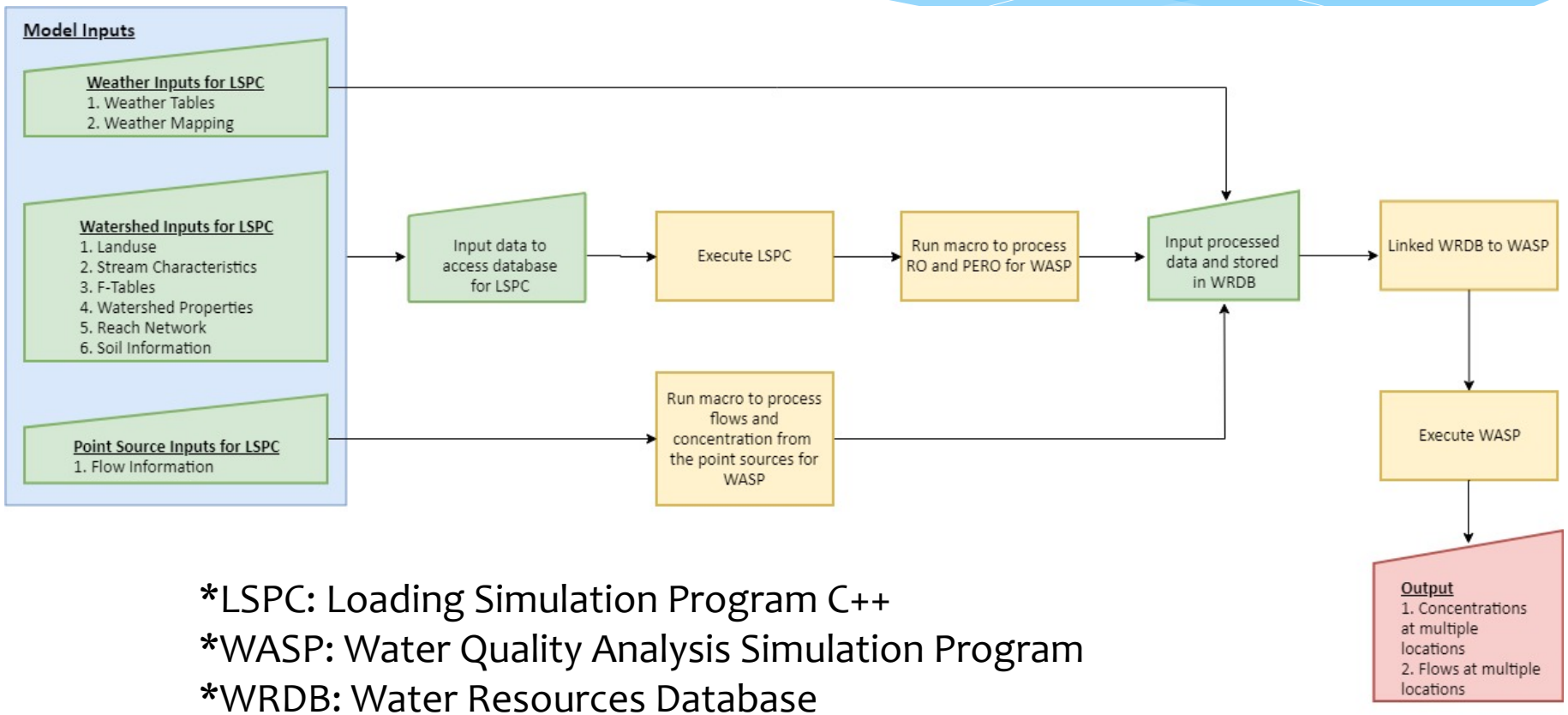
Modeling Committee Update

Big Tent Meeting

February 16, 2021

Reedy River Water Quality Group

Model Set Up: LSPC, WASP and WRDB*

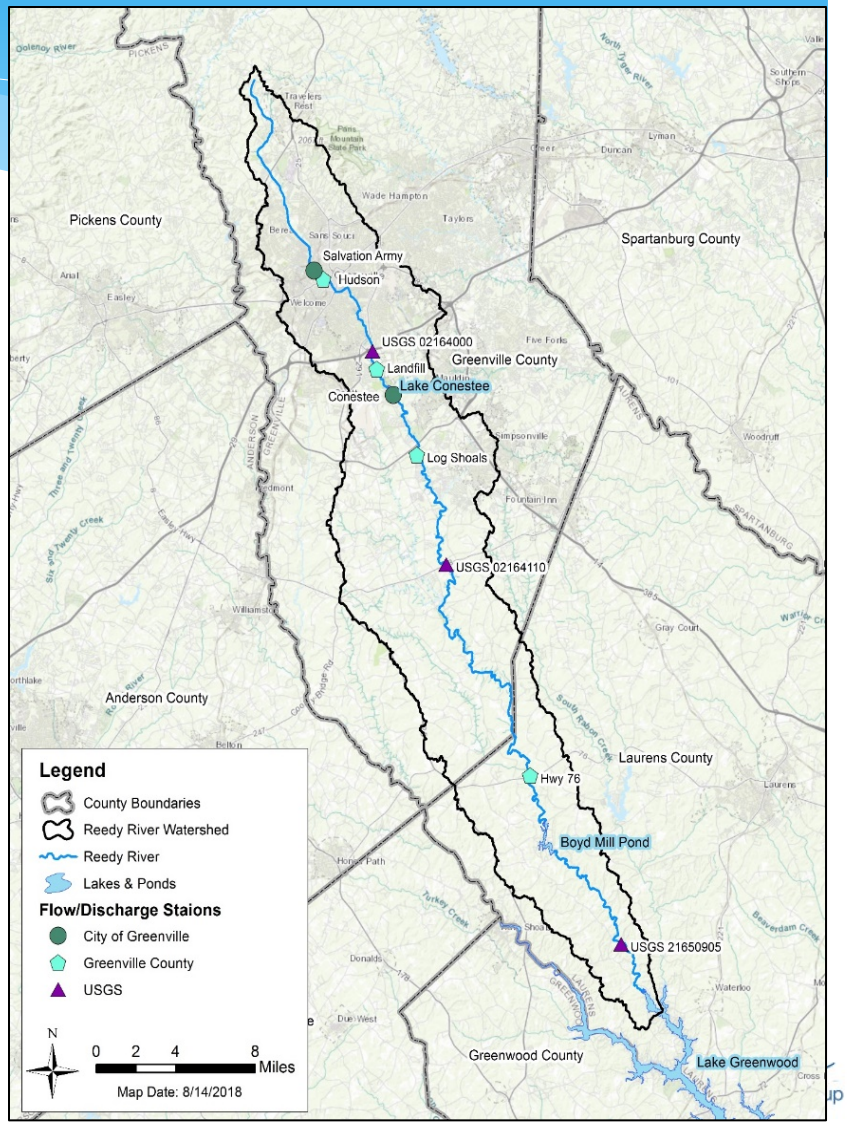


*LSPC: Loading Simulation Program C++
*WASP: Water Quality Analysis Simulation Program
*WRDB: Water Resources Database

Reedy River Water Quality Group

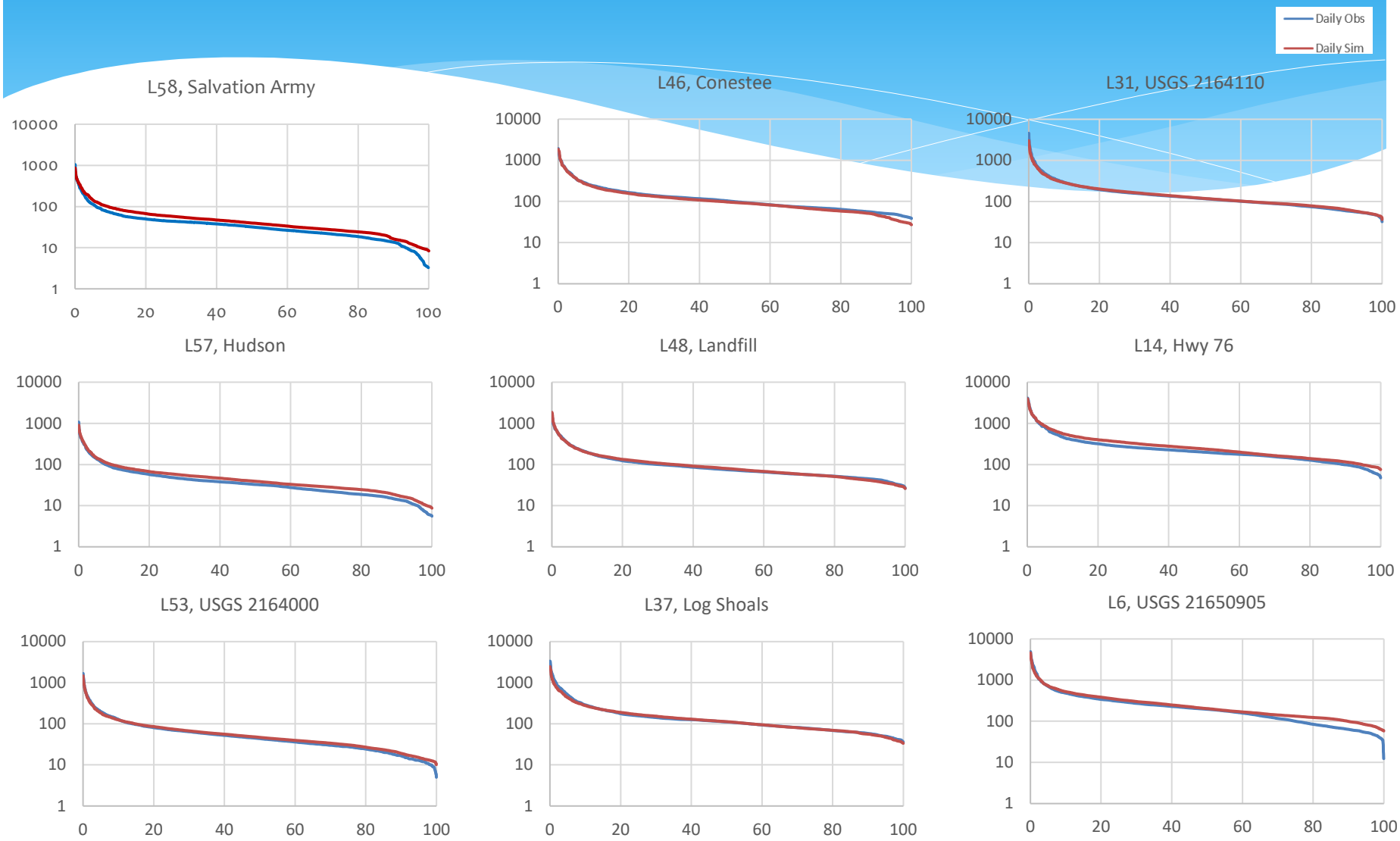
Hydrology Calibration
(COMPLETE in November 2020)

- Salvation Army: 2012 2013-2017
- Hudson: 2010 2013-2017
- USGS 0216400: 2006-2017
- Landfill: 2010 2013-2017
- Lake Conestee: 2012 2013-2017
- Log Shoals: 2010 2013-2017
- USGS 02164110: 2006-2017
- Hwy 76: 2012 2013-2017
- USGS 21650905: 2008-2017



Hydrology Calibration

Final Hydrology Calibration Run Daily Percent Exceedance



Hydrology Calibration

Final Hydrology Calibration Run Daily Flow Data Summary Statistics

Sites	Total % Error	NSE	R^2	RSR
L58, Salvation Army	16.93% (**satisfactory**)	0.65 (**good**)	0.70 (**good**)	0.59 (**good**)
L57, Hudson	12.12% (**satisfactory**)	0.70 (**good**)	0.74 (**good**)	0.50 (**very good**)
L53, USGS 2164000	4.13% (**very good**)	0.76 (**good**)	0.78 (**good**)	0.49 (**very good**)
L48, Landfill	5.34% (**good**)	0.79 (**good**)	0.86 (**very good**)	0.46 (**very good**)
L46, Conestee	-4.36% (**very good**)	0.80 (**good**)	0.83 (**very good**)	0.45 (**very good**)
L37, Log Shoals	-7.00% (**good**)	0.67 (**satisfactory**)	0.67 (**satisfactory**)	0.58 (**good**)
L31, USGS 2164110	-5.80% (**good**)	0.65 (**satisfactory**)	0.66 (**satisfactory**)	0.59 (**good**)
L14, Hwy 76	0.27% (**very good**)	0.68 (**satisfactory**)	0.69 (**satisfactory**)	0.56 (**good**)
L6, USGS 21650905	-5.59% (**good**)	0.65 (**satisfactory**)	0.66 (**satisfactory**)	0.59 (**good**)

	R^2	NSE	Percent % Error	RSR
Very Good	≥ 0.80	≥ 0.80	0-5%	≤ 0.50
Good	0.70 - 0.80	0.65 - 0.80	5-10%	0.50 - 0.60
Satisfactory	0.60 - 0.70	0. 50 - 0.65	10-15%	0.60 - 0.70
Poor	≤ 0.60	≤ 0. 50	≥ 15%	≥ 0.70

Water Quality Calibrations

1. Temp. → 2. TSS → 3. CBOD/ DO → 4. TN → 5. TP → 6. pH → 7. clorophyll-a

Owner	Site Name	Dates Considered	Hydrology	Temp.	TSS	TP	TN	CBOD	CHLA
City of Greenville	Salvation Army	2012-2017	✓		✓	✓	✓		
Greenville County	Hudson	2010-2017	✓	✓	✓	✓	✓		
SCDHEC	S-319	2006, 2010-2017						✓	
Greenville County	Parkins	2010-2017		✓	✓	✓	✓		
SCDHEC	S-013	2005-2009			✓	✓	✓	✓	
Greenville County	Mills Ave	2012-2017	✓		✓	✓	✓		
USGS	2164000	2005-2017	✓						
Greenville County	Landfill	2008-2017	✓	✓	✓	✓	✓		
City of Greenville	Conestee	2012-2017	✓						
Greenville County	Log Shoals	2010-2017	✓	✓	✓	✓	✓		
USGS	2164110	2005-2017	✓						
Greenville County	HWY 418	2008-2017		✓	✓	✓	✓		
SCDHEC	S-072	2005-2017				✓	✓	✓	
Greenville County	Hwy 76	2012-2017	✓	✓	✓	✓	✓		
SCDHEC	S-070	2006, 2015-2017				✓	✓	✓	
Greenville County	Upper BMP	2014-2017			✓	✓	✓		✓
Greenville County	Lower BMP	2014-2017			✓	✓	✓		✓
SCDHEC	S-311	2005-2014				✓	✓	✓	✓
USGS	21650905	2007-2017	✓						
SCDHEC	S-021	2005-2017				✓	✓	✓	

Water Quality Calibrations: LSPC
STEP 1

Modeling Framework Component	Parameters to be Simulated	Simulation Method
LSPC (loading from land surface)	Total nitrogen	Impervious: Buildup and washoff Pervious: Buildup and washoff Subsurface loading: Yes
	Total phosphorus	Impervious: Buildup and washoff Pervious: Sediment-associated Subsurface loading: Yes
	CBOD-slow	Impervious: Buildup and washoff Pervious: Sediment-associated Subsurface loading: Yes
	CBOD-fast	Point source only
	Sediment	LSPC's sediment component with three sediment classes (sand, silt, and clay-sized particles

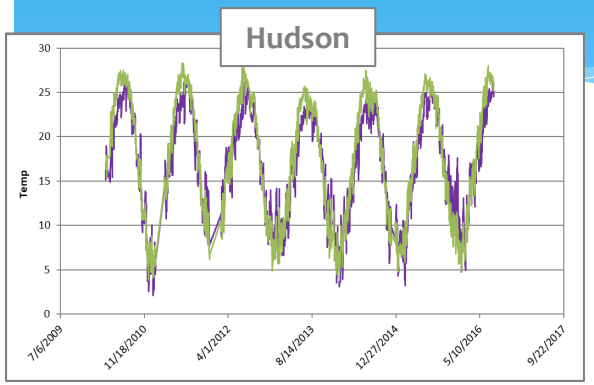
Water Quality Calibrations: LSPC *STEP 2*

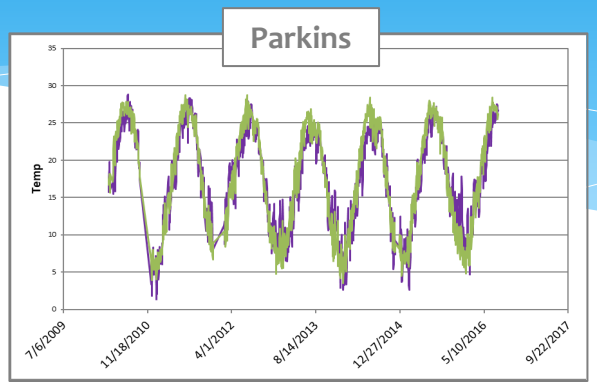
Modeling Framework Component	Parameters to be Simulated	Simulation Method
LSPC (in-stream)	Total nitrogen	Simulated as general constituents subject to in-stream attenuation (decay)
	Total phosphorus	
	CBOD-slow	
	CBOD-fast	
	Sediment	In-stream deposition, scour, and transport will be simulated. Team will also explore use of LSPC capabilities to simulate streambank erosion. This component may or may not be used in the final LSPC model, depending on whether it appears to be necessary to achieve an approximate calibration of sediment loading-related parameters in LSPC.

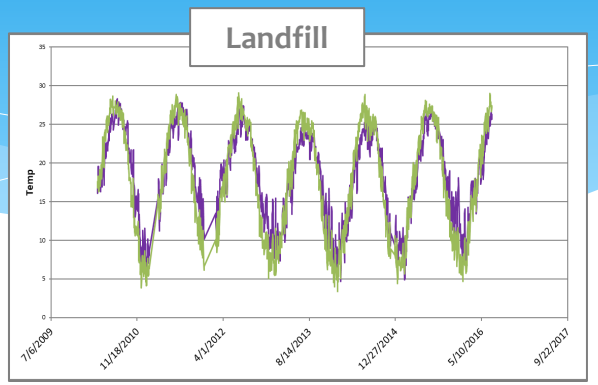
Water Quality Calibrations: WASP

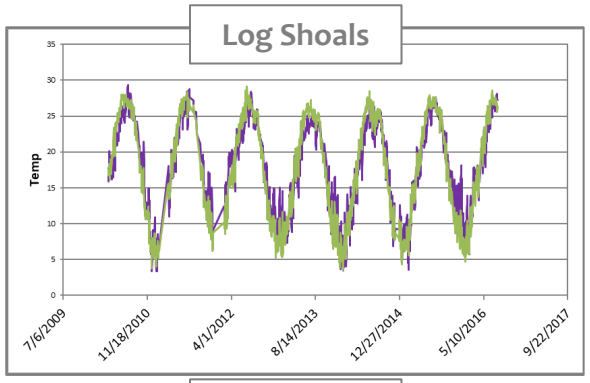
LSPC Parameter	WASP Parameter
Total nitrogen	Ammonia nitrogen
	Nitrate nitrogen
	Dissolved organic nitrogen
	Particulate organic nitrogen
Total phosphorus	Dissolved inorganic phosphorus
	Dissolved organic phosphorus
	Particulate organic phosphorus
CBOD-slow	$CBOD_1$
CBOD-fast	$CBOD_2$
Sediment fractions	Equivalent inorganic solids fractions

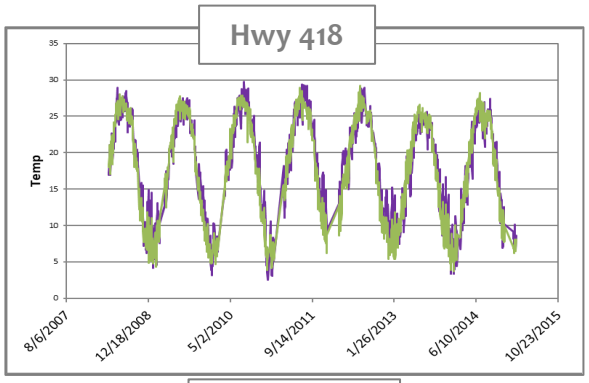
Temperature Calibrations (LSPC)

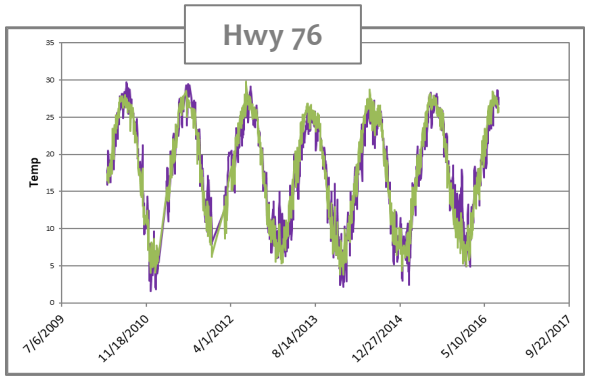


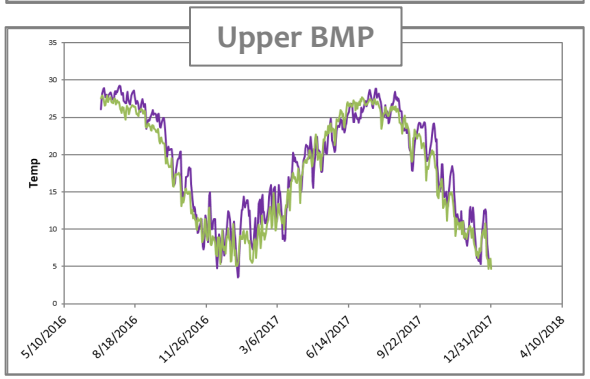


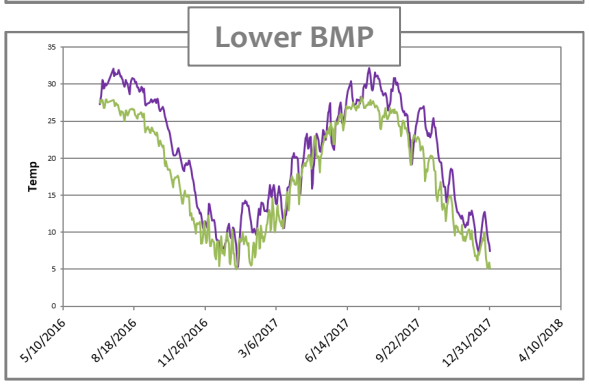












Obs

Sim

Temperature Calibrations (LSPC)

Site	OBS Avg	SIM Avg	R2	NSE	Total % Error	RSR
Hudson	16.76	17.50	0.94 (very good)	0.89 (very good)	4% (very good)	0.33 (very good)
Parkins	17.32	17.80	0.94 (very good)	0.92 (very good)	3% (very good)	0.29 (very good)
Landfill	18.22	18.15	0.93 (very good)	0.89 (very good)	0% (very good)	0.34 (very good)
Log Shoals	17.76	17.74	0.94 (very good)	0.91 (very good)	0% (very good)	0.30 (very good)
S-072 (Hwy 418 WASP sta)	18.27	18.01	0.94 (very good)	0.93 (very good)	-1% (very good)	0.26 (very good)
Hwy 76	17.67	17.83	0.94 (very good)	0.94 (very good)	1% (very good)	0.25 (very good)

	R^2	NSE	Percent % Error	RSR
Very Good	≥ 0.80	≥ 0.80	≤ 20%	≤ 0.50
Good	0.65 - 0.80	0.70 - 0.80	20-30%	0.50 - 0.60
Satisfactory	0.40 - 0.65	0.45 - 0.70	30-45%	0.60 - 0.70
Poor	≤ 0.40	≤ 0.45	≥ 45%	≥ 0.70

TSS Calibrations (LSPC)

Land Use Load Percentages

BASINS Technical Note 8: Sediment Parameter and Calibration Guidance for HSPF (Jan 2006):

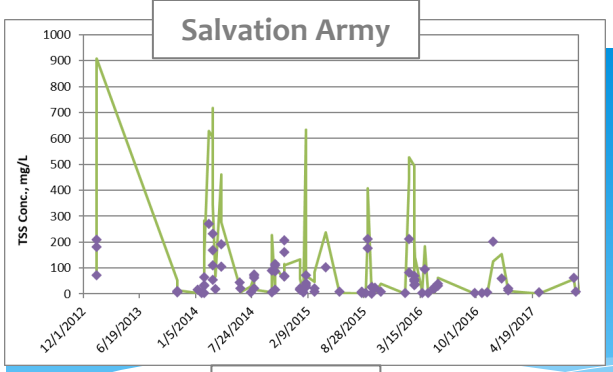
1. Estimate target (or expected) sediment loading rates from the landscape
2. Calibrate the model loading rates to the target rates
3. Adjust scour, deposition and transport parameters for the stream channel
4. Analyze sediment bed behavior (i.e. bed depths) and transport in each channel reach
5. Analyze overall sediment budgets for the land and stream contributions
6. Compare simulated and observed sediment concentrations
7. Repeating steps 1 through 6 as needed

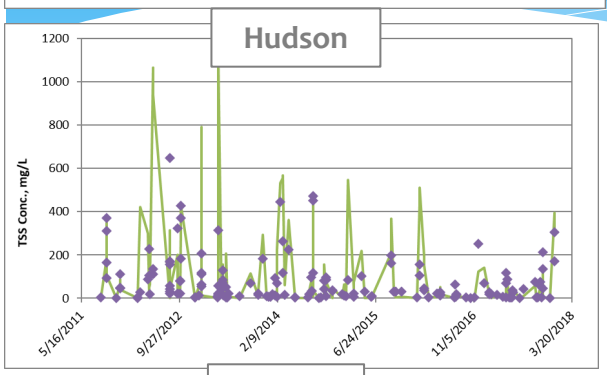
Landuse Type (sq mi in Reedy River Watershed)	2012 SPARROW	2012 LSPC	Avg Annual LSPC
Urban (90.1)	31%	34%	16%
Natural (125.7)	33%	32%	42%
Ag (16.8)	36%	34%	42%

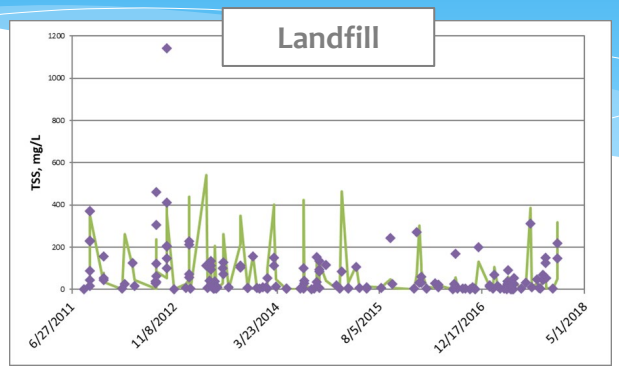
TSS Calibrations (LSPC)

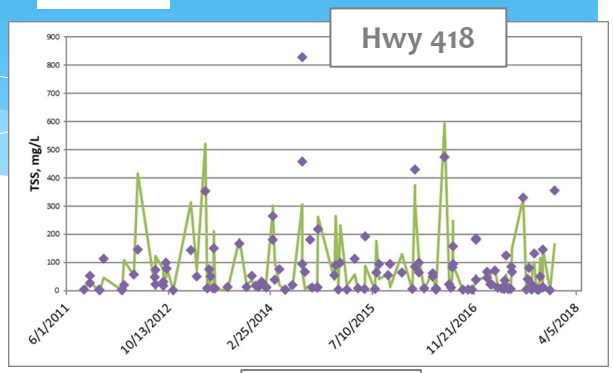
Current Status

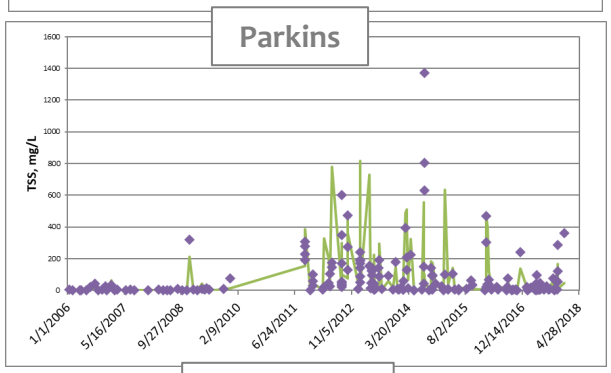
Obs
Sim

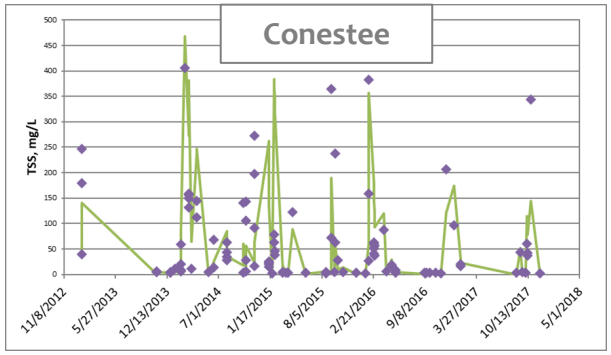


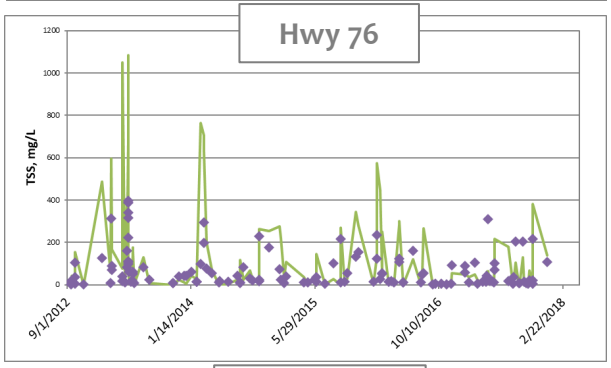


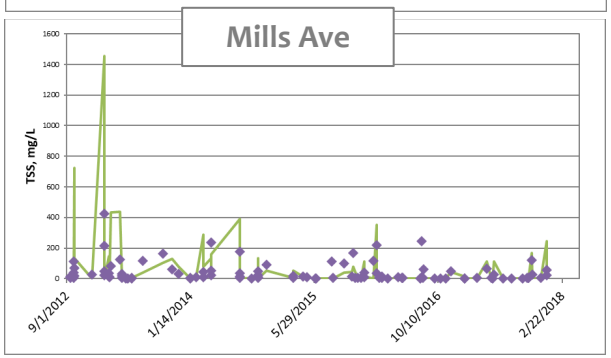


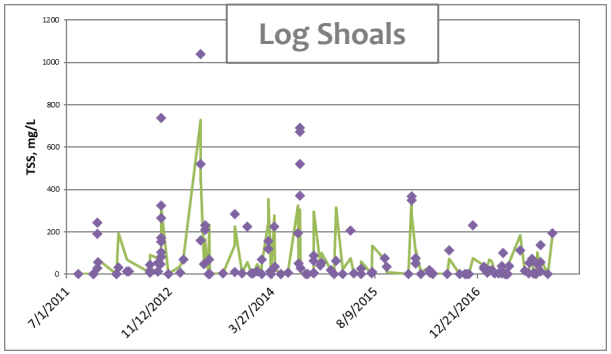


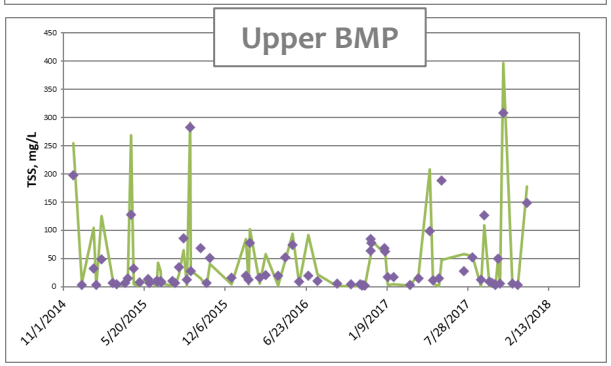












TSS Calibrations (LSPC)

Statistics using Grab Sample Data

Site	OBS Avg	SIM Avg	R2	NSE	Total % Error	RSR
Salvation Army	57.91	130.81	0.49	-5.57	126%	2.55
Hudson	80.53	117.69	0.26	-1.55	46%	1.59
Parkins	84.57	96.76	0.12	-0.42	14%	1.19
Mills Ave	41.11	76.46	0.50	-3.69	86%	2.16
Landfill	76.84	79.87	0.19	-0.03	4%	1.01
Conestee	62.70	86.79	0.25	-0.37	38%	1.17
Log Shoals	88.26	80.10	0.41	0.40	-9%	0.77
Hwy 418	76.02	76.74	0.52	0.48	1%	0.72
Hwy 76	68.79	143.89	0.55	-4.03	109%	2.23
Upper BMP	40.71	45.72	0.76	0.63	12%	0.60

TSS Calibrations (LSPC)

Statistics using regression based continuous TSS data

Site	OBS Avg	SIM Avg	R2	NSE	Total % Error	RSR
Hudson	16.8	18.0	0.36	-0.98	7%	1.41
Parkins	18.2	20.5	0.37	-0.58	13%	1.26
Landfill	17.8	16.8	0.40	-0.01	-5%	1.01
Log Shoals	15.5	19.7	0.38	0.11	27%	0.94
Hwy 418	20.2	20.5	0.45	0.20	2%	0.90
Hwy 76	24.7	28.5	0.43	-2.19	15%	1.79

	R^2	NSE	Percent % Error	RSR
Very Good	≥ 0.80	≥ 0.80	≤ 20%	≤ 0.50
Good	0.65 - 0.80	0.70 - 0.80	20-30%	0.50 - 0.60
Satisfactory	0.40 - 0.65	0.45 - 0.70	30-45%	0.60 - 0.70
Poor	≤ 0.40	≤ 0.45	≥ 45%	≥ 0.70

Schedule

Hydrology Calibration Completed

Nov 2020

Water Quality Calibration (LSPC)

December 2020-April 2021

Water Quality Calibration (WASP)

April 2021 – August 2021

Phase 3: Management Scenarios

Questions?

Name	Organization
Amanda Douglas*	Greenville County
Andy Thuman	ReWa
Chris Starker	Upstate Forever
Clifton Bell*	Greenville County
Craig Hesterlee	EPA Region IV
Cris Mancilla	ReWa
Crystal Muller	Greenville County
Danny Holiday	ReWa
Deb Sahoo*	Clemson
Flint Holbrook	Greenville County
Glenn Fernandez	EPA Region IV
Gracy Danois	EPA Region IV
Greg Wright	ReWa
Joseph Pohnan	EPA Region IV
Paul Dow	City of Greenville
Richard Powers	Home Builders Association of Greenville, SC
Tim Wool	EPA Region IV
Wade Cantrell	SCDHEC
Yoichi Matsuzuru	SCDHEC

*Modeling Team

Reedy River Water Quality Group