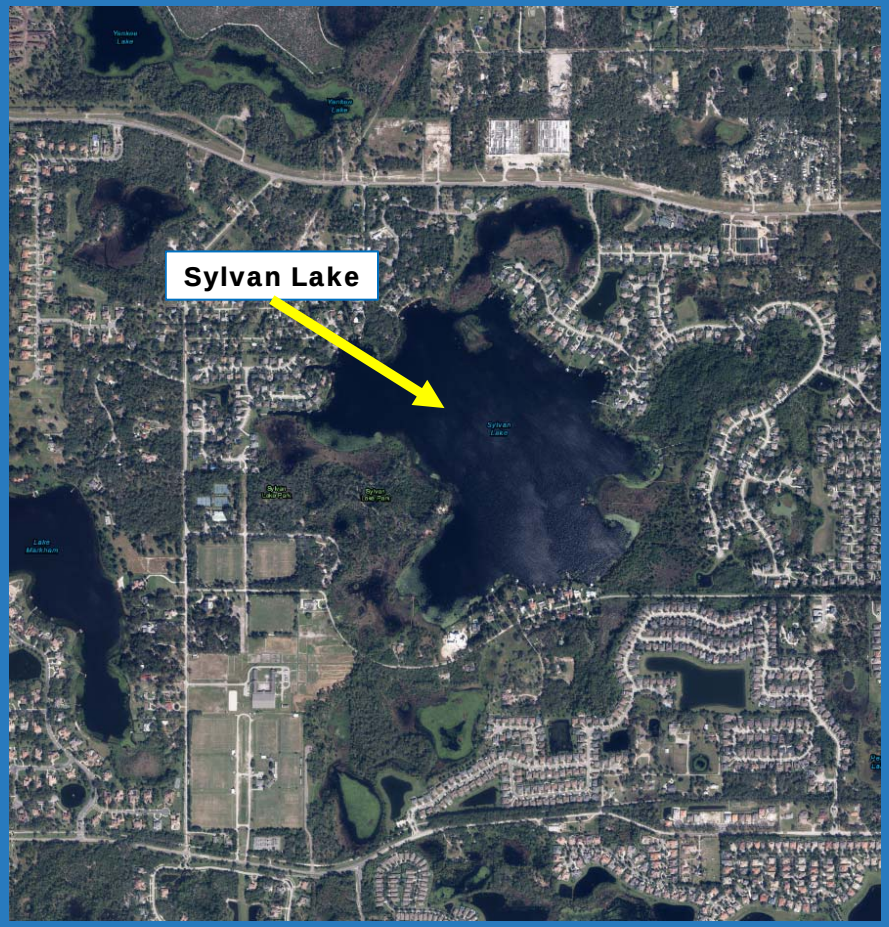
Sylvan Lake MFLs

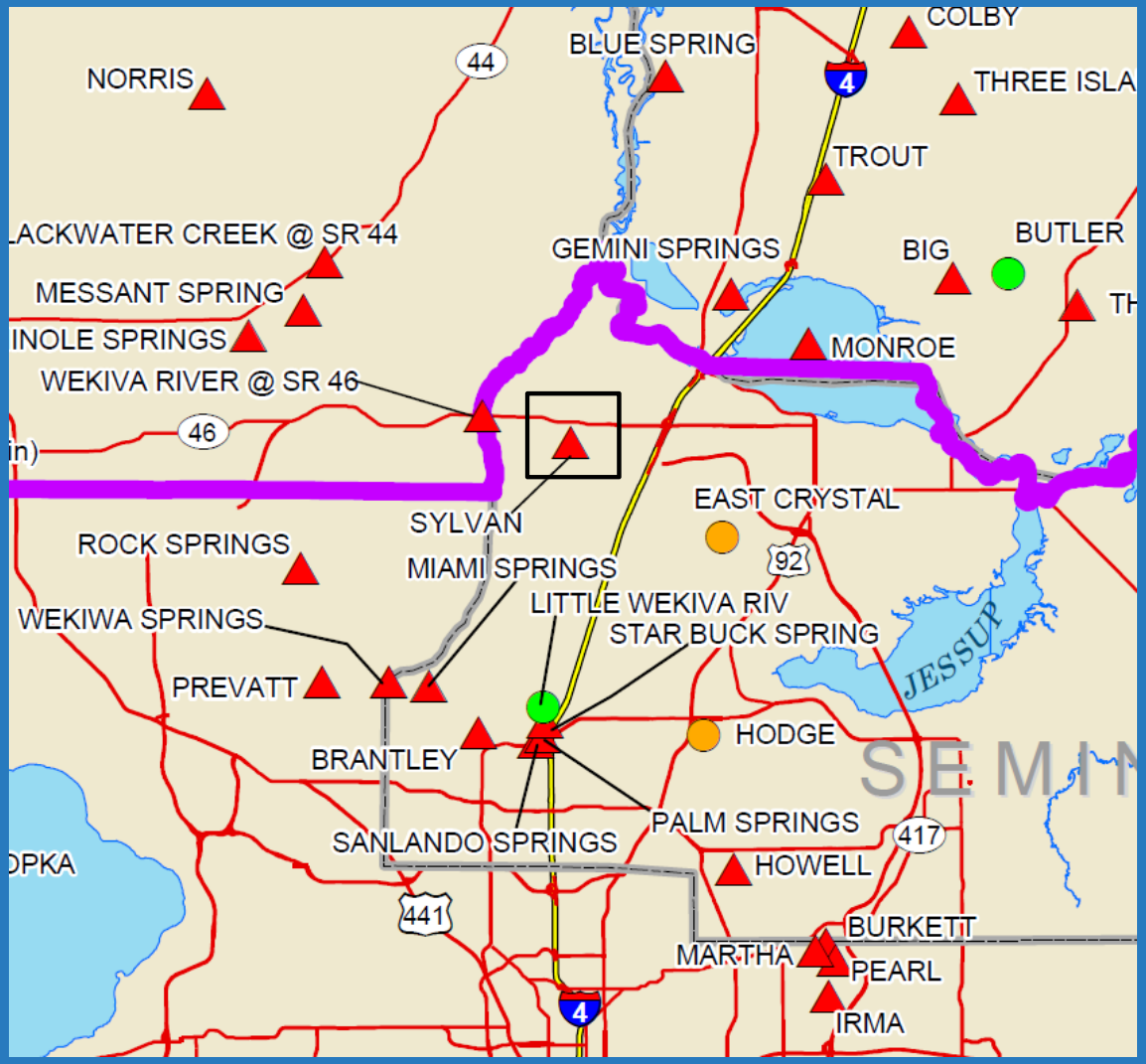
Hydrologic Modeling
Peer Review
Kick-off and Site Visit

October 22, 2019

Agenda

- Introductions and meeting objectives
- Overview of Sylvan Lake MFLs
- Overview of HSPF model
- Stakeholder comments
- Meeting adjourn


Sylvan Lake


NORRIS
44
BLUE SPRING
COLBY
THREE ISLA
TROUT
LACKWATER CREEK @ SR 44
GEMINI SPRINGS
BIG
BUTLER
MESSANT SPRING
INOLE SPRINGS
MONROE
WEKIVA RIVER @ SR 46
46
EAST CRYSTAL
SYLVAN
ROCK SPRINGS
92
MIAMI SPRINGS
LITTLE WEKIVA RIV
WEKIWA SPRINGS
STAR BUCK SPRING
JESSUP
PREVATT
HODGE
BRANTLEY
PALM SPRINGS
SANLANDO SPRINGS
417
HOWELL
441
BURKETT
MARTHA
PEARL
IRMA

Statutory Directive

Water management districts must establish MFLs that set…

"…the limit at which further withdrawals would be significantly harmful to the water resources or the ecology of the area."

Section 373.042(1), Florida Statutes (F.S.)

Statutory Directive

"...consideration shall be given to... non-consumptive uses, and environmental values..." *62-40.473, F.A.C.*

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

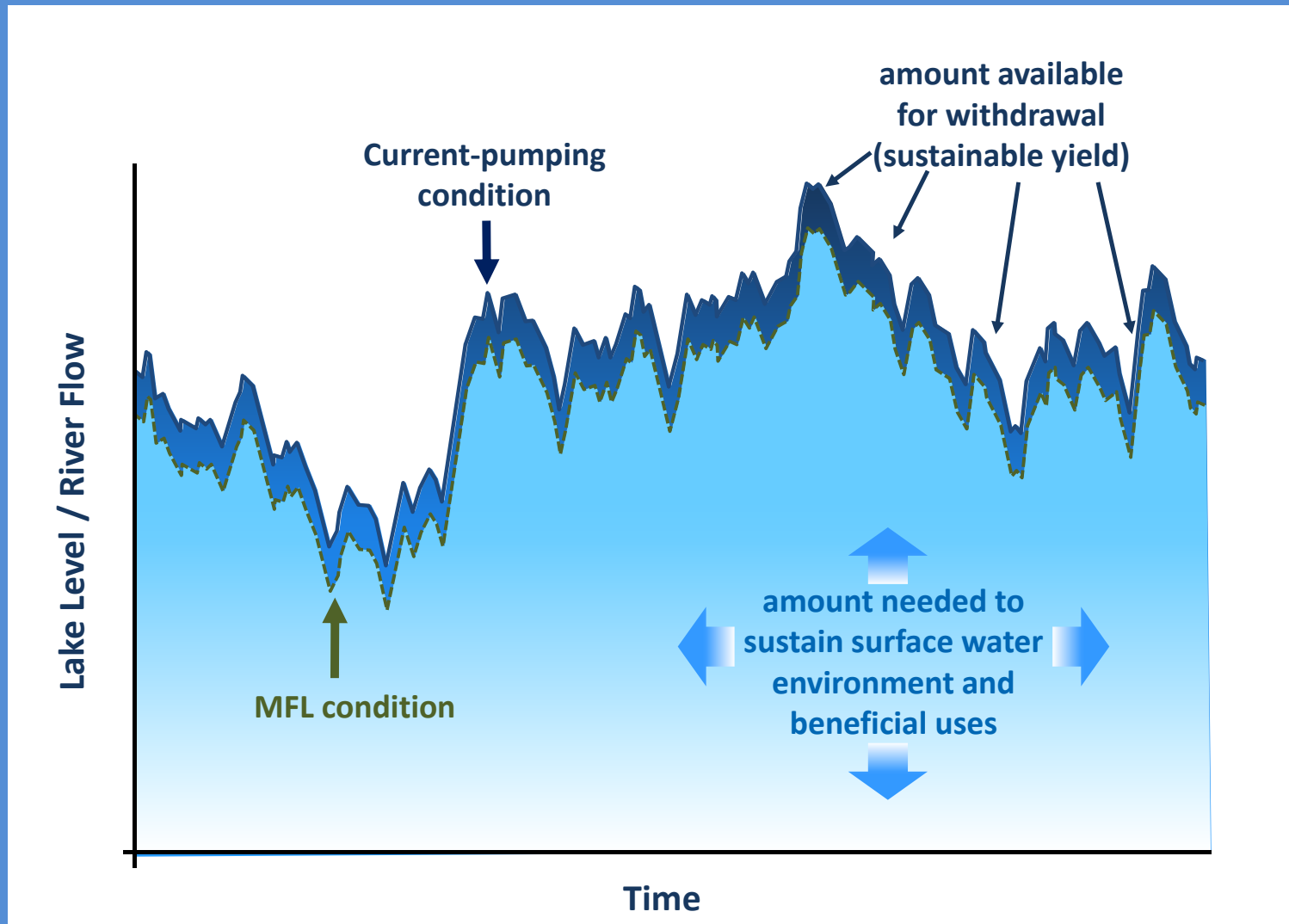
MFL Process Overview

MFLs Determination:

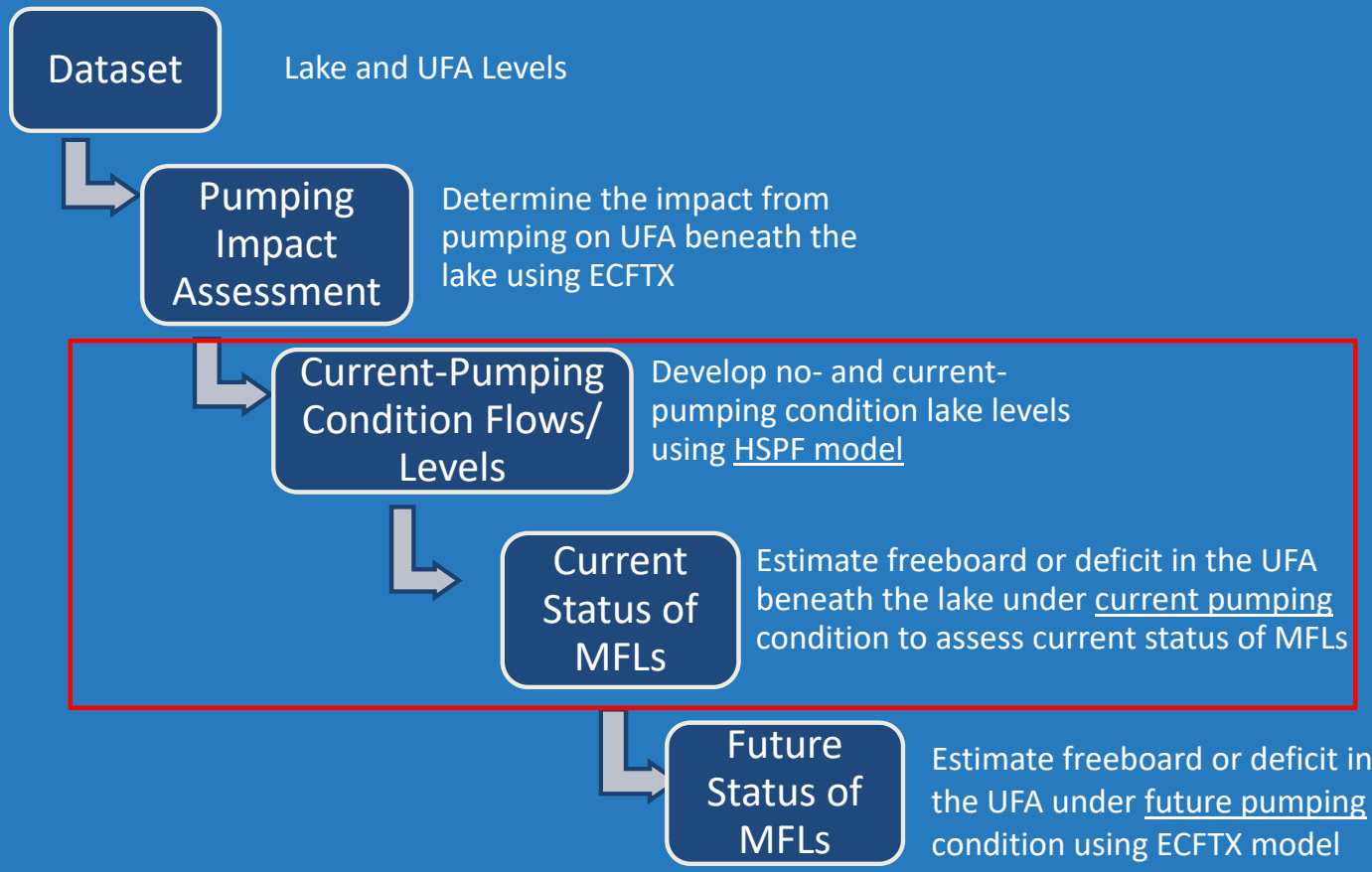
- Determine the most critical environmental features to protect and the minimum hydrologic regime required for their protection (MFLs condition)

MFLs Assessment:

- Determine the current impacted hydrologic regime (current-pumping condition)
  - Requires determination of no-pumping hydrologic regime, which represents historical no-pumping condition
- Compare the MFLs and current-pumping conditions to determine if water is available (freeboard)


amount available
for withdrawal
(sustainable yield)
Current-pumping
condition
Lake Level / River Flow
MFL condition
amount needed to
sustain surface water
environment and
beneficial uses
Time

Hydrological Analysis



Use of HSPF Model for MFLs

- **Simulation of interaction between the lake and the UFA**
- **Simulation of long-term lake levels**
- **Evaluation of the effect of pumping on critical lake levels needed for WRVs**
- **Assessment of the current status of MFLs to estimate water availability or deficit**

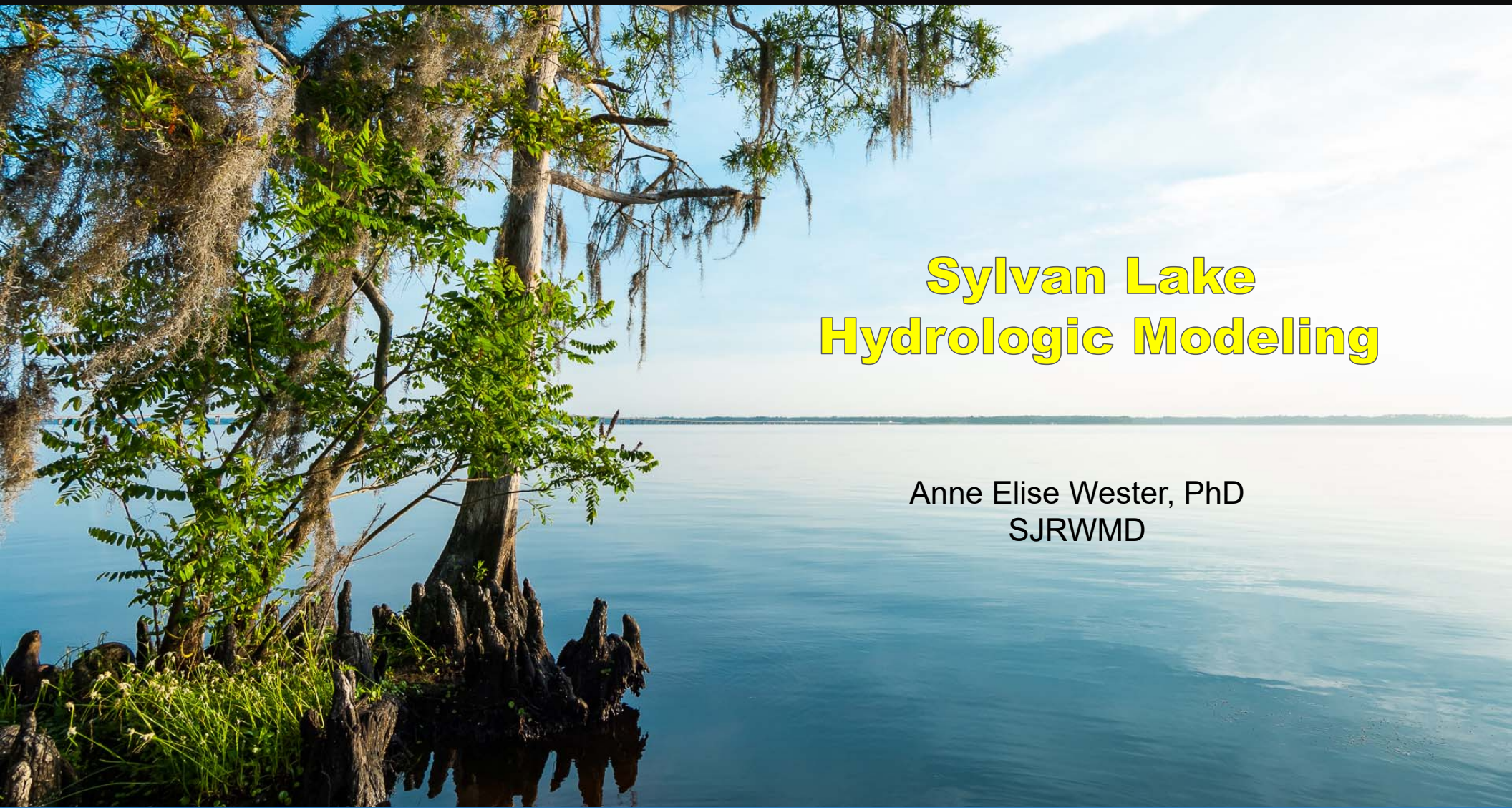
Potential Model Simulations

- **Long-term simulations**
- **Scenarios (by adjusting UFA boundary condition)**
  - **No-pumping condition simulations**
  - **Current-pumping condition simulations**

Peer Reviewer

- **Sylvan Lake - Silong Lu, PhD, PE, DWRE (Dynamic Solutions, LLC)**

St. Johns River Water Management District



Sylvan Lake Hydrologic Modeling

Anne Elise Wester, PhD
SJRWMD

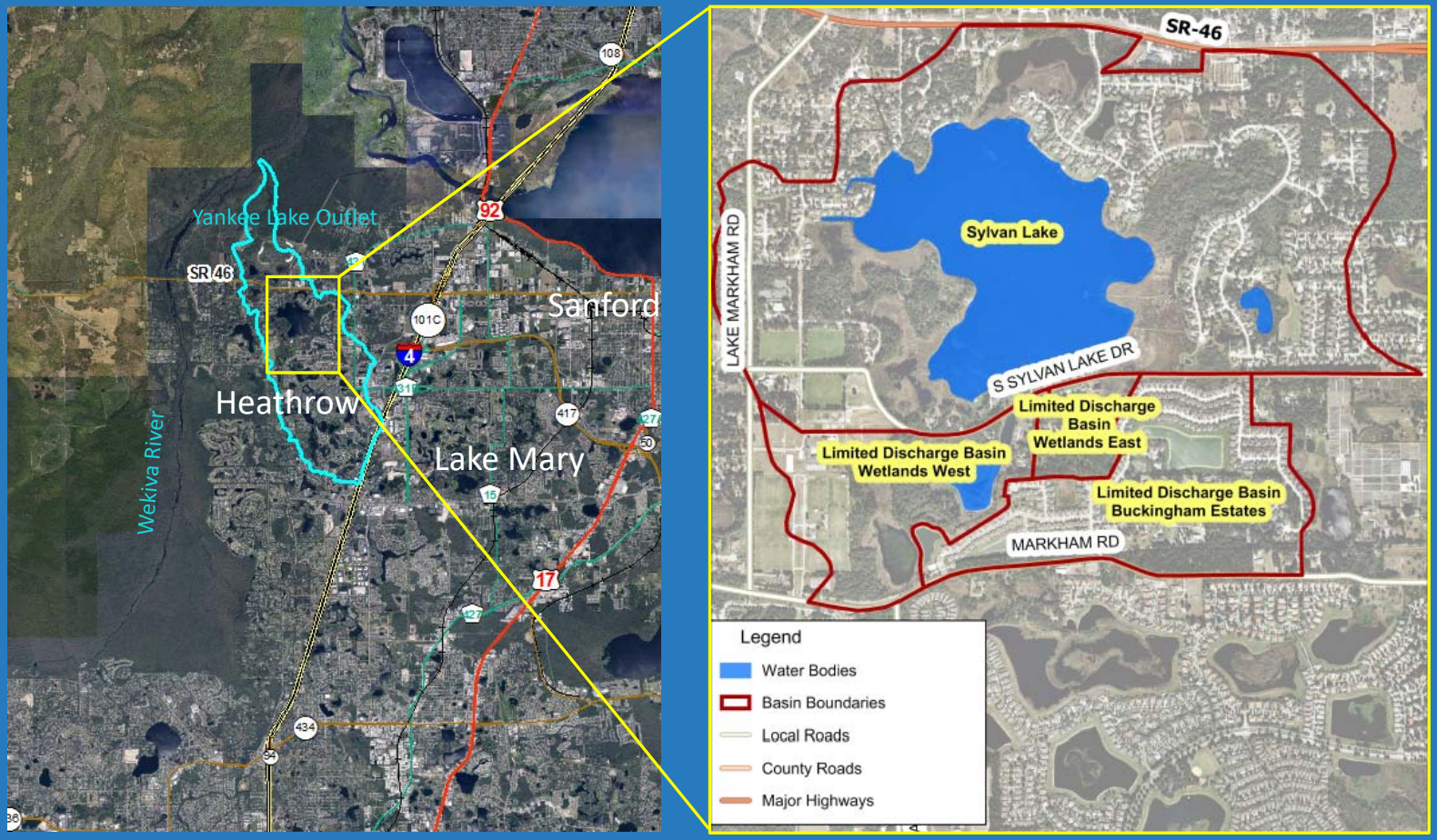
Contents

- **Background on Sylvan Lake**
- **Hydrological Model (HSPF) development and calibration**
- **Long-term simulation**

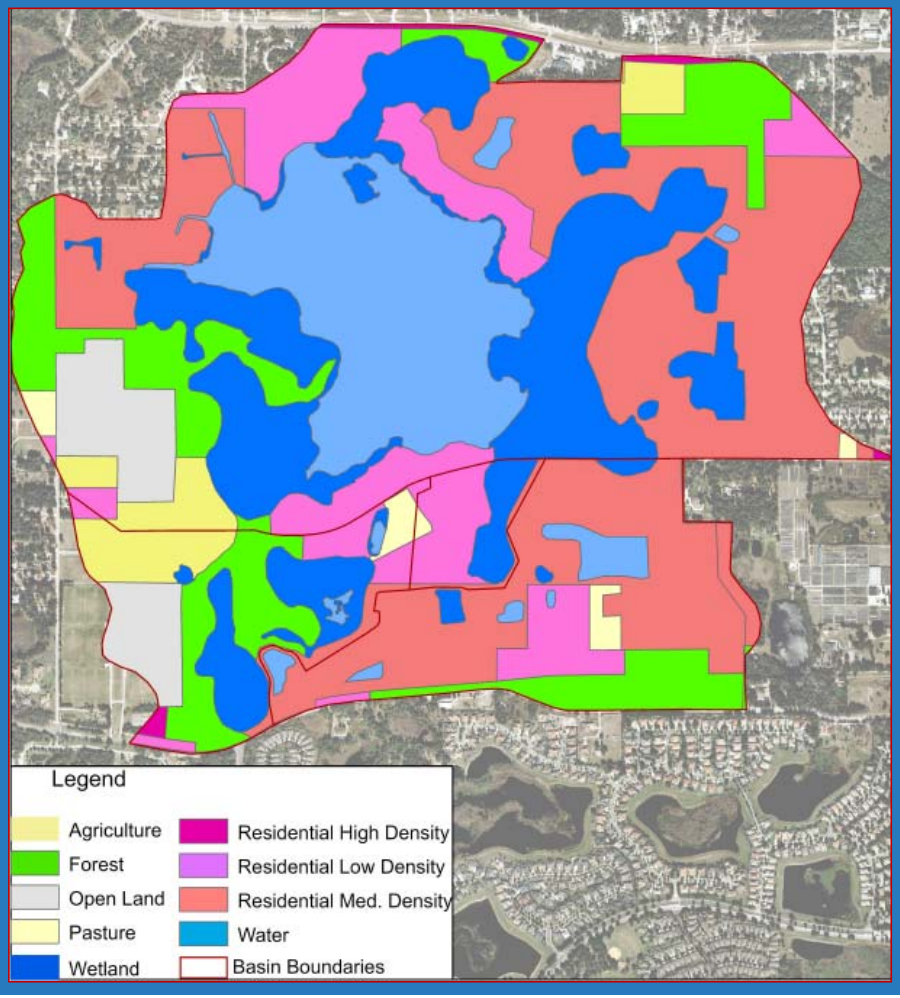
Sylvan Lake MFL

- **Model development by CDM Smith**
  - **Review data provided by SJRWMD**
  - **Develop updated Sylvan Lake HSPF**
  - **Calibrate and validate model**
- **Outflow Structure**

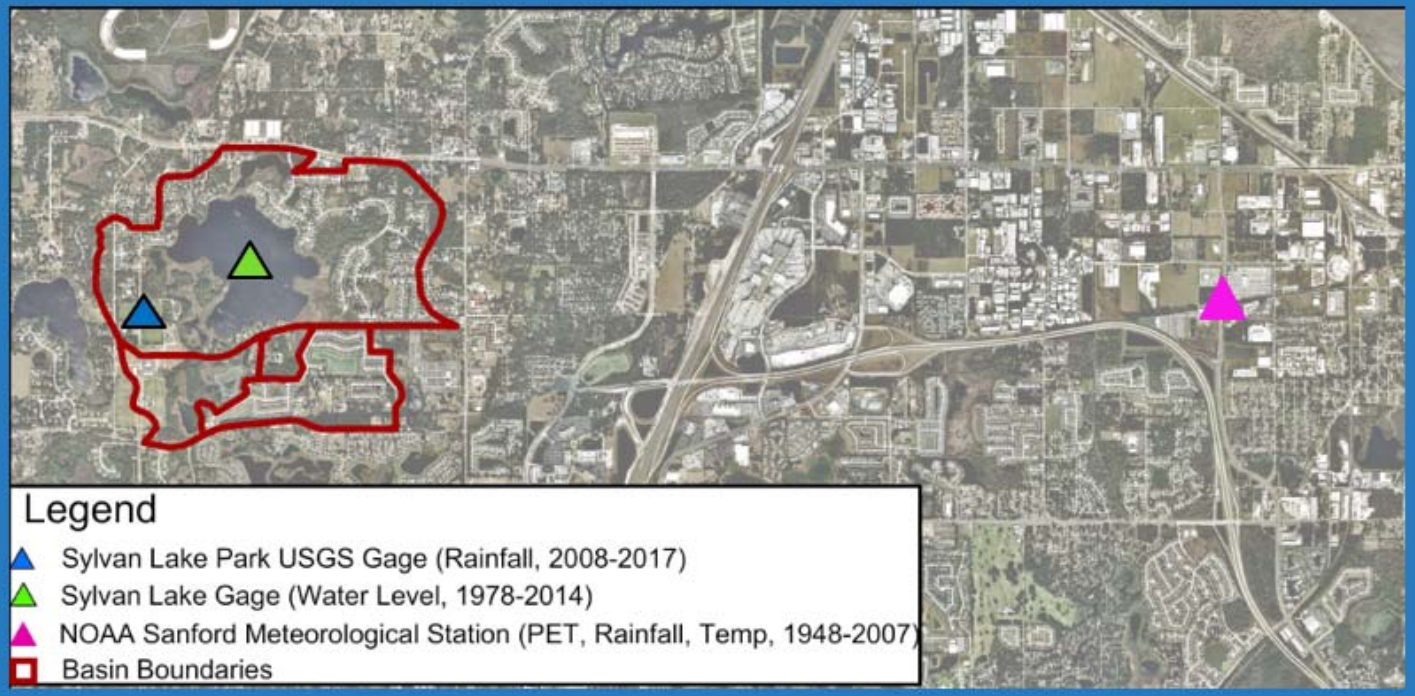
Drainage Basin



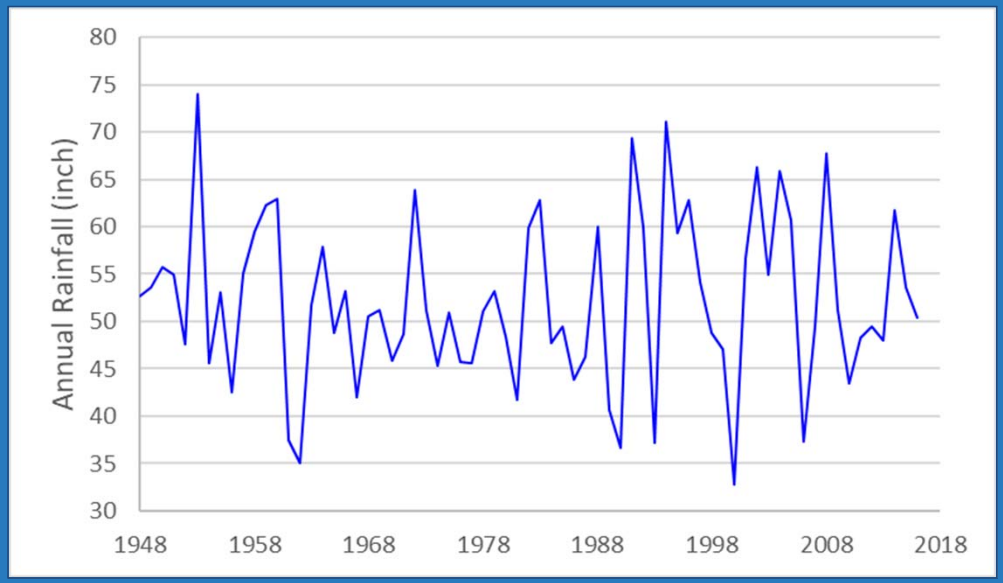
Land Use


Legend
Agriculture
Forest
Open Land
Pasture
Wetland
Residential High Density
Residential Low Density
Residential Med. Density
Water
Basin Boundaries

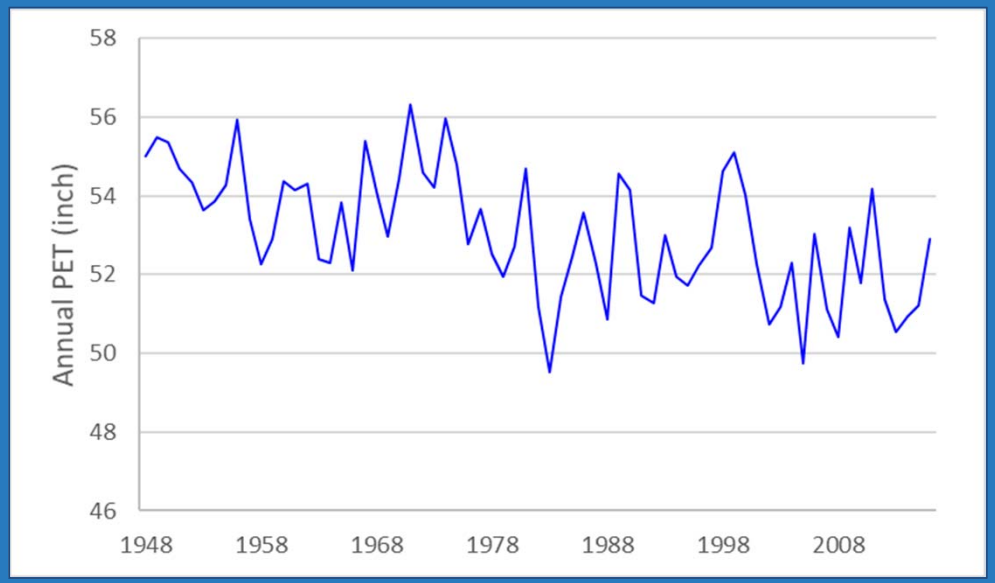
Gages


Legend
Sylvan Lake Park USGS Gage (Rainfall, 2008-2017)
Sylvan Lake Gage (Water Level, 1978-2014)
NOAA Sanford Meteorological Station (PET, Rainfall, Temp, 1948-2007)
Basin Boundaries

Rainfall and PET

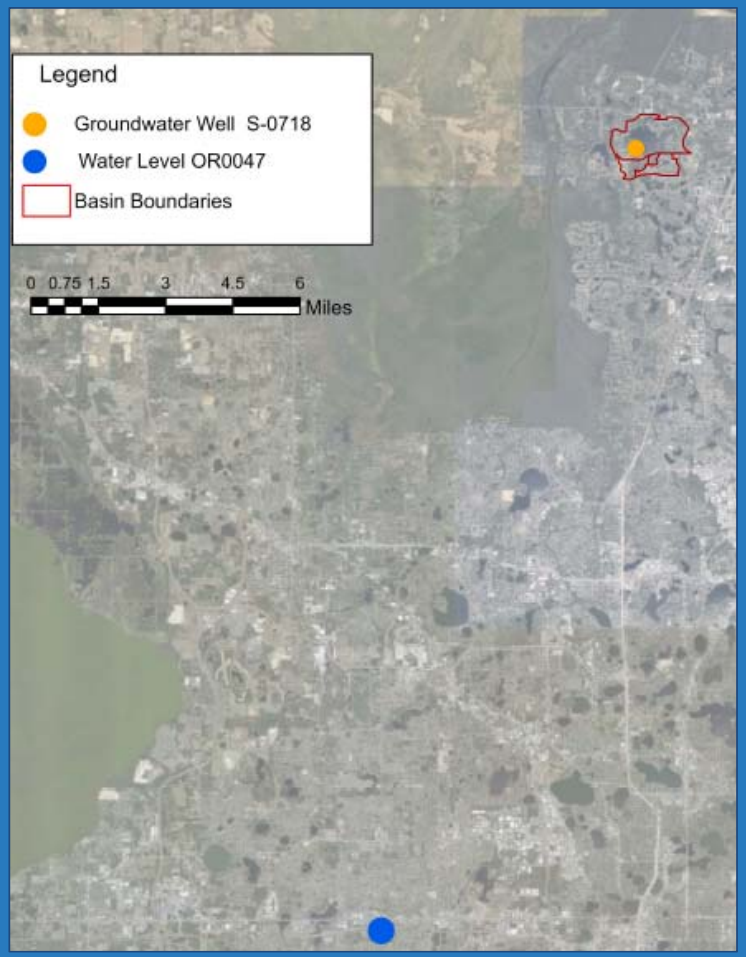


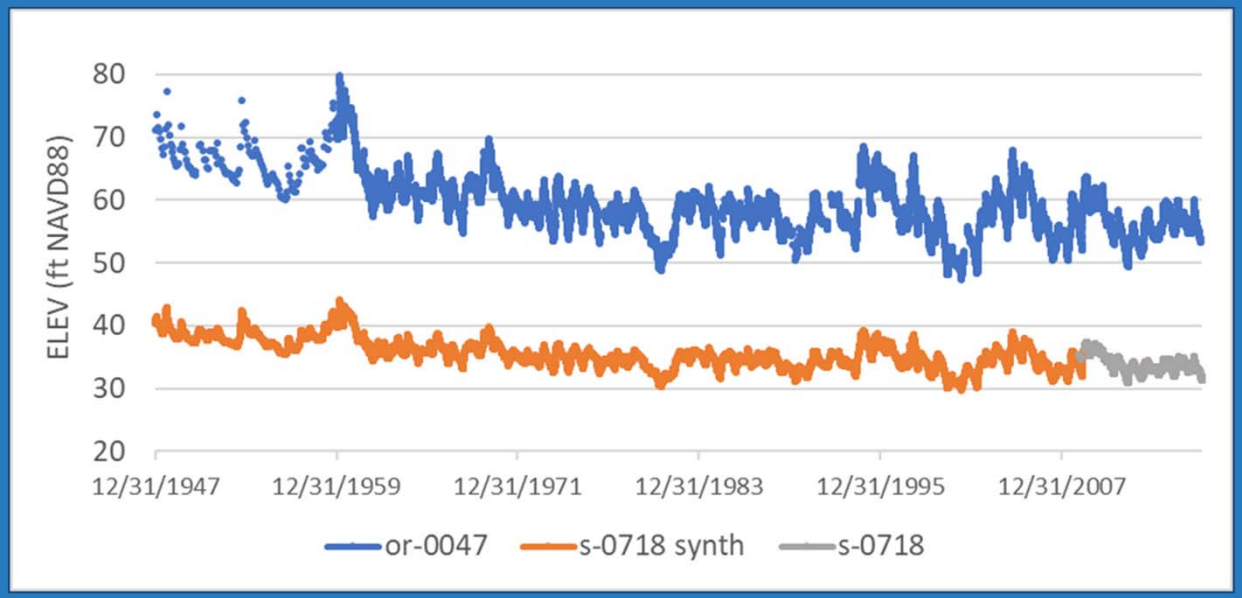
ANNUAL RAINFALL AT SANFORD (1948-2007) AND USGS (2008-2017) STATION



ANNUAL PET AT SANFORD STATION

Groundwater



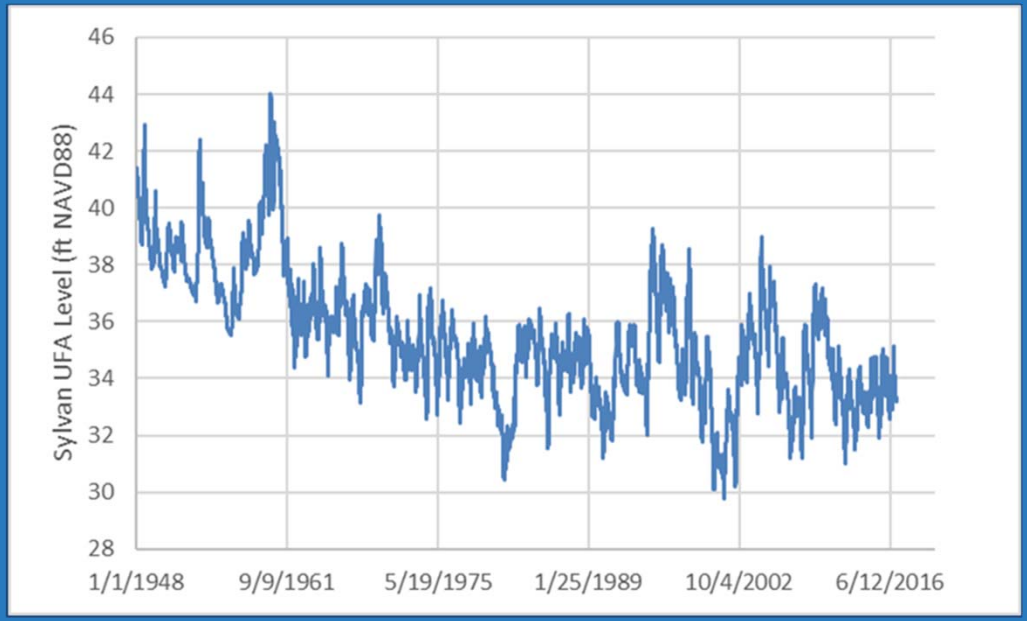


Groundwater

STATION NUMBER	STATION NAME	Data Start	Data End
30342858	S-0718 Sylvan Lk Wells at Sanford (WL) FA	2/11/2009	7/30/2017
09272094	OR0047 Obs Well at Orlo Vista (WL) FA	1/1/1997	3/16/2017

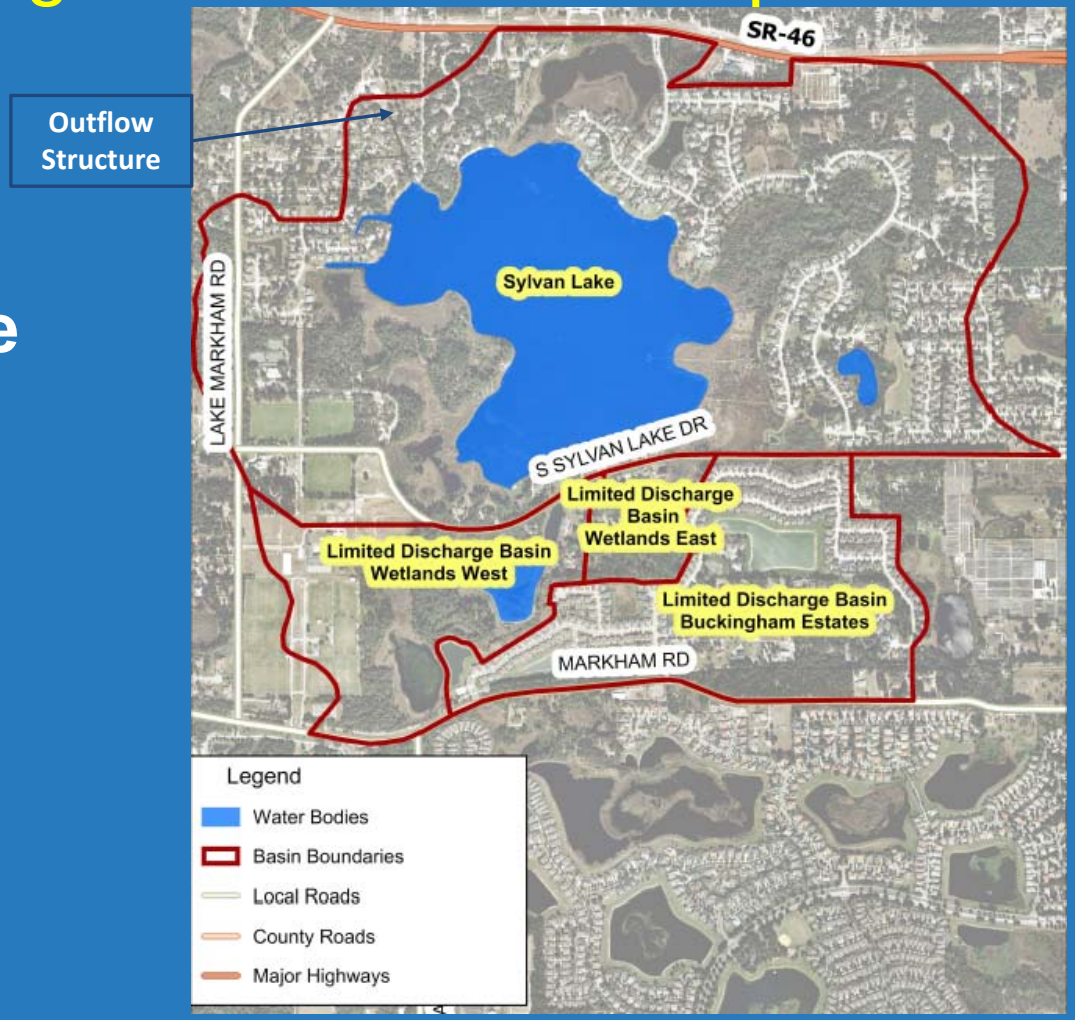
Synthesized values based on well OR-0047 were used to fill the data gap at well S-0718 prior to July 2009 in the calibration, verification and long-term models using MOVE.3

Relationship for the Synthesized S-0718 Sylvan data:
ELEV (ft, NAVD88)= 1.633 x (OR-0047 ELEV) $^{0.7521}$



Hydrological Model Setup

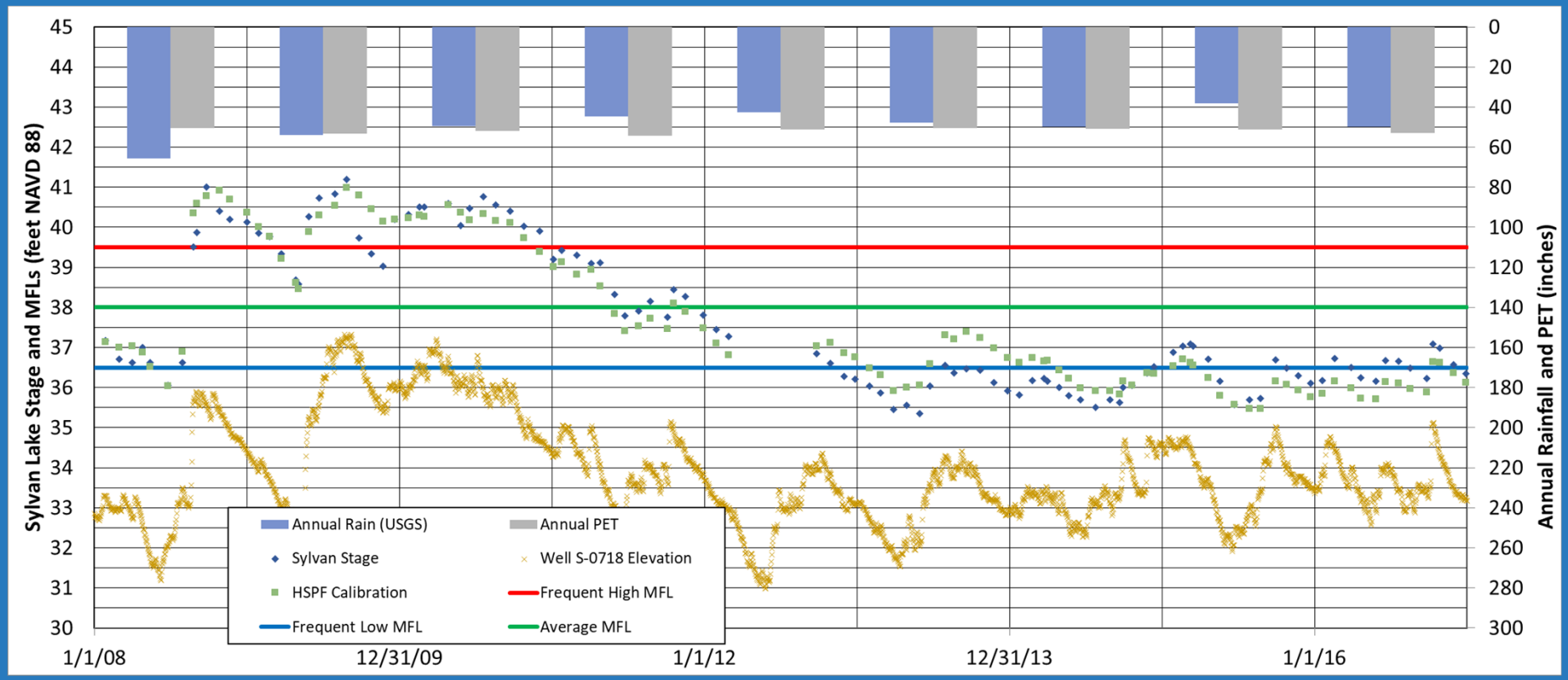
- HSPF
- 4 sub-basins
- Outflow structure
  - Modified in 2014



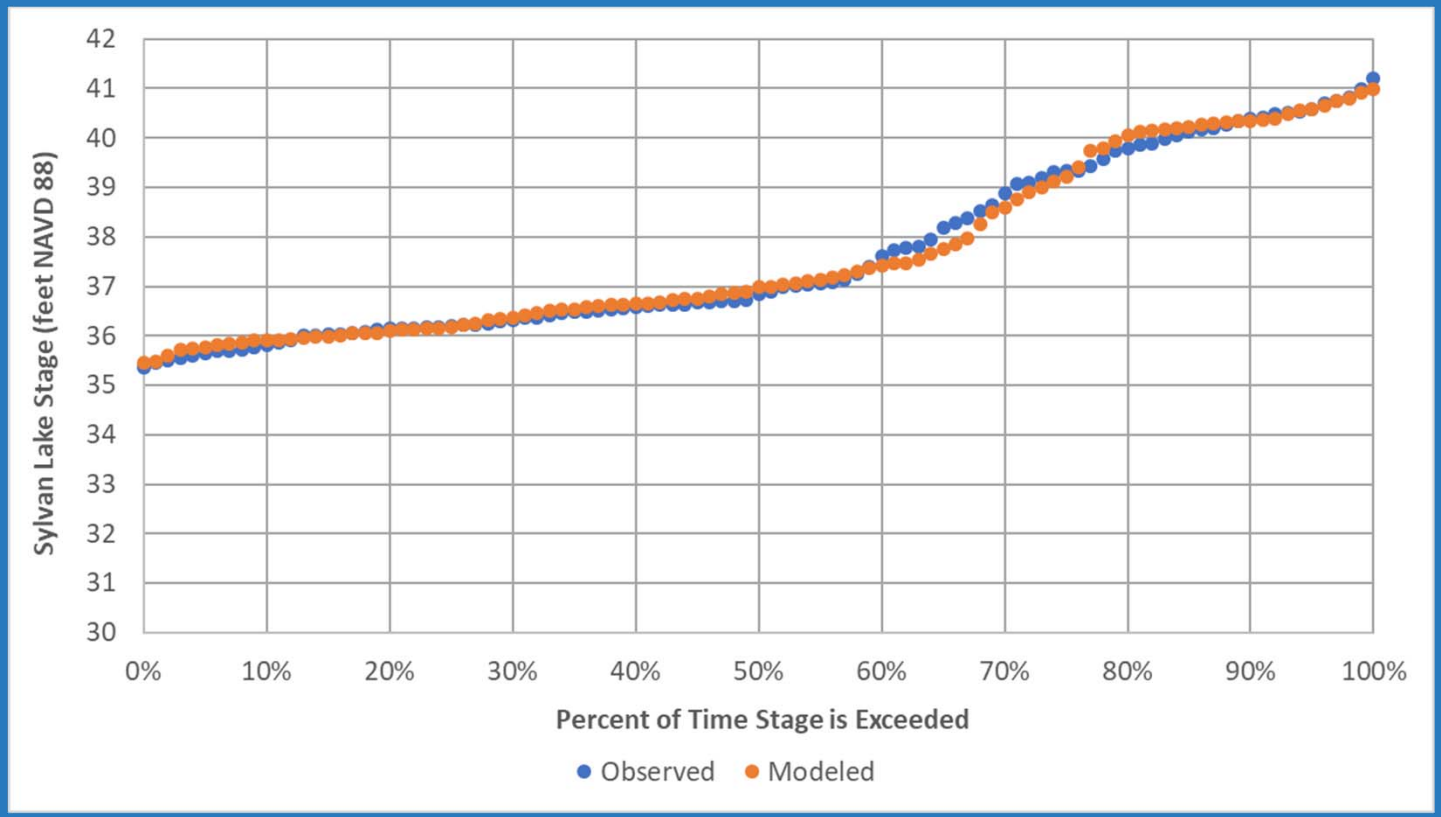
Hydrologic Model Calibration

- **Calibration Period**
  - **1/1/2008- 12/31/2016**
- **Validation Period**
  - **1/1/1997-12/31/2007**

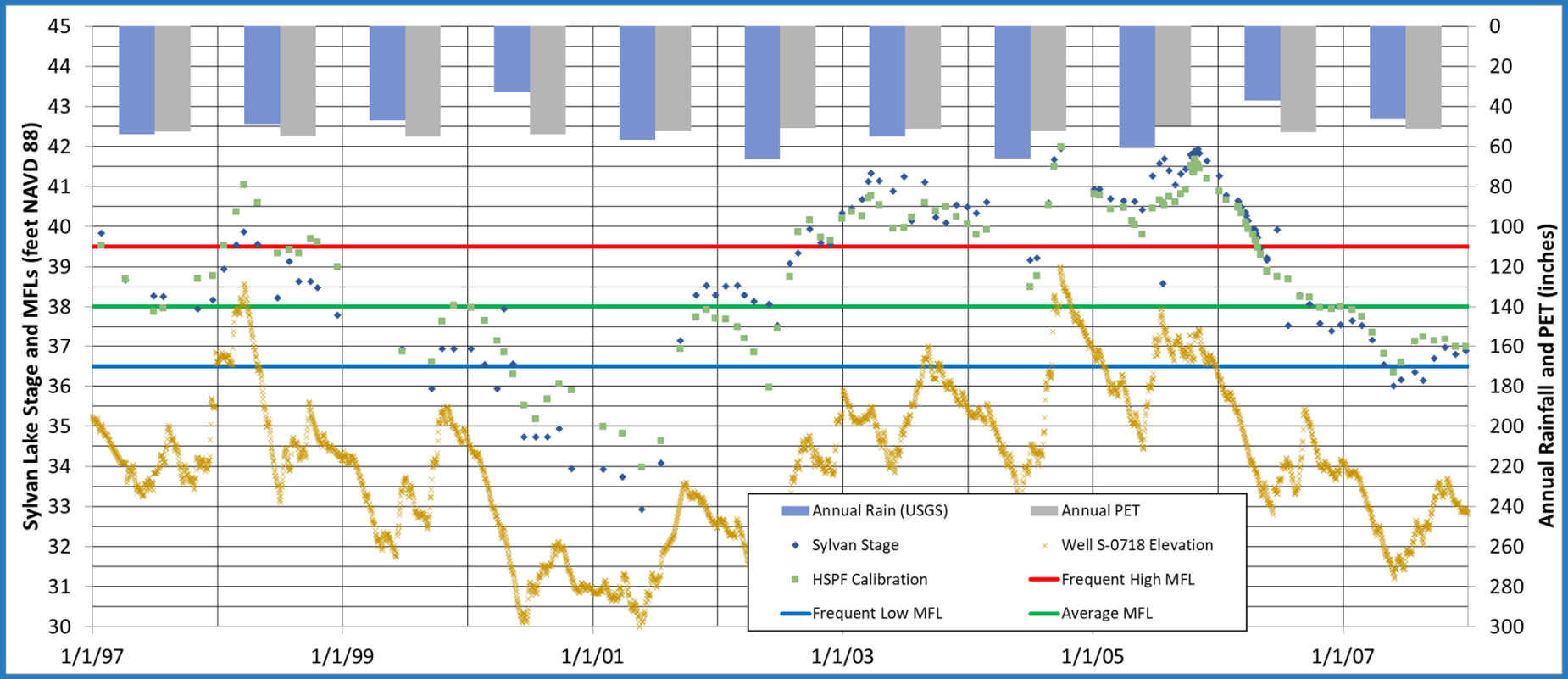
Calibration Results



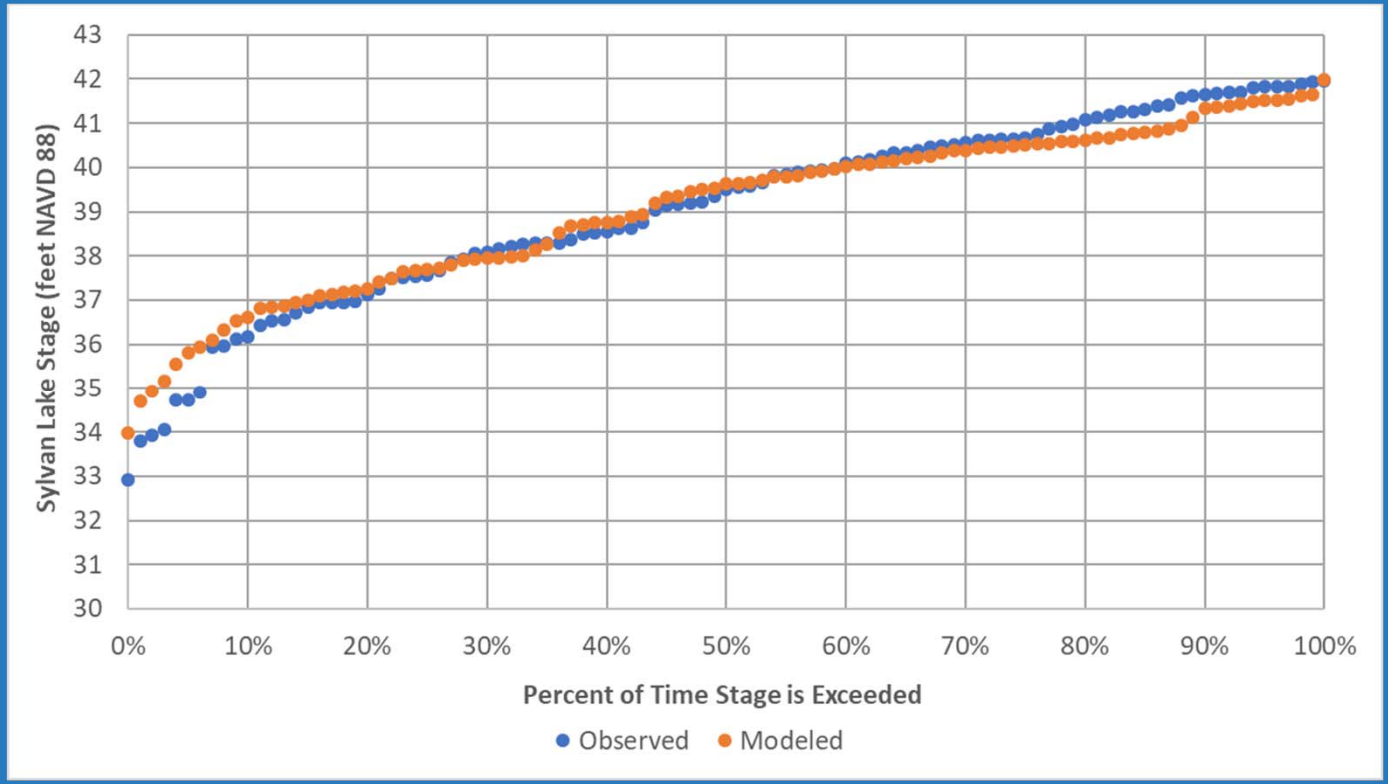
Calibration Results



Validation Results



Validation Results



Hydrologic Model Performance

Statistic	Paired Data within ½ Foot	Nash-Sutcliffe Efficiency
Calibration	72%	0.93
Validation	57%	0.90

Water Balance

LAKE INFLOWS	Average Annual Volume (acre-feet)	Average Annual Value (inches over lake surface)	Percent of Inflows
Direct Rainfall	734	48.9	63%
Pervious Inflow – Direct Tributary Area	225	15.0	19%
Impervious Inflow – Direct Tributary Area	130	8.7	11%
Baseflow Inflow – Indirect Tributary Area	74	4.9	6%
TOTAL	1,163	77.5	100%
LAKE OUTFLOWS	**Average Annual Volume (acre-feet)**	**Average Annual Value (inches over lake surface)**	**Percent of Outflows**
Evaporation	773	51.5	66%
Lake Seepage to Floridan Aquifer	399	26.6	34%
Lake Surface Discharge	0	0.0	0%
TOTAL	1,172	78.1	100%

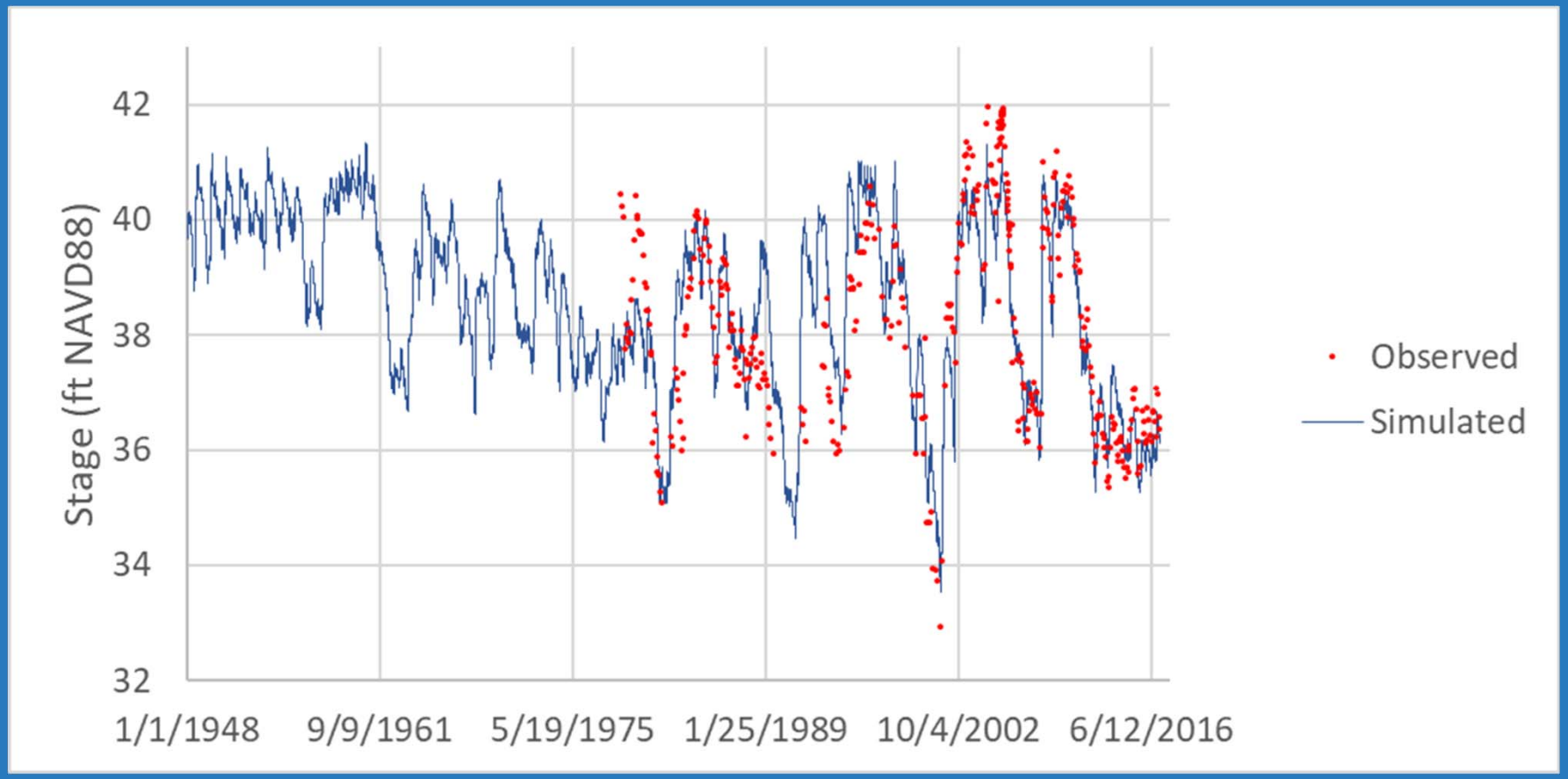
Long-term Simulation

- **Calibrated model was run from January 1, 1948 to December 31, 2016.**
  - **Extensions of hourly rainfall, PET, and daily UFA groundwater levels**
  - **All the hydrologic parameters were kept the same.**
  - **Modified outflow structure was used**

Sylvan Discharge

ELEV (ft NAVD88)	Area (acres)	Volume (acre-feet)	Pre-2014 Culvert Outflow (cfs)	Post-2014 Culvert Outflow (cfs)
36.6	162	1024	0	0
38.6	180	1365	0	0
40.5	236	1762	0	0
40.8	256	1838	0	1.8
41.0	270	1888	0.1	7.4
41.5	307	2032	1.5	20.8
42.0	345	2158	4.9	38.5
42.5	358	2371	21	47.2
43.0	371	2553	42	54.5

Long-term Results



Thank you