Mid-Coast Bacteria TMDL: Seventeenth TWG Meeting

Kevin Brannan
Oregon DEQ

April 13, 2016

Meeting Objectives

- Updates and Announcements from TWG members
- Load Duration Curves Status
- Beaches Status
- Big Elk Creek Modeling
- Other modeling

Load Duration Curve based TMDLs - Status

- Compiling reports
- Conducting additional analysis
  - Source characterization
  - Estuary

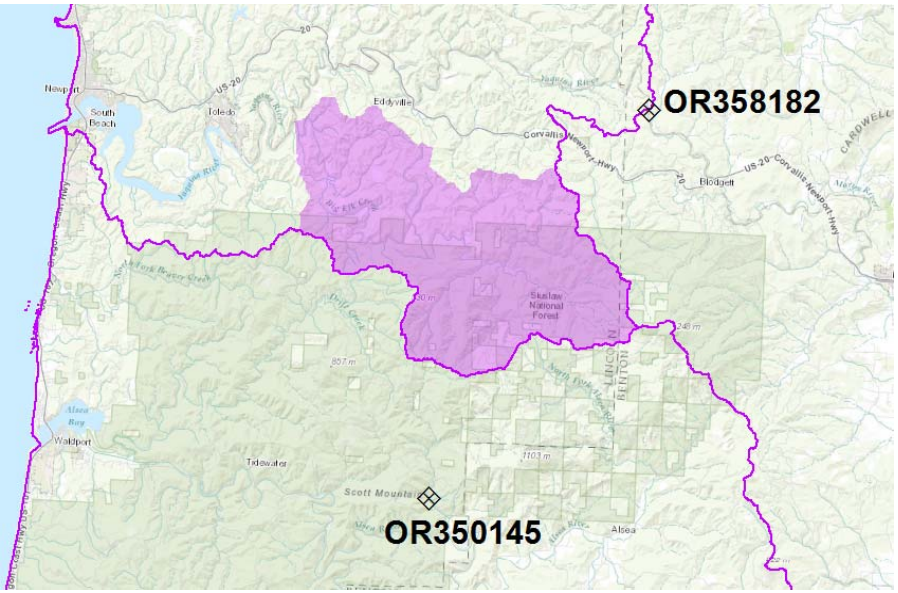
Beach TMDLs

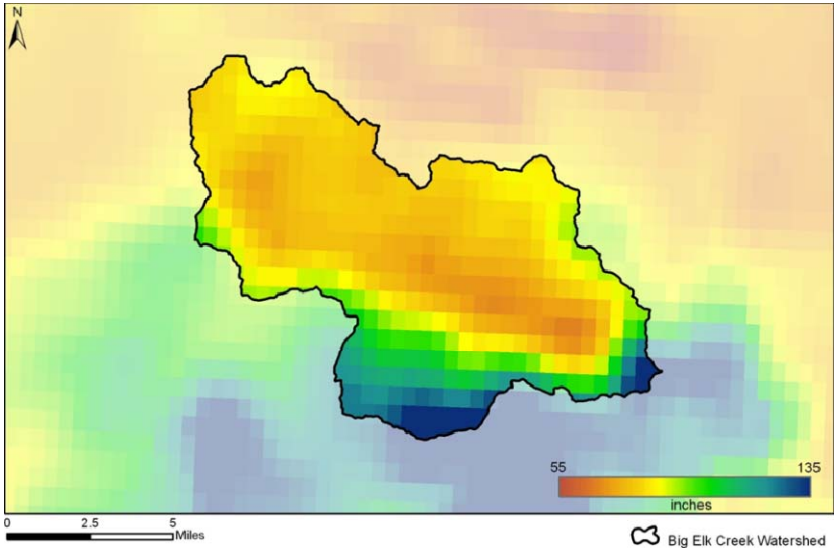
- Compiling reports
- Additional source characterization
- Additional monitoring

Watershed Modeling: Big Elk Creek

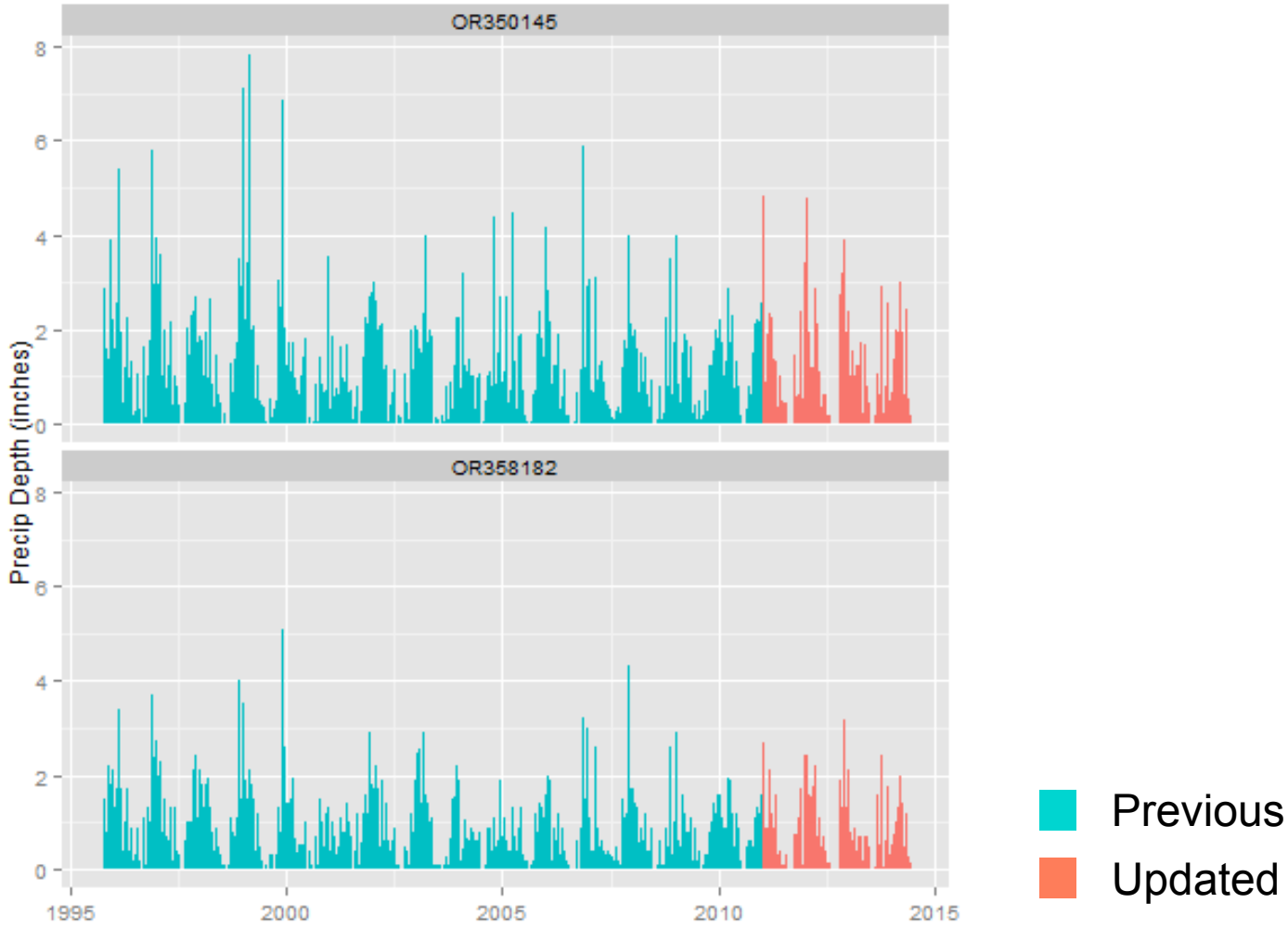
- Extended the simulation period
  - Updated simulation period 1995-10-01 to 2014-05-31
  - Previous simulation period 1995-10-01 to 2010-12-31
- Model calibration re-done
- Model parameter uncertainty analysis re-done
- Contractor reviewing overall model
  - Funded form USEPA
  - Methods for review developed
  - Completion Nov 2015

Watershed Modeling: Big Elk Creek

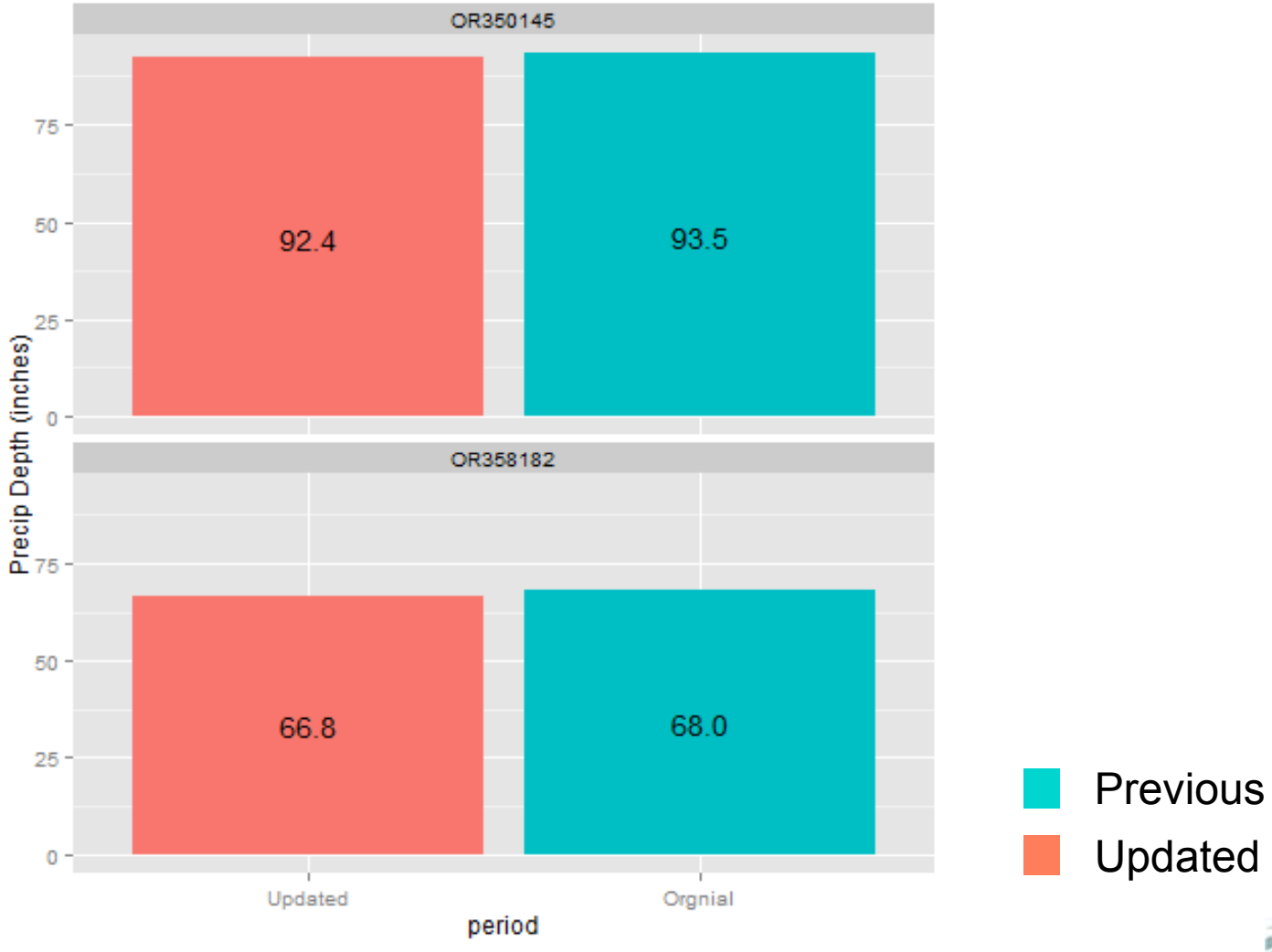




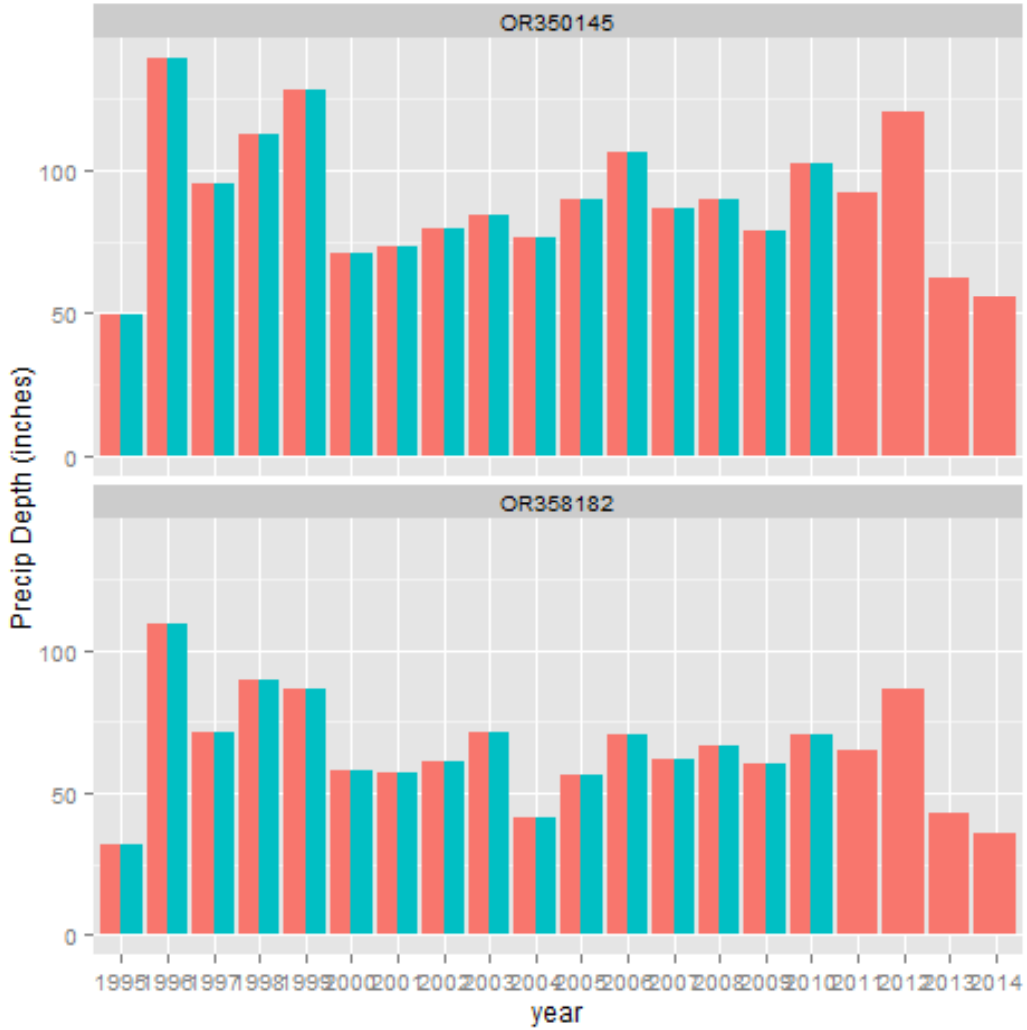
Big Elk Creek: Extended the simulation period
Daily Total Precip



Big Elk Creek: Extended the simulation period
Average Annual Precip



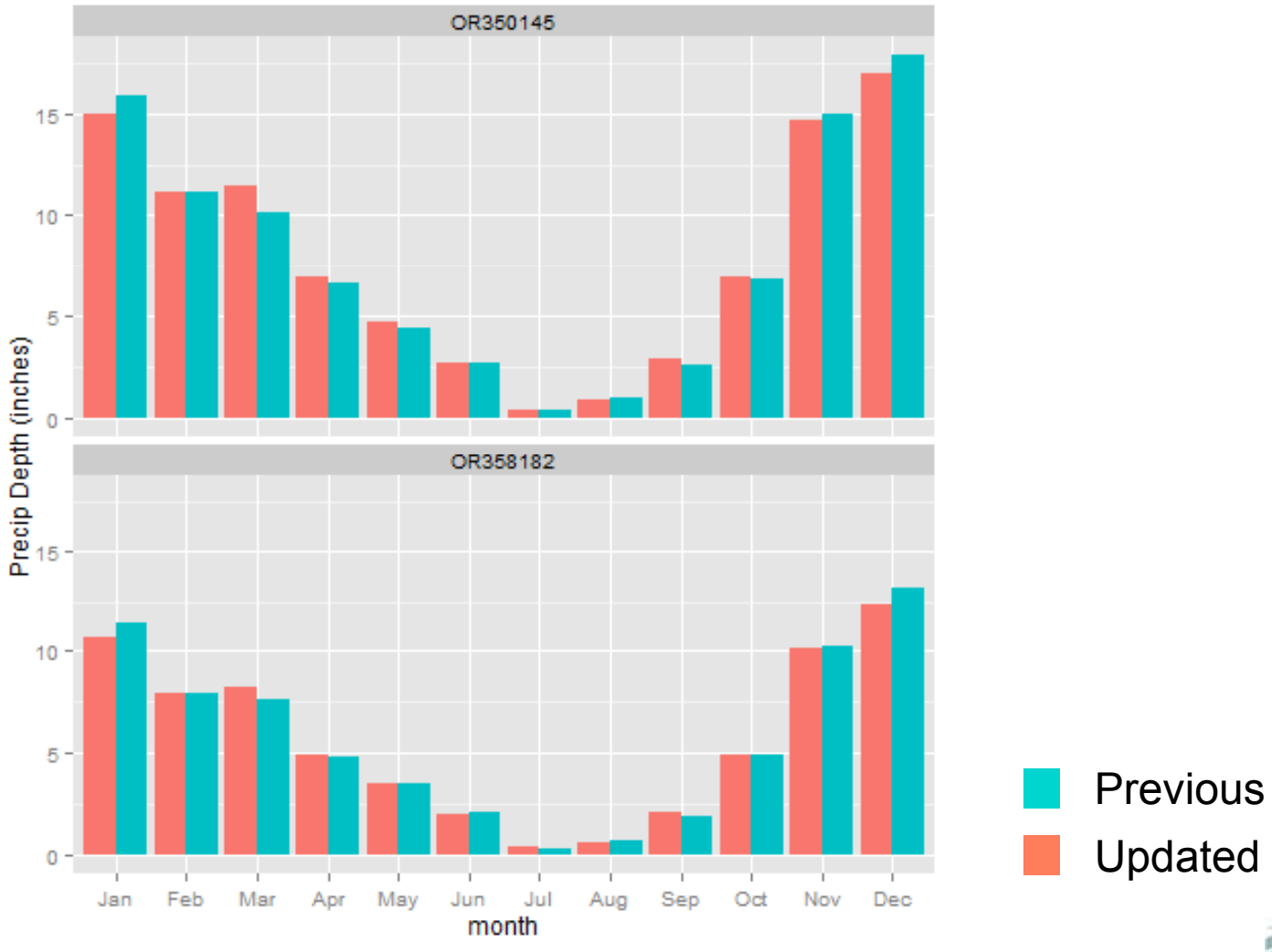
Big Elk Creek: Extended the simulation period
Annual Total Precip



Previous

Updated

Big Elk Creek: Extended the simulation period
Monthly Average Precip



Model Calibration

- Calibrated 24 parameters
- Varied by land use
  (forest, pasture or residential-transportation
- Varied by soil permeability
  (high and low permeable areas related to elevation)
- Calibrated parameters related to:
  - Soil, infiltration along with surface and sub-surface storage
  - Sub-surface flow, interflow and groundwater flow
  - Plants, ET and interception

Parameter Names and Descriptions

Parameter Name	Parameter Description
LZSN	Lower zone nominal soil moisture storage
INFILT	Index to mean soil infiltration rate
AGWRC	Groundwater recession rate
DEEPFR	Fraction of infiltrating water lost to deep aquifers
BASETP	ET by riparian vegetation as active groundwater enters streambed
AGWET	Fraction of watershed subject to direct evaporation from groundwater storage
UZSN	Nominal upper zone soil moisture storage
INTFW	Interflow coefficient
IRC	Interflow recession coefficient
CEPSC	Maximum precipitation interception
LZETP	Index to lower zone evapotranspiration

Calibration Performance Measures Definitions

- Log-transformed daily mean flows (q_{log})
- Total flow volumes (Q_{Total})
- Summer (June - August) flow volumes (Q_{smr})
- Winter (December - March) flow volumes (Q_{wtr})
- Storm volumes and peak flows for selected storm periods ($Q_{stm\text{-}i}$ and $q_{peak\text{-}i}$ for the i-th storm)
- Flow duration statistics (exceedance times for $q_{5\%}$, $q_{10\%}$, $q_{25\%}$, $q_{50\%}$ and $q_{95\%}$ flows)
- Baseflow index (the ratio of groundwater outflow to total outflow from pervious land segments, b-index)

Watershed Modeling: Big Elk Creek

Period	Start	End	Years	Storms
Original	1995-10-01	2010-12-31	15	18
Updated	1995-10-01	2014-05-31	19	23

Calibration Performance Measures: Original Period

Flow Statistic	Observed	Modeled	Percent Error
Q_{Total} (in/yr)	53.12	52.87	-0.5%
Q_{smr} (in/yr)	2.11	2.09	-0.8%
Q_{wtr} (in/yr)	28.31	27.15	-4.1%
Q_{stm} (in/yr)	4.39	3.89	-11.4%
q_{mean} (cfs)	2,350	2,176	-7.4%
Baseflow Index	0.44	0.41	-6.0%

Calibration Performance Measures: Updated Period

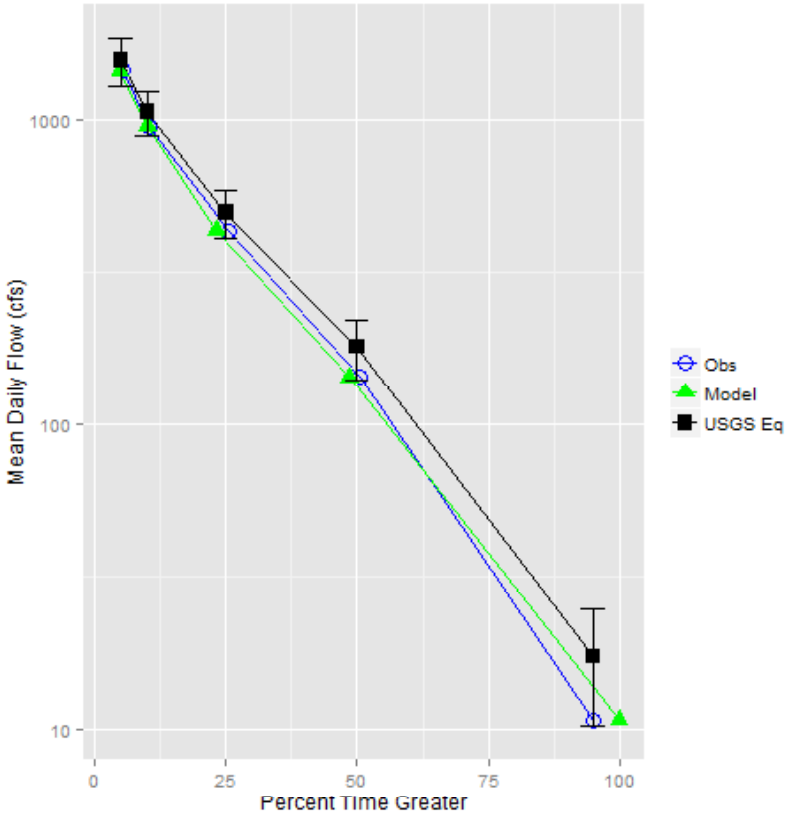
Flow Statistic	Observed	Modeled	Percent Error
Q_{Total} (acre-ft)	52.44	51.51	-1.8%
Q_{smr} (acre-ft)	2.08	2.05	-1.1%
Q_{wtr} (acre-ft)	29.76	28.25	-5.1%
Q_{stm} (acre-ft)	3.70	3.29	-11.0%
q_{mean} (cfs)	1,872	1,786	-4.6
Baseflow Index	0.44	0.435	-1.0%

Calibration Performance Measures: Updated Period

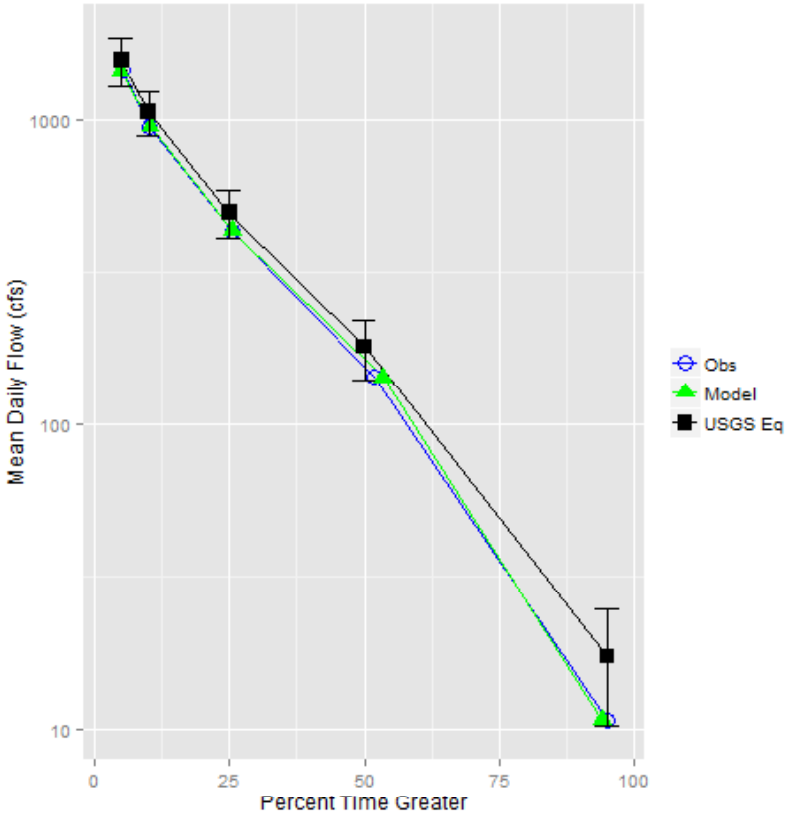
Flow Statistic	Original	Updated
Q_{Total} (acre-ft)	-0.5%	-1.8%
Q_{smr} (acre-ft)	-0.8%	-1.1%
Q_{wtr} (acre-ft)	-4.1%	-5.1%
Q_{stm} (acre-ft)	-11.4%	-11.0%
q_{mean} (cfs)	-7.4%	-4.6
Baseflow Index	-6.0%	-1.0%

Flow Duration Curves

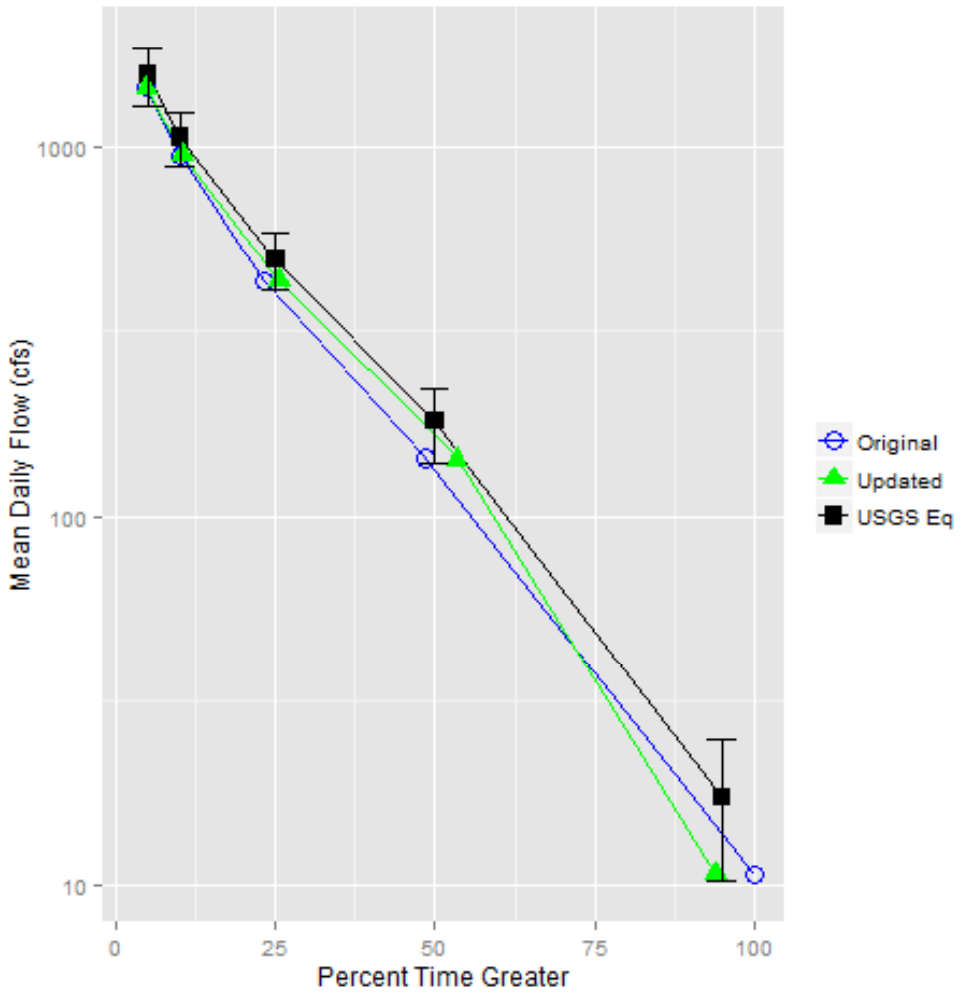
Original Period



Updated Period



Flow Duration Curves

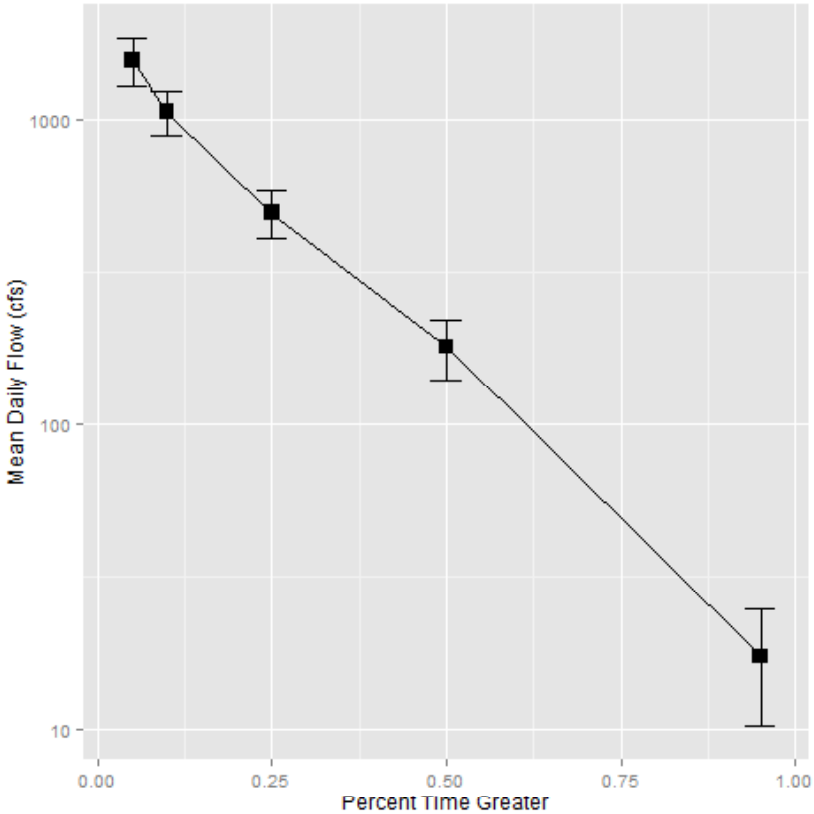


Uncertainty Analysis Re-Do

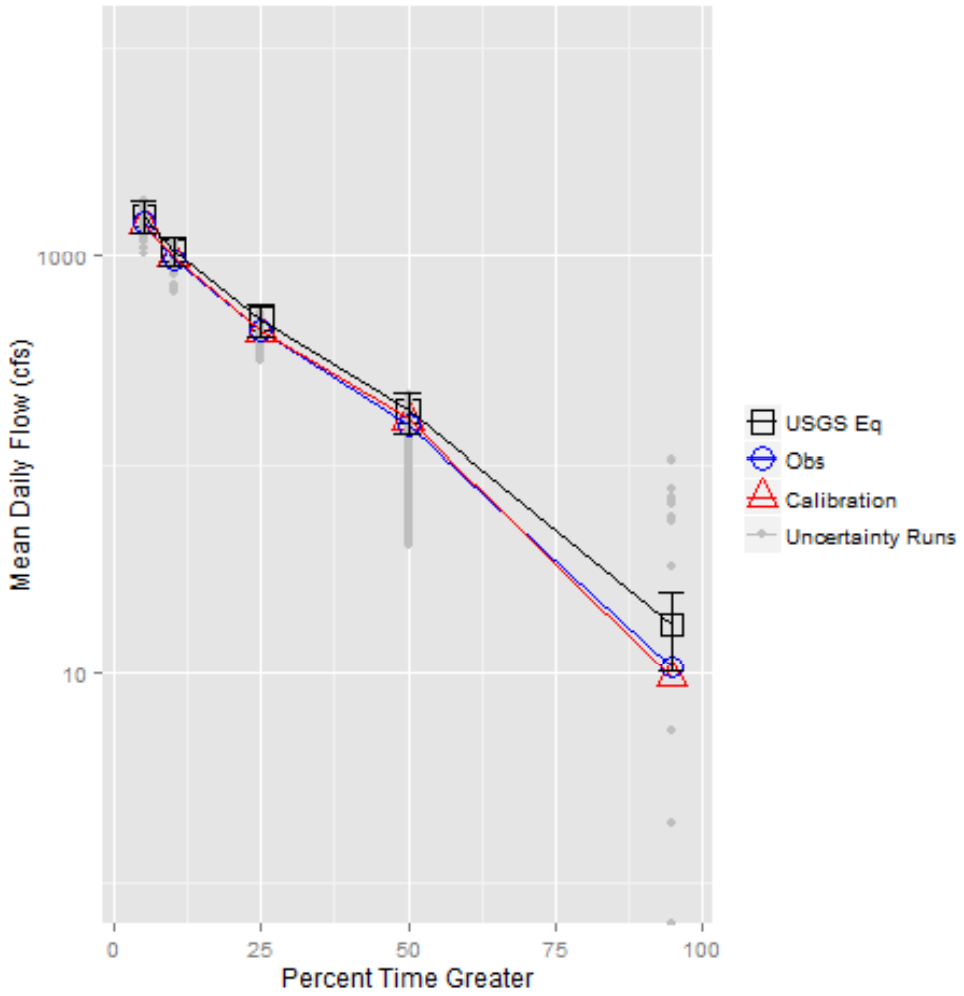
- Original
  - Generate random parameter values without considering parameter covariance
  - Run model for each parameter set
  - sub-set based on USGS FDC
- Updated
  - use Covariance Matrix to generate random parameter values
  - Constrain random parameters by calibration
  - sub-set based on USGS FDC

Uncertainty Analysis

- Used criteria that FDC within error bar bounds of USGS eq
- Allowed 2 iterations
- Set Φ_{limit} to within 1% of calibration Φ



Flow Duration Curves



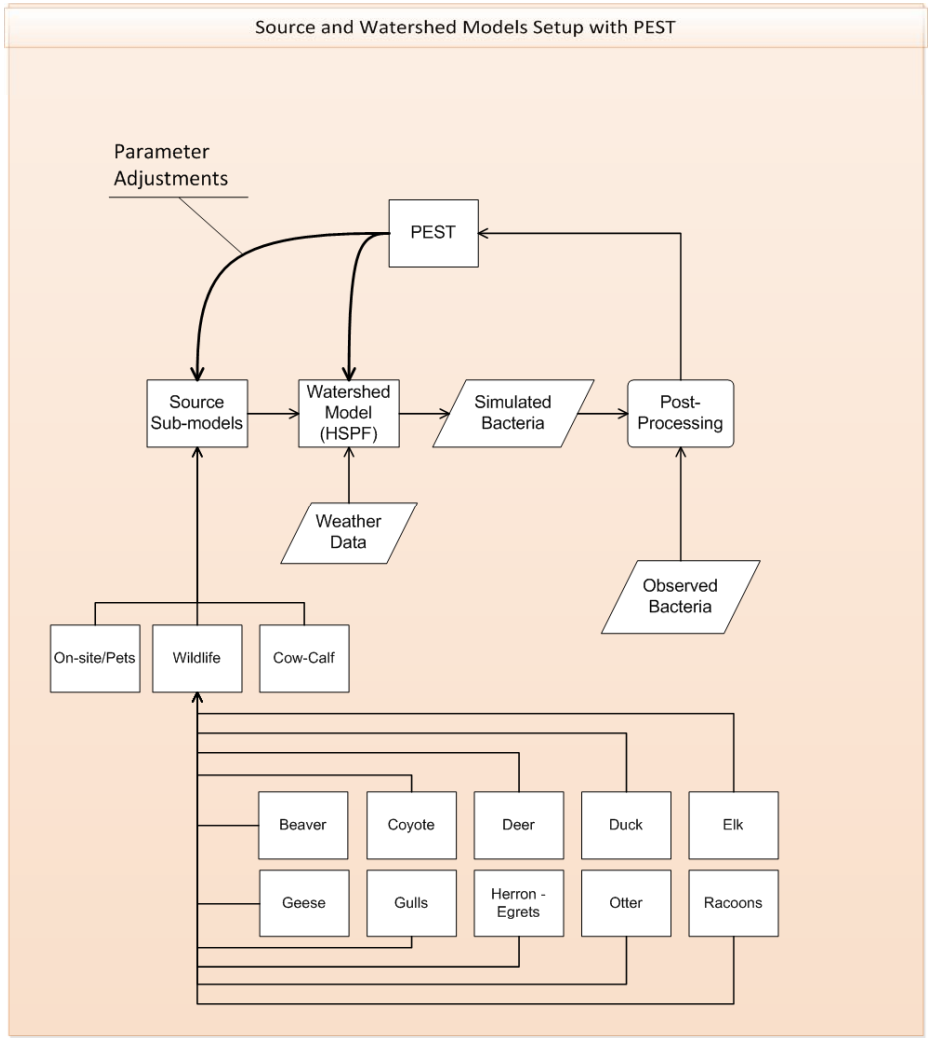
Select Uncertainty Analysis Runs

- None of the runs within UGS Eq error bars
- Vary number of points within error bars
  - 5 out of 5 points = no runs out of 1,000
  - 4 out of 5 points = 47 runs out of 1,000
  - 3 out of 5 points = 636 runs out of 1,000
  - 2 out of 5 points = 984 runs out of 1,000
  - 1 out of 5 points = 995 runs out of 1,000
- None of the runs with value within error bar for lowest flow
- Redo with tighter range and more calibration constraints

Additional calibration????

- Do additional hydrologic calibration?
- Include hydrologic calibration in water quality calibration?
- Use current hydrologic calibration and move on to water quality calibration

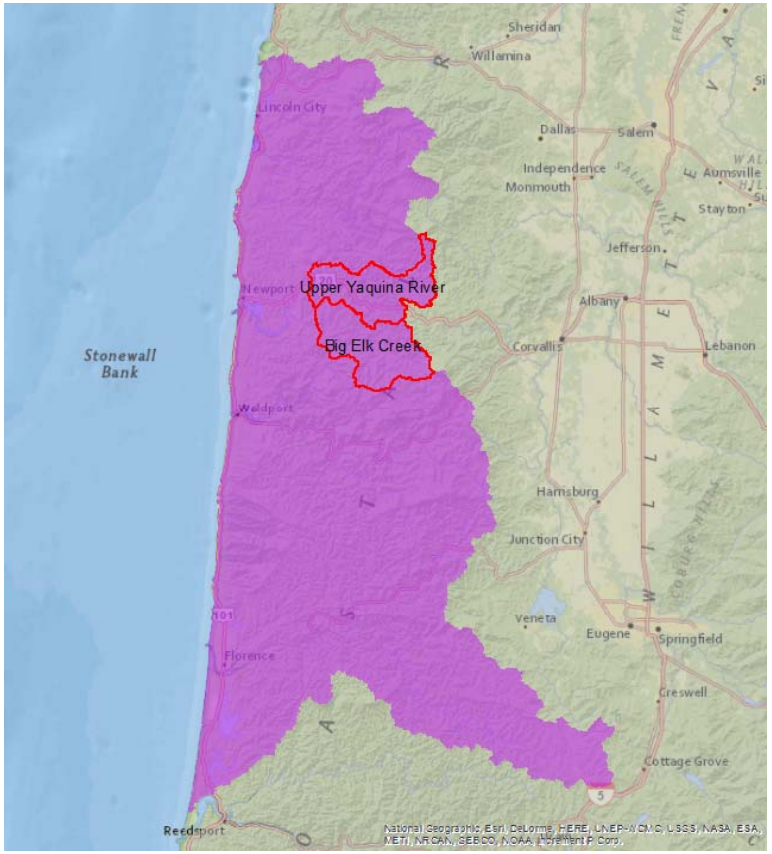
Watershed Modeling: Big Elk Creek



Watershed Modeling: Big Elk Creek (continued)

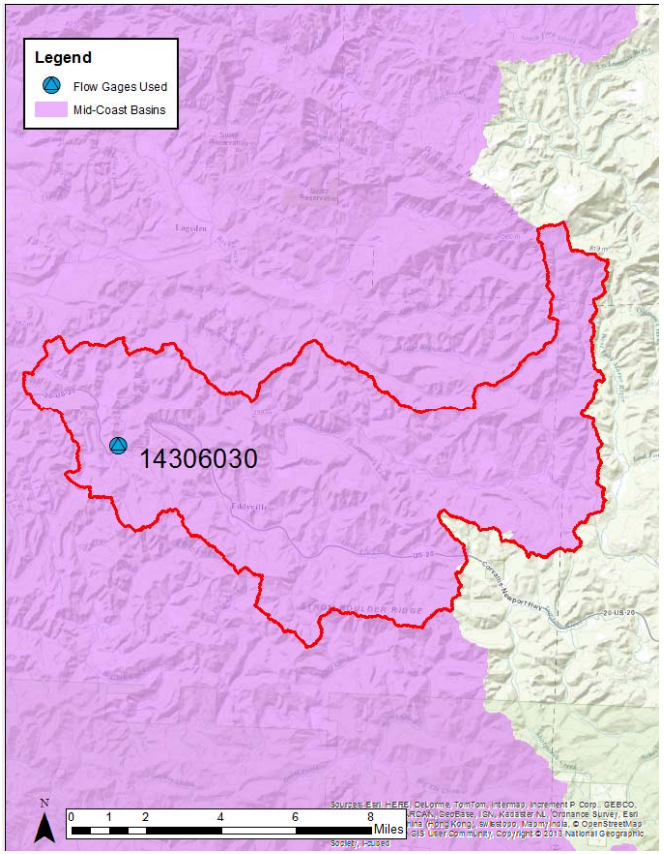
- Current ODEQ work
  - Conduct hydrologic parameter estimation/uncertainty analysis for new simulation period
  - Setup bacteria model for new simulation period
  - Continue to incorporate TWG feedback into bacteria sub-model input
- Compile report

Additional Watershed Modeling: Upper Yaquina River



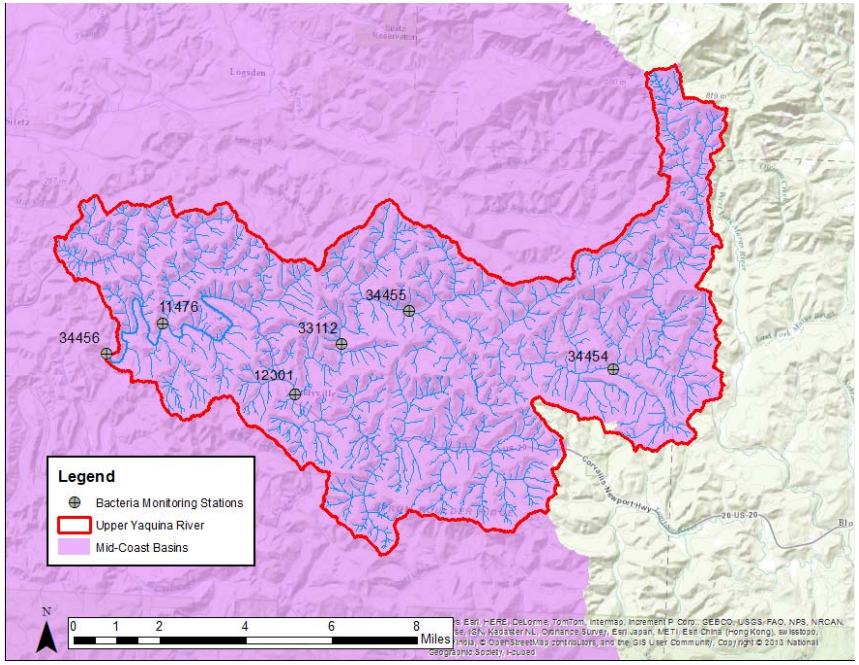
- Develop watershed model like Big Elk Creek
- Support implementation
- Begin model development for Yaquina River
- Contractor began work June-2015

Additional Watershed Modeling: Upper Yaquina River



- Utilize information from Big Elk Creek modeling
  - WDM file
  - Hydro parameters
  - Bacteria input
  - …

Watershed Modeling: Upper Yaquina River

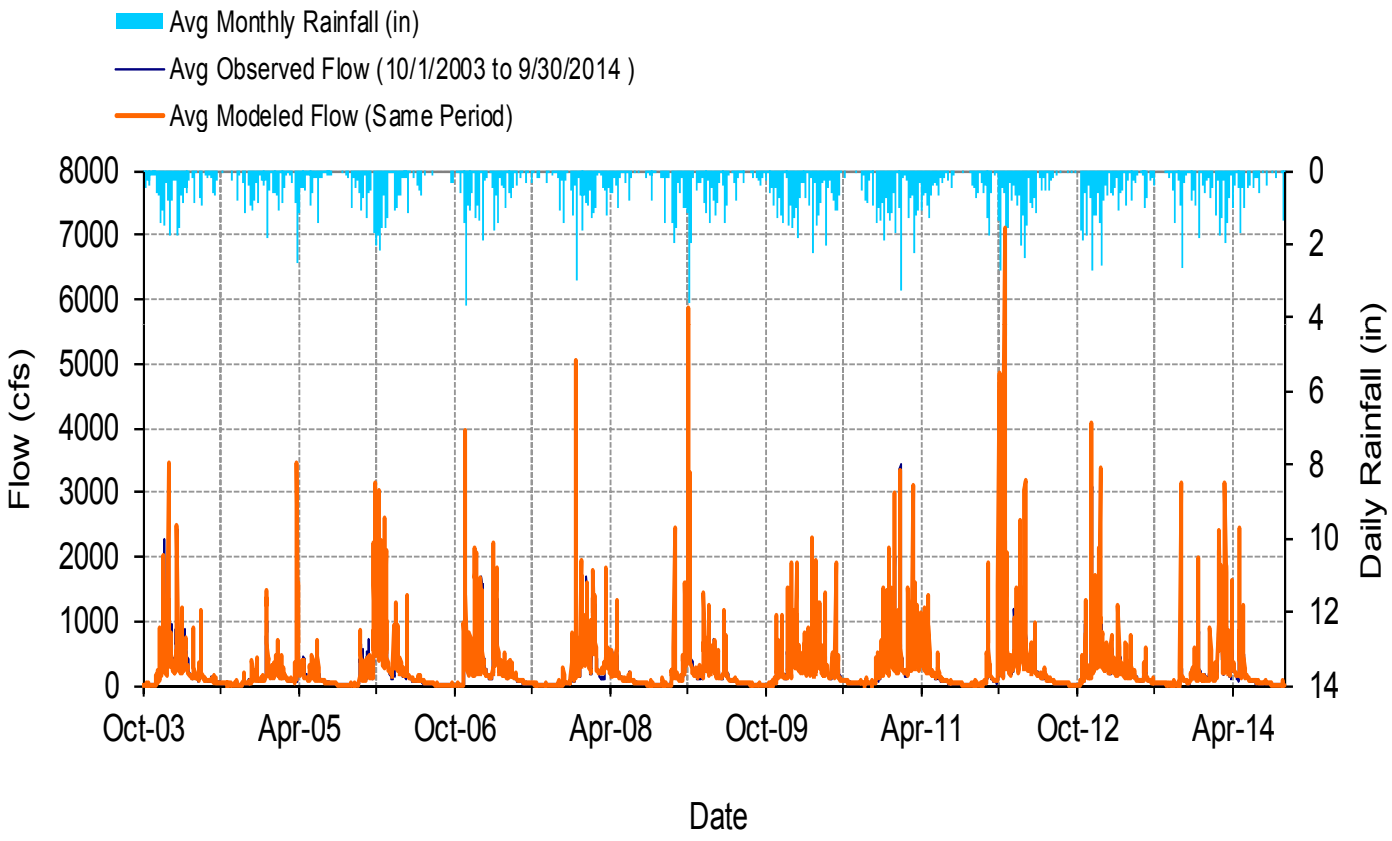


- Utilize information from Big Elk Creek modeling
  - WDM file
  - Hydro parameters
  - Bacteria input
  - Model review
  - …
- Completion estimated toward end of 2016

Additional Watershed Modeling: Upper Yaquina River

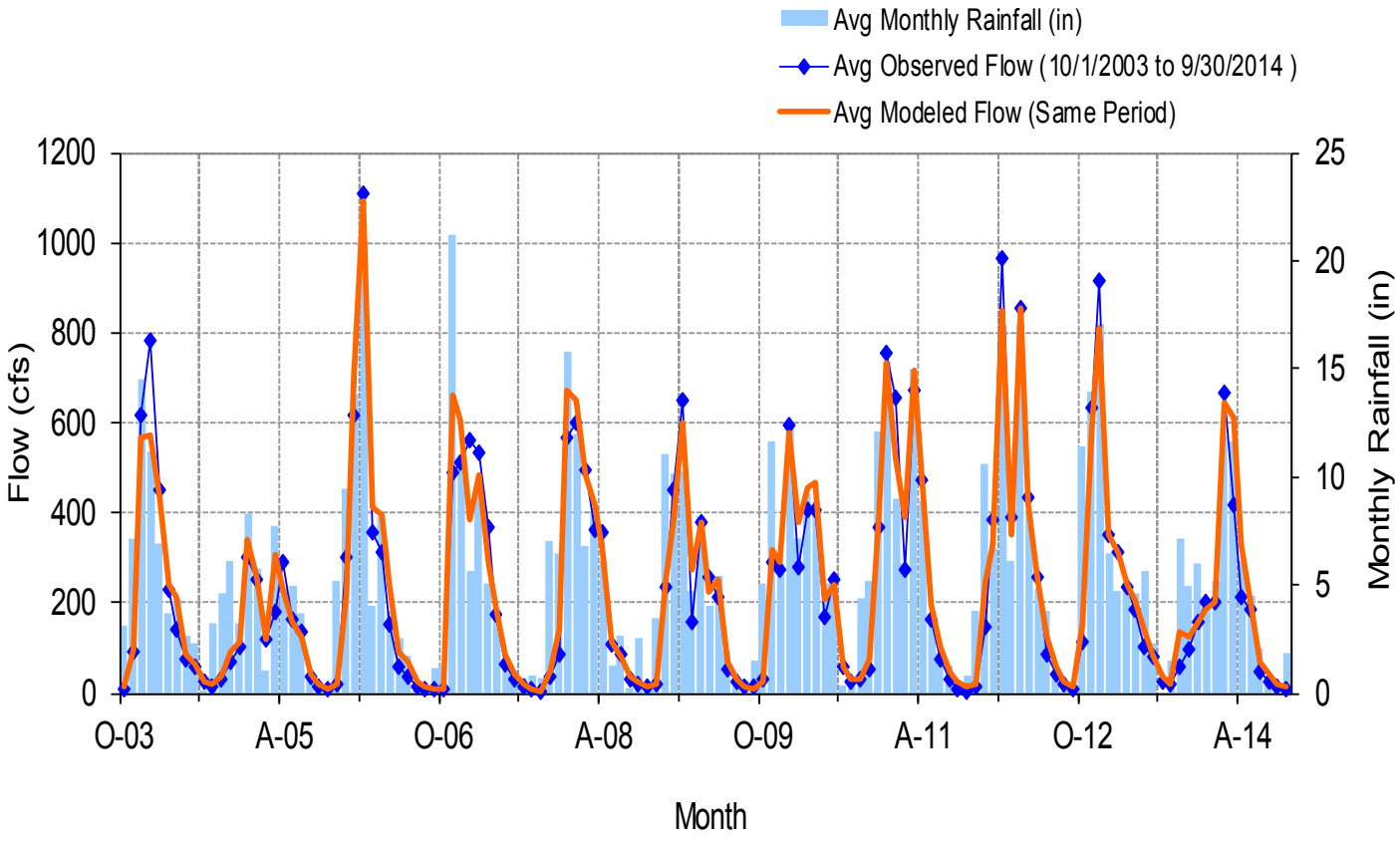
- Use for implementation and possibly for DO TMDL
- Hydrologic calibration – used Big Elk parameter values without modification
- Pause on bacteria modeling

Mean Daily Flow



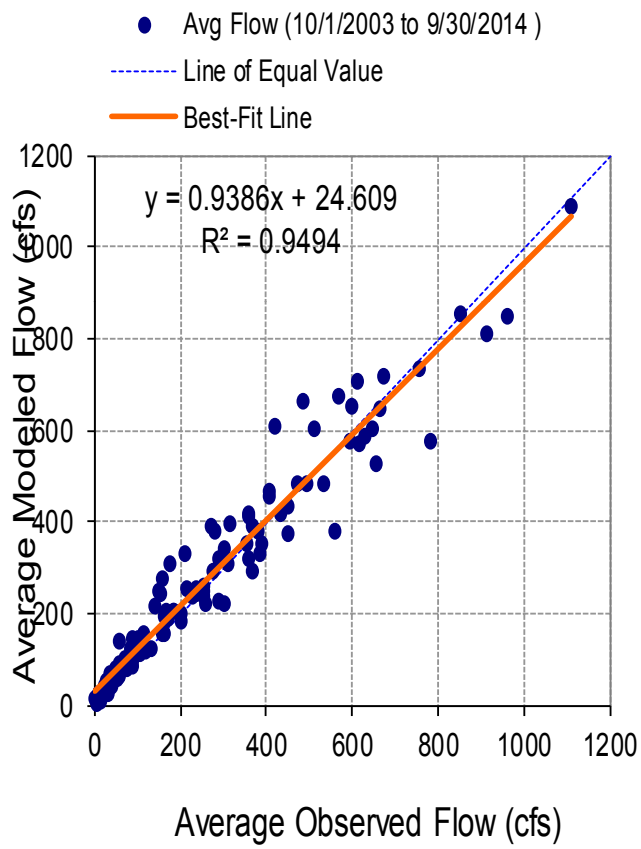
Model DSN 262 vs. S 14306030 Yaquina River Near Chitwood, Oregon

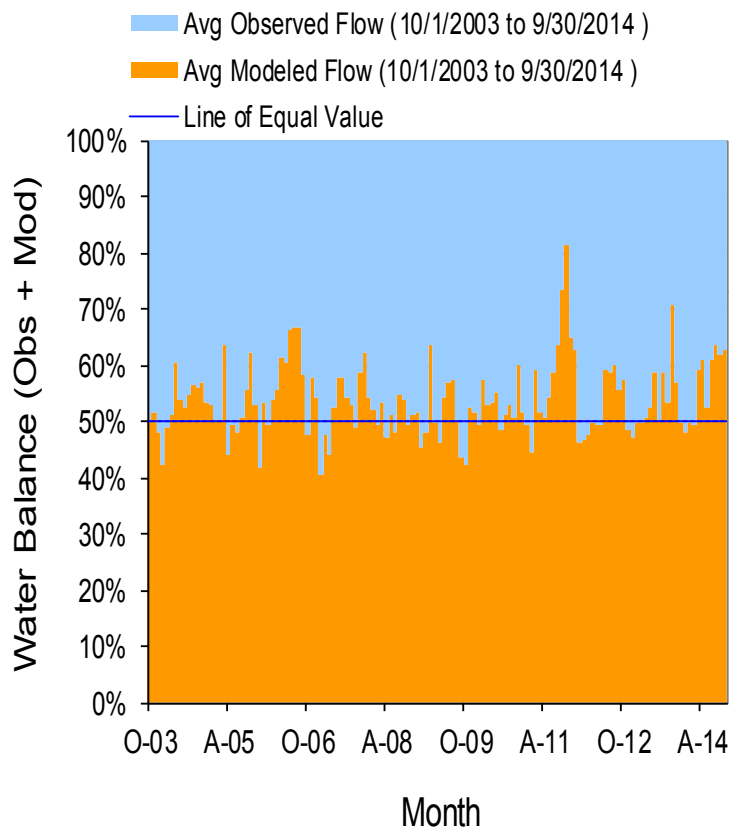
Mean Monthly Flow



Model DSN 262 vs. S 14306030 Yaquina River Near Chitwood, Oregon

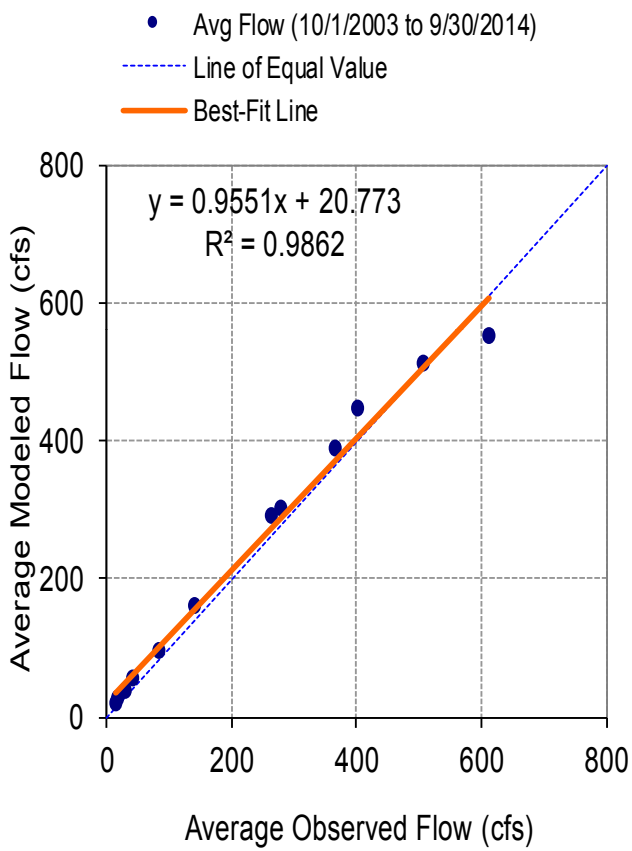
Monthly Regression and Temporal Variation

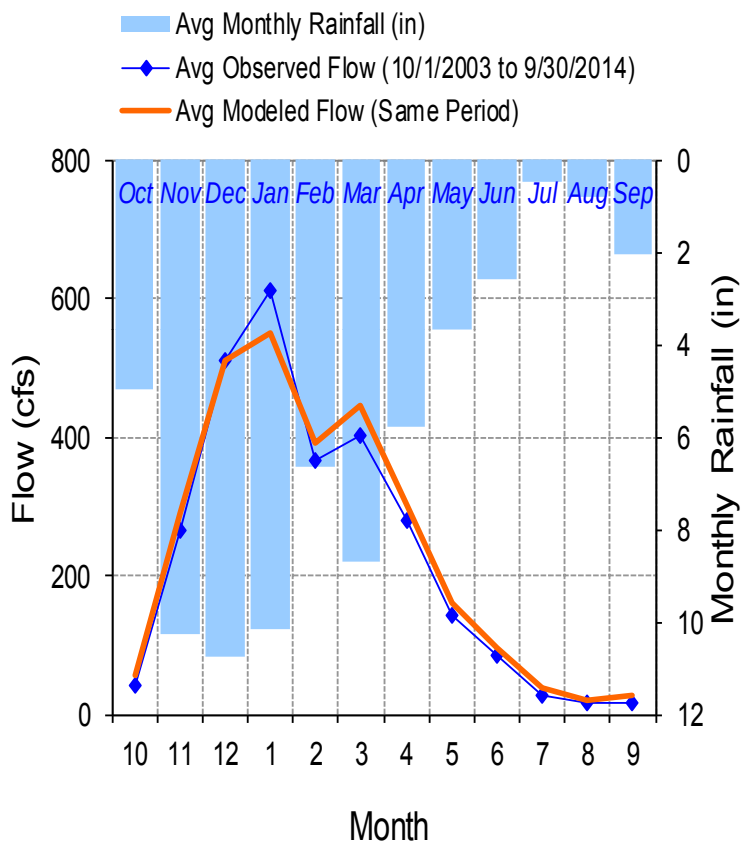




Model DSN 262 vs. S 14306030 Yaquina River Near Chitwood, Oregon

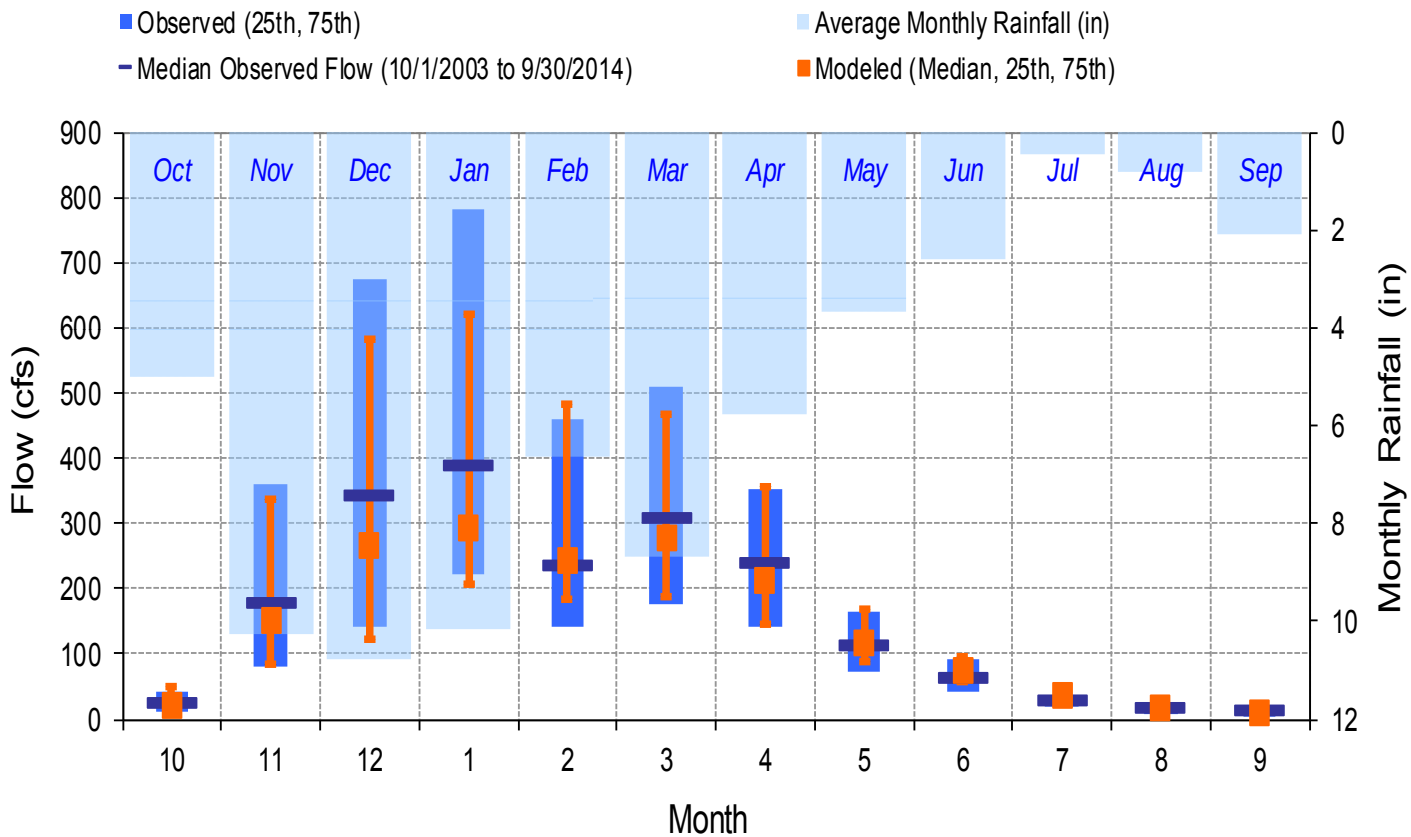
Seasonal Regression and Temporal Aggregate





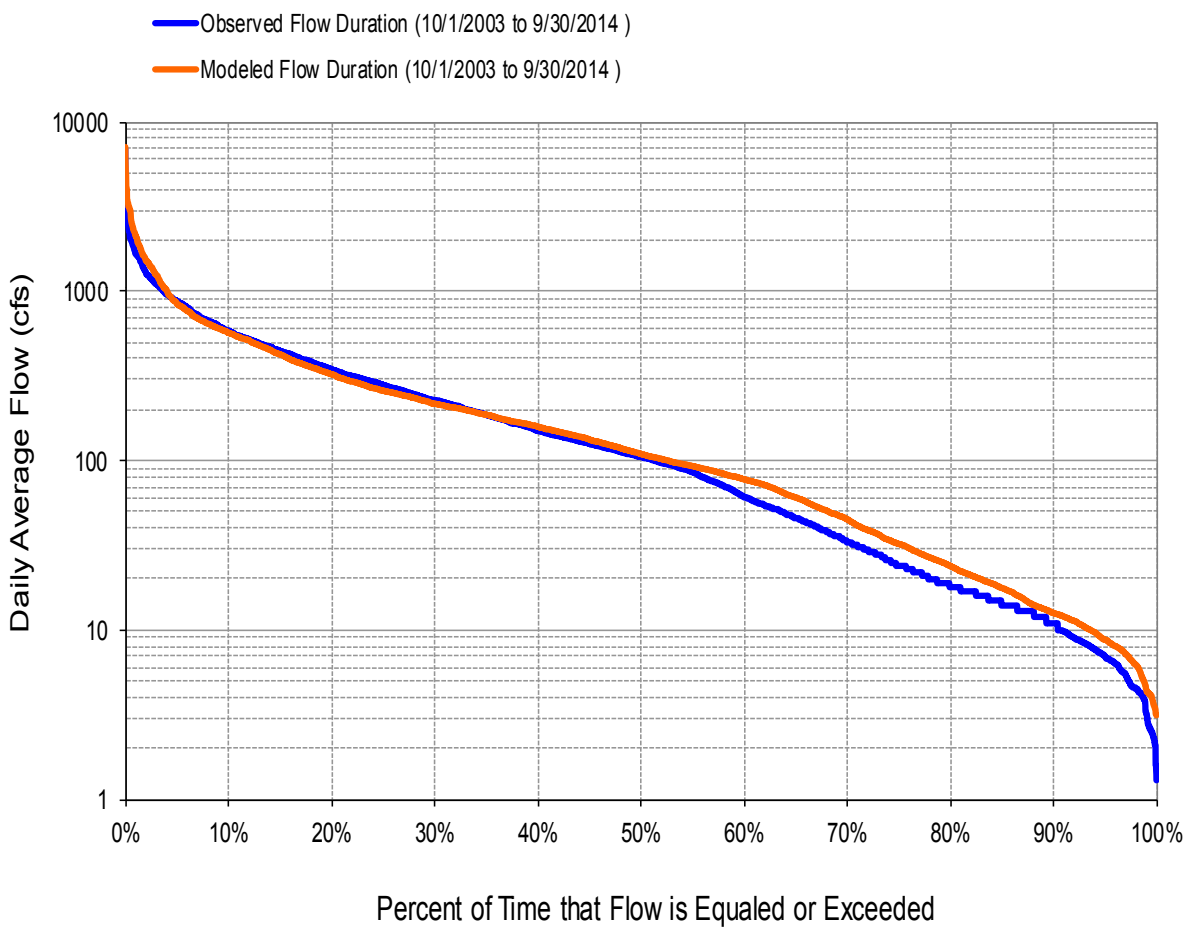
Model DSN 262 vs. S 14306030 Yaquina River Near Chitwood, Oregon

Seasonal Medians and Ranges

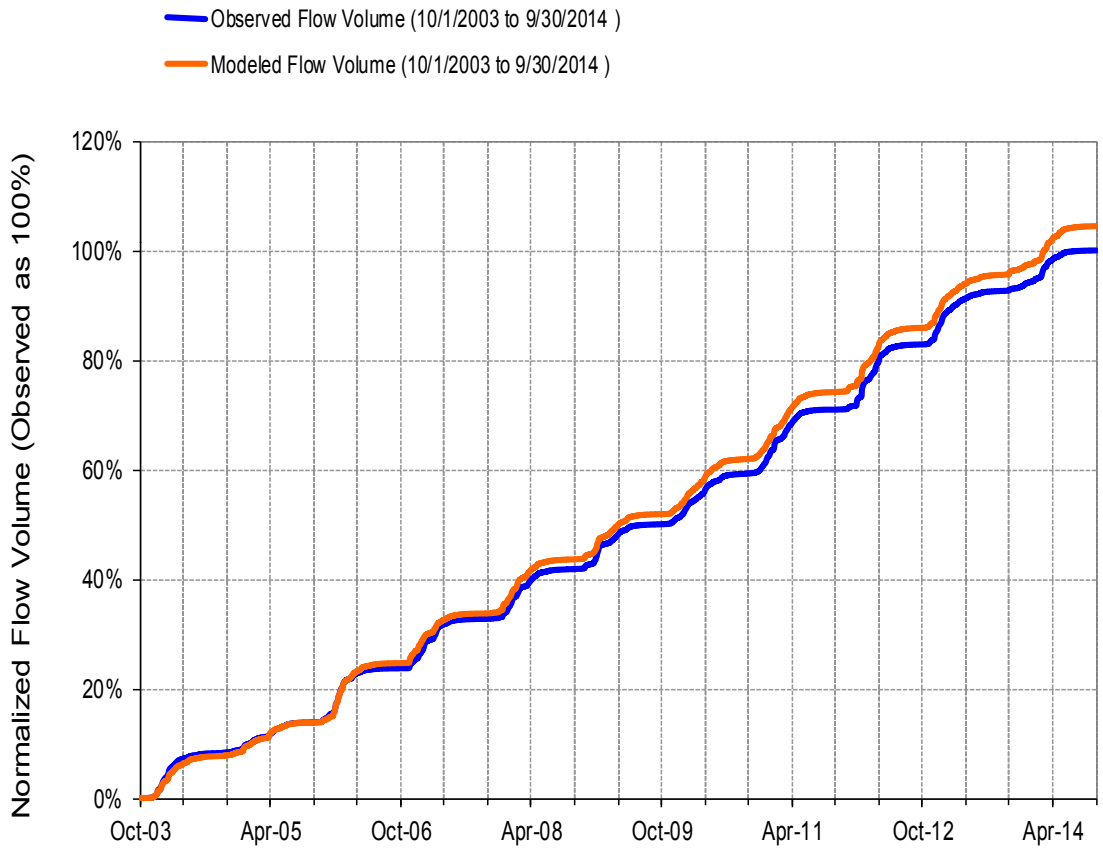


Model DSN 262 vs. S 14306030 Yaquina River Near Chitwood, Oregon

Flow Duration Curves



Normalized Cumulative Flow



HSPF Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM DSN 262		S 14306030 Yaquina River near Chitwood, Oregon	
11-Year Analysis Period: 10/1/2003 - 9/30/2014 Flow volumes are (inches/year) for upstream drainage area		Manually Entered Data Drainage Area (sq-mi): 71	
Total Simulated In-stream Flow:	**45.92**	Total Observed In-stream Flow:	**43.95**
Total of simulated highest 10% flows:	**22.53**	Total of Observed highest 10% flows:	**20.43**
Total of Simulated lowest 50% flows:	**4.07**	Total of Observed Lowest 50% flows:	**3.41**
Simulated Summer Flow Volume (months 7-9):	**1.36**	Observed Summer Flow Volume (7-9):	**0.96**
Simulated Fall Flow Volume (months 10-12):	**13.74**	Observed Fall Flow Volume (10-12):	**13.09**
Simulated Winter Flow Volume (months 1-3):	**21.95**	Observed Winter Flow Volume (1-3):	**21.89**
Simulated Spring Flow Volume (months 4-6):	**8.88**	Observed Spring Flow Volume (4-6):	**8.02**
Total Simulated Storm Volume:	**20.69**	Total Observed Storm Volume:	**14.11**
Simulated Summer Storm Volume (7-9):	**0.30**	Observed Summer Storm Volume (7-9):	**0.15**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	
Error in total volume:	4.48	10	
Error in 50% lowest flows:	**19.36**	**10**	
Error in 10% highest flows:	10.27	15	
Seasonal volume error - Summer:	**41.02**	**30**	
Seasonal volume error - Fall:	4.96	30	
Seasonal volume error - Winter:	0.27	30	
Seasonal volume error - Spring:	10.78	30	
Error in storm volumes:	**46.55**	**20**	
Error in summer storm volumes:	**105.65**	**50**	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.643	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.611		
Monthly NSE	0.933		

>> Clear

Calibration Performance Measures

Flow Statistic	Observed	Modeled	Percent Error
Q_{Total} (in)	44.0	45.92	4.8%
Q_{smr} (in)	1.0	1.36	41.0%
Q_{wtr} (in)	21.9	22.0	0.27%
Q_{stm} (in)	14.1	20.69	46.6%

Next Steps

- Big Elk Creek
  - Finish uncertainty analysis for hydrology simulation
  - Conduct bacteria modeling
  - Continue compiling report
- Upper Yaquina River on hold
- Compile LDC and Beach reports

Discussion