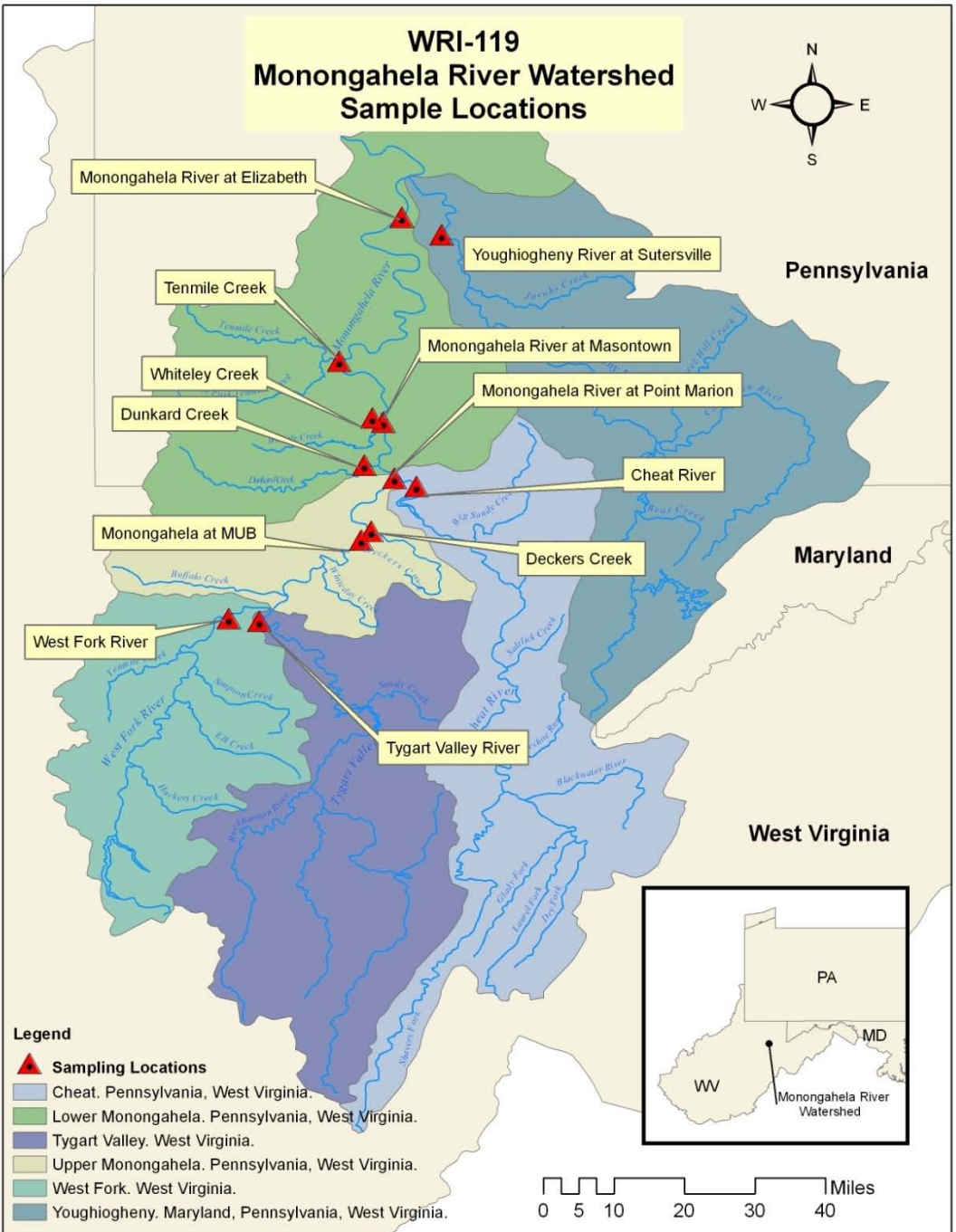


# Upper Monongahela River Water Quality Project Project WRI 119

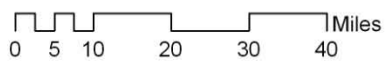
July to November 09 Results

Paul Ziemkiewicz, PhD  
Director  
West Virginia Water Research Institute

# WRI-119 Monongahela River Watershed Sample Locations



- Legend**
- ▲ **Sampling Locations**
  - Cheat. Pennsylvania, West Virginia.
  - Lower Monongahela. Pennsylvania, West Virginia.
  - Tygart Valley. West Virginia.
  - Upper Monongahela. Pennsylvania, West Virginia.
  - West Fork. West Virginia.
  - Youghiogheny. Maryland, Pennsylvania, West Virginia.

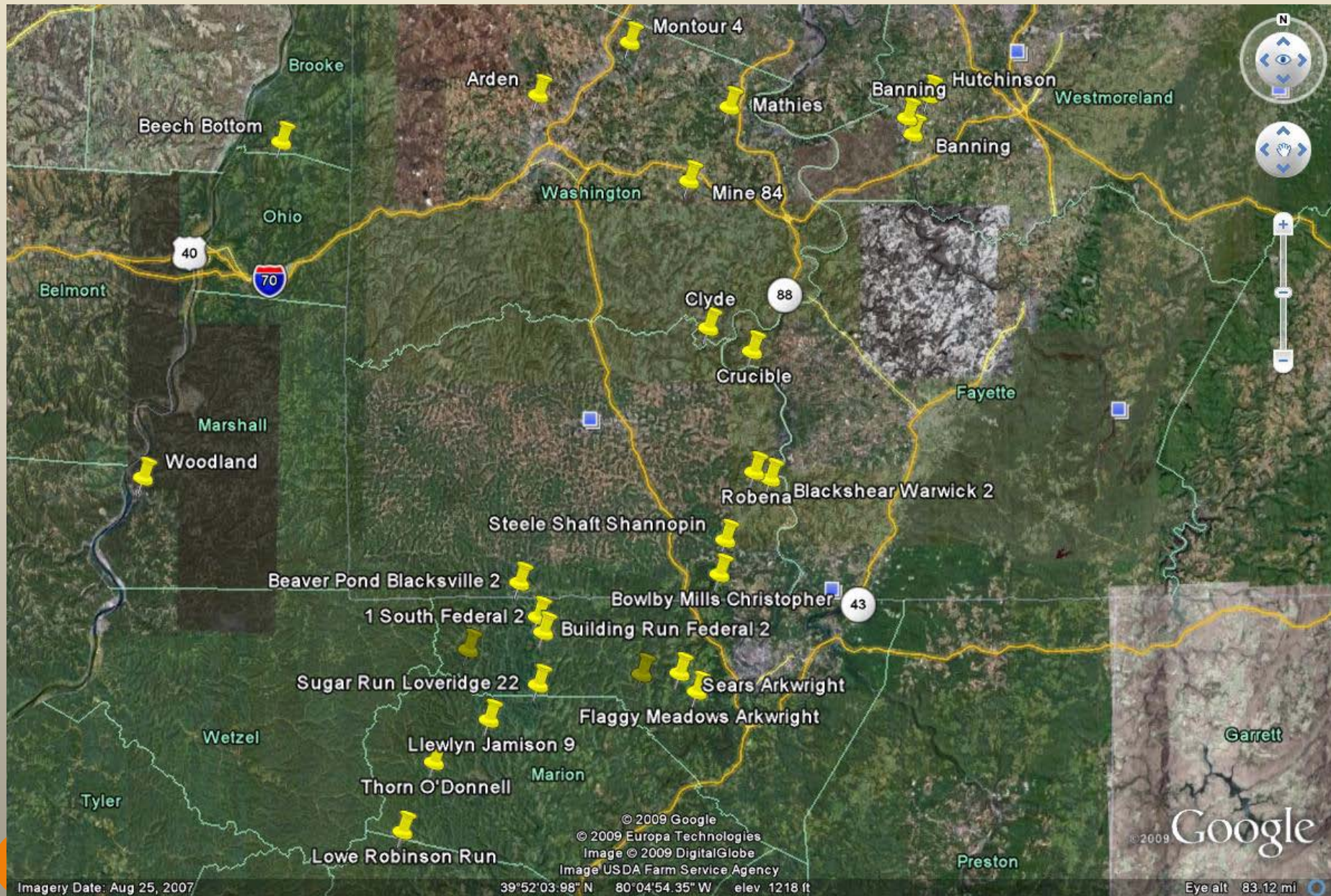


# Sampling Sites:

- WF 01 West Fork River DS Worthington, WV
- TY 02 Tygart Valley River, Coalfax, WV
- Mon 03 Monongahela River at MUB
- DE 04 Deckers Creek in Morgantown
- Mon 05 Monongahela River at Point Marion, PA
- CR 06 Cheat River at tailrace of dam
- DU 07 Dunkard Creek Shannopin Gage
- Mon 08 Monongahela River at Masontown
- WH 09 Whiteley Creek
- TM 10 Tenmile Creek near Route 88
- Mon 11 Monongahela River, Elizabeth PA
- YR 12 Youghiogheny River near Sutersville, PA

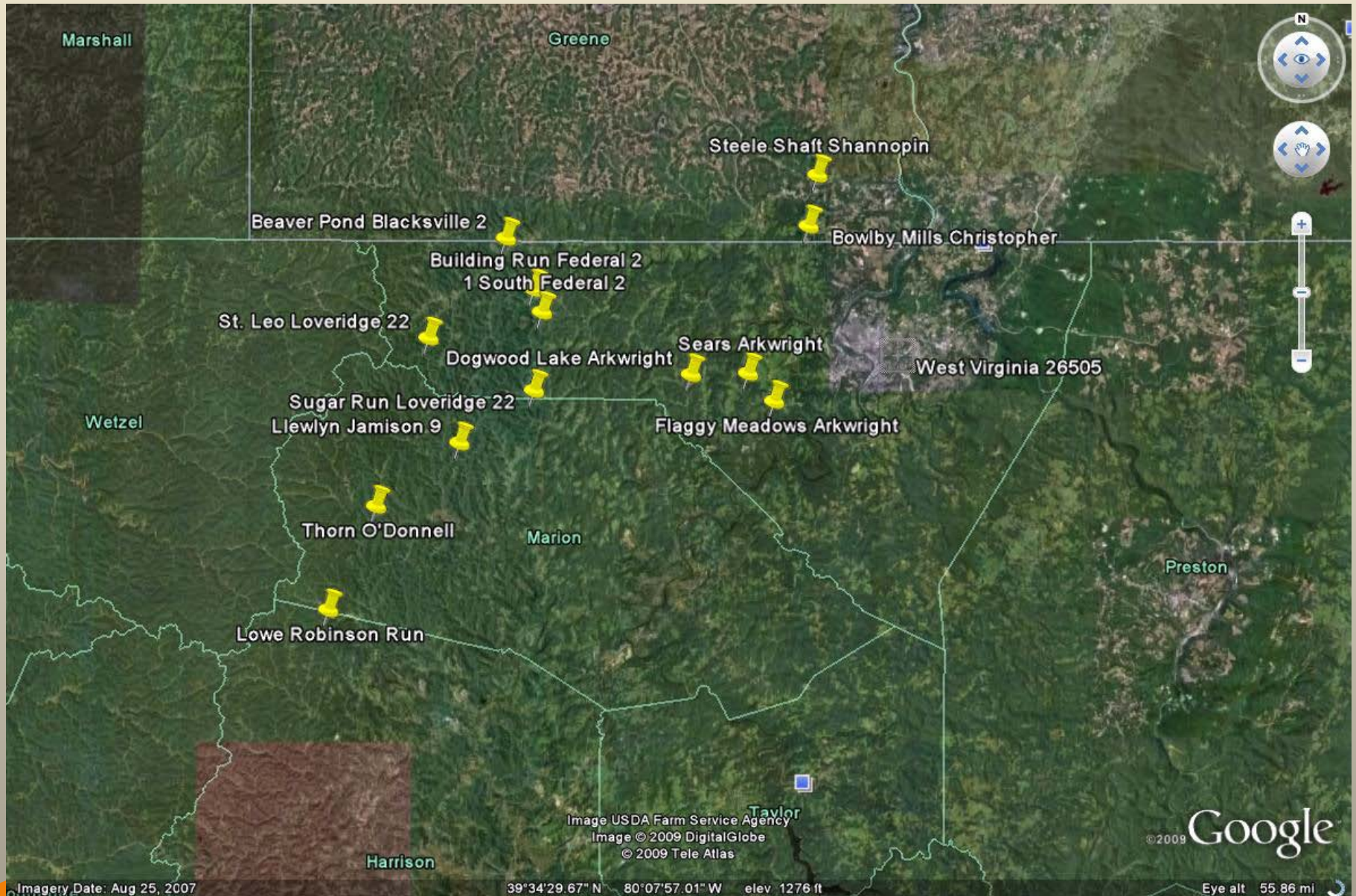


# Pittsburgh Basin-Major AMD plants





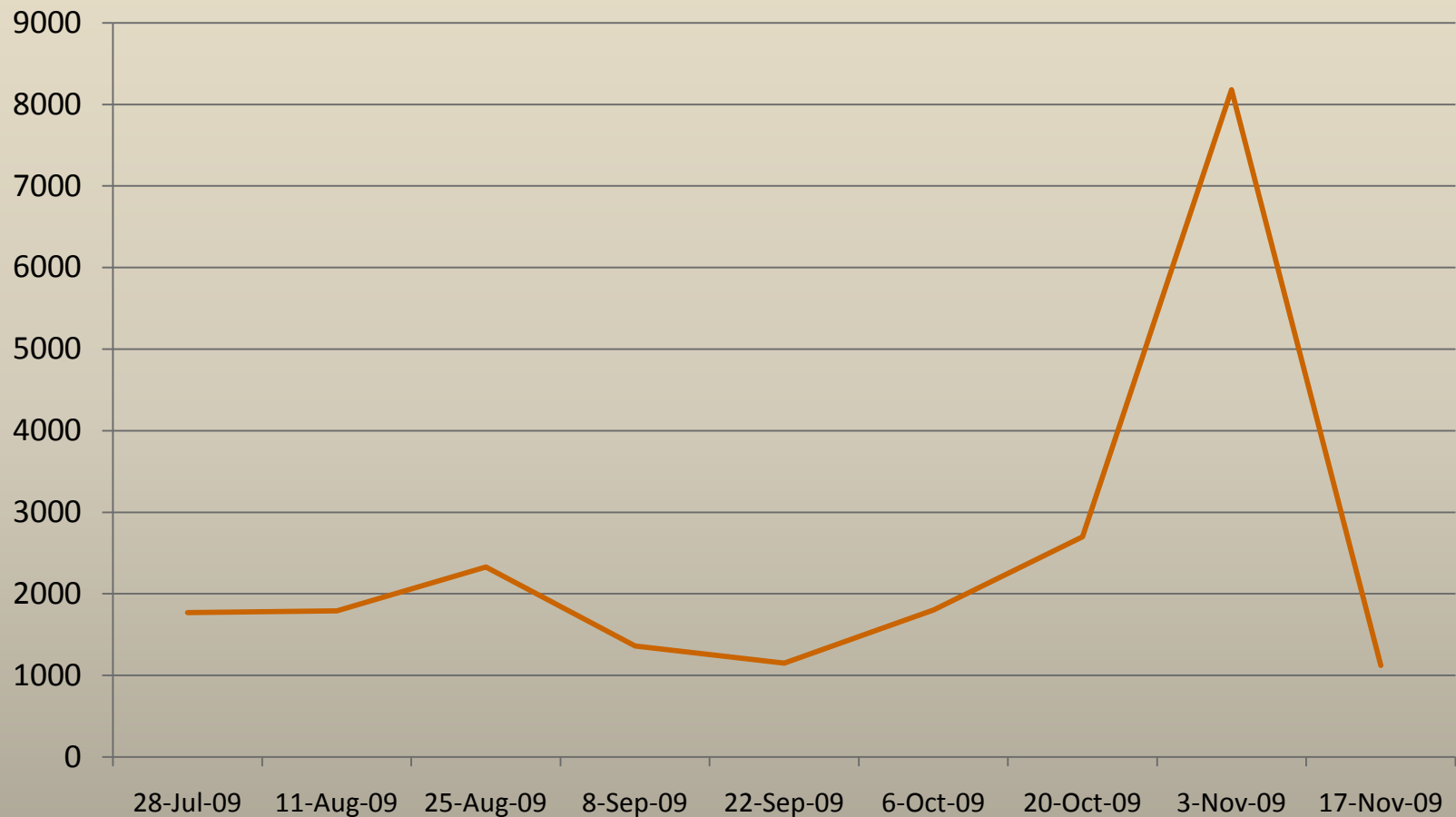
# Major AMD treatment Plants-Upper Mon River



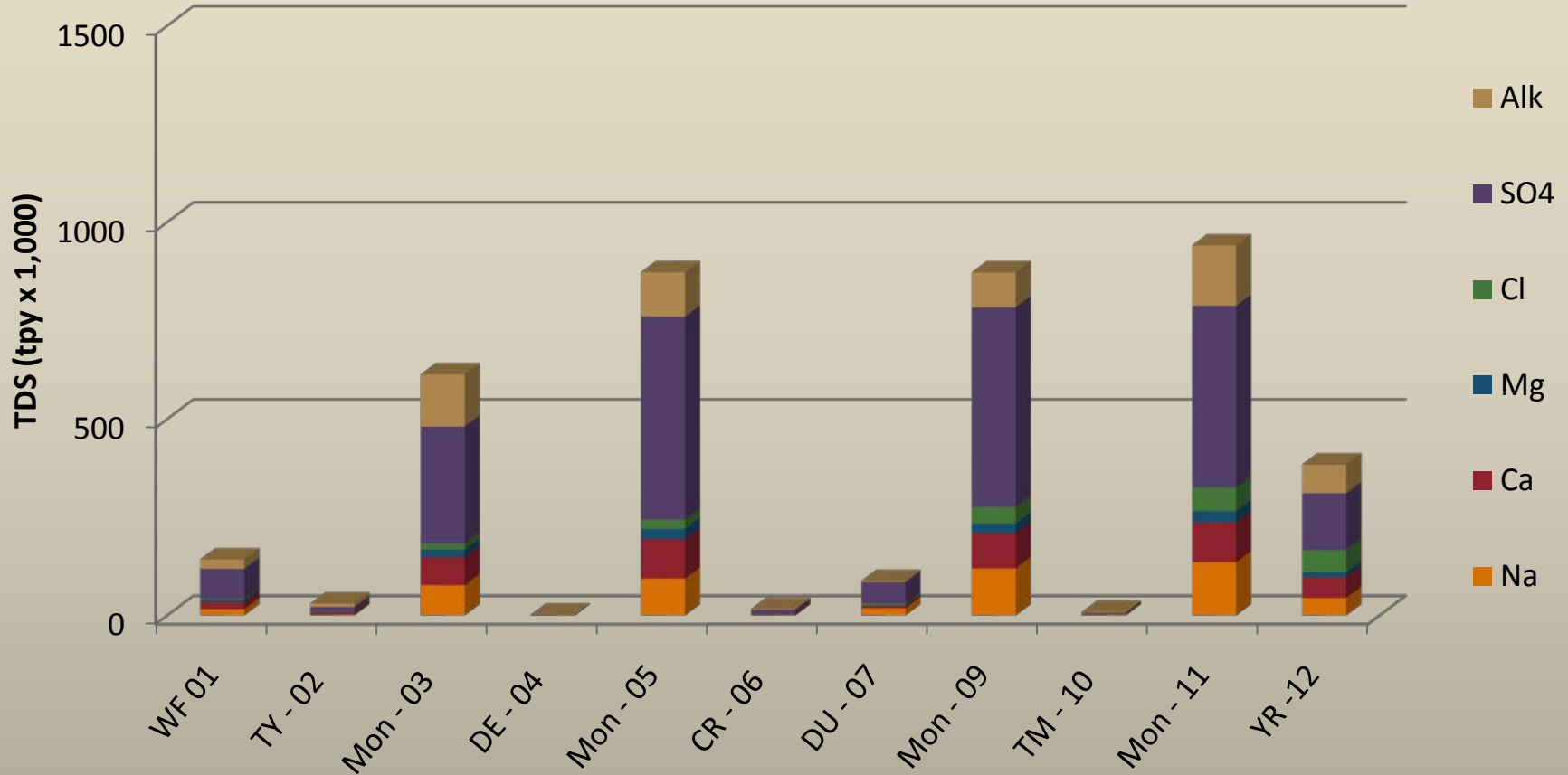
# Estimated TDS loads (tpy) from Upper Mon AMD treatment plants

	average observed	maximum observed	full pump capacity
Dunkard Ck	153,340	190,784	257,950
Robinson Run (Mon Co.)	11,000	22,000	17,600
Flaggy Meadows Run	12,205	34,166	47,300
Indian Ck	12,975	30,008	115,500
Paw Paw Ck	2,200	4,400	11,550
Buffalo Ck	10,043	36,938	36,300
Robinson Run (Marion Co.)	3,900	9,779	27,500
Total	205,662	328,075	513,700

### August to November Flow at Masontown PA (cfs)

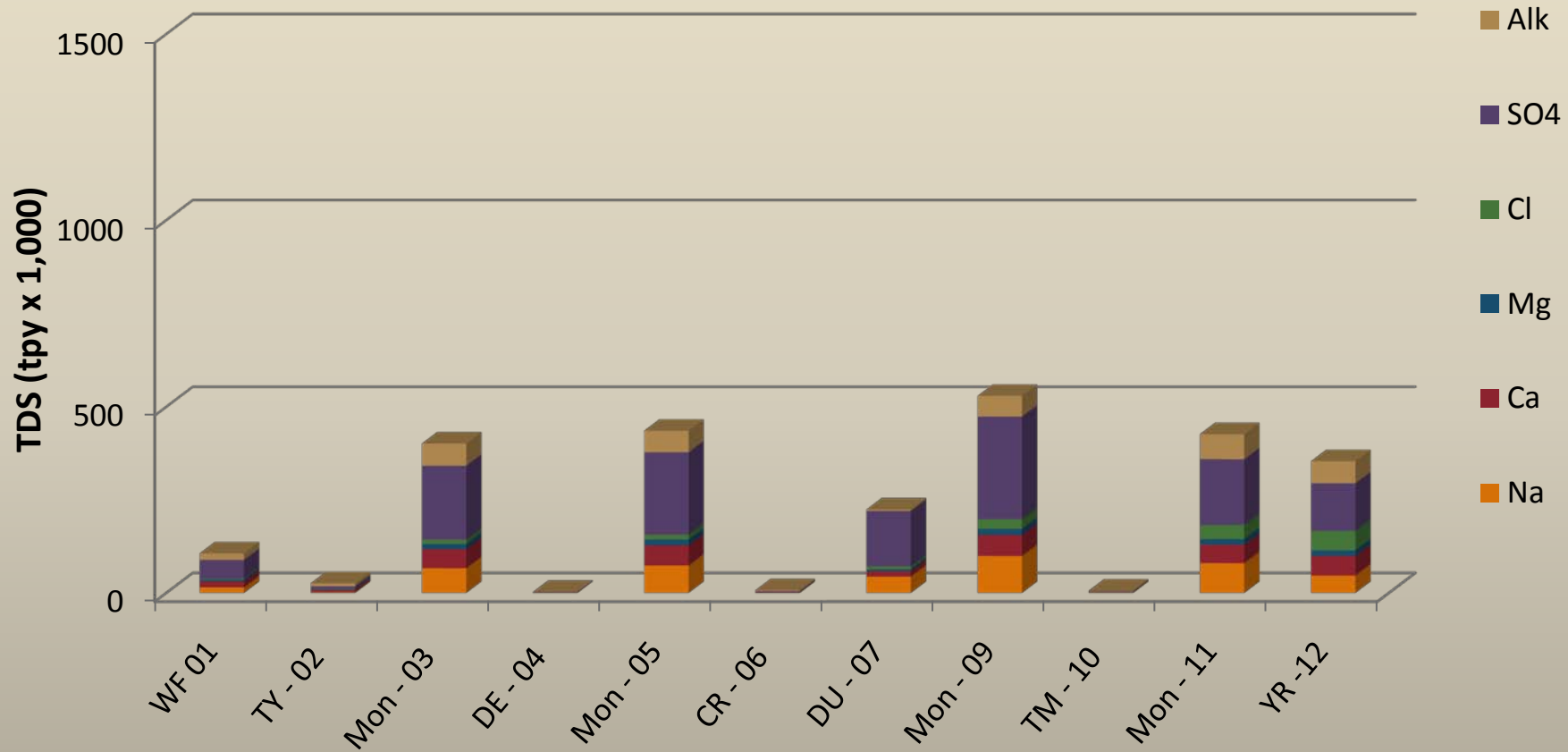


## Monongahela River TDS Loading 28 July 2009

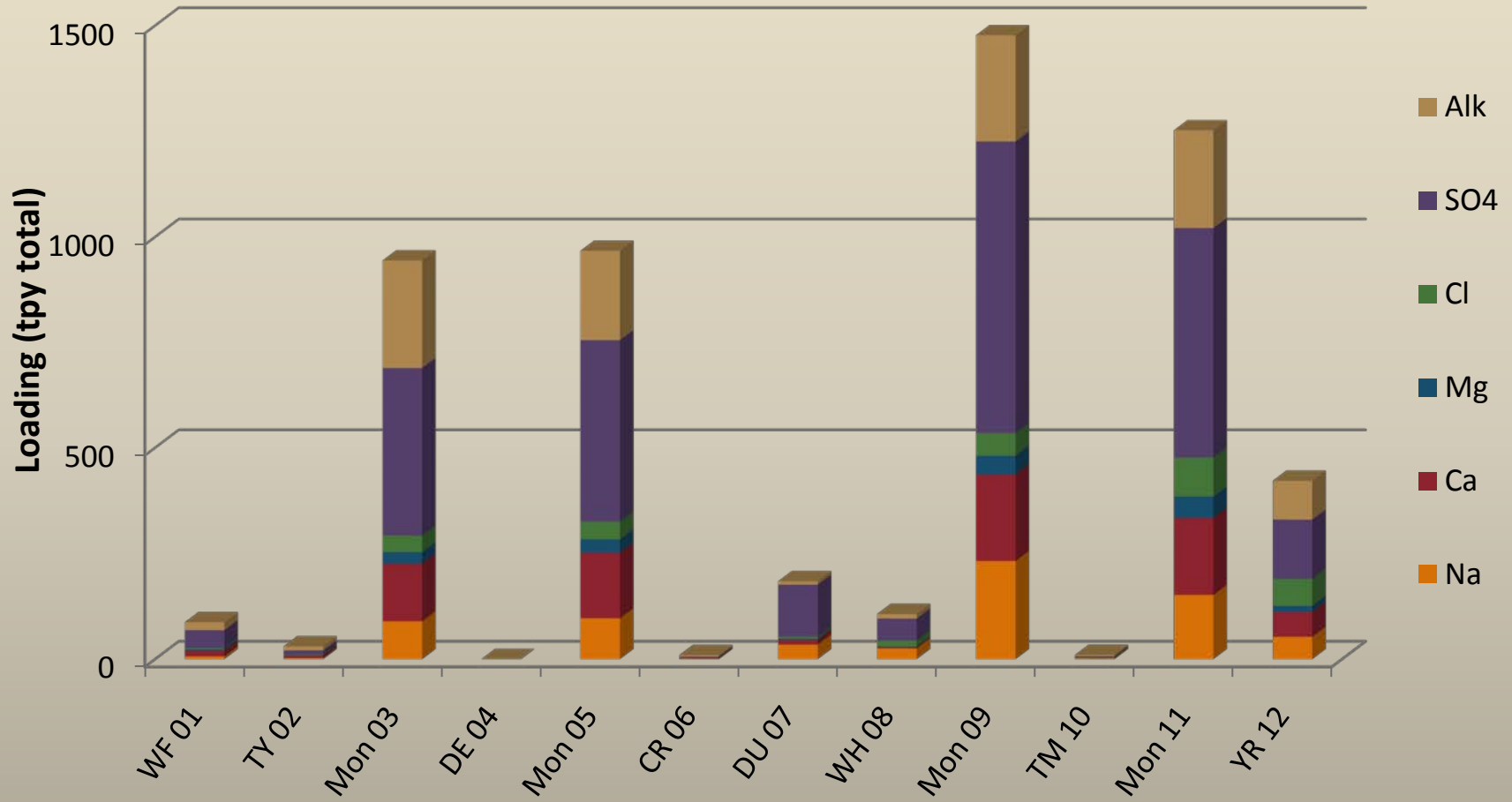




## Monongahela River TDS Loading 8 September 2009



# Monongahela River TDS Loading 3 November 2009

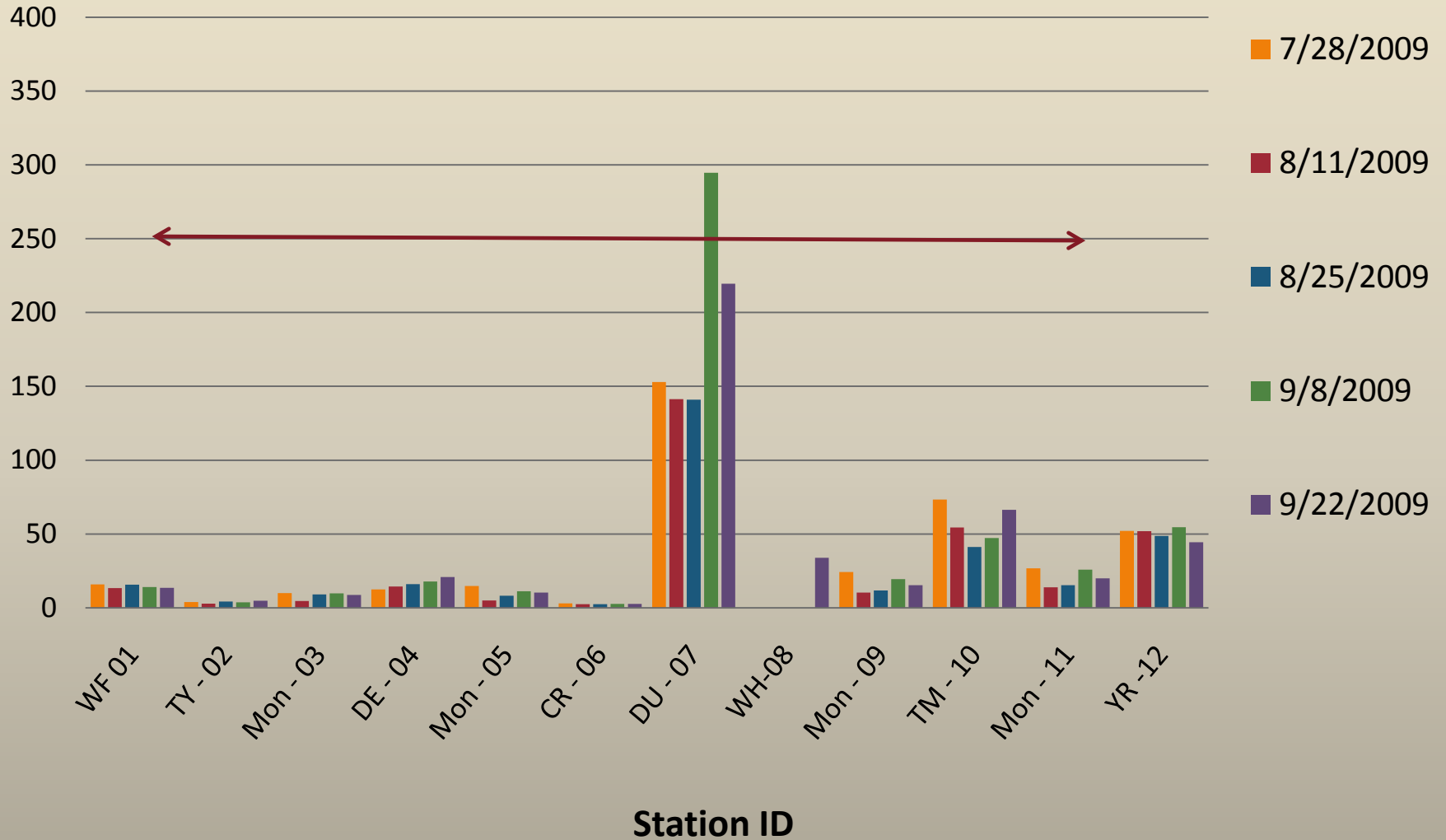


# Dunkard Creek Fish Kill September 09

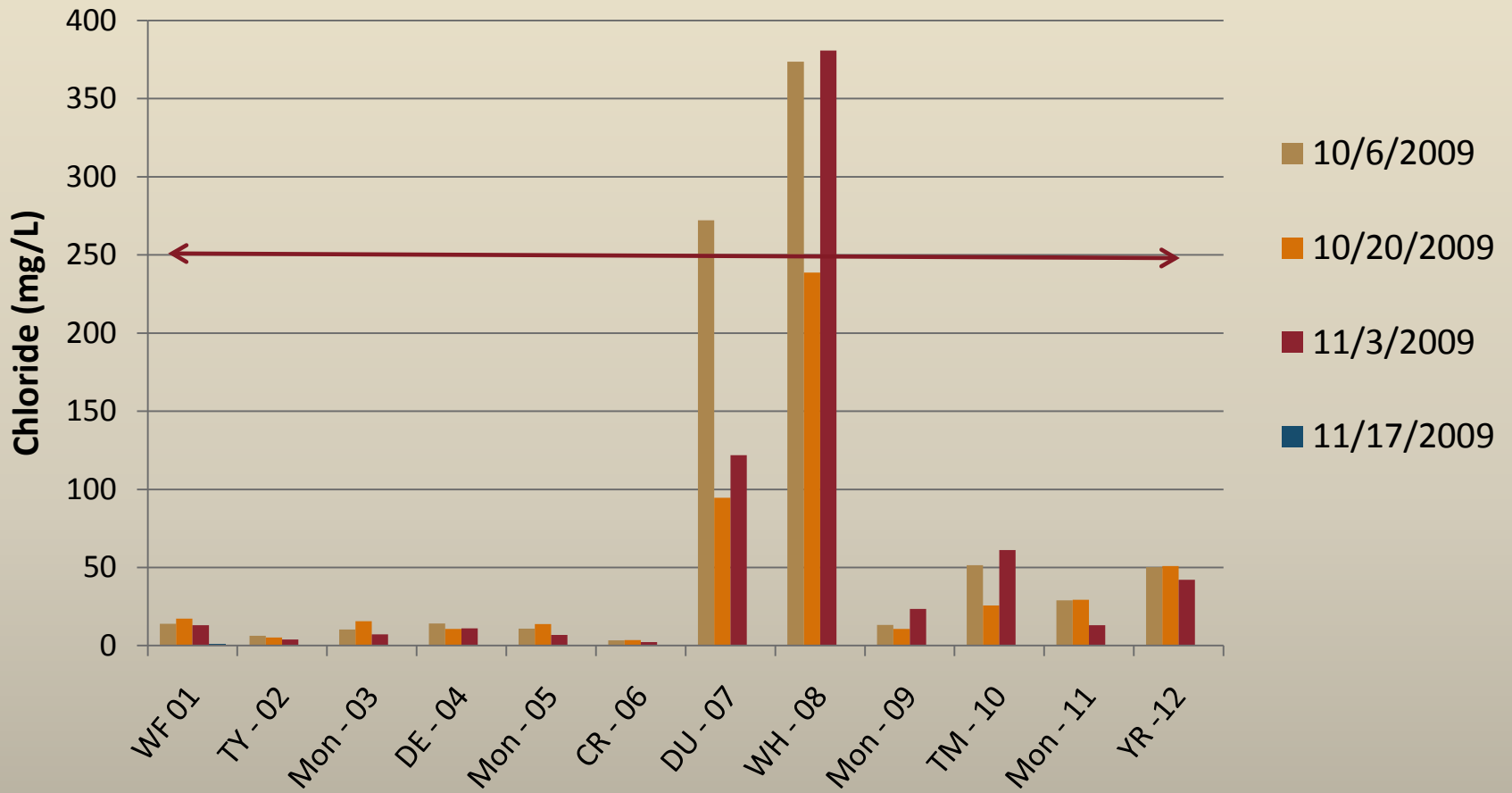
## Stream Chemistry and Loads



# Chloride (mg/L)

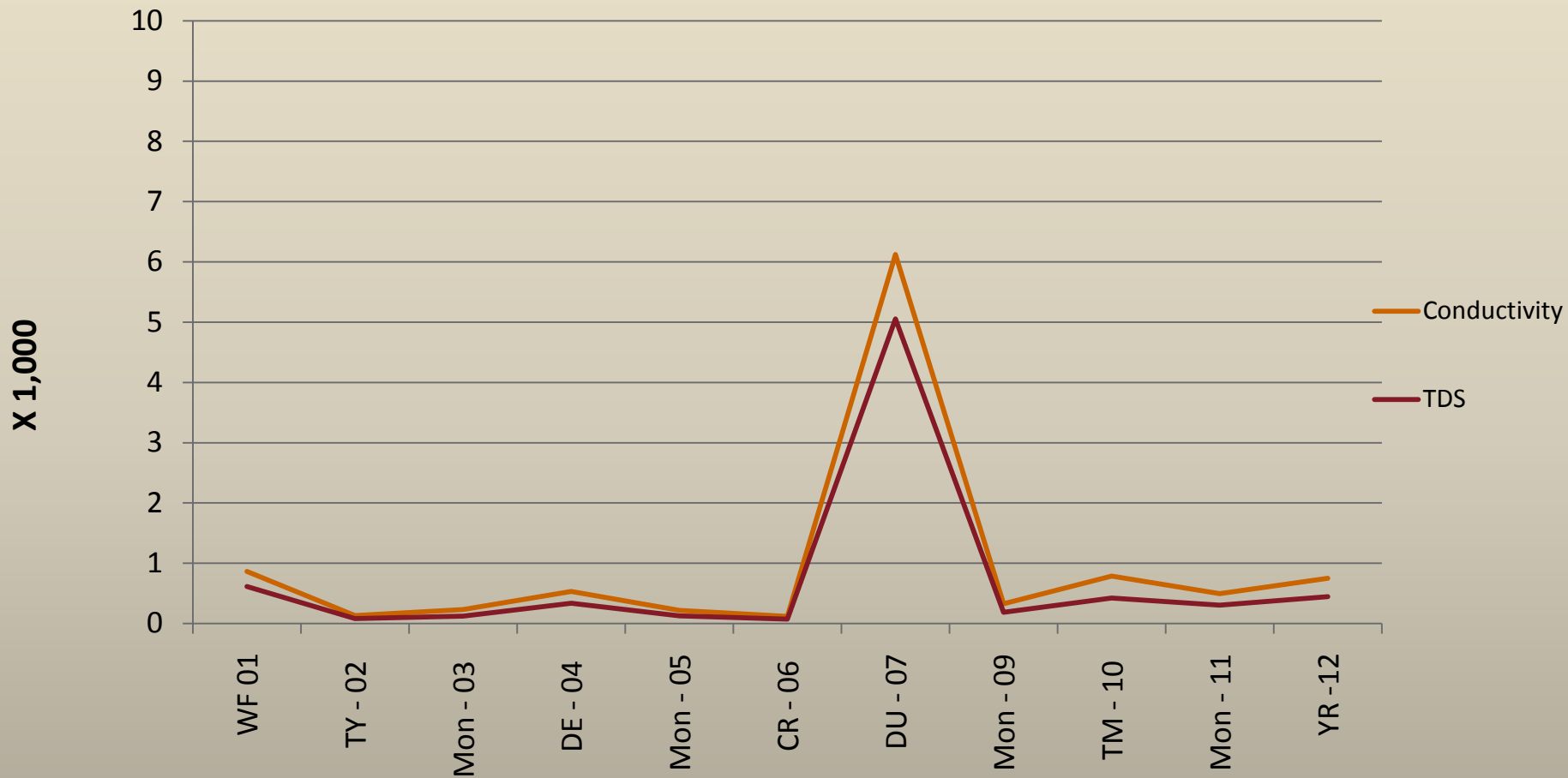


# Chloride



# Conductivity vs. TDS

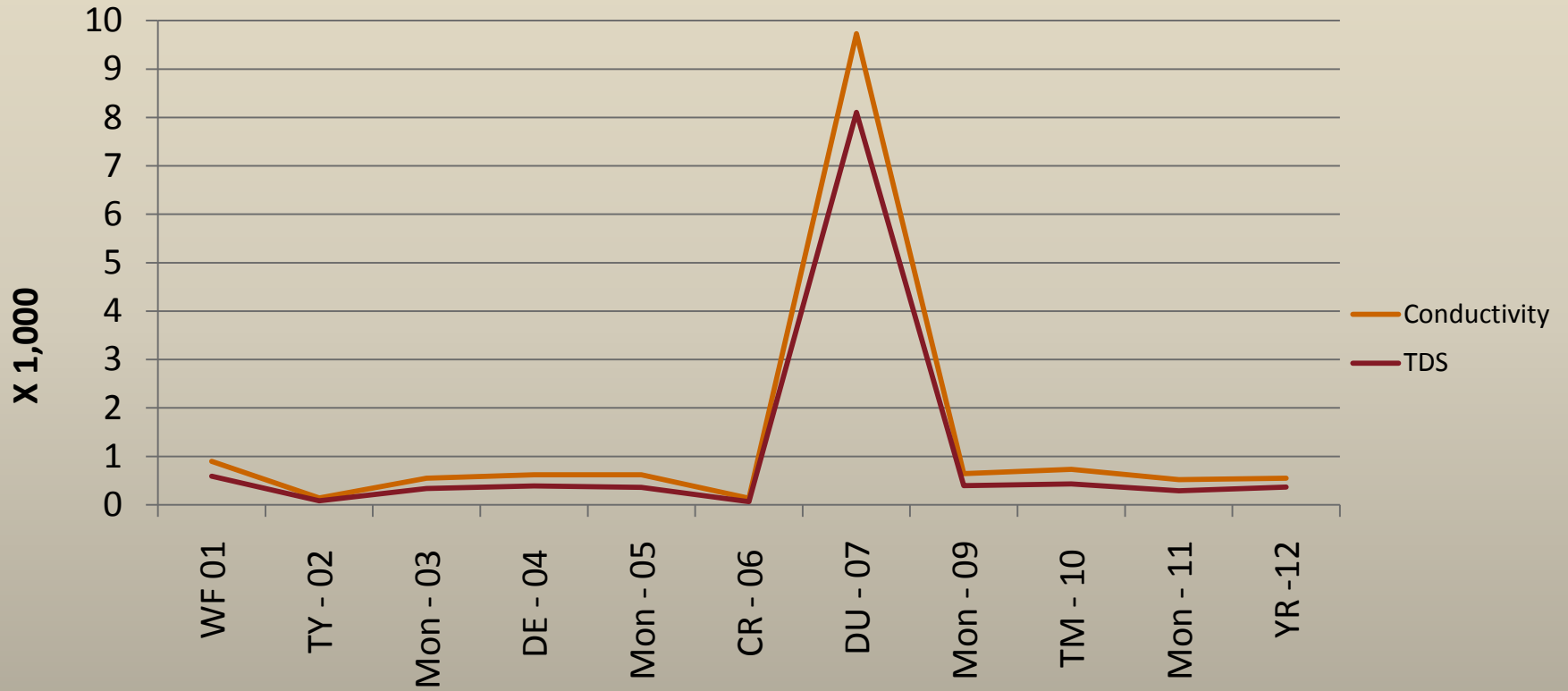
11 Aug 09





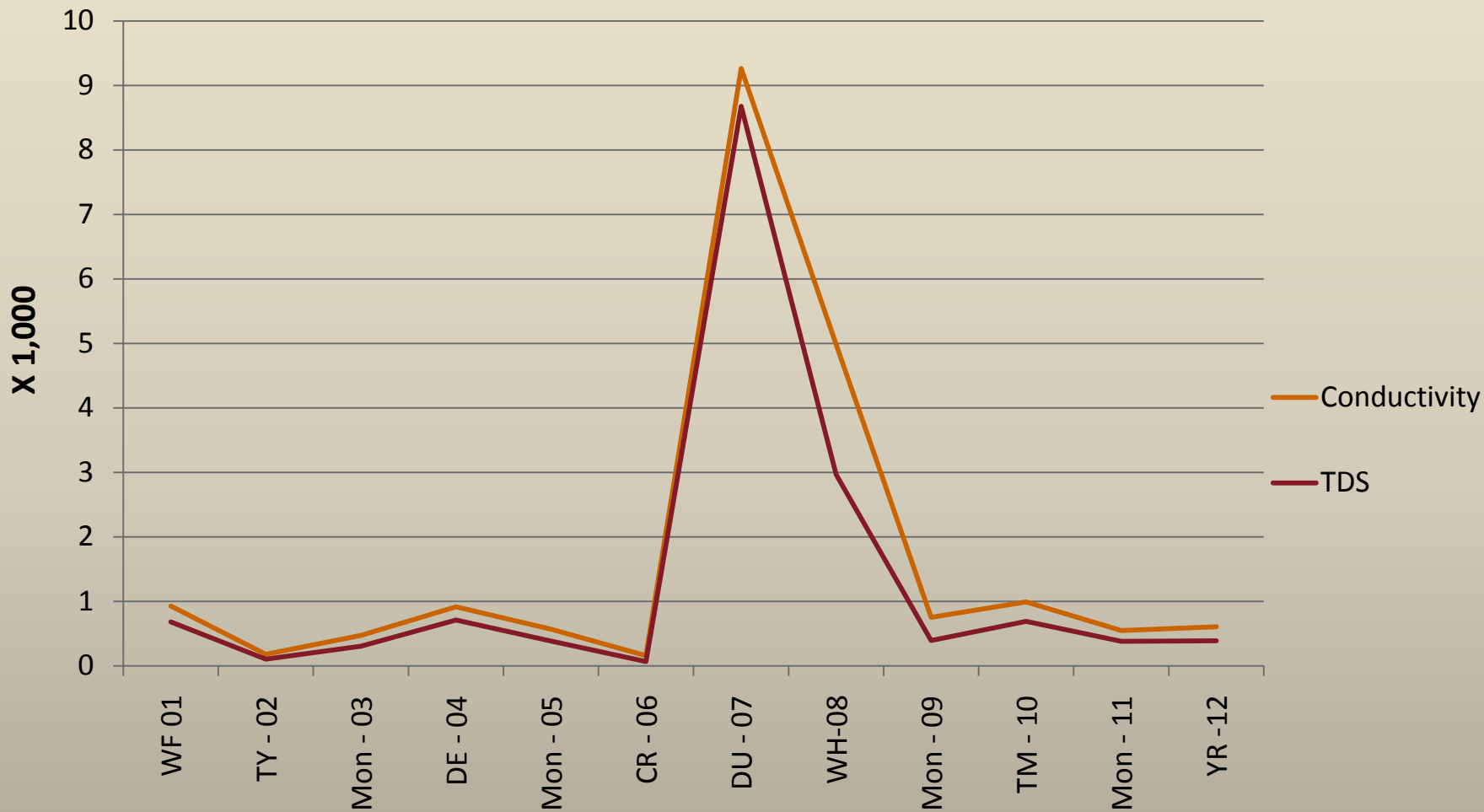
# Conductivity vs. TDS

8 Sep 09



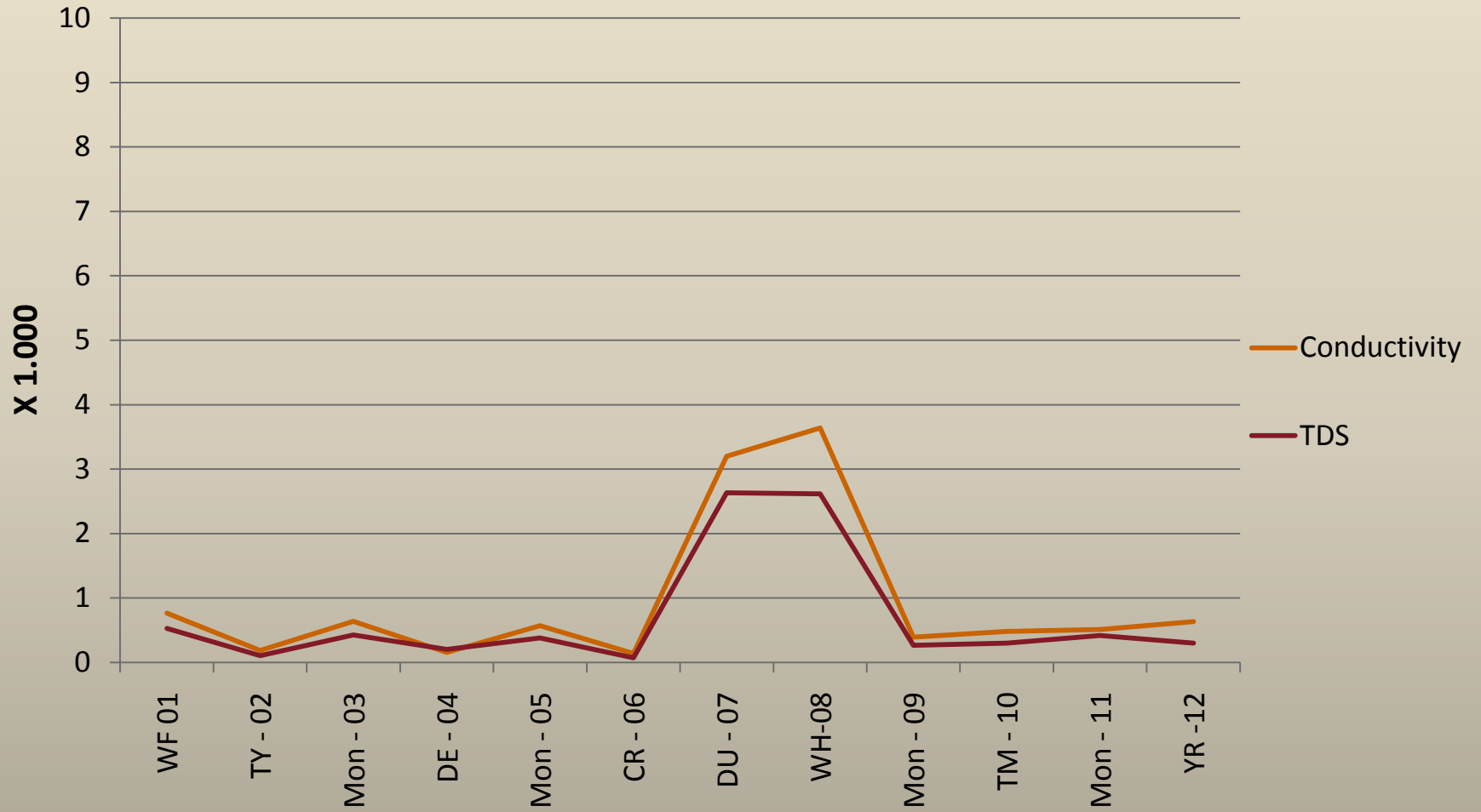
# Conductivity vs. TDS

22 Sep 09



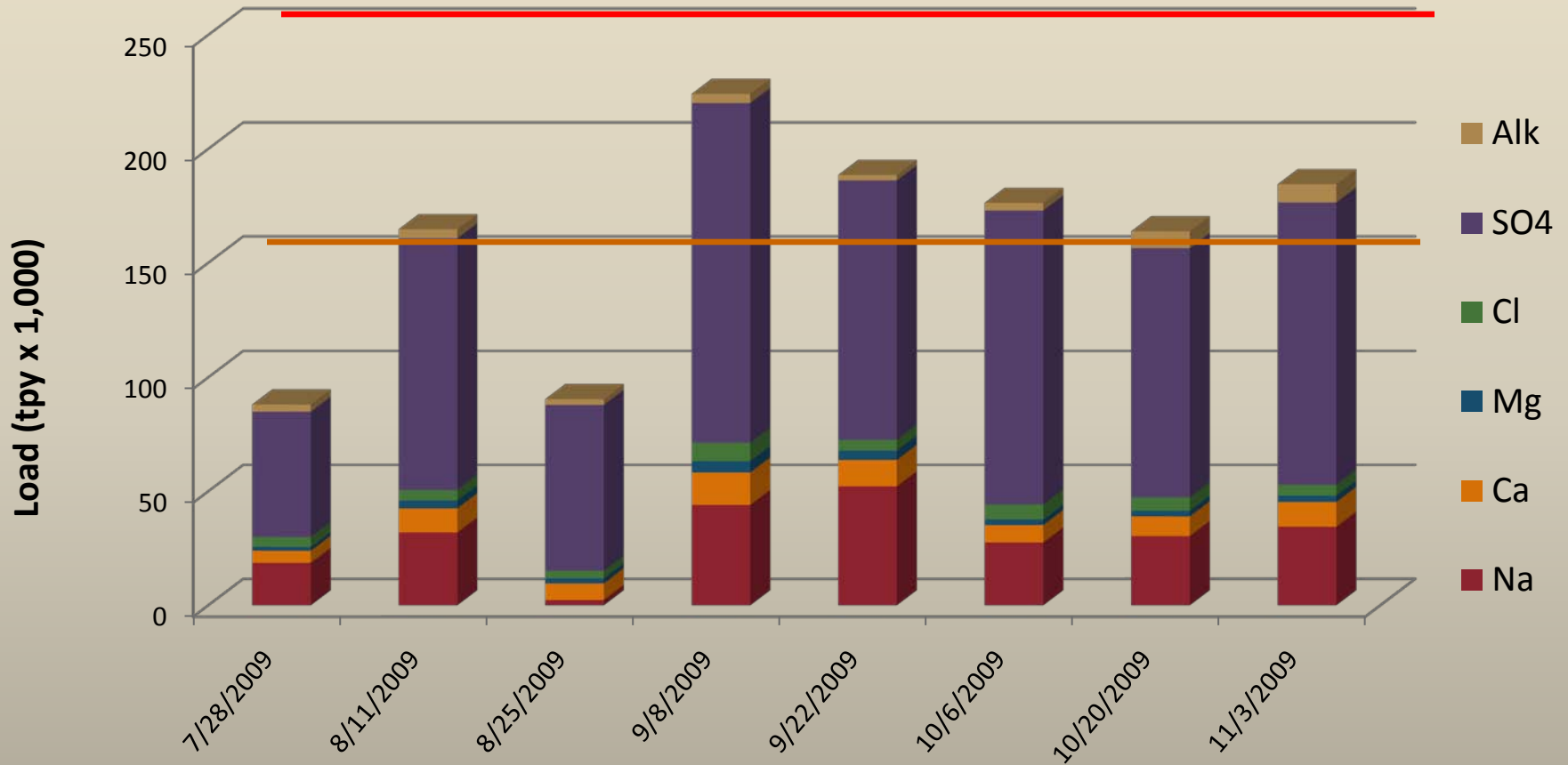
# Conductivity vs. TDS

20 Oct 09

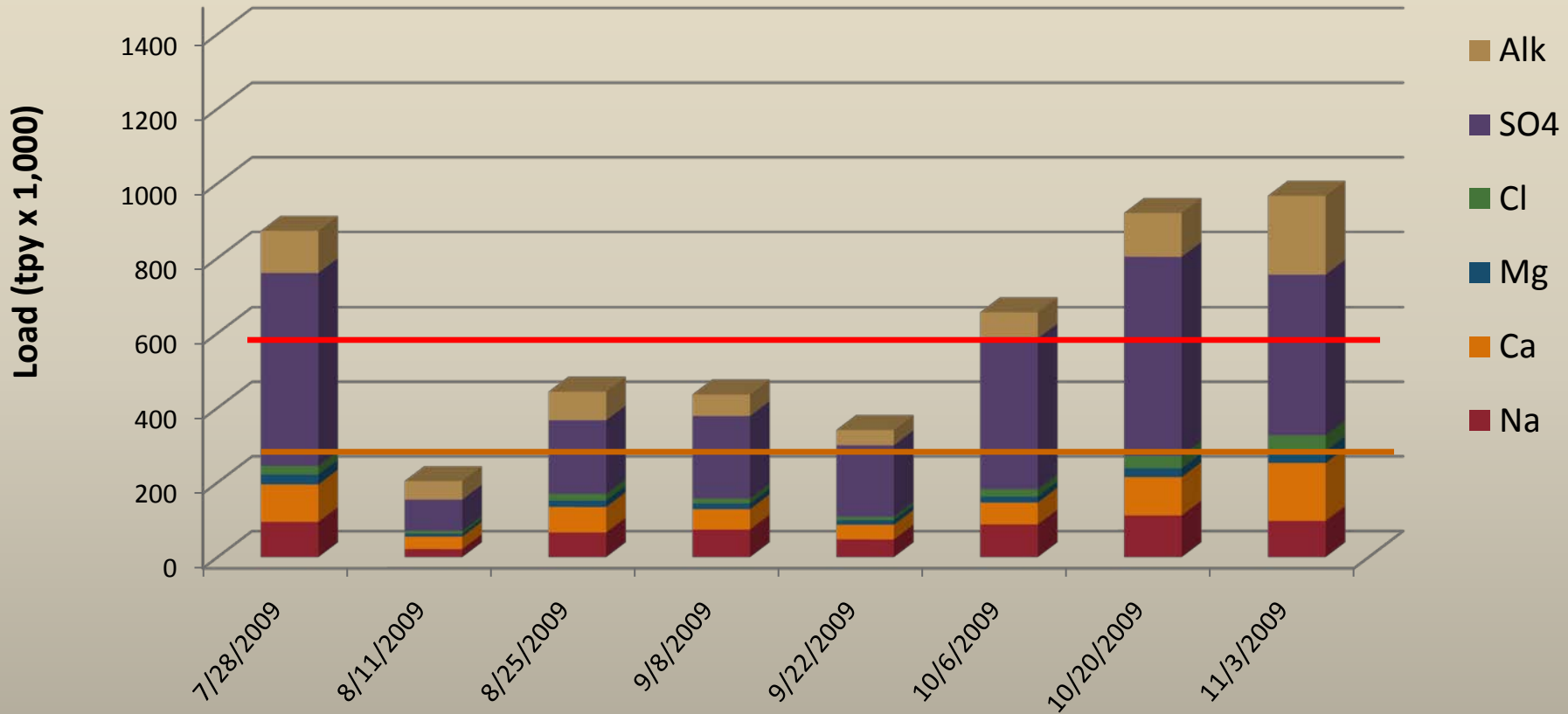




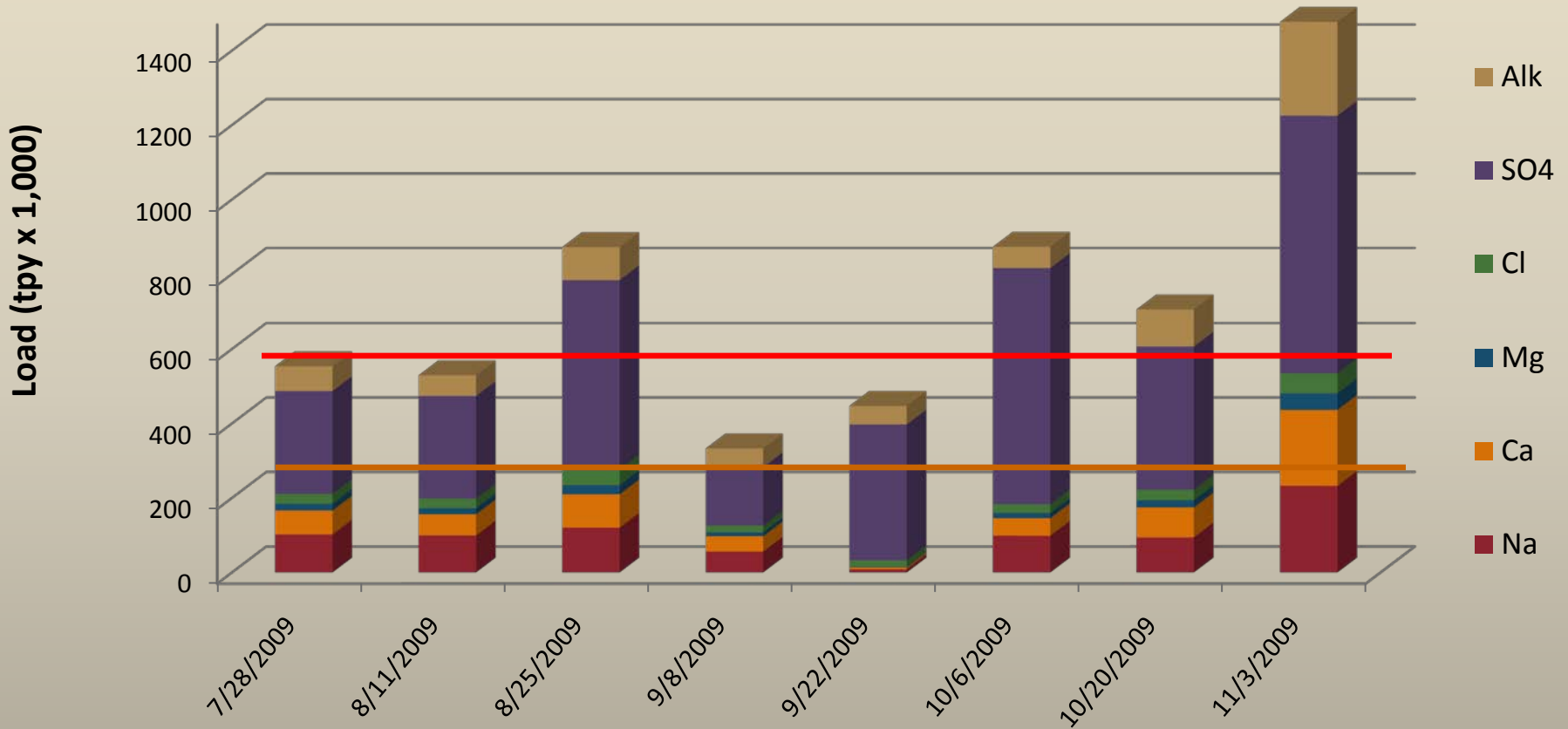
### Dunkard Ck.



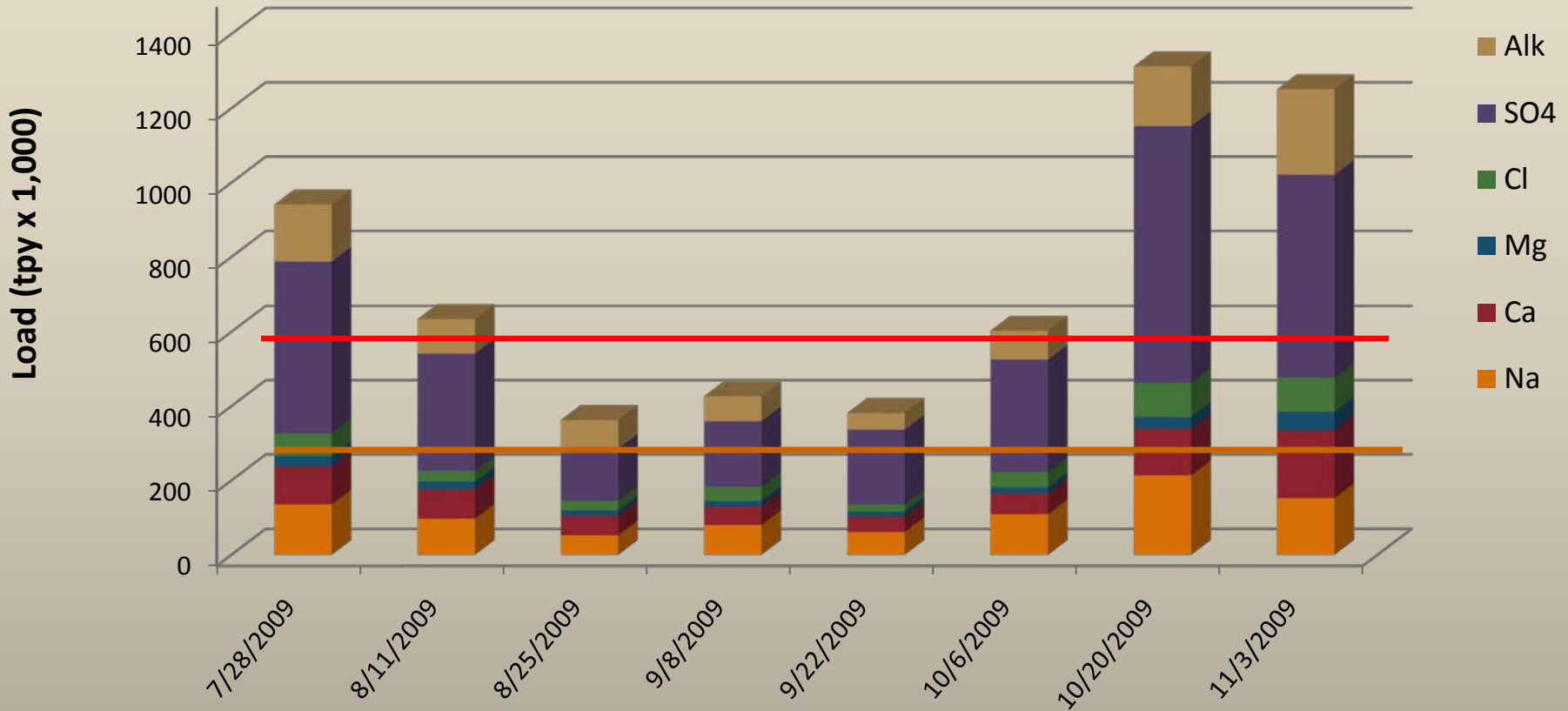
# Mon River at Pt. Marion PA



# Mon River at Masontown PA



# Mon River at Elizabeth PA



# TDS in The Monongahela River

	Relative Loadings		
	1 frac job		
	6 million gal	1 UG mine	
flow	5.7	2,000	gpm
TDS	250,000	8,500	mg/L
TDS	3,139	37,400	tpy
ratio Frac/mine	12	1	
# units	120	10	
TDS	376,712	374,000	tpy

# Effect of Blacksville 2 early Sept 09

## all data in mg/L

Analyte	US	<b>BV 2</b>	DS	US Miracle
	BV2		BV2	Run
Sulfate	1,070	<b>10,800</b>	6,730	1,360
Sodium	697	<b>5,780</b>	4,040	786
Chloride	444	<b>6,120</b>	3,740	447
Total Alkalinity	180	<b>42</b>	86	162
Calcium	100	<b>718</b>	473	111
Magnesium	33	<b>377</b>	229	49
Potassium	10	<b>55</b>	36	8
Nitrite+Nitrate N		<b>1</b>	1	2
TDS calc	2,533	<b>23,893</b>	15,335	2,924



# Distribution of TDS in Dunkard Ck-2008

average 2008	TDS mg/L	Flow (cfs)	TDS (tpy)	
US Steele Shaft	371	361.7	123,285	56%
Steele Shaft	9178	10.0	89,417	40%
AML discharges	1525	7.0	12,085	5%
Mouth of Dunkard *	1078	378.7	221,736	101%

# Distribution of TDS in Dunkard Ck-2008

	TDS mg/L	Flow (cfs)	TDS (tpy)	
<u>high flow 2008</u>			<u>12-May-08</u>	
US Steele Shaft	324	758.5	243,766	77%
Steele Shaft	8439	13.6	113,467	36%
AML discharges	2177	4.9	8,060	3%
Mouth of Dunkard	413	777.0	316,280	115%
<u>medium flow 2008</u>			<u>17-Jan-08</u>	
US Steele Shaft	352	251.6	88,659	46%
Steele Shaft	9765	10.4	100,566	52%
AML discharges	1807	4.0	7,959	4%
Mouth of Dunkard	742	266.0	194,530	101%
<u>low flow 2008</u>			<u>17-Nov-08</u>	
US Steele Shaft	436	83.9	37,430	20%
Steele Shaft	9330	5.9	54,217	28%
AML discharges	1438	3.2	7,857	4%
Mouth of Dunkard	2080	93.0	190,654	52%

# TDS in The Monongahela River

## Assimilative Capacity

<b>9 Oct 09</b>	Pt Marion	Elizabeth	
flow	1,305	2,210	cfs
TDS	357	500	mg/L
TDS	459,176	1,089,088	tpy
difference		629,912	tpy

<b>Drought</b>	Pt Marion	Elizabeth	
flow	400	500	cfs
TDS	500	500	mg/L
TDS	197,120	246,400	tpy
difference		49,280	tpy

<b>High Flow</b>	Pt Marion	Elizabeth	
flow	12,000	18,000	cfs
TDS	500	500	mg/L
TDS	5,913,600	8,870,400	tpy
difference		2,956,800	tpy

# Conclusions:

- None of the TDS constituents are cumulative or toxic at reasonable concentrations
- Upper Mon AMD plants generate between 200,000 and 500,000 tpy of TDS
- That accounts for between 20 to 100% of TDS in the Mon
- For much of the year the Mon can easily assimilate that sort of loading while maintaining a [TDS] below 500 mg/L
- A managed, load-weighted discharge program would be much superior to an end of pipe [TDS] limit
- That will require a simple, robust, basin-wide monitoring program

# Questions?

## Monongahela River Monitoring Program

Paul Ziemkiewicz, PhD

Director

West Virginia Water Research Institute

West Virginia University