Wekiva Basin MFLs
Modeling Peer Review
Kick-off and Site Visit

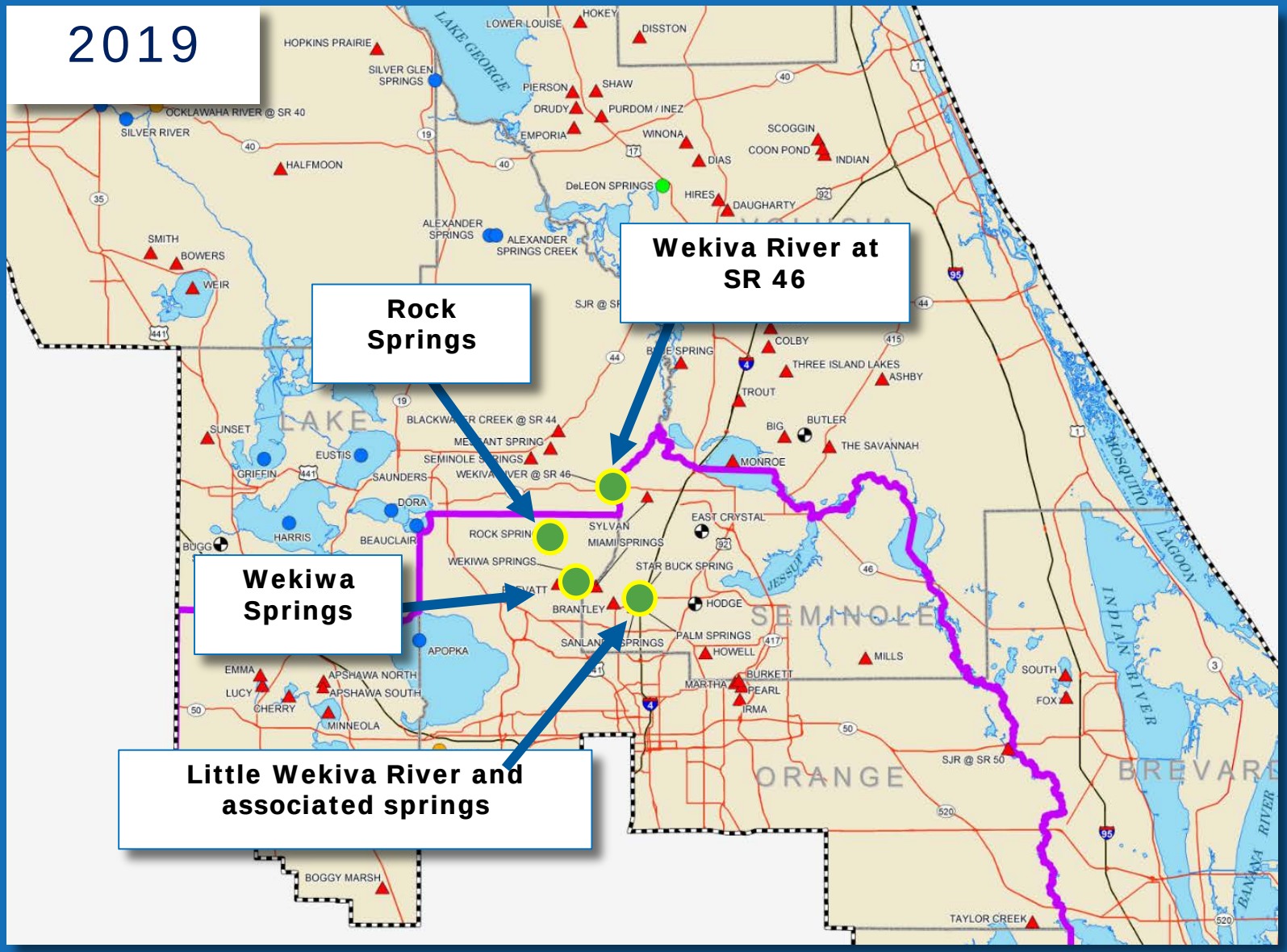
September 26, 2018

Agenda

- Introductions and meeting objectives
- Overview of Wekiva Basin MFLs
- Overview of HSPF / HEC-RAS models
- Stakeholder comments
- Site visit overview
- Meeting summary
- Stakeholder comments
- Meeting adjourn

Wekiva Basin MFLs

2019



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."

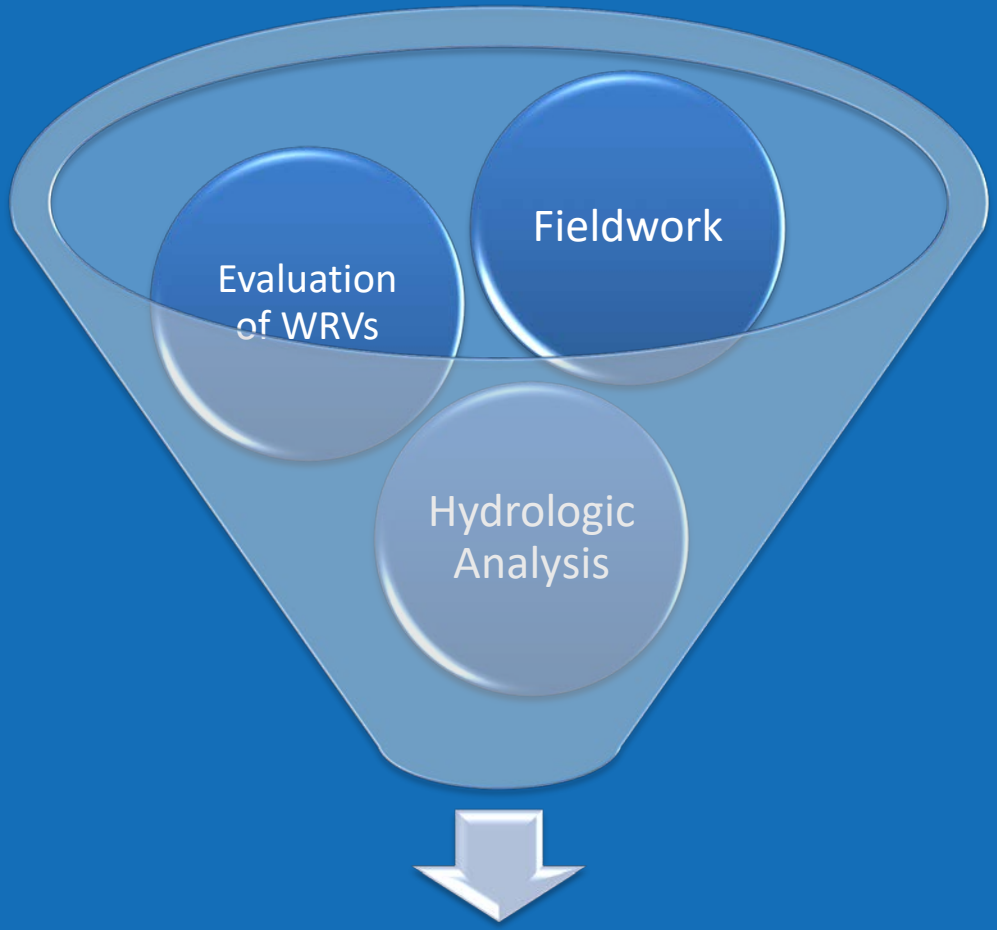
Section 373.042(1), Florida Statutes (F.S.)

Statutory Directive

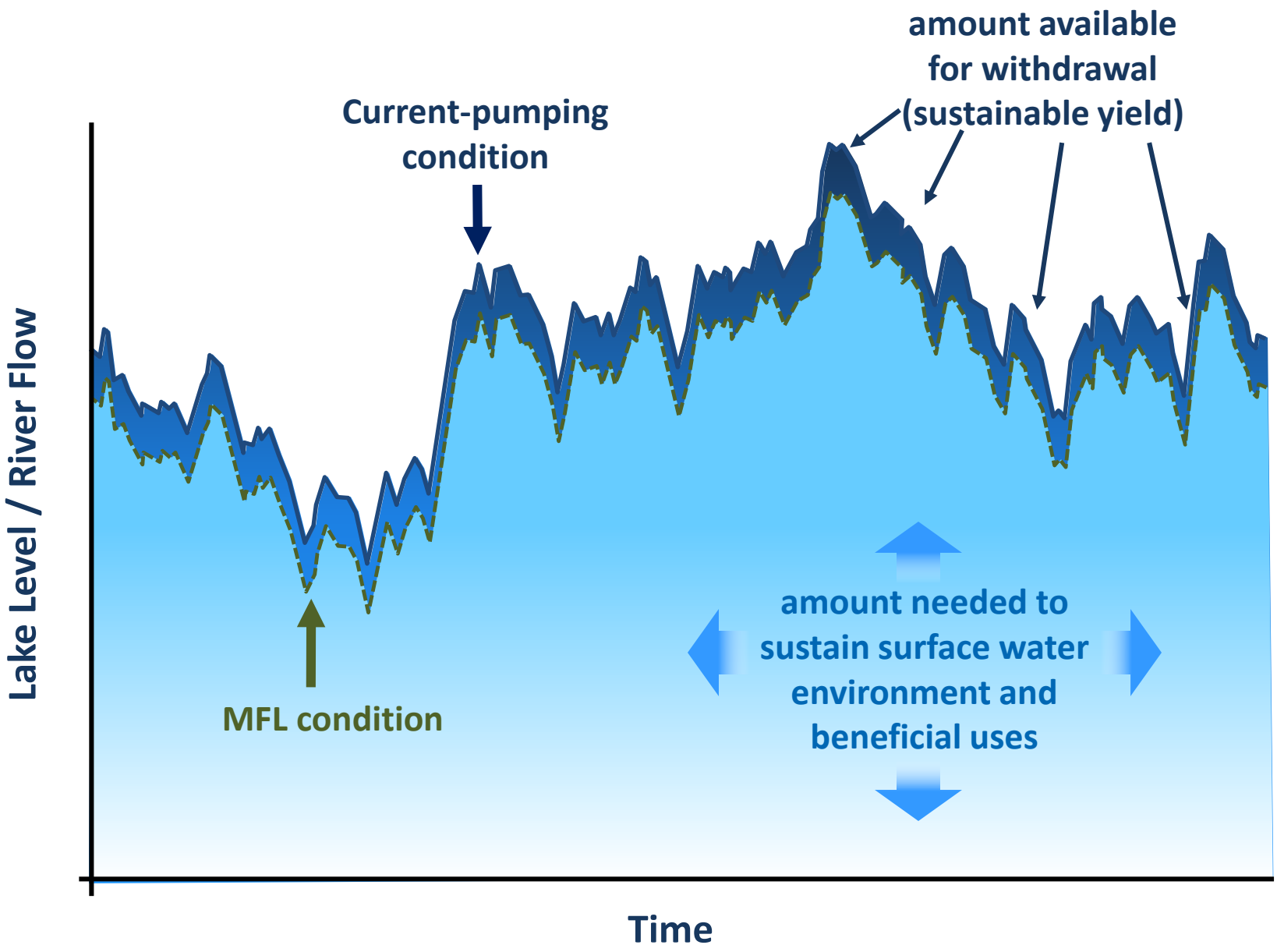
"…consideration shall be given to… non-consumptive uses, and environmental values…" *62-40.473, F.A.C.*

- **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**

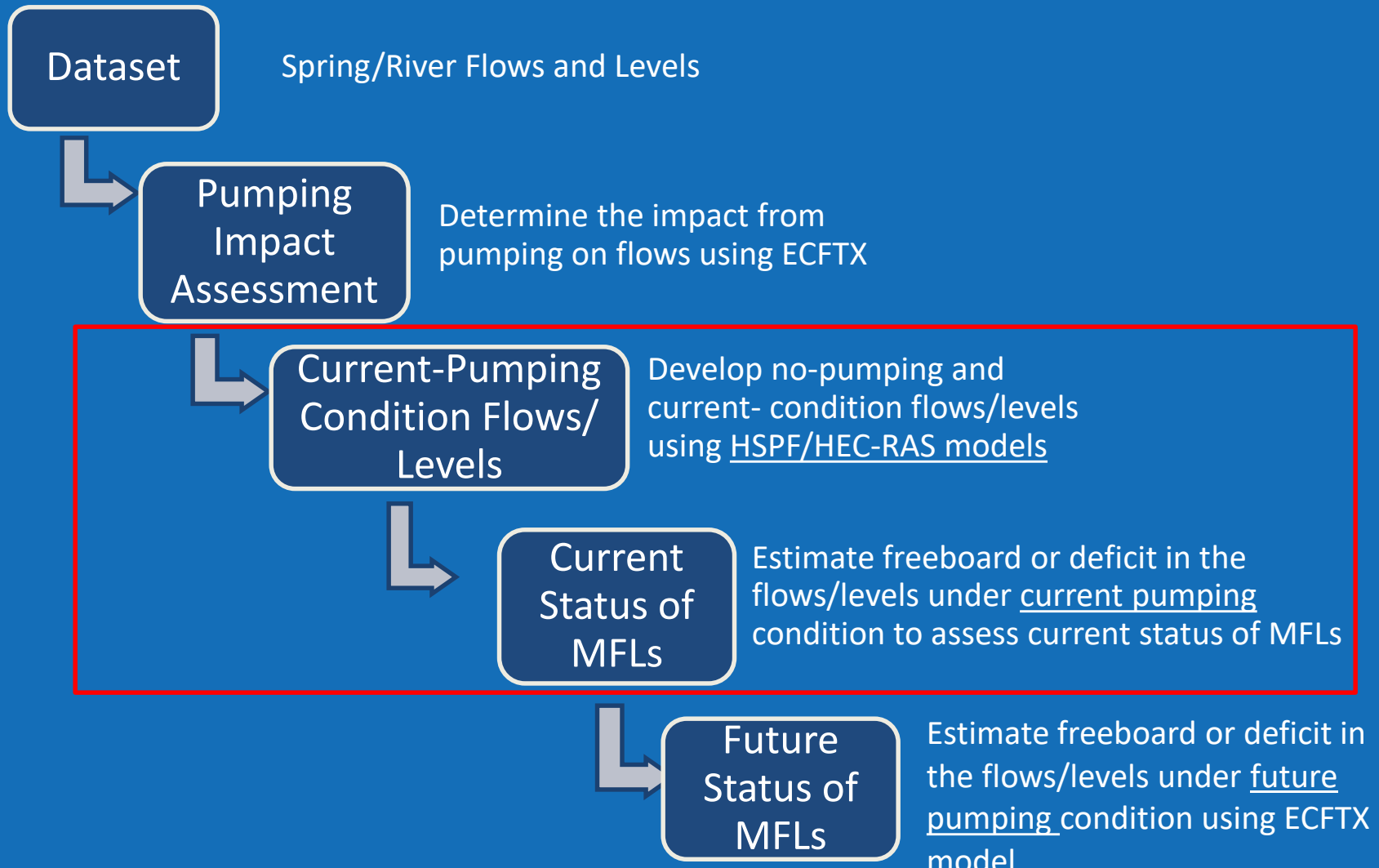
MFL Process Overview



MFL Determination and Assessment


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/HEC-RAS Models for MFLs

- **Evaluation of the effect of pumping on critical stage/flow/velocity profiles needed for WRVs (fish and wildlife habitat, recreation, water quality, etc)**
- **Stage-flow relationships for evaluation of the effect of flow reduction on WRVs**
- **Assessment of the current status of MFLs to estimate water availability or deficit**

Potential Model Simulations

- Long-term simulations (50-60 yrs)
- Scenarios (by adjusting spring flows boundary condition)
  - Flow reduction simulations (e.g. 1%, 5% and 10% etc.)
  - No-pumping condition simulations
  - Current-pumping condition simulations

Peer Reviewers

- **Patrick Tara, PE (Intera, Inc)**
- **Silong Lu, PhD, PE, DWRE (Dynamic Solutions, LLC)**

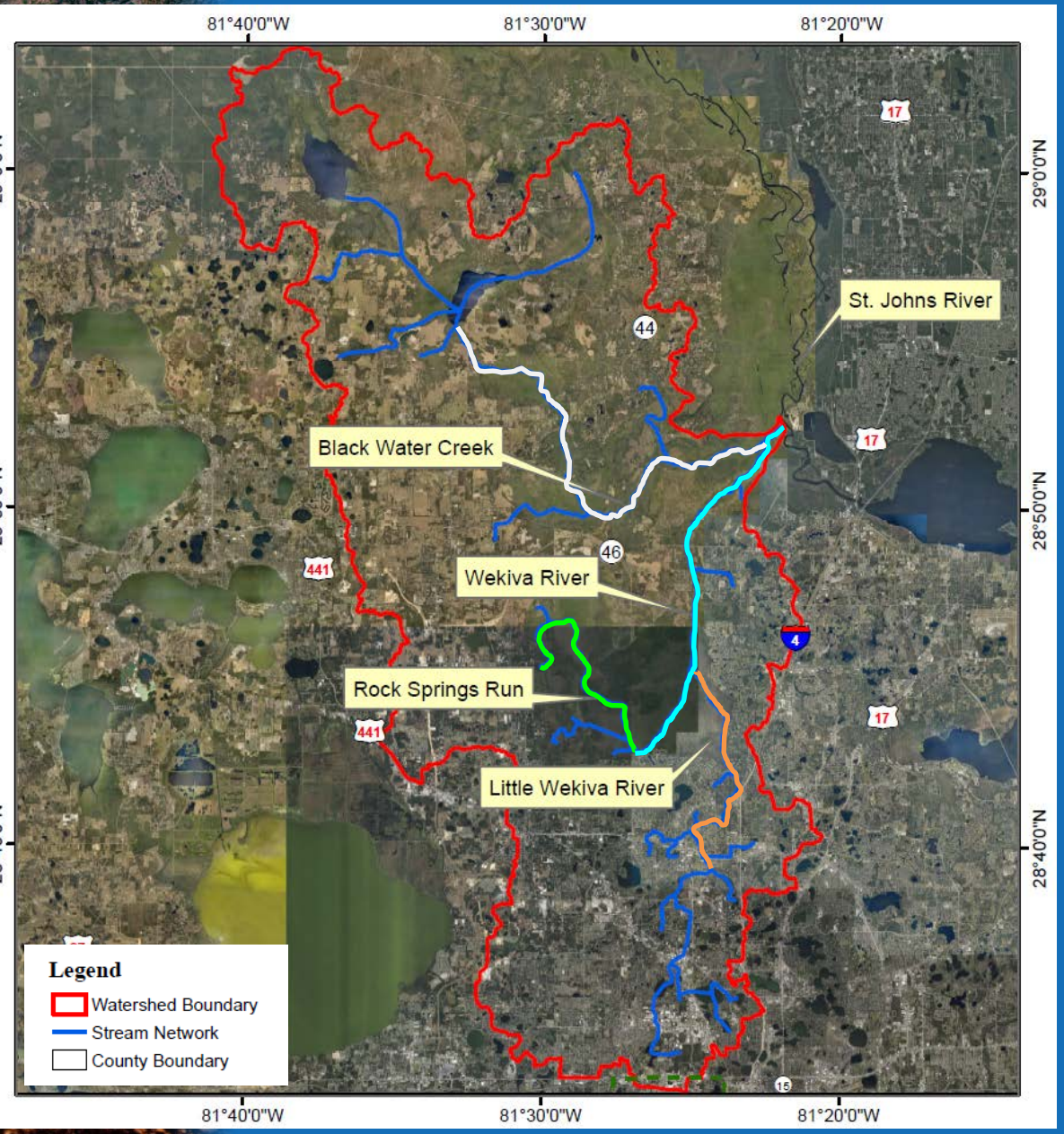
Hydrologic and hydraulic modeling in the Wekiva River Basin

September 26, 2018

Choung-hyun Seong, PhD
SJRWMD

Contents

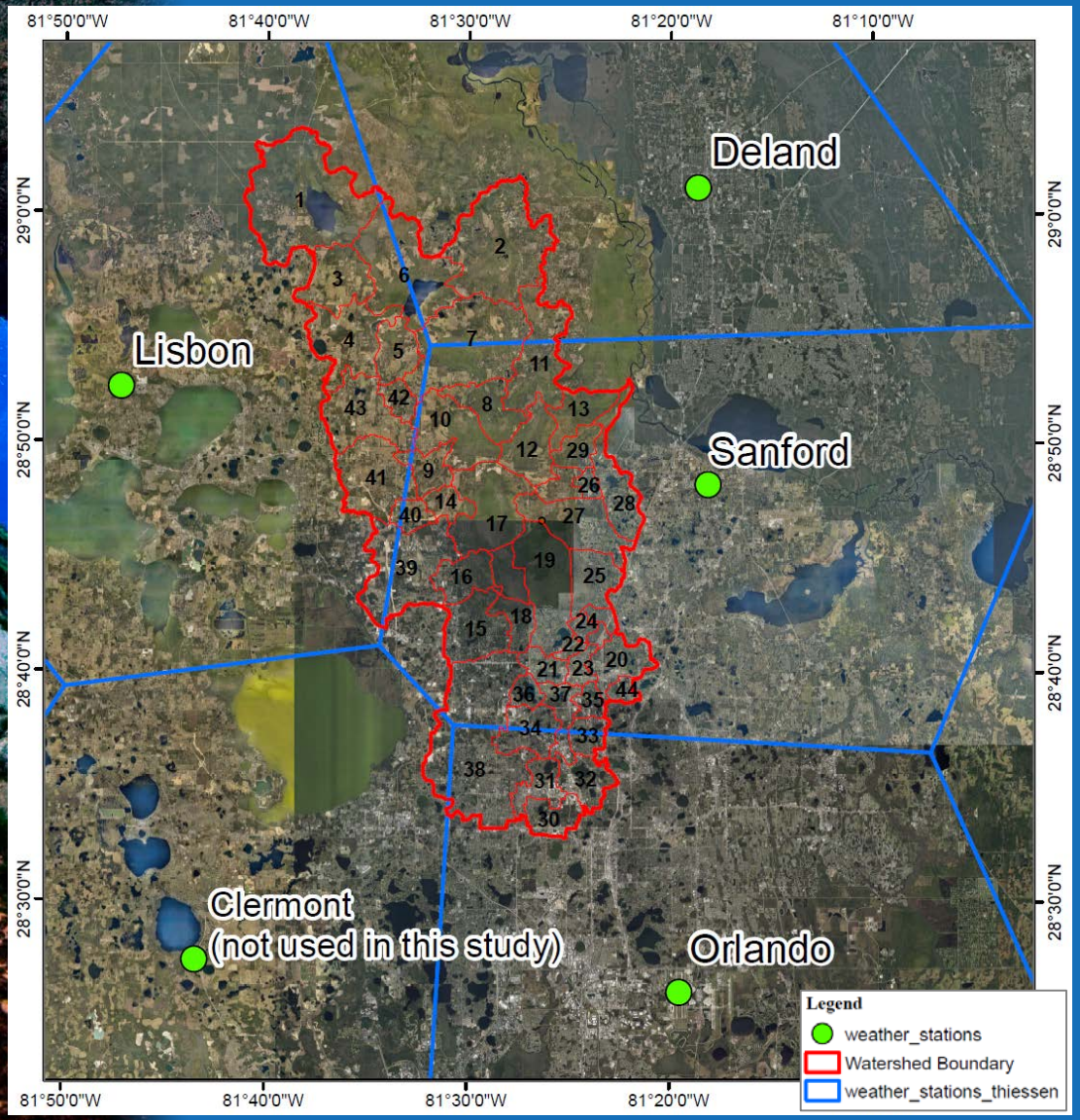
- **Background**
- **Hydrologic modeling (HSPF)**
- **Hydraulic modeling (HEC-RAS)**



Wekiva River Basin

- **Area: 376 mi^2**
- **Waterbodies**
  - **Wekiva River (16 mi)**
  - **Little Wekiva River (15 mi)**
  - **Rock Springs Run (9 mi)**
  - **Black Water Creek (18 mi)**

Meteorological data

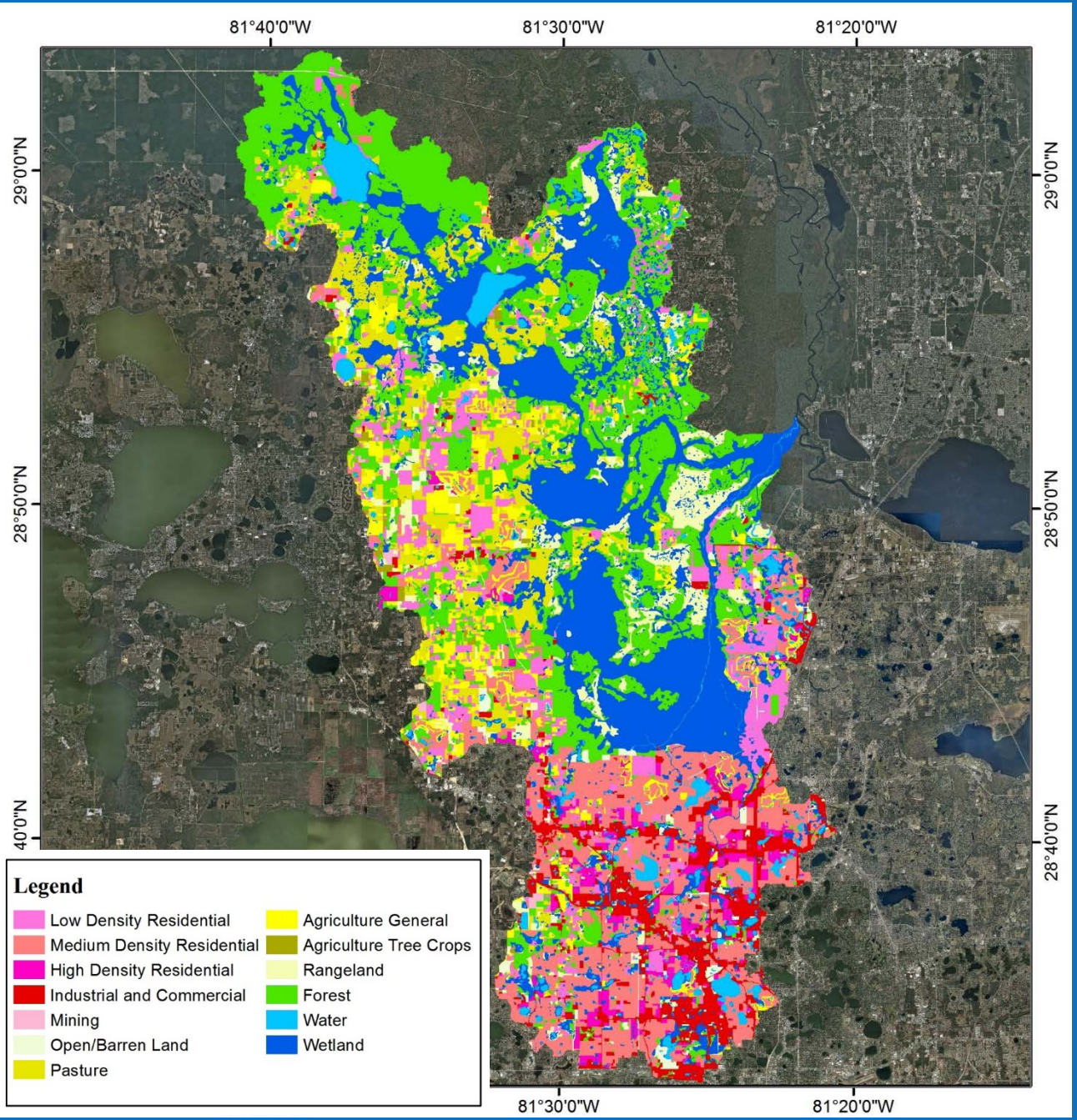


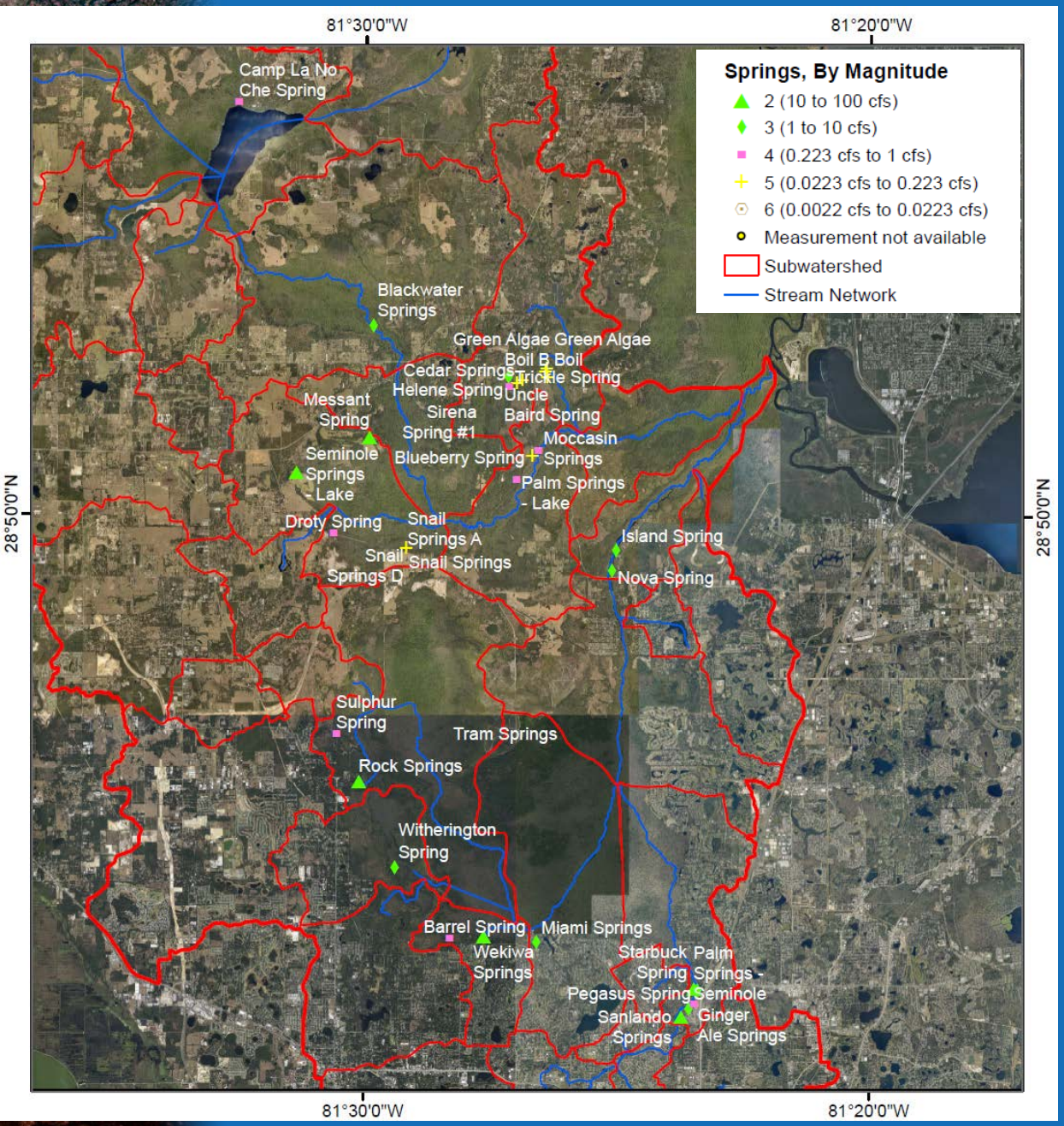
- **Precipitation**
  - **Avg. annual: 51 inches (1970-2016)**
  - **Thiessen Polygon**
- **Potential evapotranspiration (PET)**
  - **Hargreaves method adjusted with USGS satellite ET data (GOES)**

Land Use Data

- Urban: 27.7%
- Pasture: 8.5%
- Agriculture: 11.4%
- Forest: 24.3%
- Water and wetland: 28.1%

- 13 land use classes



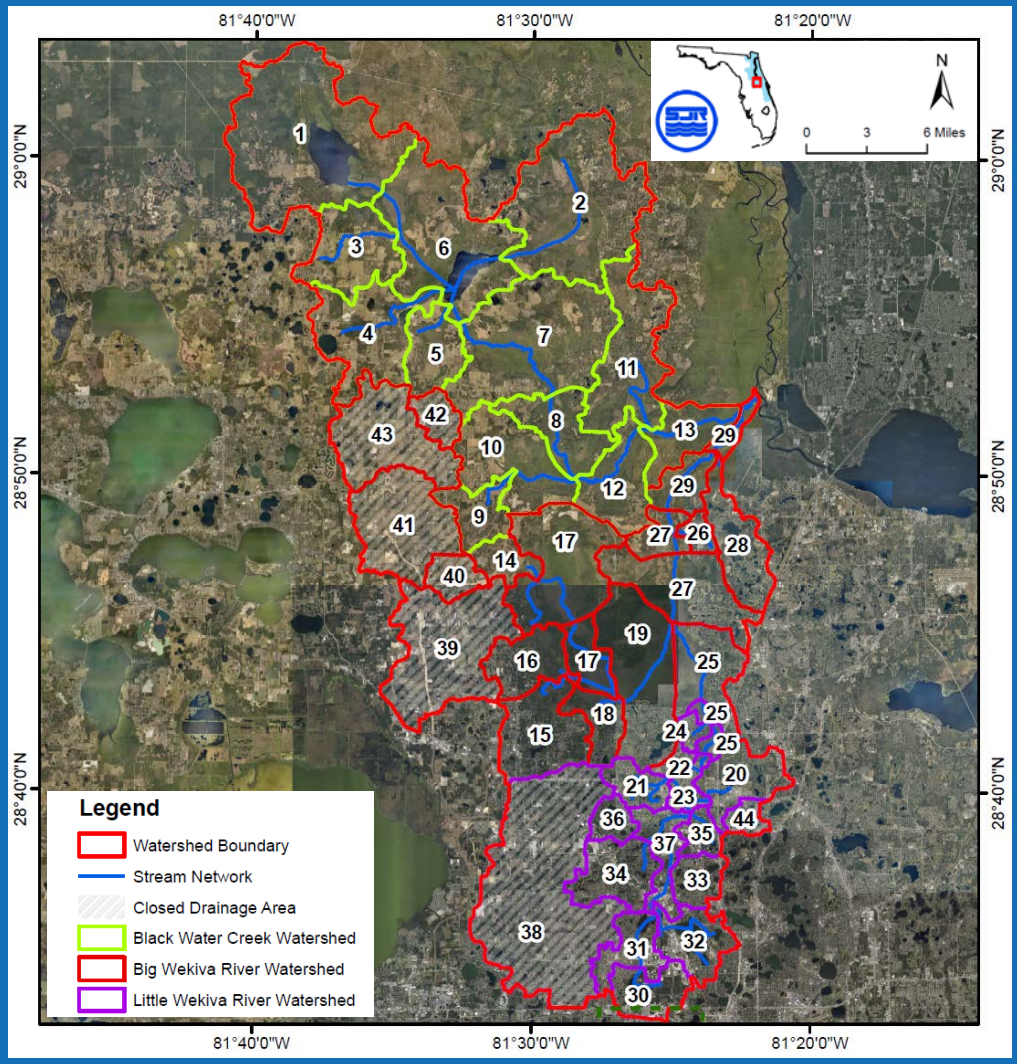


Springs data

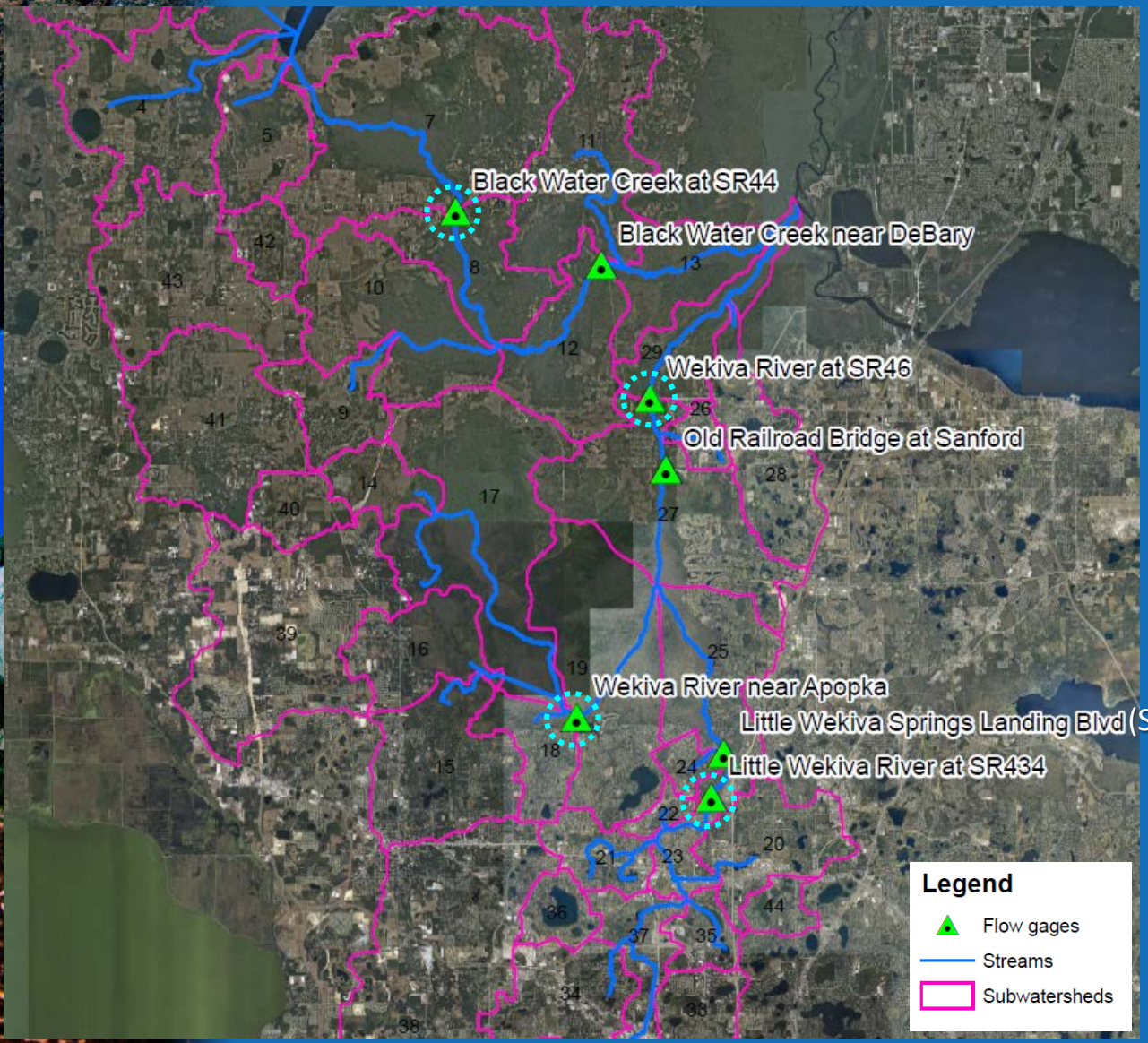
- 34 springs
- Major springs
  - Wekiwa (62 cfs)
  - Rock (56)
  - Seminole (36)
  - Sanlando (20)
  - Starbuck (12)
  - Messant (14)

Hydrologic Model Setup

- Hydrologic Simulation Program – Fortran (HSPF)
- 44 subwatersheds
- 3 sub-models
  - Black Water Creek watershed (13 subsheds)
  - Little Wekiva River watershed (16)
  - Wekiva River watershed (15)

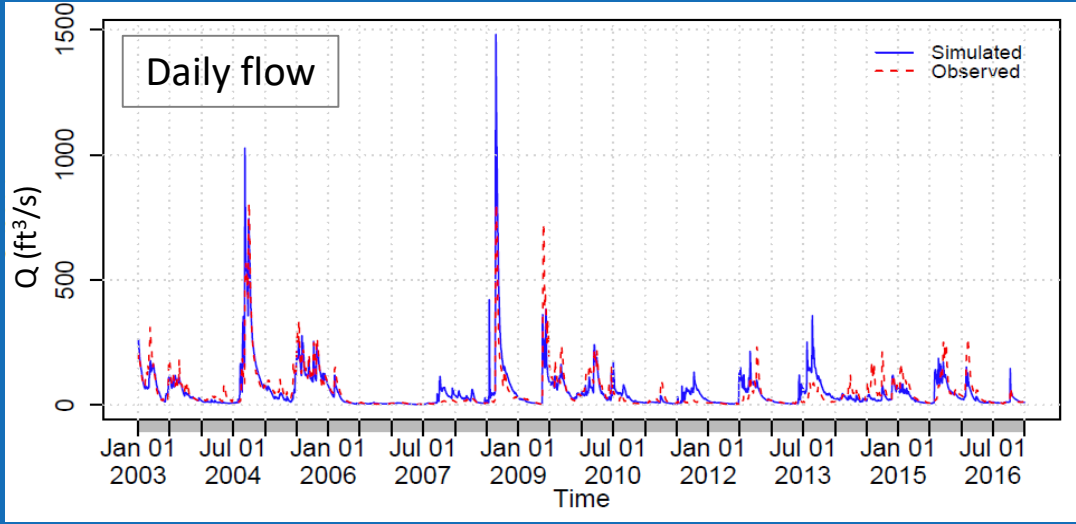


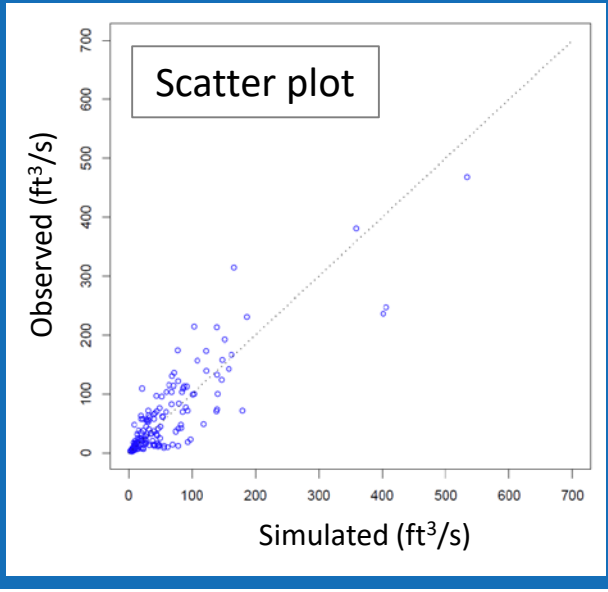
Hydrologic model calibration

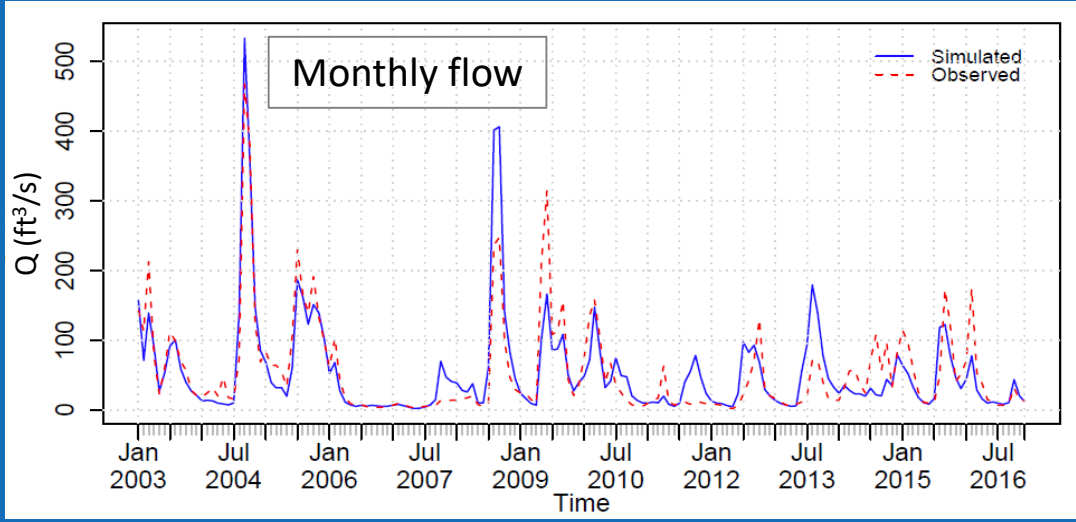


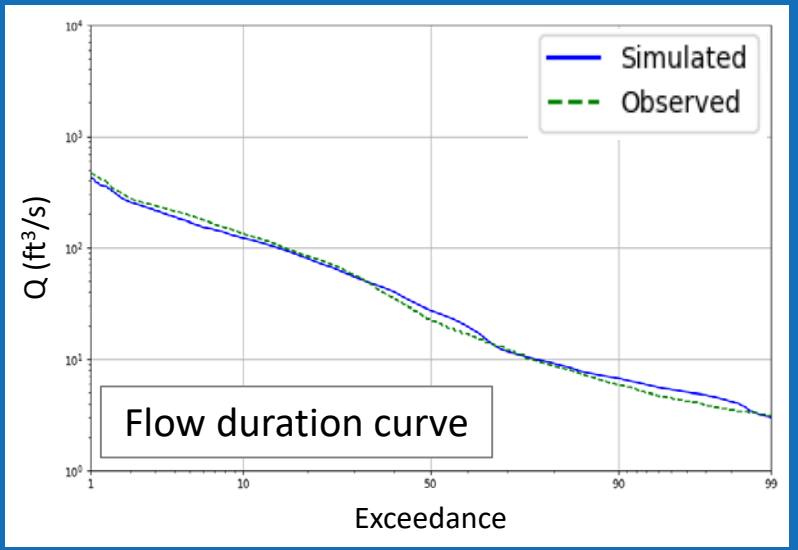
- **Parameter estimation using PEST**
- **7 stream flow gages**
- **2003-2016 (14 yrs)**
  - **SLB: 2003-2009**
  - **Near Apopka: 2003-2011, 2016**

Black Water Creek - SR44

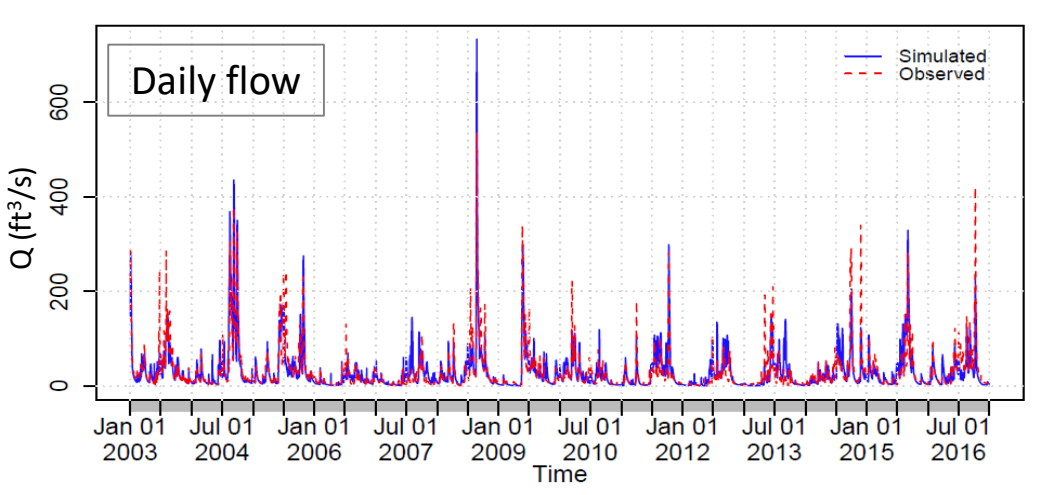


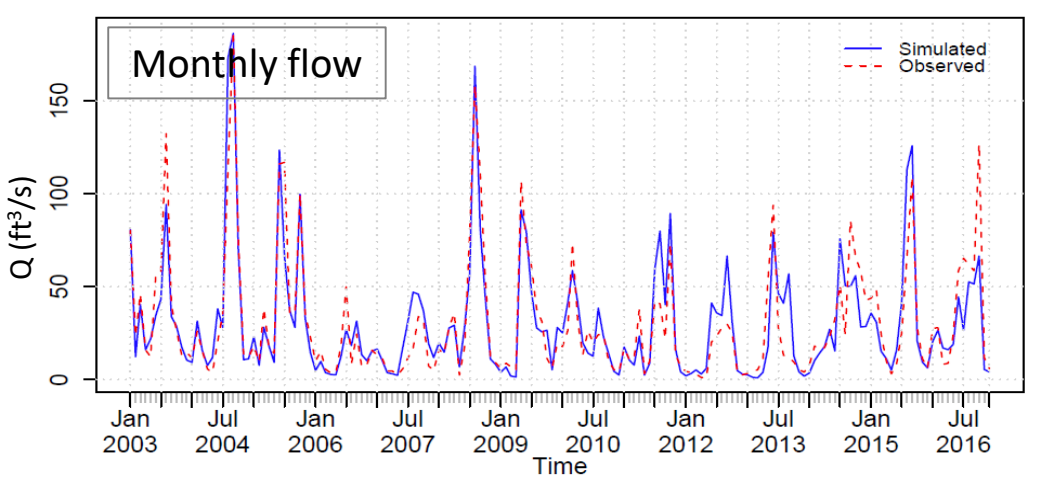


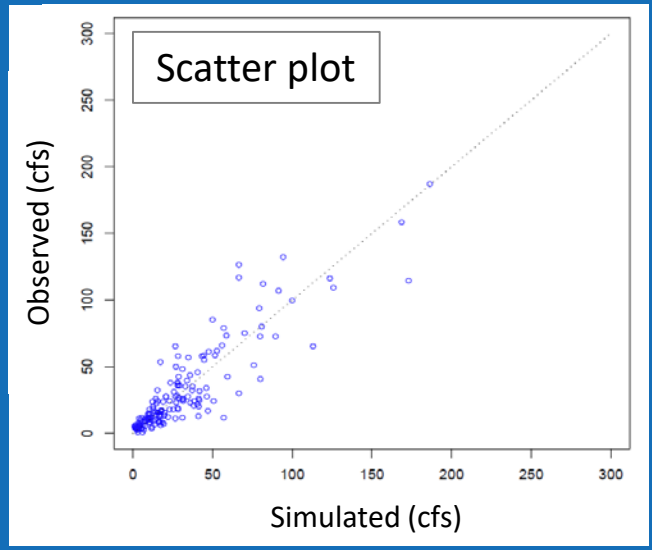


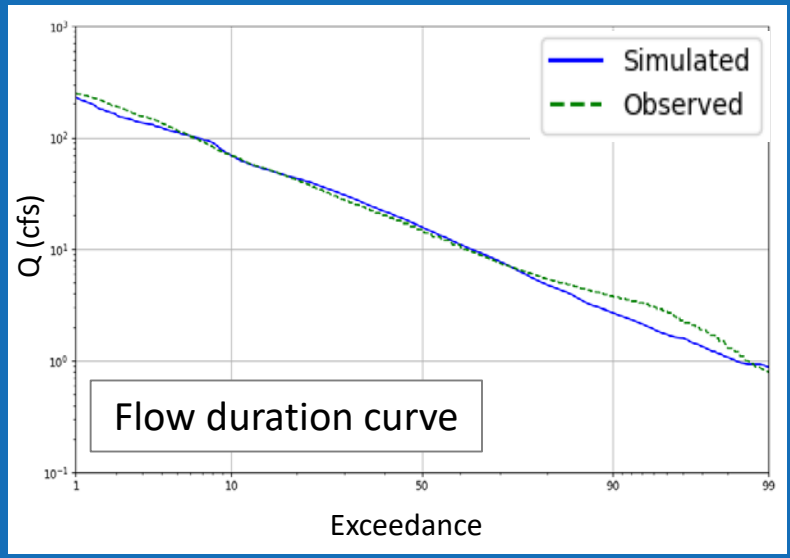


Little Wekiva River - SR434

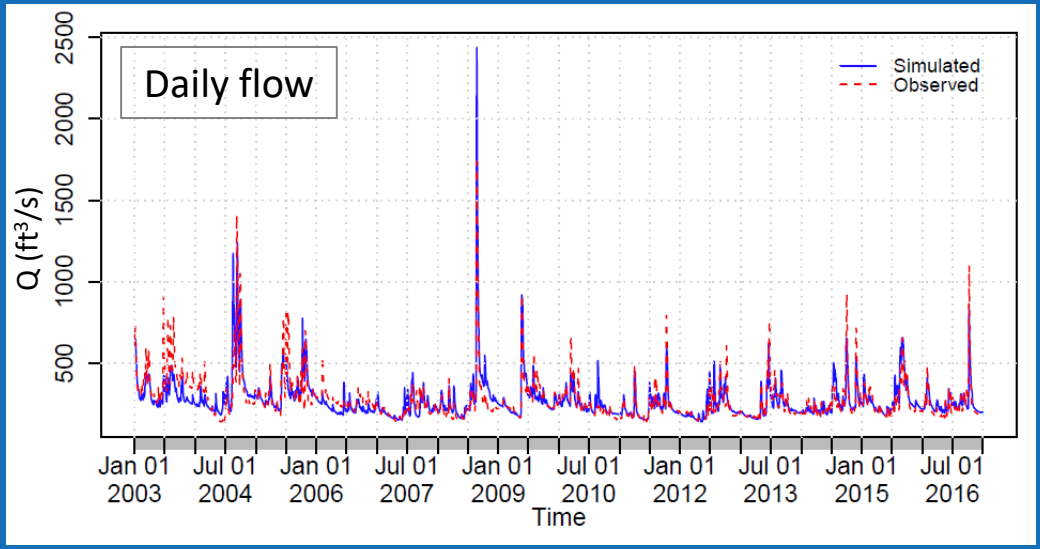


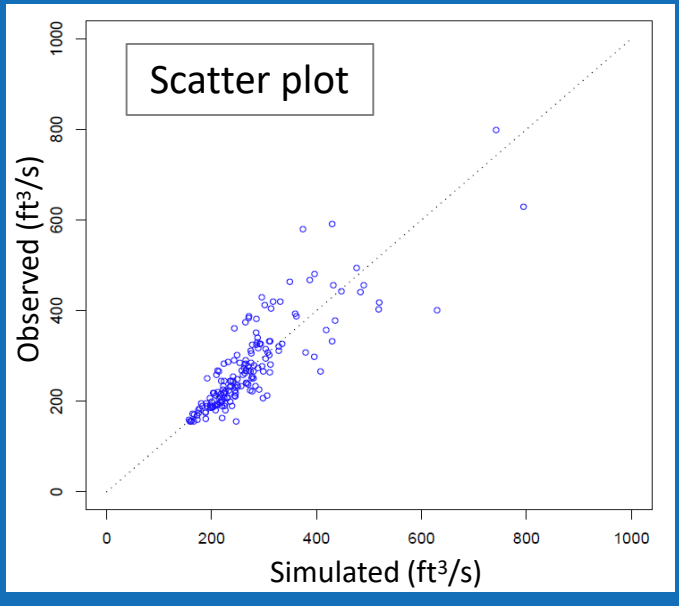


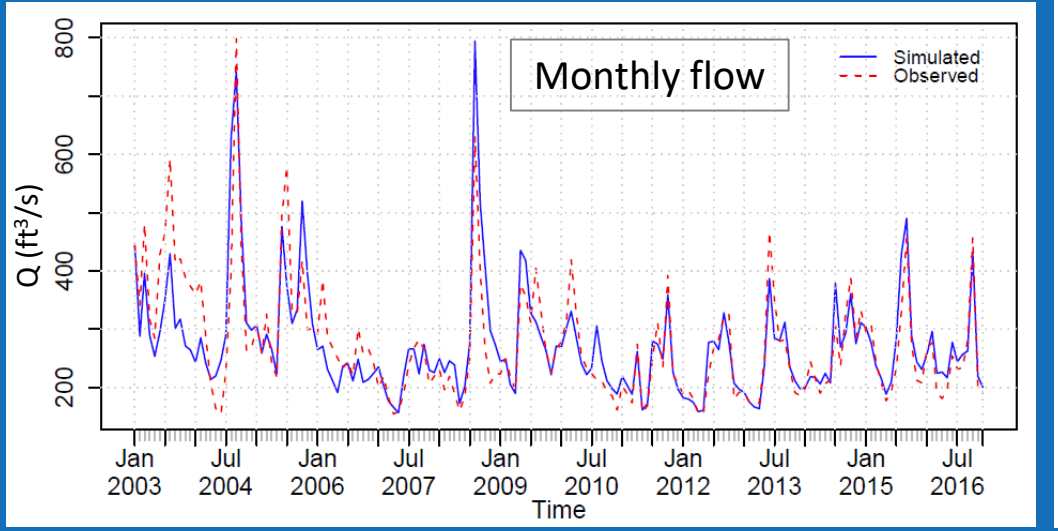


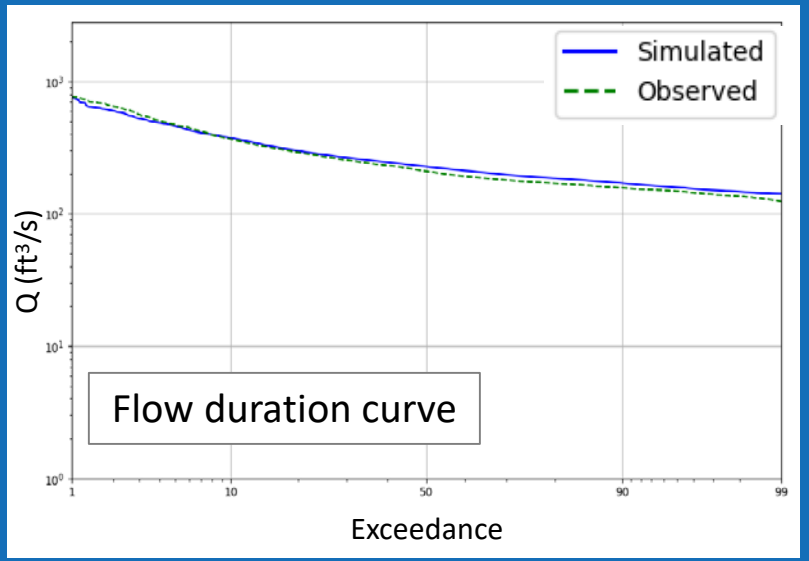


Wekiva River - SR46

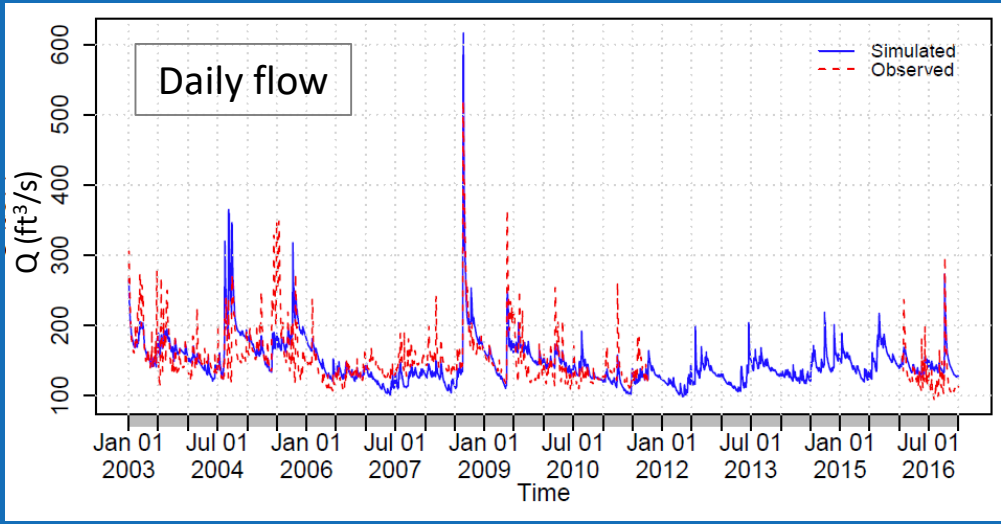


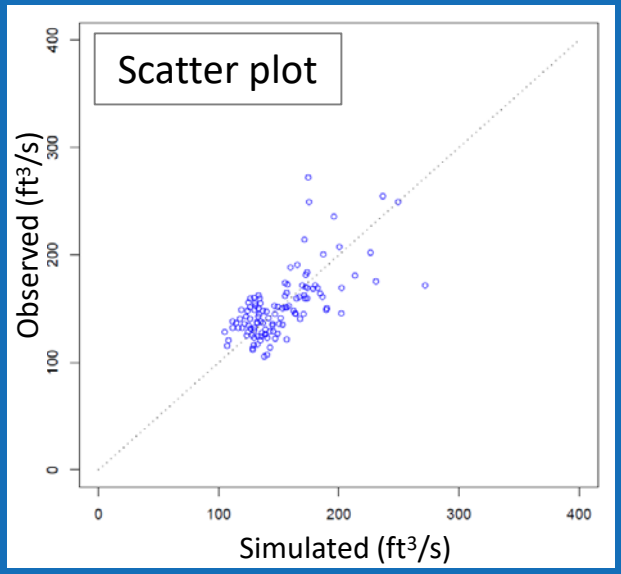


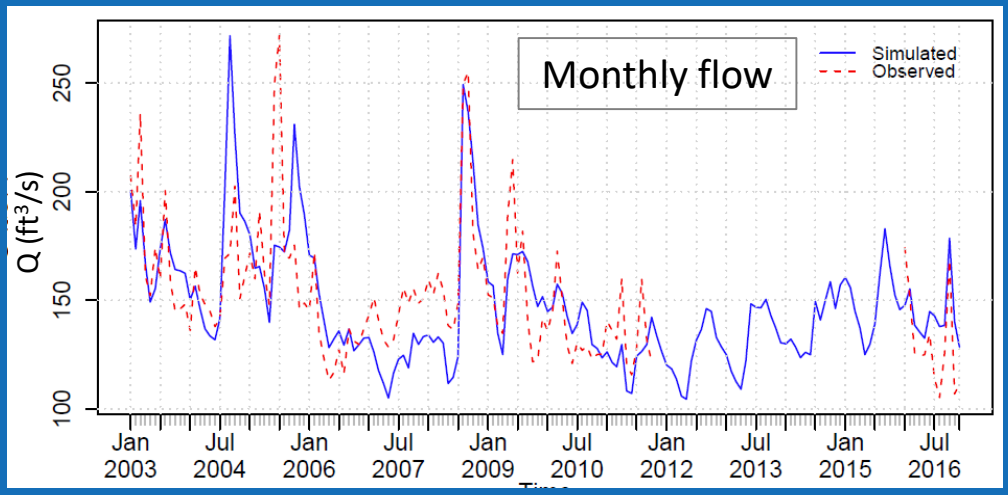


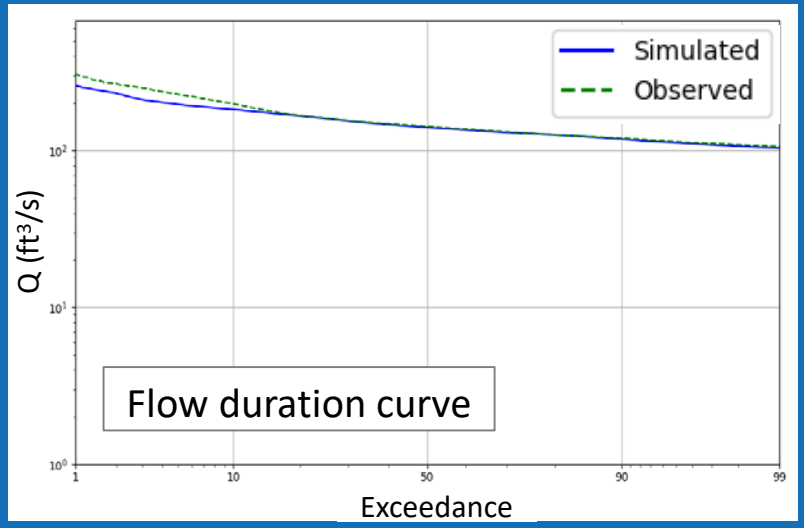


Wekiva River - Near Apopka







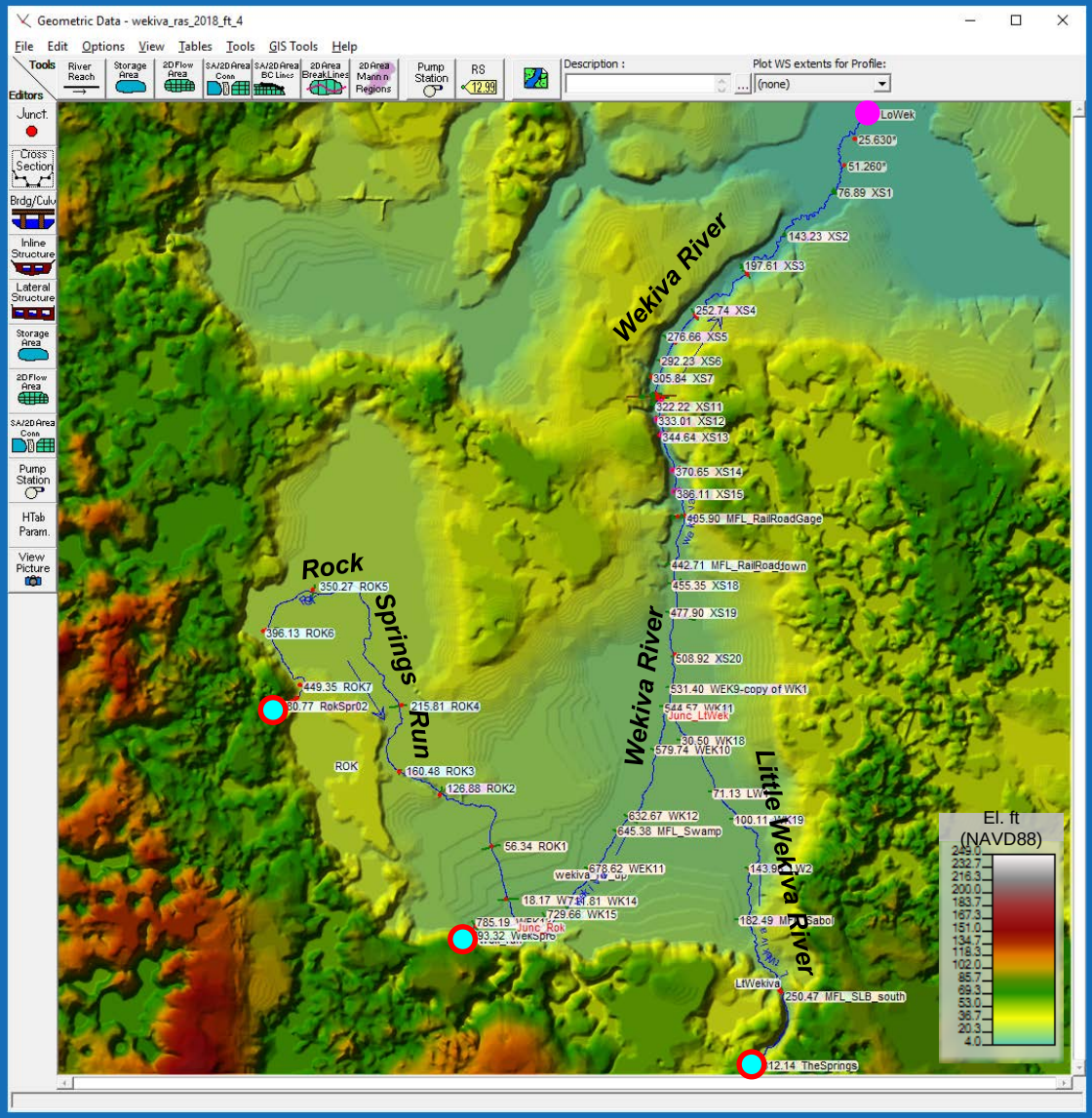


Hydrologic model performance

Statistics		Black Water Creek		Little Wekiva River		Wekiva River		
		SR44	Near Debary	SR434	SLB	Near Apopka	Old Railroad (RR)	SR46
Daily	R^2	0.69	0.64	0.69	0.76	0.50	0.73	0.69
	PBIAS %	-1.00	-1.10	-0.40	-6.90	0.00	4.80	-0.30
	high10%	-3.41	1.46	-4.29	-15.02	-6.91	-1.52	-3.99
	low50%	11.76	0.90	-1.26	9.99	0.53	9.28	4.28
	NSE	0.63	0.53	0.67	0.76	0.45	0.71	0.67
Monthly	R^2	0.75	0.70	0.79	0.82	0.45	0.77	0.72
	PBIAS %	-1.30	-1.20	-0.50	-6.60	0.10	4.80	-0.30
	NSE	0.72	0.65	0.79	0.80	0.34	0.74	0.70

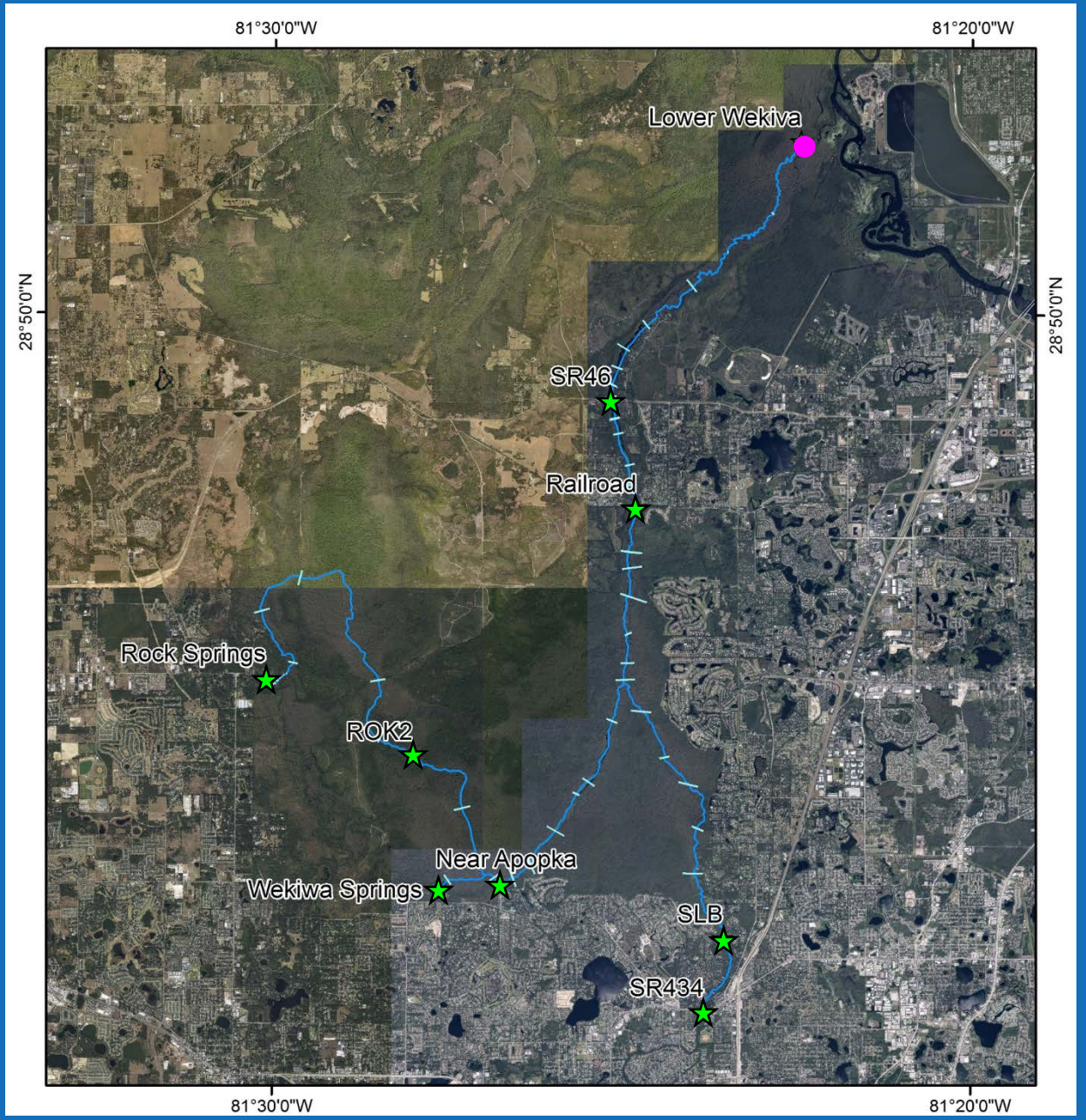
Hydraulic modeling in the Wekiva River

- HEC-RAS
- 72 stream cross sections
- Boundary conditions
  - 3 upstream flow boundaries ( )
  - 1 downstream stg boundary ( )
  - Internal boundary conditions using the HSPF model results
- Steady state
  - 13 surface water profiles between 2008-2016
- Unsteady state
  - 6-month period in 2009

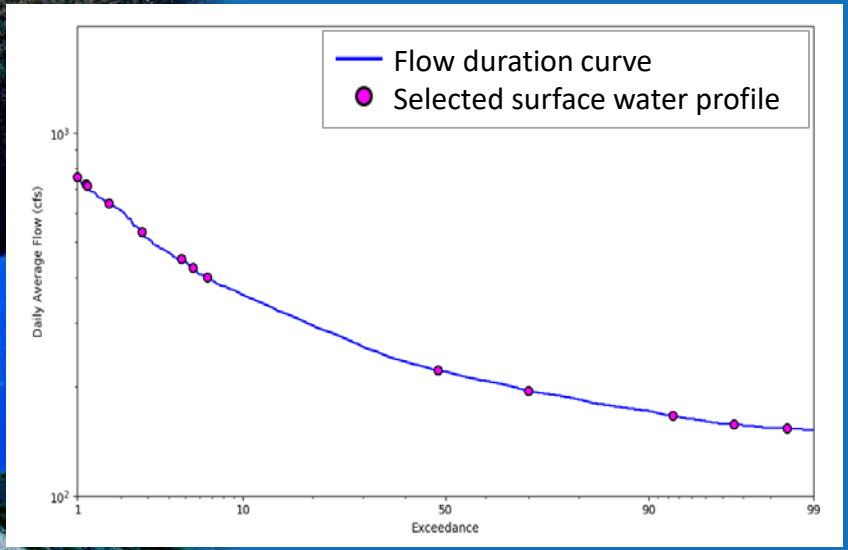


Hydraulic model calibration

- 8 stream stage gages(★)
- Data period: 2008-2016
  - SLB: 2008-2009
  - ROK2: 2014-2016
  - Near Apopka: 2008-2012, 2016



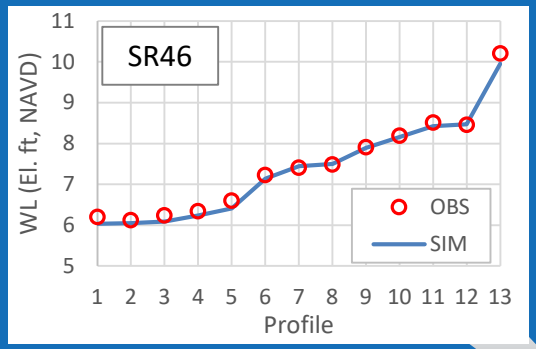
Steady state – selected surface water profile

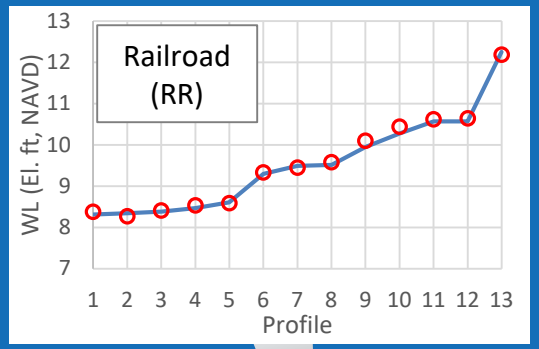


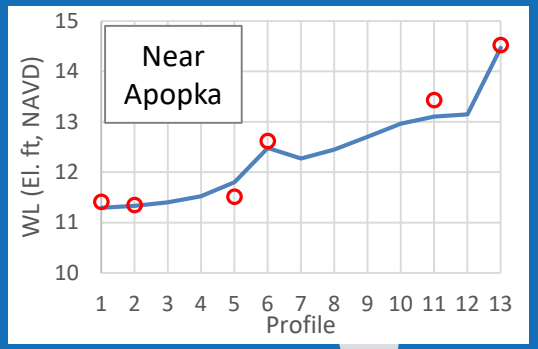
Flow duration curve at SR46 in the Wekiva River (2008-2016)

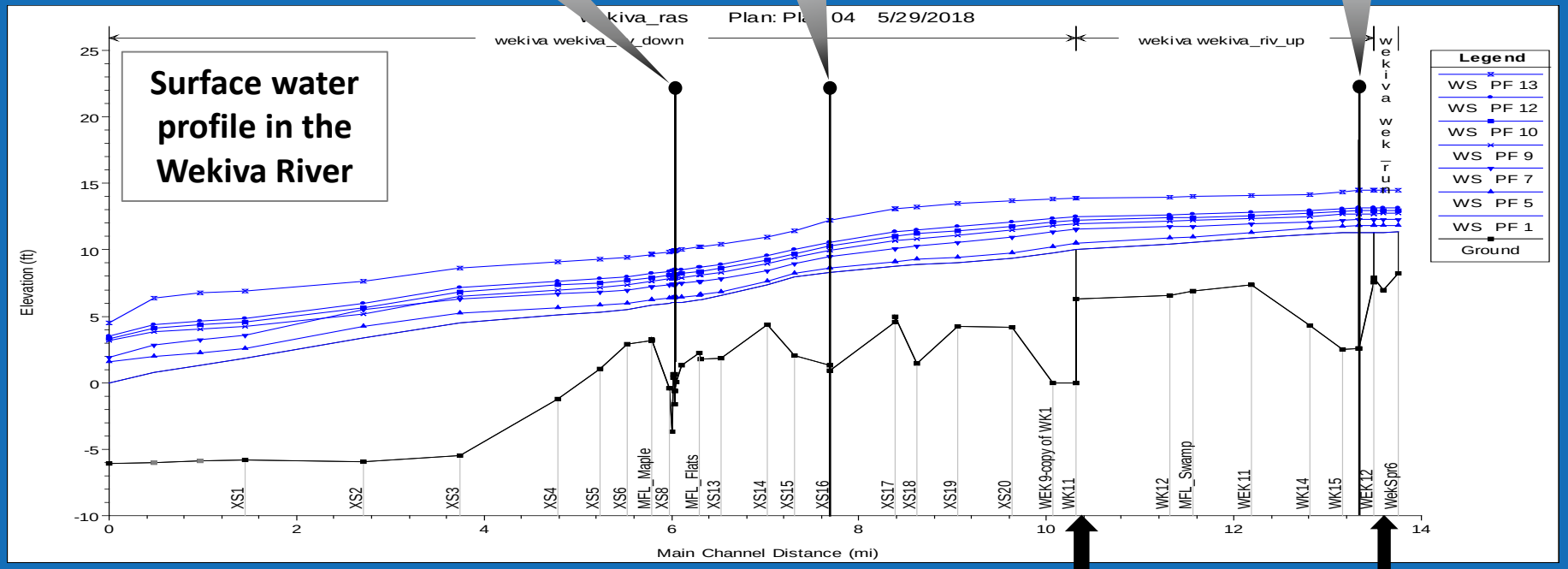
Profile	Date	Flow at SR46	% flow at SR46
PF1	4/17/2012	150	0.6
PF2	5/14/2012	155	2.3
PF3	4/9/2013	164	6.5
PF4	5/14/2013	196	31.0
PF5	2/15/2016	225	54.0
PF6	8/27/2012	407	93.7
PF7	9/9/2015	467	95.9
PF8	12/4/2014	479	96.3
PF9	9/30/2014	665	98.6
PF10	10/1/2014	797	99.2
PF11	5/22/2009	922	99.6
PF12	10/2/2014	927	99.6
PF13	8/23/2008	1740	100.0

Simulation result - steady state





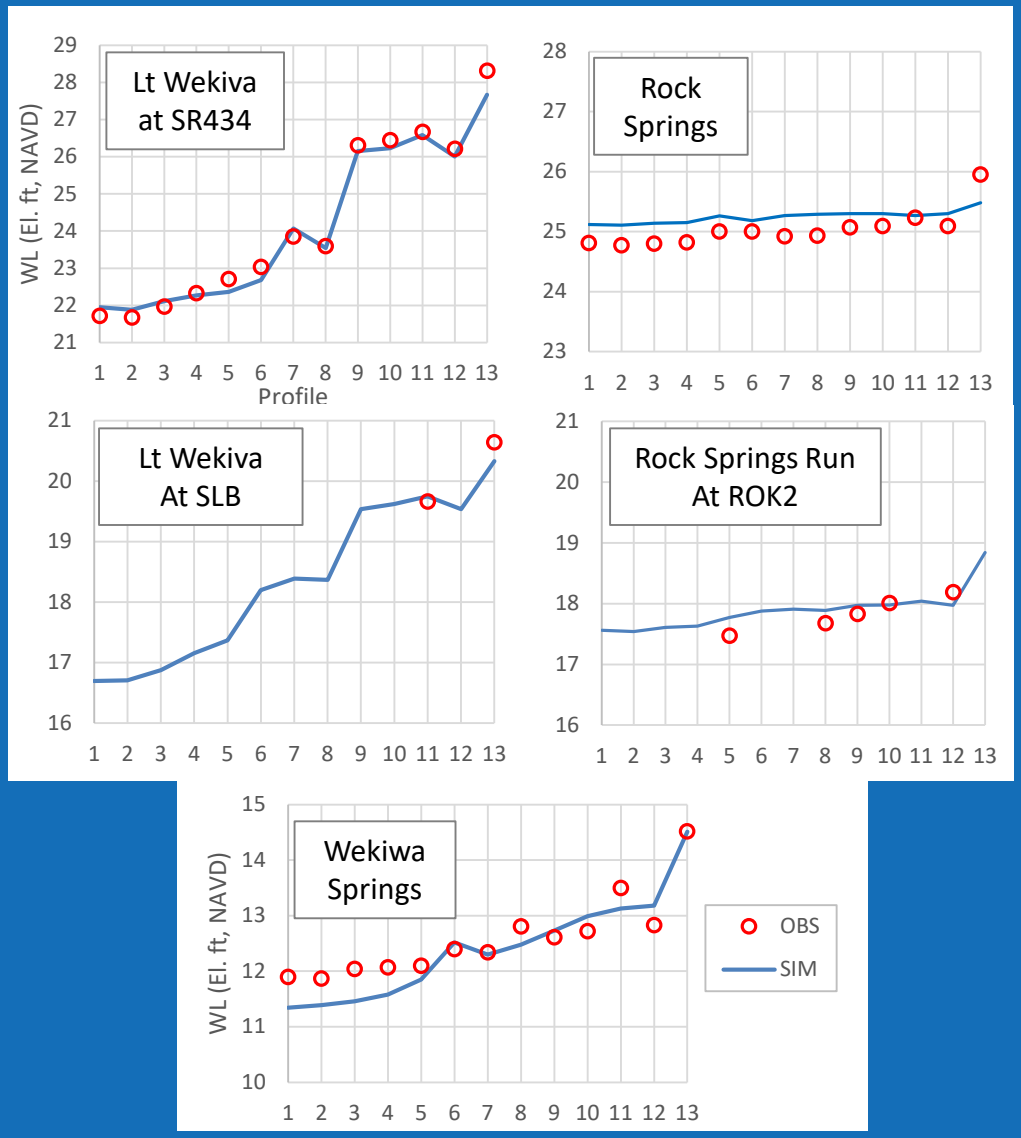


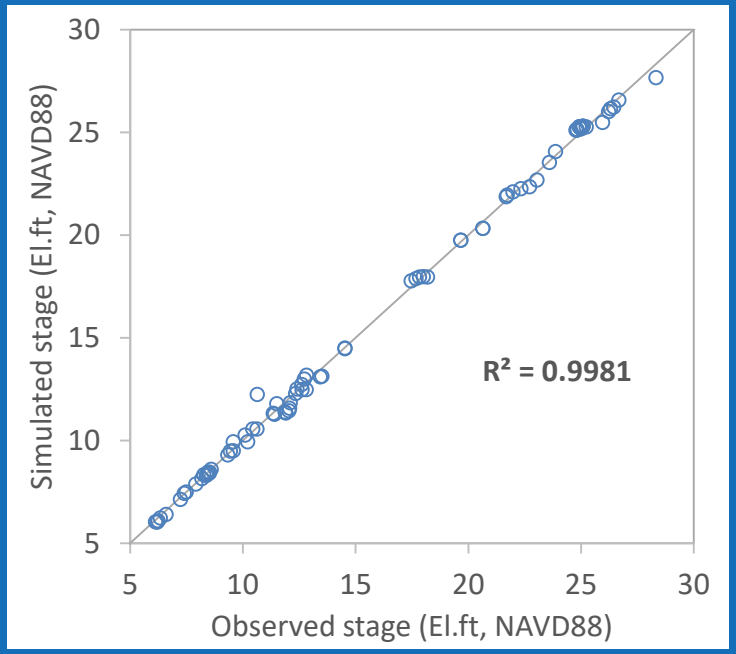


Little Wekiva River

Rock Springs Run

Simulation result - steady state

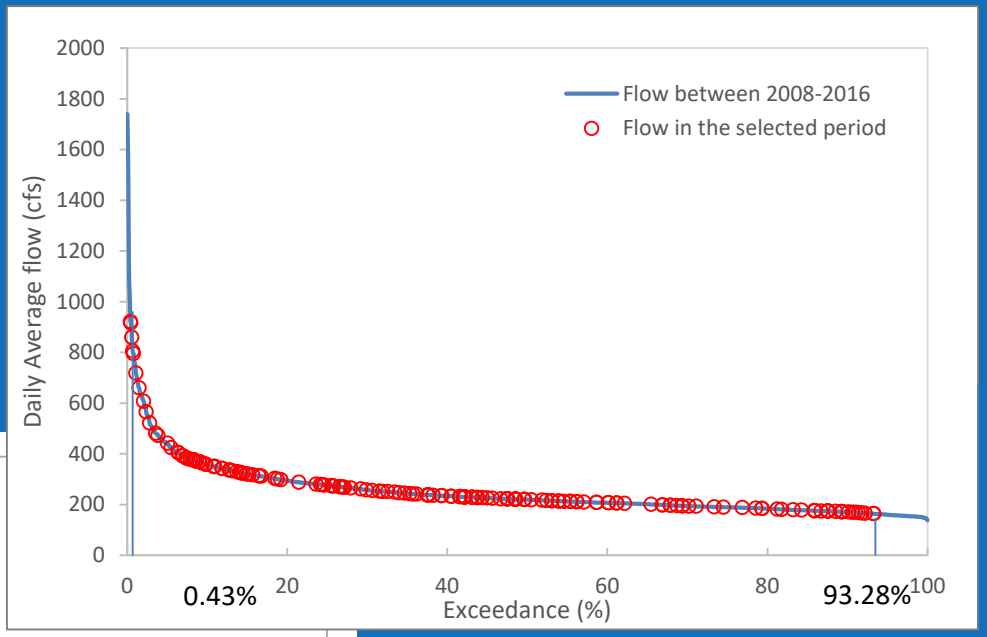




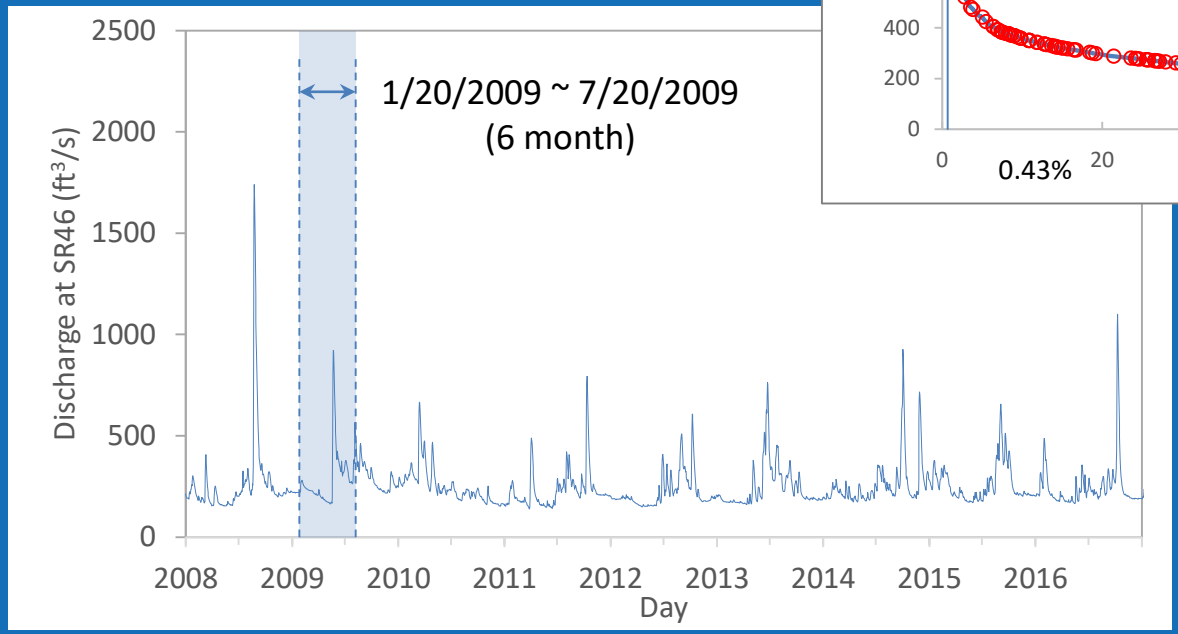
Comparison of simulated and observed stages in all 8 stations

Unsteady state – simulation period

- **Selected simulation period covers flow exceedance between 0.43 – 93.28%**

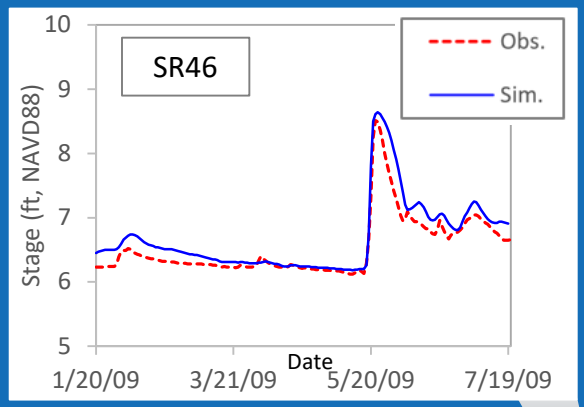


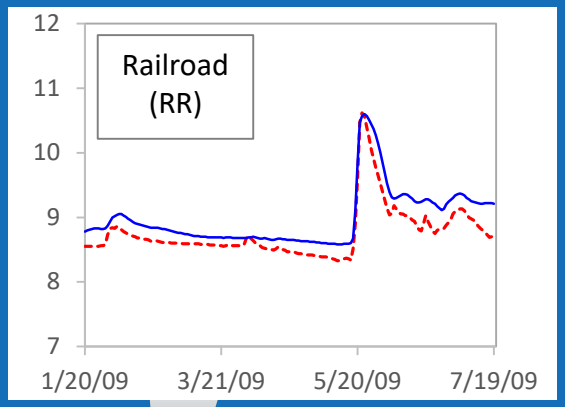
Flow duration curve at SR46 in the Wekiva River (2008-2016)

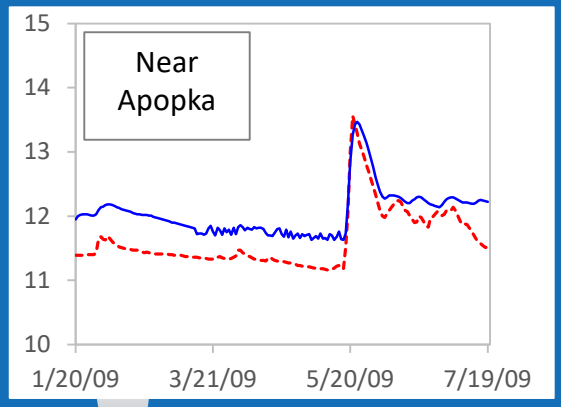


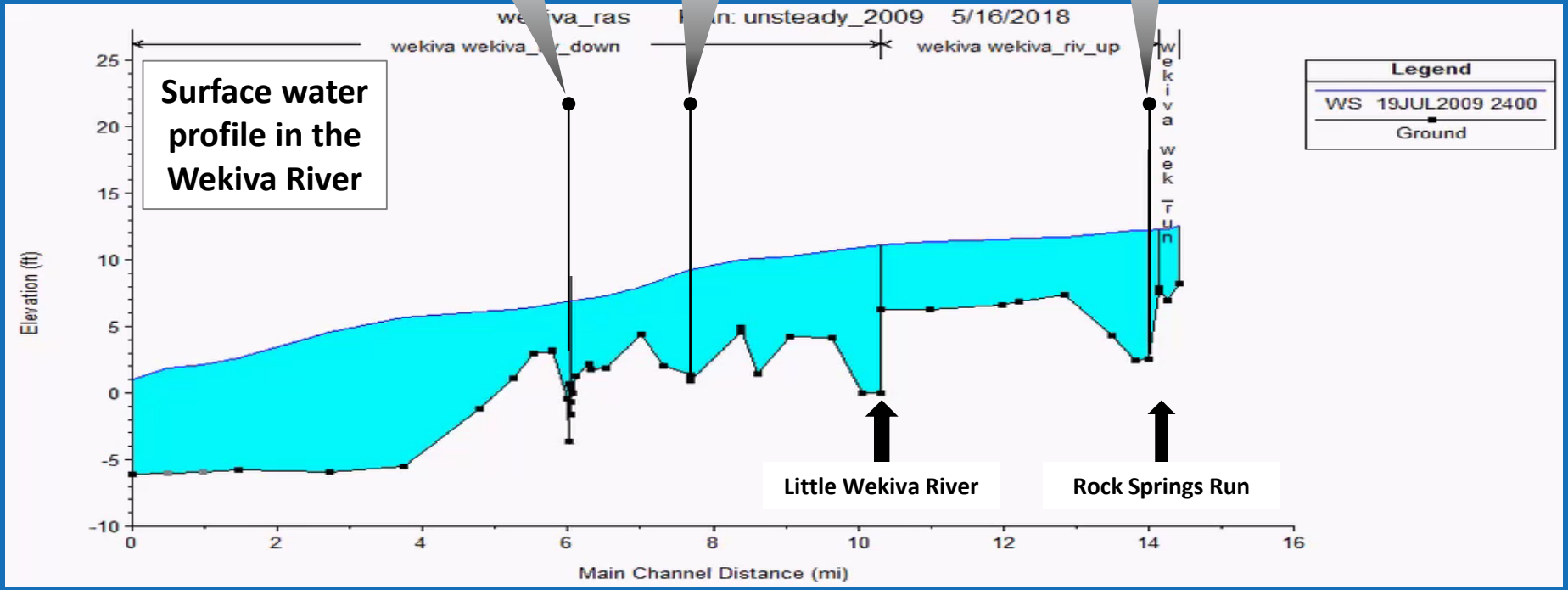
Stream flow in the Wekiva River at SR46

Simulation result - unsteady state



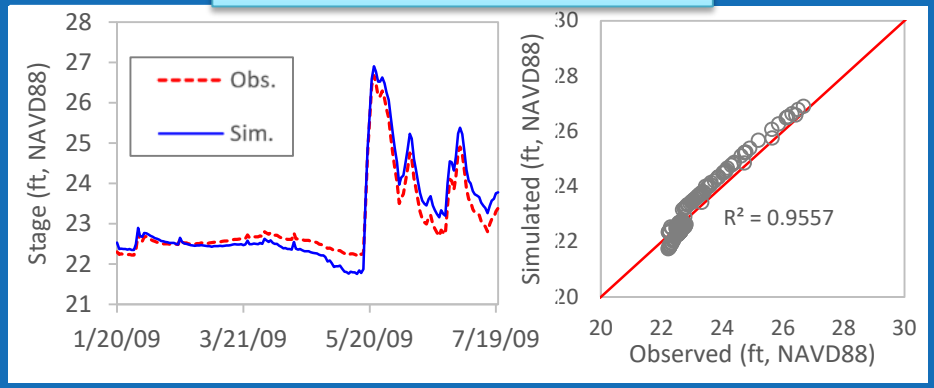




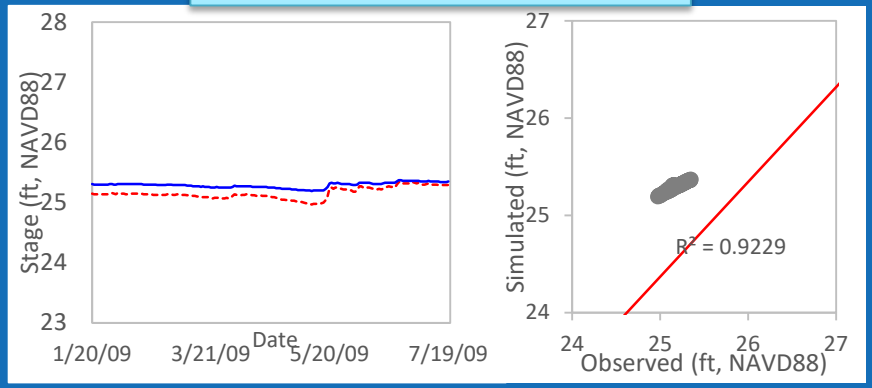


Simulation result - unsteady state

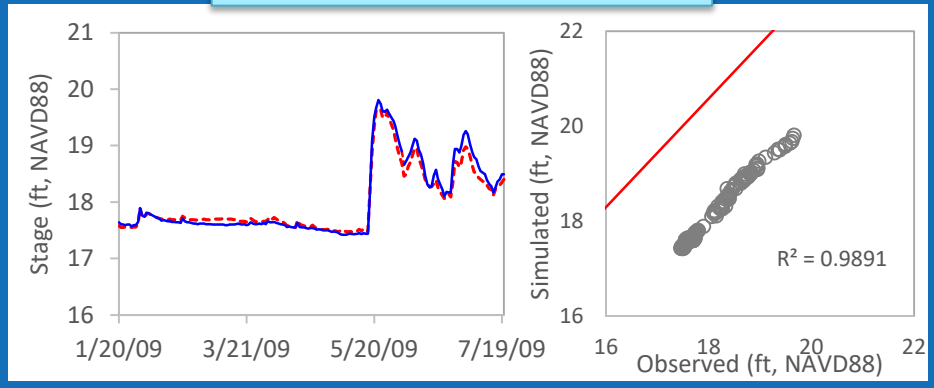
Little Wekiva River at SR434



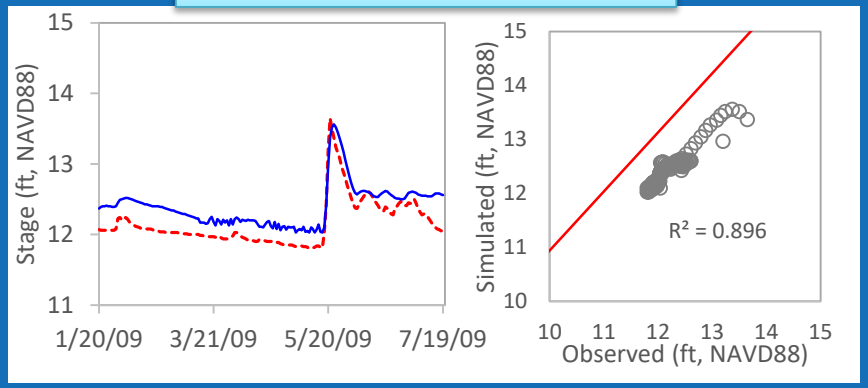
Rock Springs



Little Wekiva River at SLB



Wekiwa Springs



Simulation result - unsteady state

Stream	Station	Diff. in ft (Obs. – Sim.)			R^2	RMSE	PBIAS (%)
		Mean	Max	Min			
Little Wekiva River	SR434	0.07	0.23	-0.46	0.96	0.32	0.27
	SLB	0.03	0.15	-0.04	0.99	0.11	0.14
Rock Springs Run	Rock Springs	0.13	0.02	0.22	0.92	0.14	0.53
Wekiwa Run	Wekiwa Springs	0.24	-0.09	0.23	0.90	0.26	1.99
Wekiva River	Near Apopka	0.42	-0.09	0.47	0.90	0.45	3.57
	Railroad	0.23	-0.02	0.25	0.94	0.25	2.59
	SR46	0.15	0.13	0.06	0.96	0.20	2.32

Thank you!

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