Lake Weir HSPF Model Review

9/17/2019

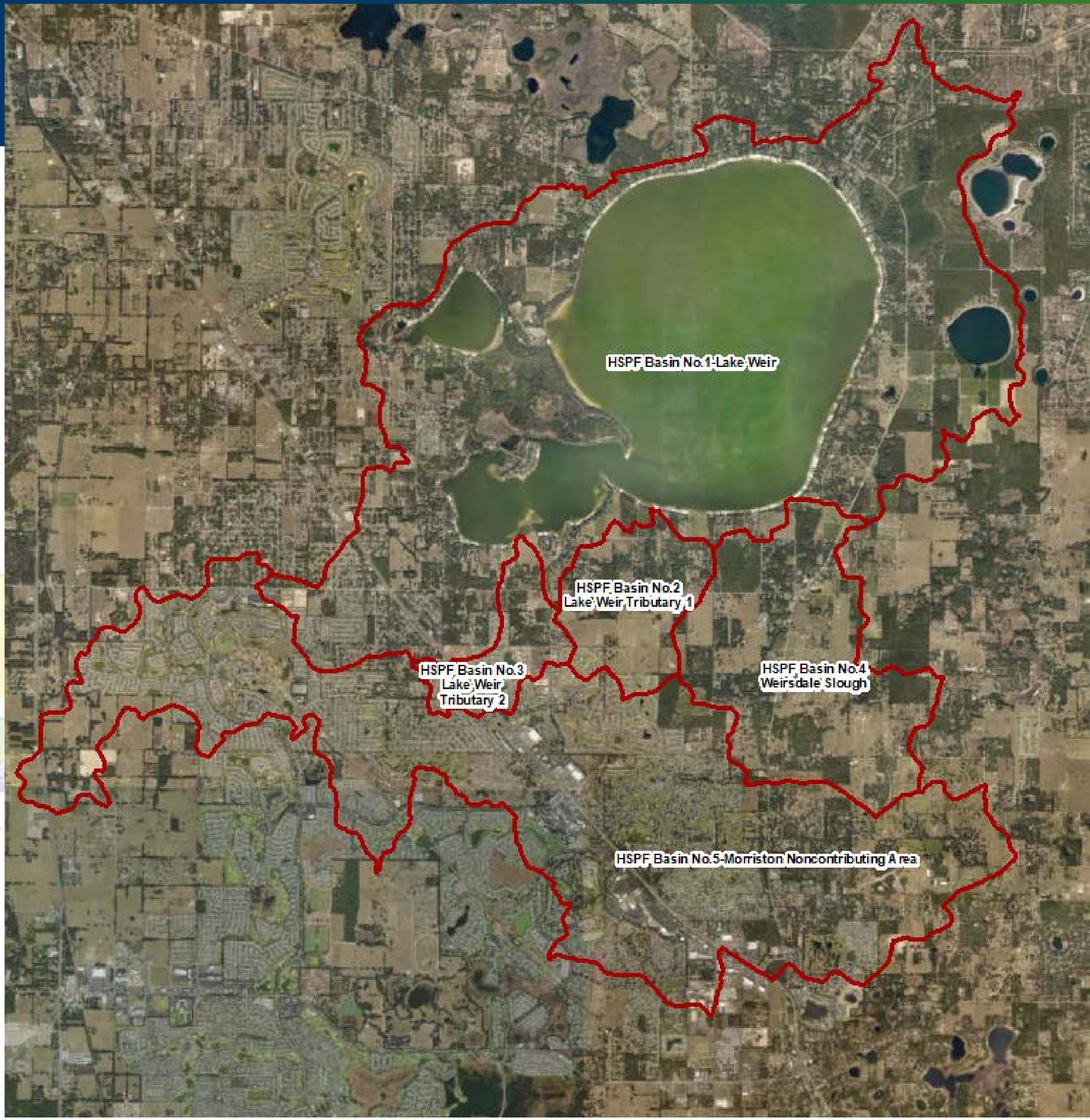
Review Findings

- Model setup
- Input Data Review
- Calibration Review
- Long-term Simulation Review
- Conclusion

Model Setup

Basin Conceptualization

- 5 basins
- 4 directly contributing to Lake Weir
- 1 indirectly through groundwater outflow only



Morriston Basin

- Basin 5, defined as Morriston Basin in the model, is a closed or internally drained basin and produces no direct runoff to Lake Weir
- Although basin 5 does not share a boundary with the lake (basin 5 is 1.5 miles from the lake), the Active GroundWater Outflow (AGWO) is routed directly to the lake
- The pervious land segments for basin 5 have runoff that is not routed

Morriston Basin

- There are impervious land segments associated with Basin 5 that have large surface water outflows
- If the basin is internally drained, the large volumes of impervious outflow need to be routed somewhere to preserve mass balance
- If the basin drainage to a sink is not present, then the parameters should be adjusted to reduce the impervious surface outflow

```
***IMPLND 501        39.66    RCHRES  1   2
***IMPLND 502        52.08    RCHRES  1   2
***IMPLND 503        998.24   RCHRES  1   2
***IMPLND 504        420.48   RCHRES  1   2
```

Time Series List				
History 1	from LakeWeir.hbn	from LakeWeir.hbn	from LakeWeir.hbn	from LakeWeir.hbn
Constituent	SURO	SURO	SURO	SURO
Land Segment	501	502	503	504
Id	1658	1664	1670	1676
Min	18.454	18.454	18.454	18.454
Max	51.865	51.865	51.865	51.865
Mean	36.798	36.798	36.798	36.798

Input data

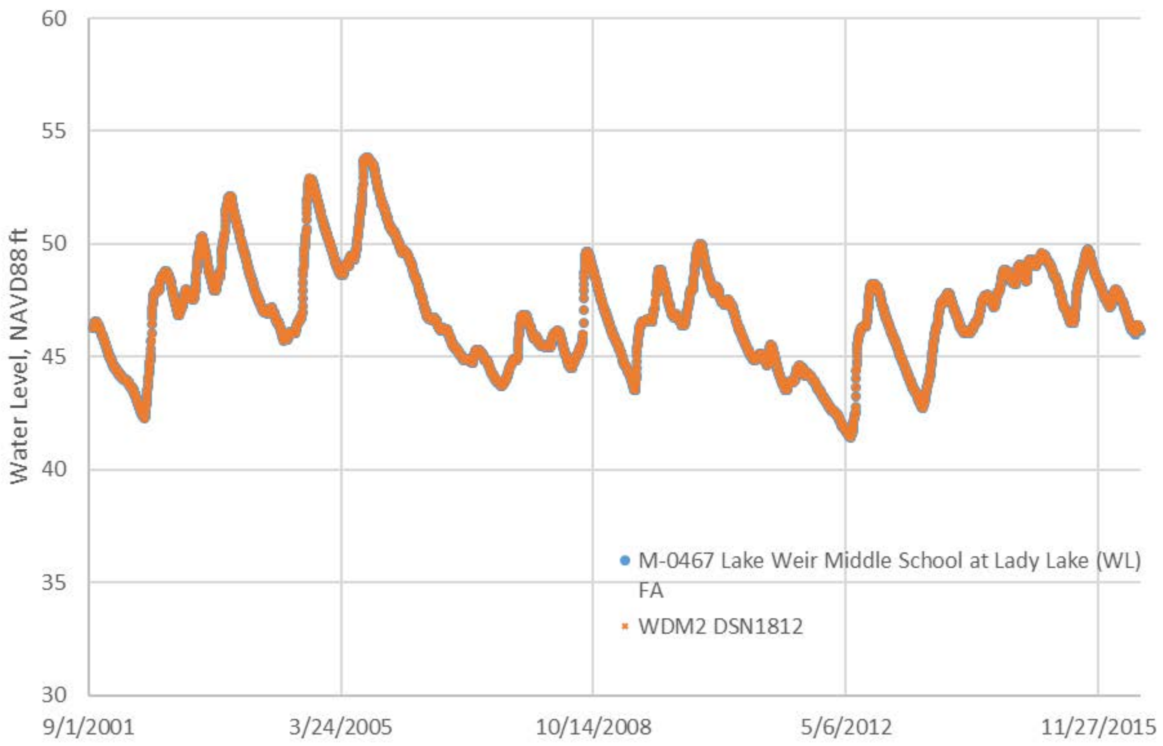
Rainfall

Appendix A Lake Weir Data Review Summary Report , DSLLC 2016

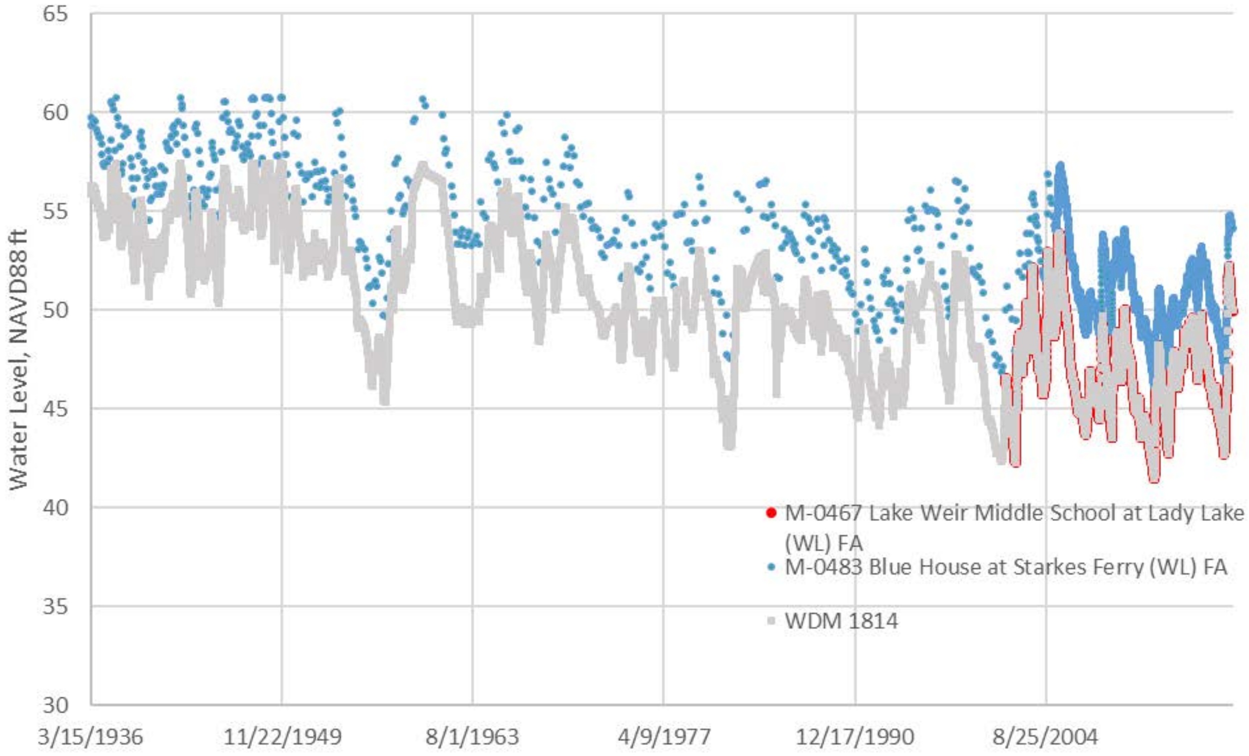
The composite rainfall data were obtained by combining data at NOAA station of Lisbon (01/01/1948 – 05/26/1988) and SJRWMD station of Smith Lake at Belleview (05/27/1988 – 12/31/2015). Rainfall data from another NOAA station (Ocala) and three SJRWMD stations (Sunny Hill South #1, Sunny Hill C-D #5, and Blue House at Starkes Ferry) were used to fill in the missing rainfall data.

- Additional details could be added to the documentation to address the development of the record and additional gap-filling techniques that were used.

Groundwater Levels



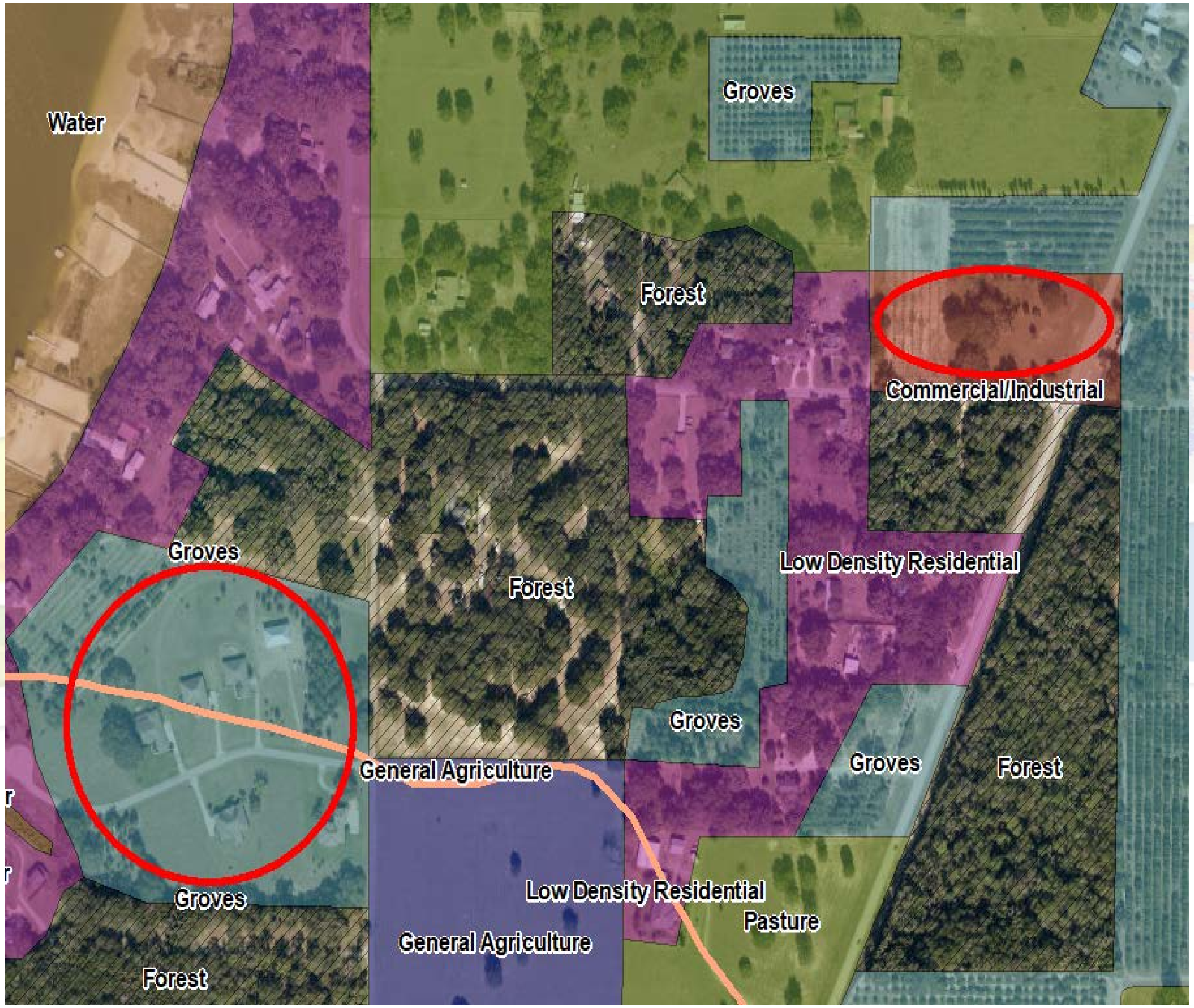
Comparison of Well M-0467 Lake Weir Middle School at Lady Lake Data (DSLLC, 2016)



Comparison of Well M-0467 Lake Weir Middle School at Lady Lake Data, M-0483 Blue House at Starkes Ferry, and the extended Lady Lake well time series produced from Line of Organic Correlation (LOC) WDM 1814 (District, 2019)

Land Use

- 2009 Land Use coverage used to develop land segments
- 2009 falls within the calibration period
- Discrepancies in land use when compared to more recent aerials
- For future use of this model, land use would need to be updated to reflect the correct land use in the watershed

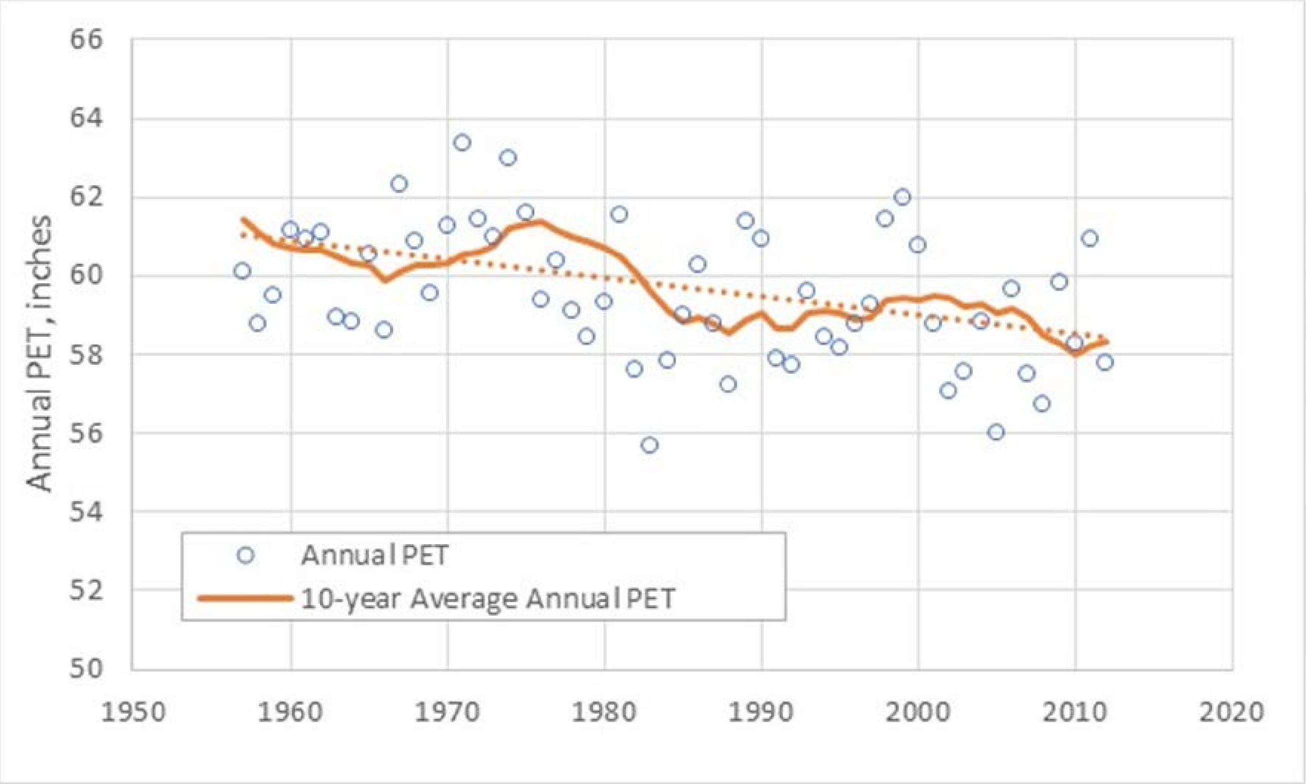


Potential Evapotranspiration (PET) Data

Table 2. Annual potential evapotranspiration (PET) accumulation (in/yr) of time period used in HSPF

	Calibration Model		Long-term Simulation Model	
	PET (DSLLC, 2016)	PET Adj (DSLLC, 2016)[1]	PET (District, 2019)	PET Adj (District, 2019)
Min	58.91	47.72	57.95	46.95
Max	64.19	52.00	65.91	53.39
Median	60.72	49.19	61.59	49.89
Mean	61.16	49.55	61.60	49.91

1. Multiplier of 0.8101 was used by the SJRWMD to adjust the calculated evaporation values by the Hargreaves approach to match GOES PET estimates



Non-Adjusted Annual PET Trend

Model Calibration

Summary Statistics for Daily and Monthly Stages

Stage	Sample size	Mean-Observed	Mean-Modeled	NSE	Percentage of modeled stages within ±0.5 feet of measured data
Daily	4,108	51.83	51.87	0.93	83.9%
Monthly	132	51.83	51.87	0.932	84.8%

Total Actual Evapotranspiration (TAET) Summary

Year	Low Density Res.	Medium Density Res.	High Densit y Res.	Comm. / Indust.	Mining	Open	Pasture	Gen. Ag.	Groves	Range/ Shrub	Forest	Water	Wetland	PET	SUPY
	P:101	P:102	P:103	P:104	P:105	P:106	P:107	P:108	P:109	P:110	P:111	P:112	P:113		
2003	35.65	35.65	35.65	35.65	33.70	33.58	36.97	39.91	39.91	41.50	41.55	39.11	39.11	47.83	51.26
2004	33.06	33.06	33.06	33.06	30.82	30.72	34.20	37.26	37.26	38.69	39.02	38.99	38.99	49.12	54.00
2005	34.80	34.80	34.80	34.80	32.65	32.66	36.00	39.11	39.11	40.68	41.19	40.16	40.16	47.72	54.37
2006	21.71	21.71	21.71	21.71	19.95	20.50	22.94	24.63	24.63	25.20	26.29	21.89	21.89	51.19	25.69
2007	29.18	29.18	29.18	29.18	27.58	27.47	30.31	32.34	32.34	33.35	33.40	33.29	33.29	49.49	46.28
2008	30.67	30.67	30.67	30.67	28.32	28.67	31.71	34.76	34.76	35.86	37.02	38.74	38.74	48.84	45.23
2009	31.54	31.54	31.54	31.54	29.60	29.75	32.70	34.71	34.71	36.01	36.35	34.59	34.59	50.22	49.37
2010	32.49	32.49	32.49	32.49	29.90	30.20	33.05	35.41	35.41	37.00	37.52	33.54	33.54	50.03	43.73
2011	29.38	29.38	29.38	29.38	27.36	27.31	30.57	33.15	33.15	34.55	34.64	34.03	34.03	52.00	42.81
2012	33.56	33.56	33.56	33.56	30.99	31.18	34.05	36.36	36.36	37.83	38.11	35.40	35.40	50.12	48.50
2013	28.23	28.23	28.23	28.23	26.61	26.79	29.31	30.97	30.97	32.07	32.33	32.45	32.45	49.19	39.63
2014	36.42	36.42	36.42	36.42	34.33	34.22	37.42	40.48	40.48	42.12	42.16	43.00	43.00	48.82	64.13
Avg.	31.39	31.39	31.39	31.39	29.32	29.42	32.43	34.92	34.92	36.24	36.63	35.43	35.43	47.83	51.26

SURO and RETS Summary for Impervious areas

- RETSC in the uci file is set to 0.1 in for all impervious land use

Year	I:101 SURO	I:101 RETS	I:102 SURO	I:102 RETS	I:103 SURO	I:103 RETS	I:104 SURO	I:104 RETS	I:201 SURO	I:201 RETS	I:203 SURO	I:203 RETS
2003	40.2	0.0	40.2	0.0	40.2	0.0	40.2	0.0	40.2	0.0	40.2	0.0
2004	43.7	0.0	43.7	0.0	43.7	0.0	43.7	0.0	43.7	0.0	43.7	0.0
2005	42.1	0.0	42.1	0.0	42.1	0.0	42.1	0.0	42.1	0.0	42.1	0.0
2006	18.5	0.0	18.5	0.0	18.5	0.0	18.5	0.0	18.5	0.0	18.5	0.0
2007	36.0	0.0	36.0	0.0	36.0	0.0	36.0	0.0	36.0	0.0	36.0	0.0
2008	35.4	0.0	35.4	0.0	35.4	0.0	35.4	0.0	35.4	0.0	35.4	0.0
2009	37.9	0.0	37.9	0.0	37.9	0.0	37.9	0.0	37.9	0.0	37.9	0.0
2010	34.7	0.0	34.7	0.0	34.7	0.0	34.7	0.0	34.7	0.0	34.7	0.0
2011	34.7	0.0	34.7	0.0	34.7	0.0	34.7	0.0	34.7	0.0	34.7	0.0
2012	38.4	0.0	38.4	0.0	38.4	0.0	38.4	0.0	38.4	0.0	38.4	0.0
2013	28.2	0.0	28.2	0.0	28.2	0.0	28.2	0.0	28.2	0.0	28.2	0.0
2014	51.9	0.0	51.9	0.0	51.9	0.0	51.9	0.0	51.9	0.0	51.9	0.0

Water Balance Summary for Pervious Land Use

Land use	SUPY	PET	TAET	SURO	IGWI	AGWI
P:101	47.08	49.55	31.39	0.84	8.38	6.72
P:102	47.08	49.55	31.39	0.84	8.38	6.72
P:103	47.08	49.55	31.39	0.84	8.38	6.72
P:104	47.08	49.55	31.39	0.84	8.38	6.72
P:105	47.08	49.55	29.32	0.48	9.76	7.82
P:106	47.08	49.55	29.42	0.41	9.78	7.84
P:107	47.08	49.55	32.44	0.28	8.25	6.62
P:108	47.08	49.55	34.92	0.10	7.10	5.69
P:109	47.08	49.55	34.92	0.09	7.10	5.70
P:110	47.08	49.55	36.24	0.22	6.22	4.99
P:111	47.08	49.55	36.63	0.02	6.23	4.99
P:112	47.08	49.55	35.43	0.00	8.50	6.82
P:113	47.08	49.55	35.43	0.00	8.50	6.82
P:201	47.08	49.55	31.22	0.81	8.51	6.82
P:203	47.08	49.55	31.22	0.81	8.51	6.82
P:206	47.08	49.55	29.22	0.40	9.92	7.95
P:207	47.08	49.55	32.28	0.28	8.36	6.71
P:208	47.08	49.55	34.81	0.10	7.18	5.76
P:209	47.08	49.55	34.81	0.09	7.18	5.76
P:210	47.08	49.55	36.14	0.21	6.29	5.04
P:211	47.08	49.55	36.54	0.02	6.28	5.04
P:212	47.08	49.55	35.31	0.00	8.62	6.91
P:213	47.08	49.55	35.31	0.00	8.62	6.91

Land use	SUPY	PET	TAET	SURO	IGWI	AGWI
P:301	47.08	49.55	31.30	0.84	8.44	6.77
P:302	47.08	49.55	31.30	0.84	8.44	6.77
P:303	47.08	49.55	31.30	0.84	8.44	6.77
P:304	47.08	49.55	31.30	0.84	8.44	6.77
P:306	47.08	49.55	29.32	0.42	9.84	7.89
P:307	47.08	49.55	32.36	0.29	8.30	6.66
P:308	47.08	49.55	34.86	0.10	7.14	5.72
P:309	47.08	49.55	34.86	0.10	7.14	5.73
P:310	47.08	49.55	36.19	0.22	6.25	5.01
P:311	47.08	49.55	36.58	0.02	6.25	5.01
P:312	47.08	49.55	35.36	0.00	8.57	6.87
P:313	47.08	49.55	35.36	0.00	8.57	6.87
P:401	47.08	49.55	31.14	0.77	8.58	6.88
P:402	47.08	49.55	31.14	0.77	8.58	6.88
P:404	47.08	49.55	31.14	0.77	8.58	6.88
P:406	47.08	49.55	29.13	0.37	9.99	8.01
P:407	47.08	49.55	32.21	0.26	8.42	6.75
P:408	47.08	49.55	34.75	0.09	7.22	5.79
P:409	47.08	49.55	34.75	0.09	7.22	5.79
P:410	47.08	49.55	36.10	0.19	6.33	5.08
P:411	47.08	49.55	36.49	0.02	6.31	5.06
P:412	47.08	49.55	35.25	0.00	8.68	6.96
P:413	47.08	49.55	35.25	0.00	8.68	6.96

Land use	SUPY	PET	TAET	SURO	IGWI	AGWI
P:501	47.08	49.55	31.06	0.72	8.66	6.95
P:502	47.08	49.55	31.06	0.72	8.66	6.95
P:503	47.08	49.55	31.06	0.72	8.66	6.95
P:504	47.08	49.55	31.06	0.72	8.66	6.95
P:506	47.08	49.55	29.04	0.34	10.07	8.07
P:507	47.08	49.55	32.14	0.23	8.48	6.80
P:508	47.08	49.55	34.69	0.08	7.26	5.82
P:509	47.08	49.55	34.69	0.07	7.26	5.82
P:510	47.08	49.55	36.06	0.18	6.37	5.11
P:511	47.08	49.55	36.45	0.02	6.34	5.08
P:512	47.08	49.55	35.18	0.00	8.74	7.00
P:513	47.08	49.55	35.18	0.00	8.74	7.00

- PET is low
- Range/shrub and forest segments have higher TAET than water and wetland segments

Water Balance Summary for Impervious Land Use

Land use	SUPY	PET	SURO	IMPEV	RETS	SURS
I:101- I:104	47.08	49.55	36.80	10.29	0.00	0.00
I:201- I:203	47.08	49.55	36.80	10.29	0.00	0.00
I:301- I:304	47.08	49.55	36.80	10.29	0.00	0.00
I:401-I:404	47.08	49.55	36.80	10.29	0.00	0.00
I:501-I:504	47.08	49.55	36.80	10.29	0.00	0.00

Annual Water Balance (Source: Appendix C DSLLC(2016)

Year	ΔVolume	Rainfall	Runoff	ET	Overflow	Seepage
2004	5,600	26,700	8,590	24,300	0	5,390
2005	8,000	27,800	9,010	24,500	0	4,310
2006	-18,000	12,800	1,960	25,700	0	7,060
2007	-2,900	22,000	6,270	23,600	0	7,570
2008	200	21,600	8,190	23,400	0	6,190
2009	300	23,600	6,820	24,000	0	6,120
2010	-2,300	21,300	6,780	24,400	0	5,980
2011	-7,200	20,200	4,680	24,500	0	7,580
2012	0	22,400	7,090	23,200	0	6,290
2013	-4,700	17,900	4,360	22,400	0	4,560
2014	15,000	29,900	11,100	22,800	0	3,200
Average	-545	22,382	6,805	23,891	0	5,841

Note: Unit is acre-feet; sign – means that lake loses water.

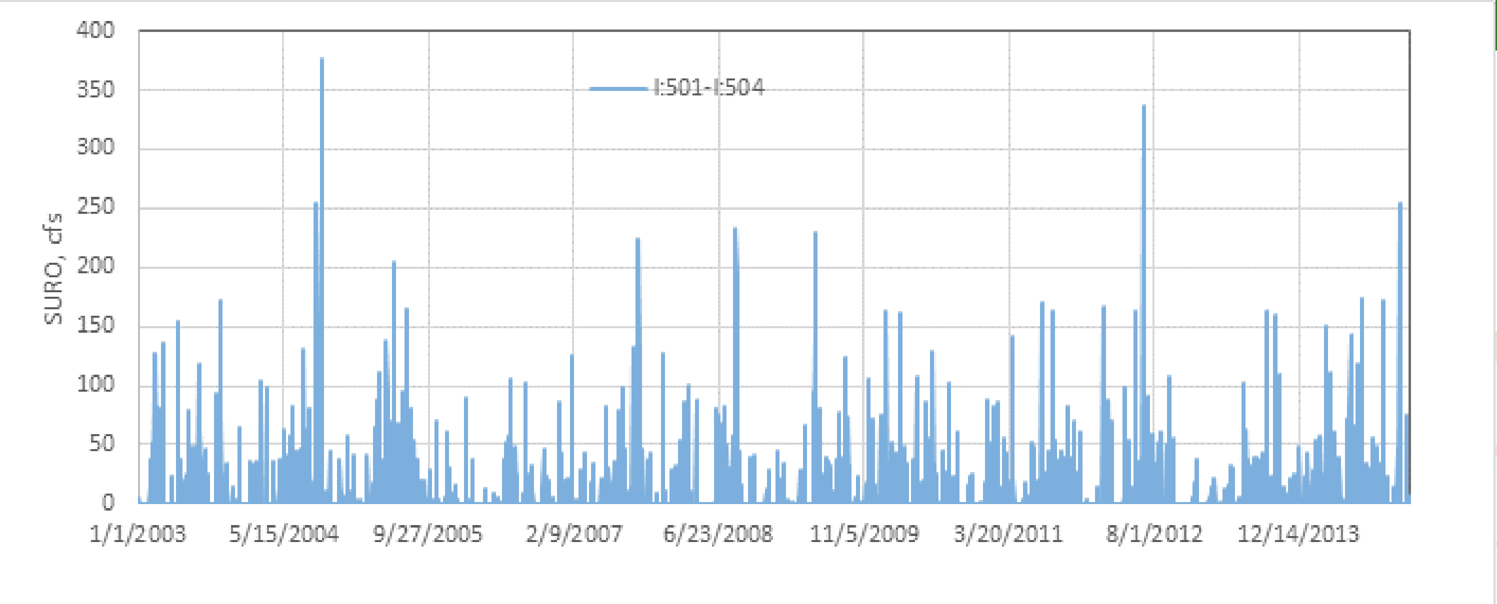
Lake Weir Annual Water Balance (Source: Appendix C, Table 7, DSLLC(2016))

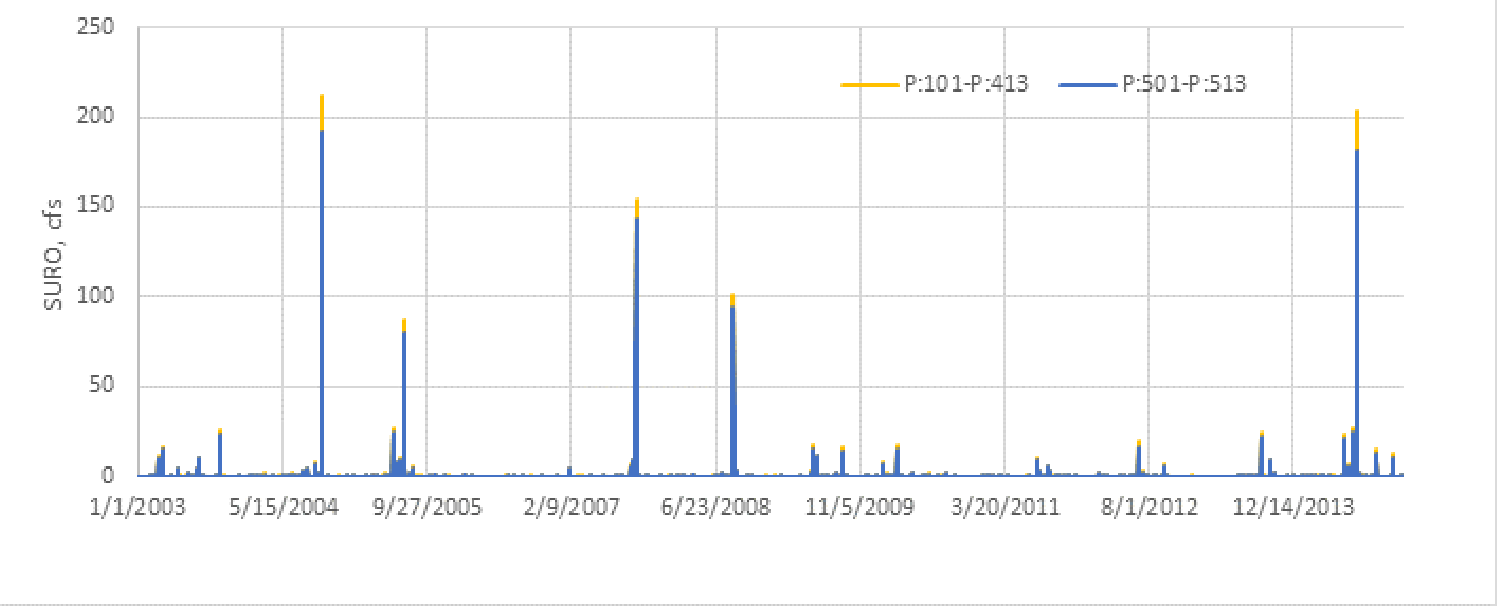
Basin 5: SURO Totals

- Basin 5 impervious runoff extremely high
- Basin 5 pervious runoff almost exceeds runoff from all the other pervious basins
- Basin 5 runoff is not routed
  - Recommend adjusting parameters to prevent runoff

  OR

  - Route runoff to aquifer





Basin Discharges in cfs

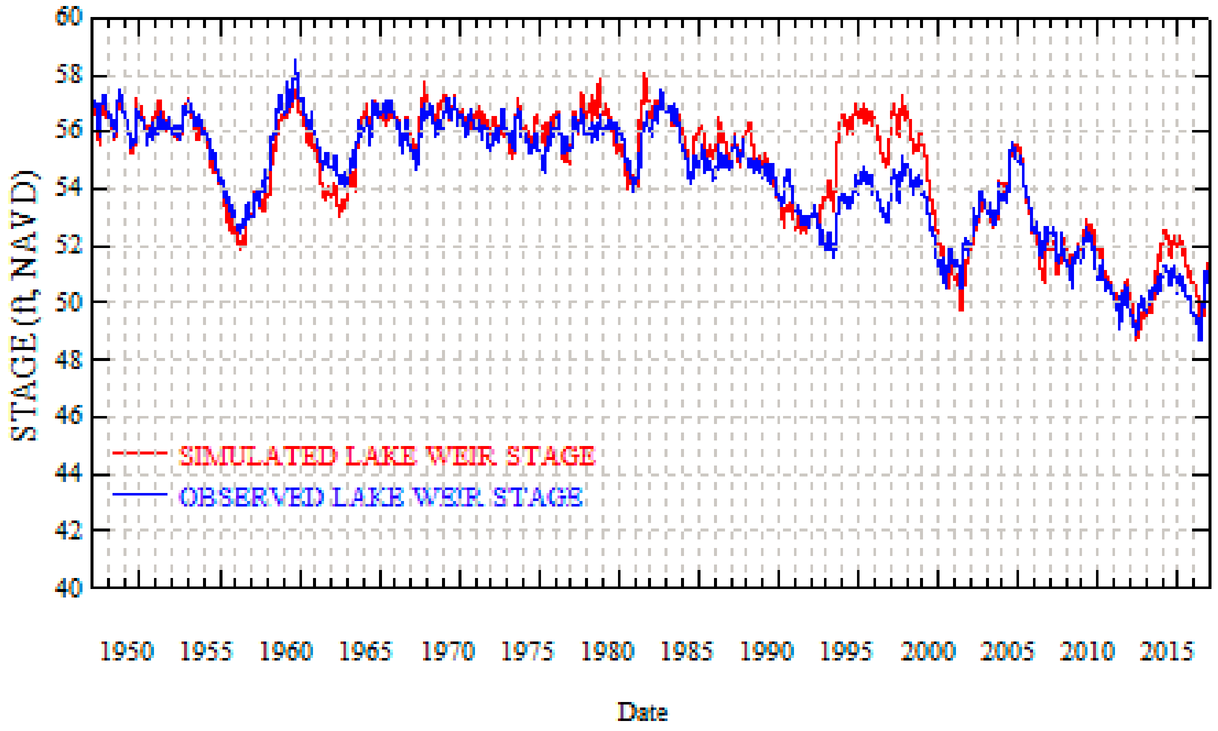
- Basin 5 discharges are quite large
- Tributary basins are much smaller and therefore contribute less basin runoff
- Tributary flows from basin 2, 3, and 4 provide significant inflow to the lake
- Surrogate Palatlakaha River:
  - 221 square miles
  - Peak flows on the order of 700 cfs
  - In comparison basin 5 is about 13 square miles

Basin	Maximum PERLND PERO	Maximum PERLND SURO	Maximum total outflow (PERO + IMPLND SURO)
Basin 1	182	134	268
Basin 2	18	16	24
Basin 3	22	17	45
Basin 4	63	52	78
Basin 5	243	192	619

Long-term Simulation Review

Long Term Simulation Results

- Overall, the long term simulation replicated the observed data very well
- All data was prepared following standard practices; the tech memo documentation could be expanded to better describe procedures used
- One discrepancy period was noted from 1994-1999, rainfall was noted as a possible cause; further investigation and sensitivity analysis may be warranted



Long-term Simulation VS. Calibrated model Input

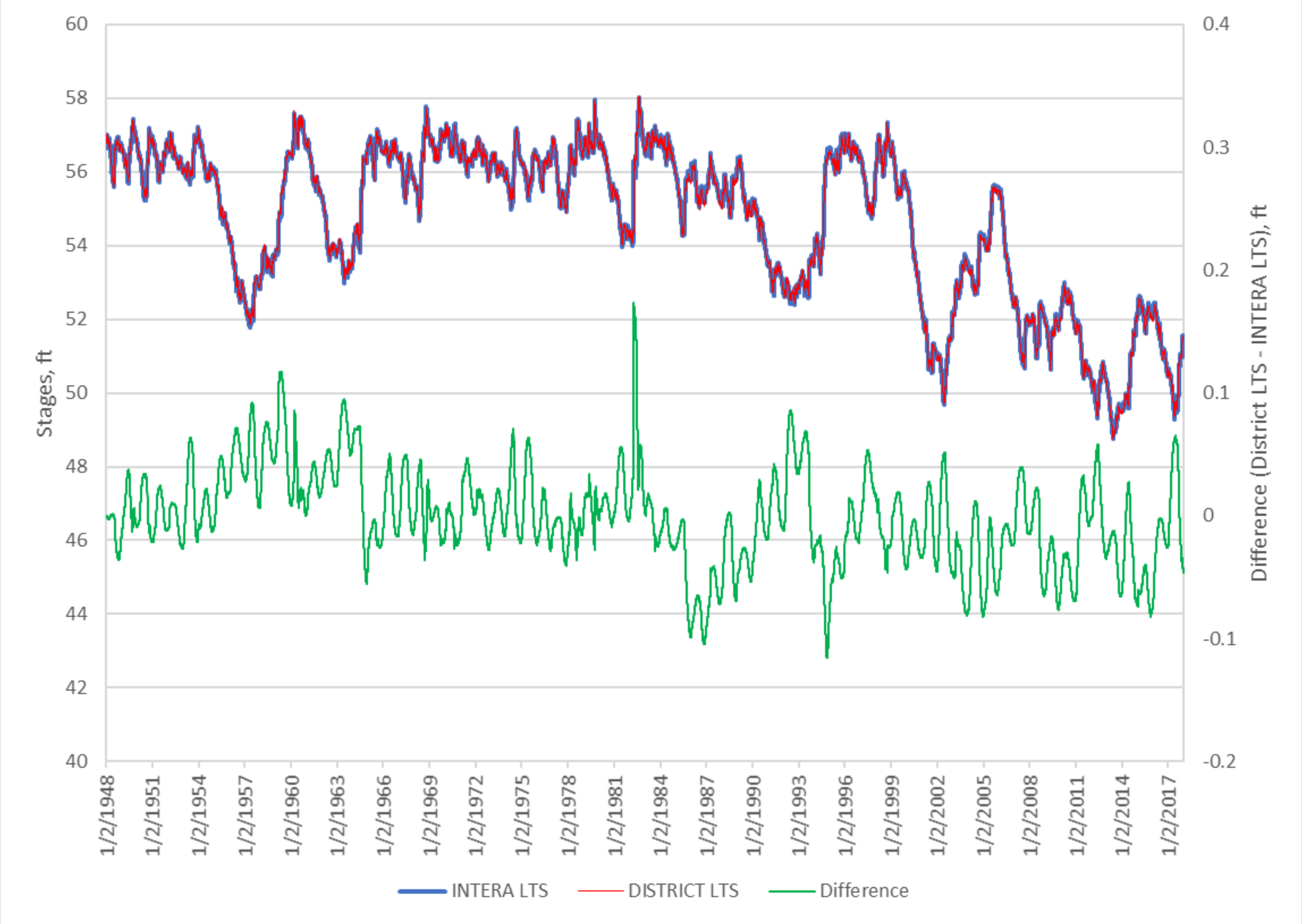
- Comparison of District provided LTS model and calibrated model demonstrated some discrepancies in the input data:
  - VLE
  - MON-LZETPARM
  - INFILT
  - DEEPFR
  - LZETP
  - UZS
  - LZS
  - Special Actions – GENER 2
- The long term simulation should have identical basin parameters as found in the calibration data set

Long-term Simulation Comparison

- Changed the calibrated model UCI: Dates, external sources block, and initial conditions to match the District provided long-term simulation model (named it INTERA LTS) to document changes

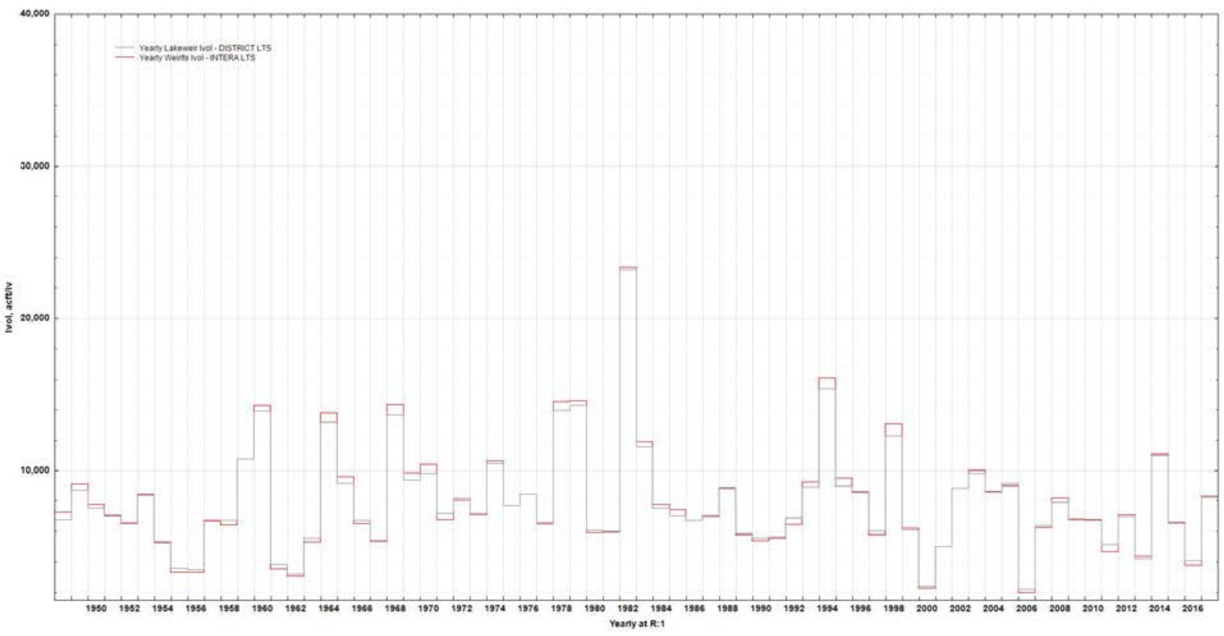
Difference (District LTS- INTERA LTS)	
Average	-0.00057
Max	0.174
Min	-0.116

LTS – Long-term Simulation



Lake Inflow Comparison

- To further determine effects of parameter changes between calibration and LTS; lake inflows were compared
- Adjusted basin parameters had little impact on overall basin response



Conclusion

Conclusion

- Model calibration agrees well with observed data
- Basin 5 water balance should be appropriate and represent a closed basin
- Runoff from basin 2, 3, and 4 seem high and difficult to support given aerial reconnaissance of inflow locations
- PET seems low for wetland and high for pasture and forest
- Sensitivity analysis is desired to evaluate impacts of basin inflows and lake leakage
- LTS looks reasonable and adequate for evaluating impacts to lake levels

Basin 2


Hope Park Rd
SE 161st Pl
SE Sunset Harbor Rd
SE 162nd Pl
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Google Earth

Basin 3

Basin 4