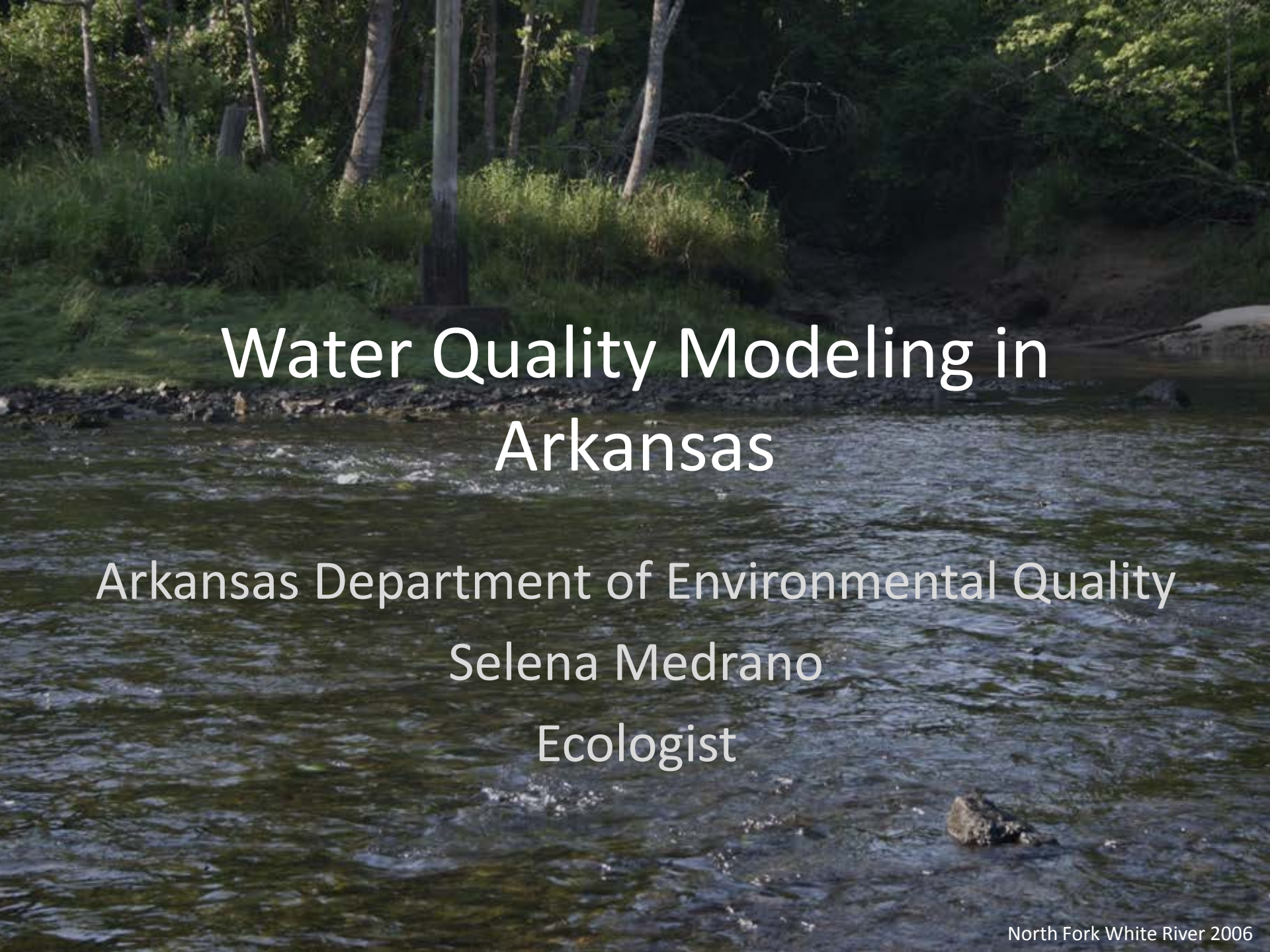

Water Quality Modeling in Arkansas

Arkansas Department of Environmental Quality
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Ecologist

North Fork White River 2006

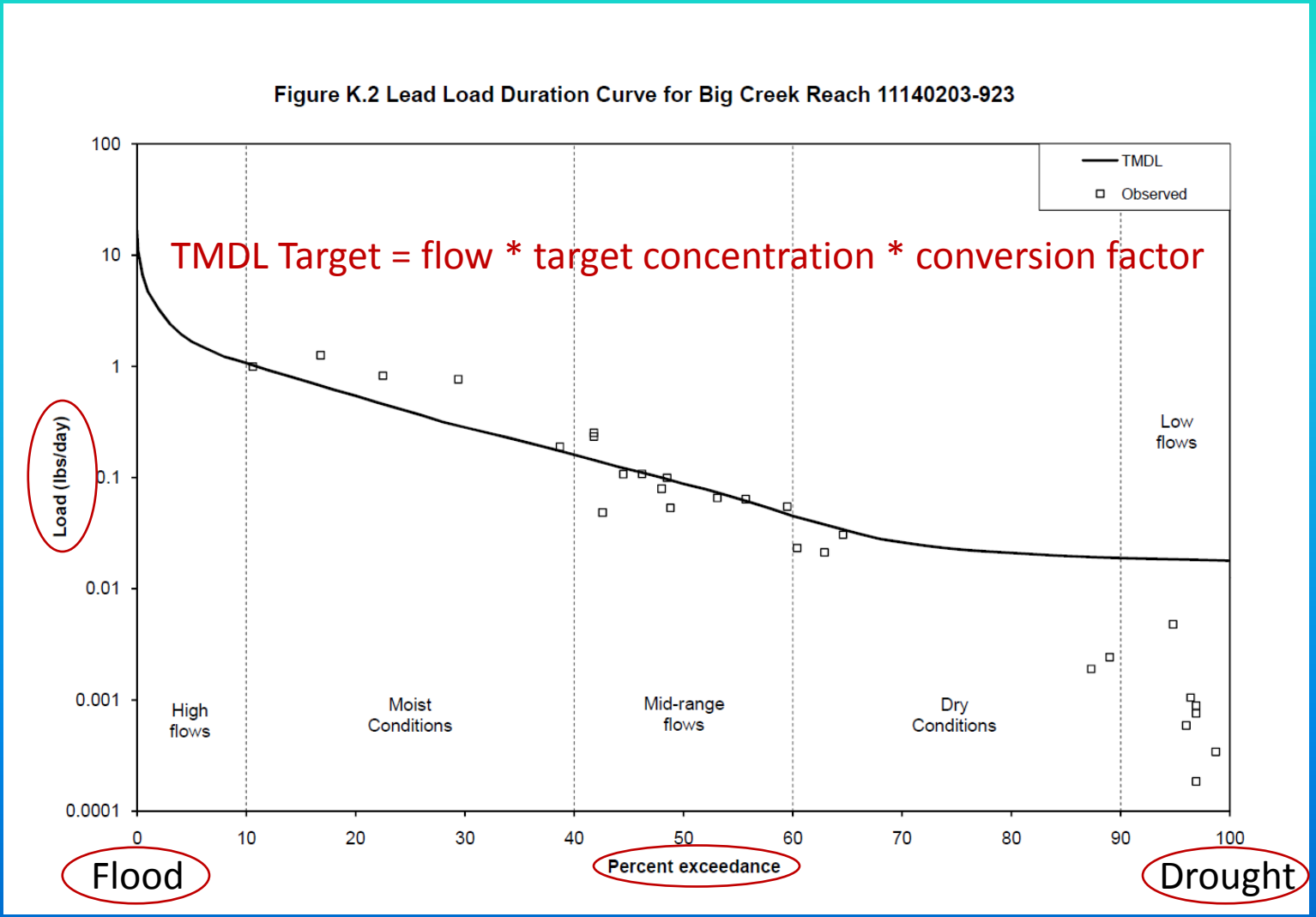
Topics

- Load Duration Curves
  - Why
  - How
  - Usefulness
- LA-QUAL for Dissolved Oxygen
  - Why
  - How
  - Usefulness

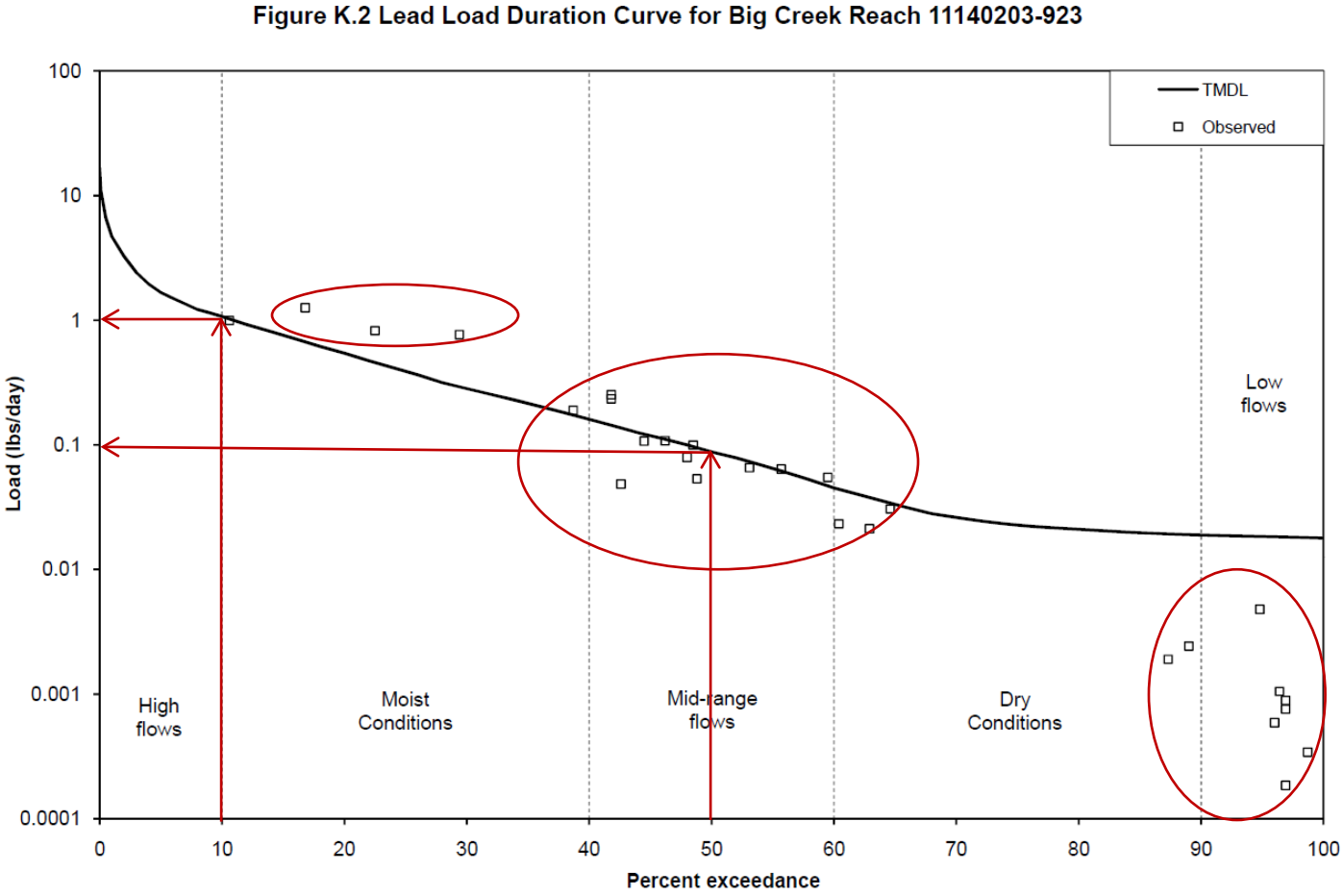
Load Duration Curves – Why?

- Straightforward
- Visual
- Target BMPs
- Long-term flow data

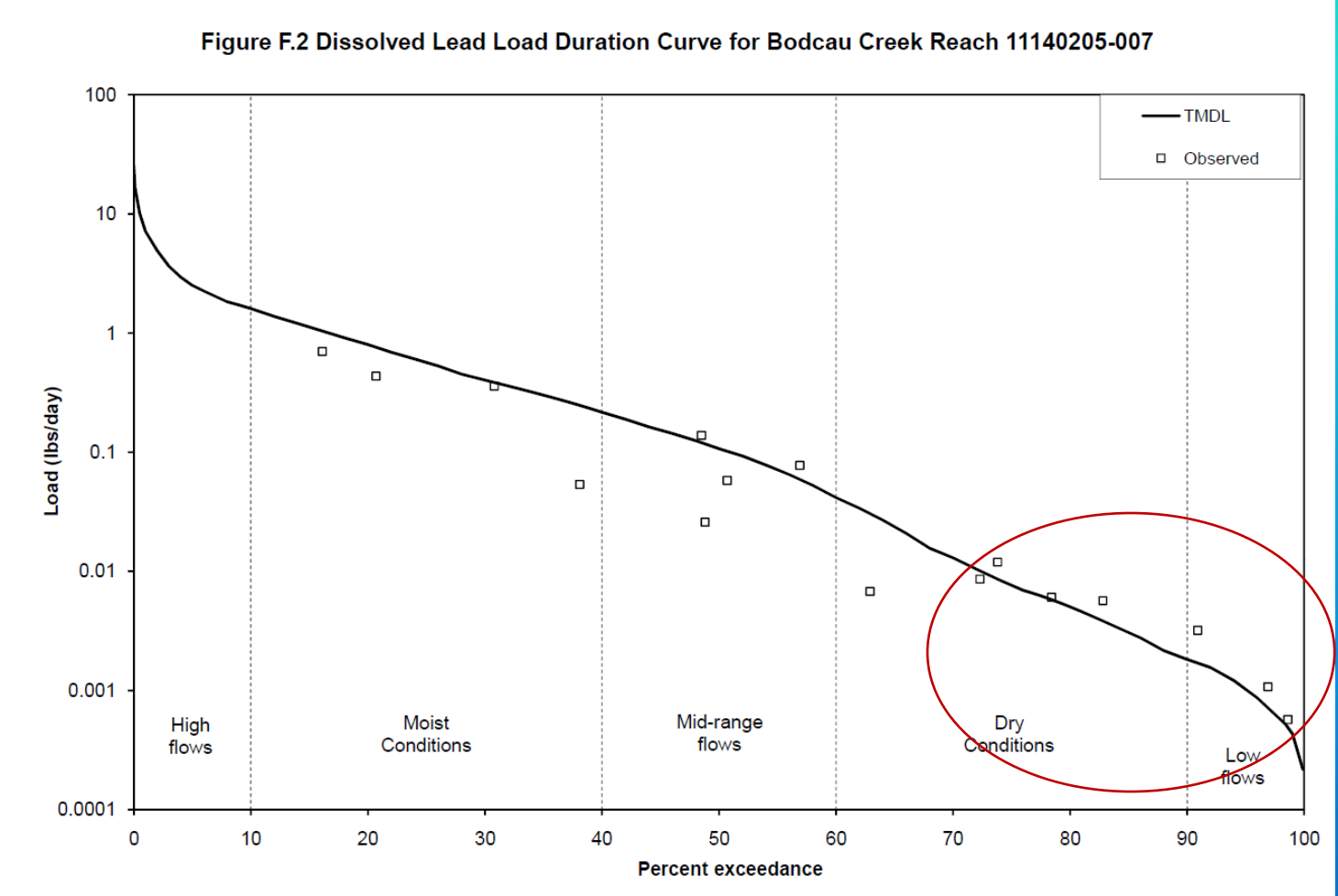
Load Duration Curves – How?



Load Duration Curves – Usefulness



Load Duration Curves – Usefulness



LA-QUAL for Dissolved Oxygen – Why?

- Includes relevant physical, chemical, and biological processes (hydraulics, ammonia nitrogen, CBOD, & temperature)
- Allows user specification of NPS loads as mass rather than flow + concentration

LA-QUAL for Dissolved Oxygen – How?

LA-QUAL Model for Beech Creek upstream of Lake Columbia
Winter projection to meet 5.0 mg/L DO at temp of 22 C

INPUT/OUTPUT LOADING SUMMARY

	FLOW m^3/s	DO kg/d	BOD1 kg/d	BOD2 kg/d	ORG-N kg/d	NH3-N kg/d	NO3-N kg/d	ORG-P kg/d	PO4-P kg/d	CHL A	PERIP	NCM
HEADWATER FLOW	0.03200	13.88	0.00	10.11	0.00	0.43	0.00	0.00	0.00	0.00		0.00
INCREMENTAL INFLOW	0.06500	28.19	0.00	20.54	0.00	0.86	0.00	0.00	0.00	0.00		0.00
INCREMENTAL OUTFLOW	0.00000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
WASTELOADS	0.00000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
WITHDRAWLS	0.00000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
FLOW THRU LOWER BNDRY	-0.09700	-45.16	0.00	-26.84	0.00	-0.90	-1.21	0.00	0.00	0.00		0.00
DISPERSION THRU LOWER BNDRY		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
DISPERSION THRU HDWTR BNDRY		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
NON-POINT INPUT		0.00	0.00	31.80	0.00			0.00				0.00
NATURAL REAERATION		413.42										
DAM REAERATION		0.00										
SOD BACKGROUND		-369.48										
BOD1 DECAY		0.00	0.00									
BOD1 SETTLING		0.00	0.00									
ANAEROBIC BOD1 DECAY			0.00									
BOD2 DECAY		-35.61		-35.61								
BOD2 SETTLING		0.00		0.00								
ANAEROBIC BOD2 DECAY				0.00								
BOD2 HYDROLYSIS			0.00	0.00								
ORG-N DECAY		0.00			0.00	0.00						
ORG-N SETTLING					0.00	0.00						
NH3-N DECAY (NITRIFICATION)		-5.25				-1.21	1.21					
NH3-N BACKGROUND SEDIMENT SOURCE						0.81						
DENITRIFICATION			0.00				0.00					
ORG-P HYDROLYSIS								0.00	0.00			
ORG-P SETTLING								0.00	0.00			
PO4-P BACKGROUND SEDIMENT SOURCE									0.00			
PHYTOPLANKTON GROWTH/PHOTOSYNTHESIS		0.00				0.00	0.00		0.00	0.00		
PHYTOPLANKTON RESPIRATION/EXCRETION		0.00				0.00			0.00	0.00		
PHYTOPLANKTON SETTLING		0.00				0.00			0.00	0.00		
PHYTOPLANKTON DEATH			0.00	0.00	0.00			0.00		0.00		
PERIPHYTON GROWTH/PHOTOSYNTHESIS		0.00				0.00	0.00		0.00		0.00	
PERIPHYTON RESPIRATION/EXCRETION		0.00				0.00			0.00		0.00	
PERIPHYTON DEATH			0.00	0.00	0.00			0.00			0.00	
NCM DECAY		0.00										0.00
NCM SETTLING		0.00										0.00
TOTAL INPUTS	0.09700	455.48	0.00	62.45	0.00	2.10	1.21	0.00	0.00	0.00	0.00	0.00
TOTAL OUTPUTS	-0.09700	-455.51	0.00	-62.45	0.00	-2.11	-1.21	0.00	0.00	0.00	0.00	0.00
NET CONVERGENCE ERROR	0.00000	-0.02	0.00	0.00	0.00	-0.01	0.01	0.00	0.00	0.00	0.00	0.00

LA-QUAL for Dissolved Oxygen – Usefulness

WINTER TMDL CALCULATIONS FOR BEECH CREEK UPSTREAM OF LAKE COLUMBIA

stream length = 17.2 km
stream width = 6.43 m

	Flow rate in model (m3/sec)	Conc's in model		Constituent loads		Oxygen demand		Oxygen demand from benthic sources				Total oxygen demand (kg/day)
		CBOD (mg/L)	NH3-N (mg/L)	CBOD (kg/day)	NH3-N (kg/day)	CBOD (kg/day)	NH3-N (kg/day)	Rate of NH3 source in model (g/m2/day)	Rate of O2 demand at 20 C (g/m2/day)	Rate of O2 demand w/ temp. correction (g/m2/day)	Load of O2 demand for entire reach (kg/day)	
Headwater	0.032	3.657	0.154	10.11	0.426	10.11	1.84					11.95
Incremental inflow	0.065	3.657	0.154	20.54	0.865	20.54	3.74					24.28
NPS loads (Data Type 19)				31.80		31.8						31.8
Sediment oxygen demand									2.915	3.306	365.66	365.66
Benthic NH3 source								0.0064	0.02771	0.02771	3.06	3.06
											Total =	436.75

Pros and Cons

Load Duration Curves

- Pros
  - Long-term flow data
  - Visual representation
  - Targets BMPs
  - Load can be calculated anywhere along flow regime
- Cons
  - Considers only parameter of concern and no interactions

LA-QUAL

- Pros
  - Considers relevant physical, chemical, and biological processes
- Cons
  - Requires calibration
  - Occasionally, field data not available, must use published values
  - No visual representation

Questions

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