

Causes of Low Dissolved Oxygen in the Smithland Pool of the Ohio River



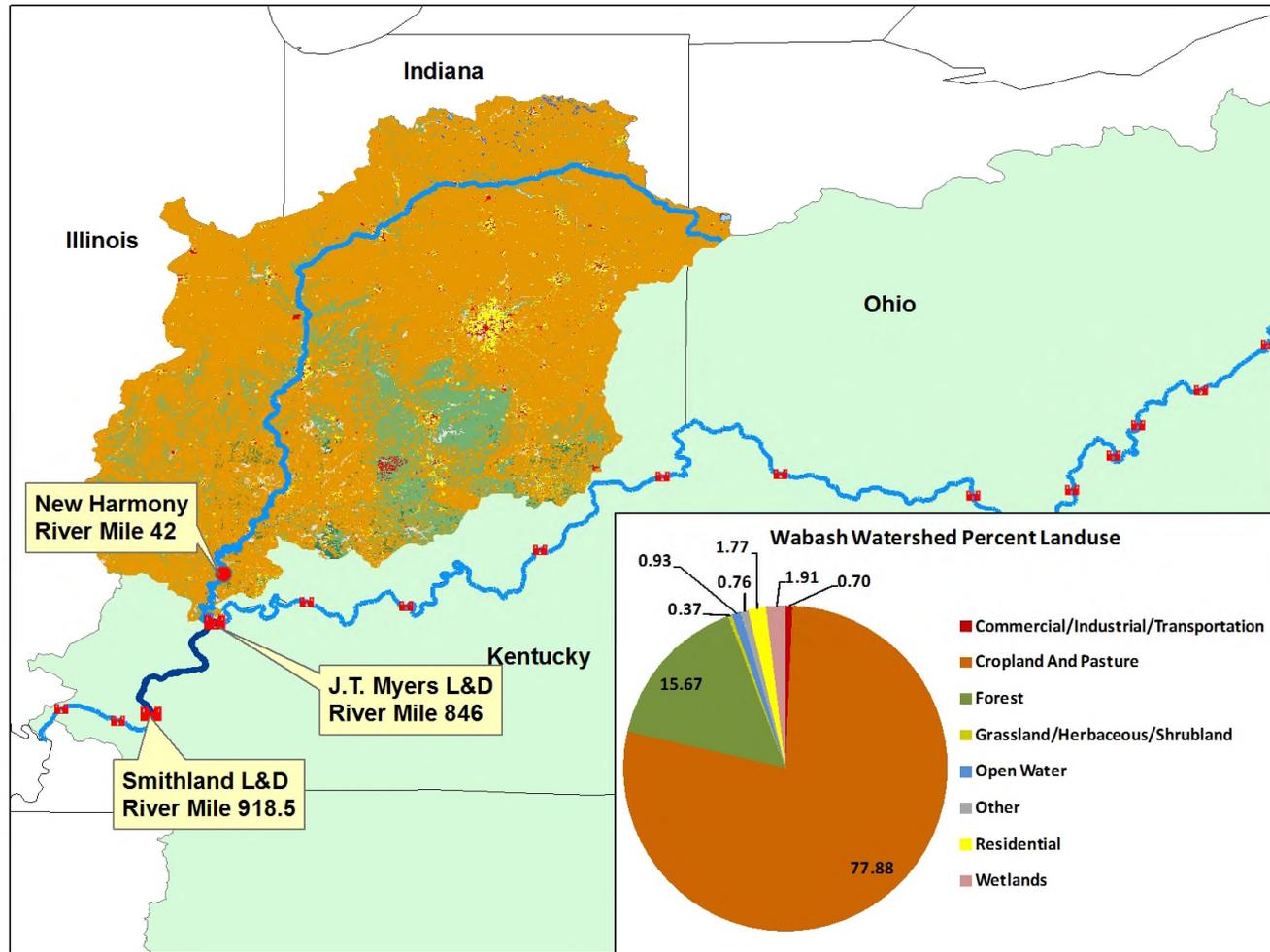
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Project Location

The Smithland Pool of the Ohio River was listed as impaired for dissolved oxygen due to ongoing exceedances of ORSANCO's 5 mg/L standard.

The Smithland Pool is 70 miles long. The Wabash River is the largest tributary in the Pool. Land use in the Wabash River is dominated by agriculture. Previous studies have identified the Wabash River as the largest contributor of nutrients to the Ohio River.



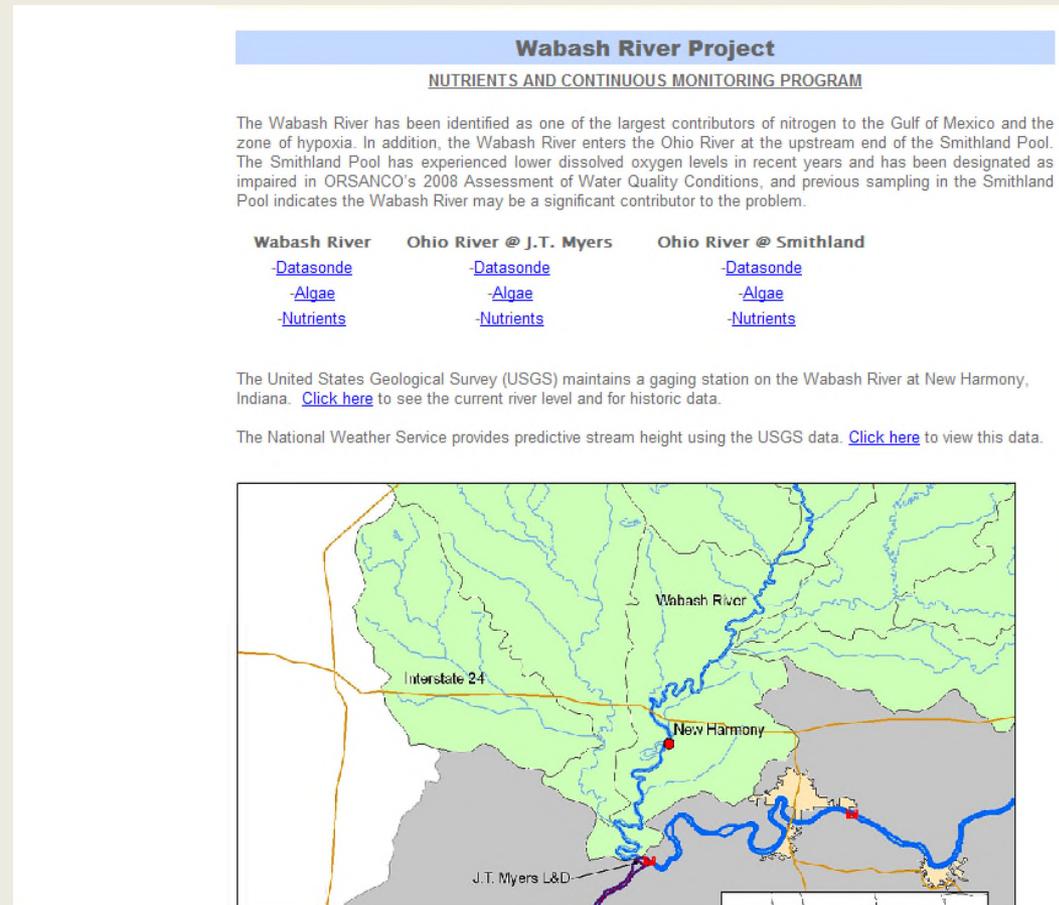
Project Description

- Evaluate the Wabash River as a possible cause of low dissolved oxygen in the Smithland Pool.
- 5 year project. Budget of \$300,000. Data collected from 7/1/2010 to 1/22/2015.



Study Design

- Sampling Stations on Wabash River (Mile 42), Ohio River at JT Myers L&D (Mile 846) and Smithland L&D (Mile 918)
- Continuous monitor data downloaded 3/day
 - pH, conductivity, temp, turbidity, dissolved oxygen, chlorophyll a
- Nutrients collected every 2 weeks
 - Ammonia, TKN, Nitrate/Nitrite, Total Phosphorus, BOD, TSS, Algae, Chlorophyll
 - Ohio River samples collected during summer months
- Annual Report and Data available at www.orsanco.org



Challenges



Dissolved Oxygen

Station	Max Diurnal Range	# days >6mg/L Range	# days <5 mg/L average	# days <4 mg/L instant
Wabash R.	10.94	49	13	65
JT Myers L&D	7.25	2	0	12
Smithland L&D	7.03	3	38	19

Diurnal range is caused by algal respiration

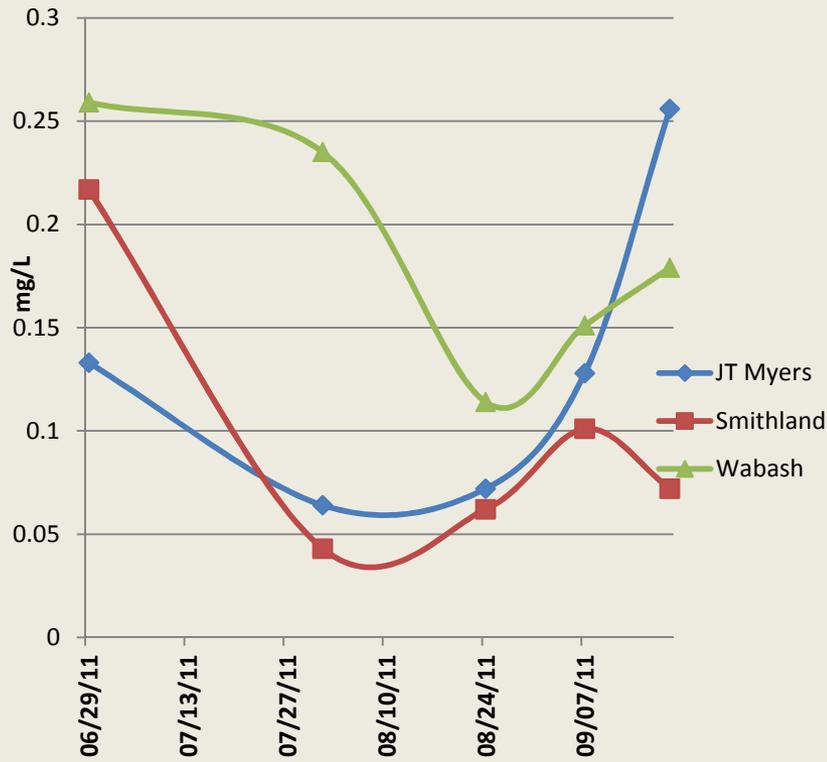
Wabash R. low DO associated with large diurnal range

JT Myers/Smithland low DO associated with minimal diurnal range

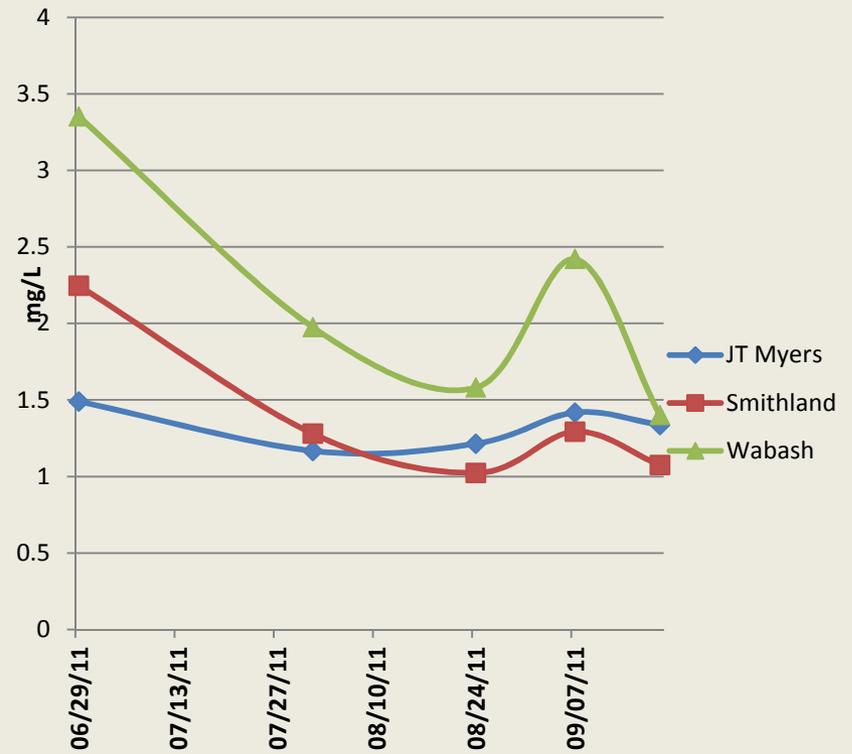
Period: 7/1/2010 to 9/30/2012 (3 summers)

Nutrient Concentrations

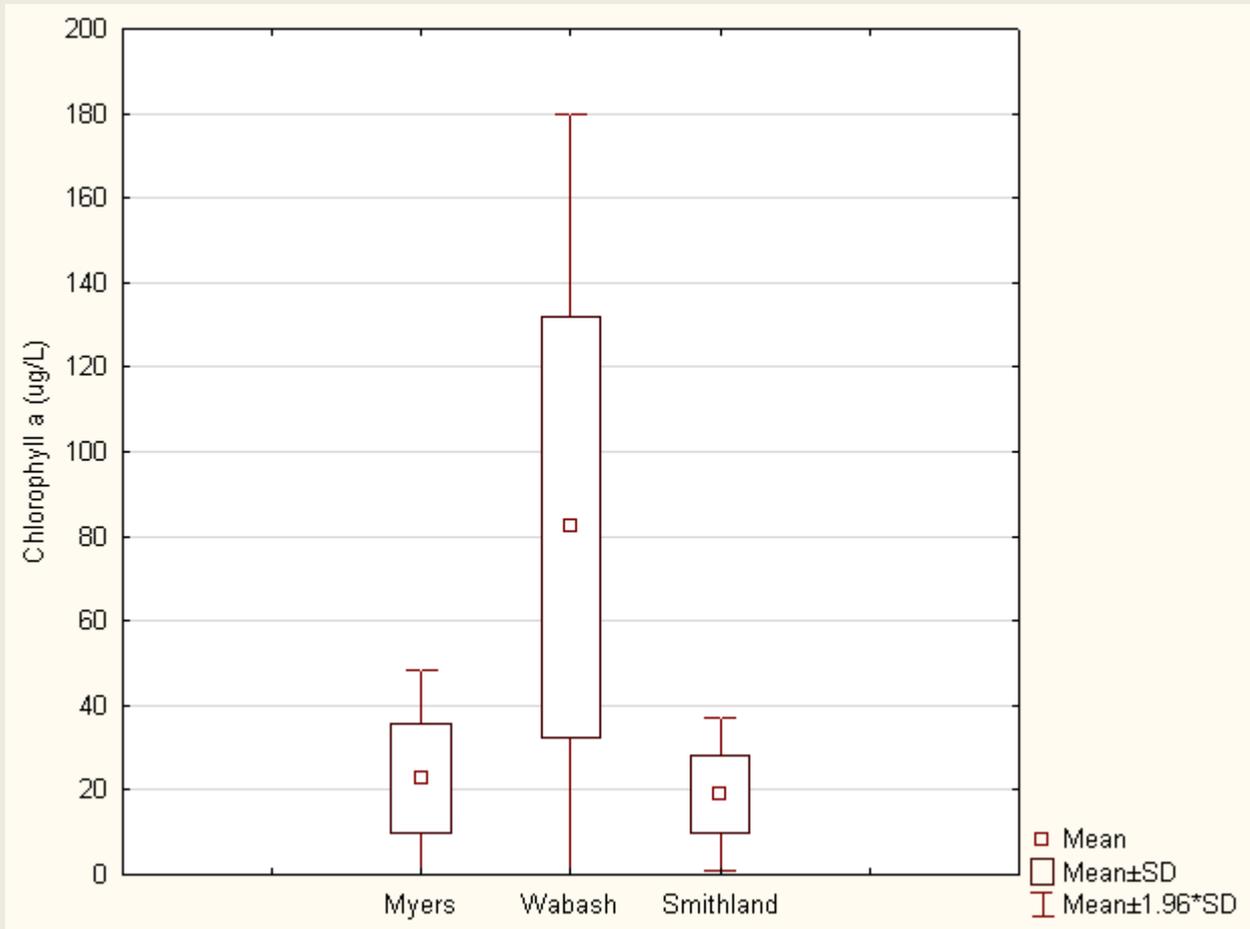
Total Phosphorus (mg/L)



Total Nitrogen (mg/L)



Chlorophyll *a*



Algae Community

- TESTS FOR DIFFERENCES BETWEEN Visit GROUPS

- (averaged across all Location groups)
- Groups too small

- TESTS FOR DIFFERENCES BETWEEN Location GROUPS

- (using Visit groups as samples)

- Global Test

- Sample statistic (Global R): 0.034
- Significance level of sample statistic: 17.6%
- Number of permutations: 9999 (Random sample from a large number)
- Number of permuted statistics greater than or equal to Global R: 1761

- Pairwise Tests

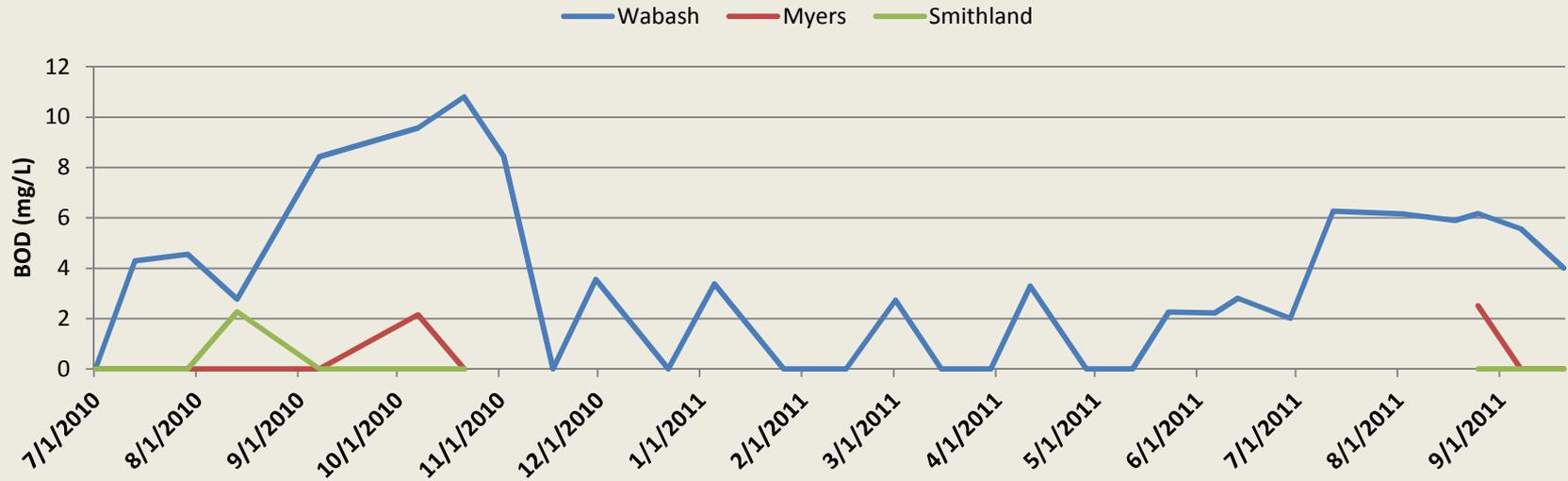
•	R	Significance	Possible	Actual	Number >=	
•Groups	Statistic	Level %	Permutations	Permutations	Observed	
•JT Meyers, Smithland	-0.058	87.5	5200300	9999	8749	
•JT Meyers, Wabash River	0.111	4.8	5200300	9999	474	
•Smithland, Wabash River	0.056	14.9	5200300	9999	1484	

Summary of Results:

- Very little variance is accounted for in this 2-way ANOSIM – Global R= -0.034
- No sig diff between 3 Locations $p < 0.176$
- Not enough power to test for differences between visits
- Significant pairwise difference exhibited b/w JTM & Wabash ($p < 0.048$)
 - The relative magnitude of pairwise p-values indicate there is a marginal influence of the Wabash Algae assemblage to the Ohio River

BOD

BOD July 2010-Sep 2011



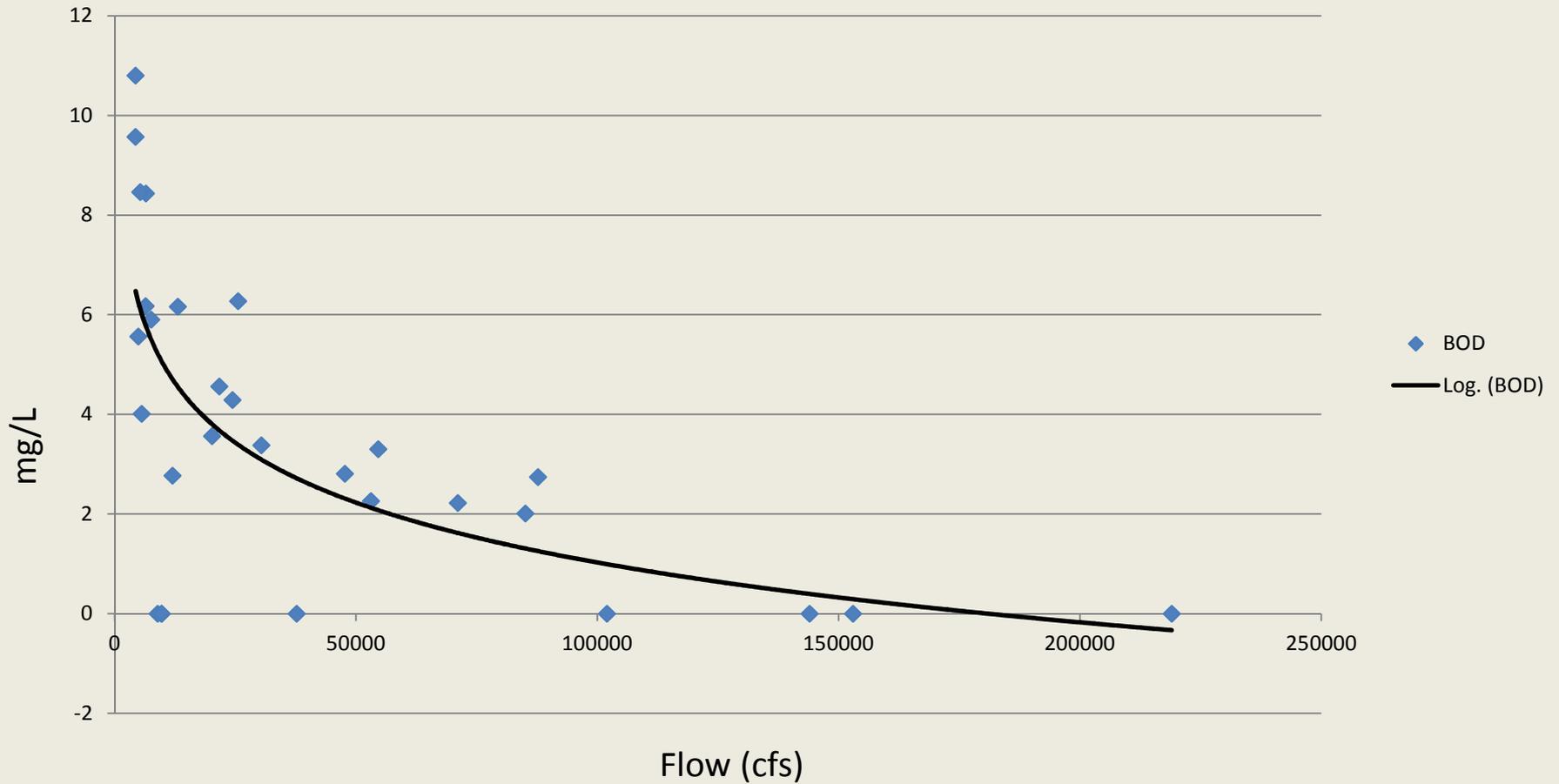
Max BOD Wabash River = 10.8 mg/L

Max BOD JT Myers = 2.51

Max BOD Smithland = 2.27

Effect of Flow on BOD

Wabash River BOD vs Flow



Summary of Results

- DO pattern indicates Ohio River low DO not caused by algae blooms on the Ohio River
- Algae Community shows effect of Wabash River on Smithland Pool
- Algae concentration does not show effect of Wabash River on Smithland Pool
- High water year on the Wabash River. Low problem year for DO on the Ohio River
- Wabash River is a source of BOD to Ohio River.
 - High BOD occurs during algae blooms
 - Pattern mimics point source signature

Conclusions

- Original hypothesis: Algae blooms on the Ohio River, fed by nutrients and algae from the Wabash River, cause DO sags in the Smithland Pool.
- New hypothesis: Large volumes of algae enter the Ohio River from the Wabash River and die-off. The die-off of algae creates a high BOD load which causes the DO sags in the Smithland Pool.

Questions?

