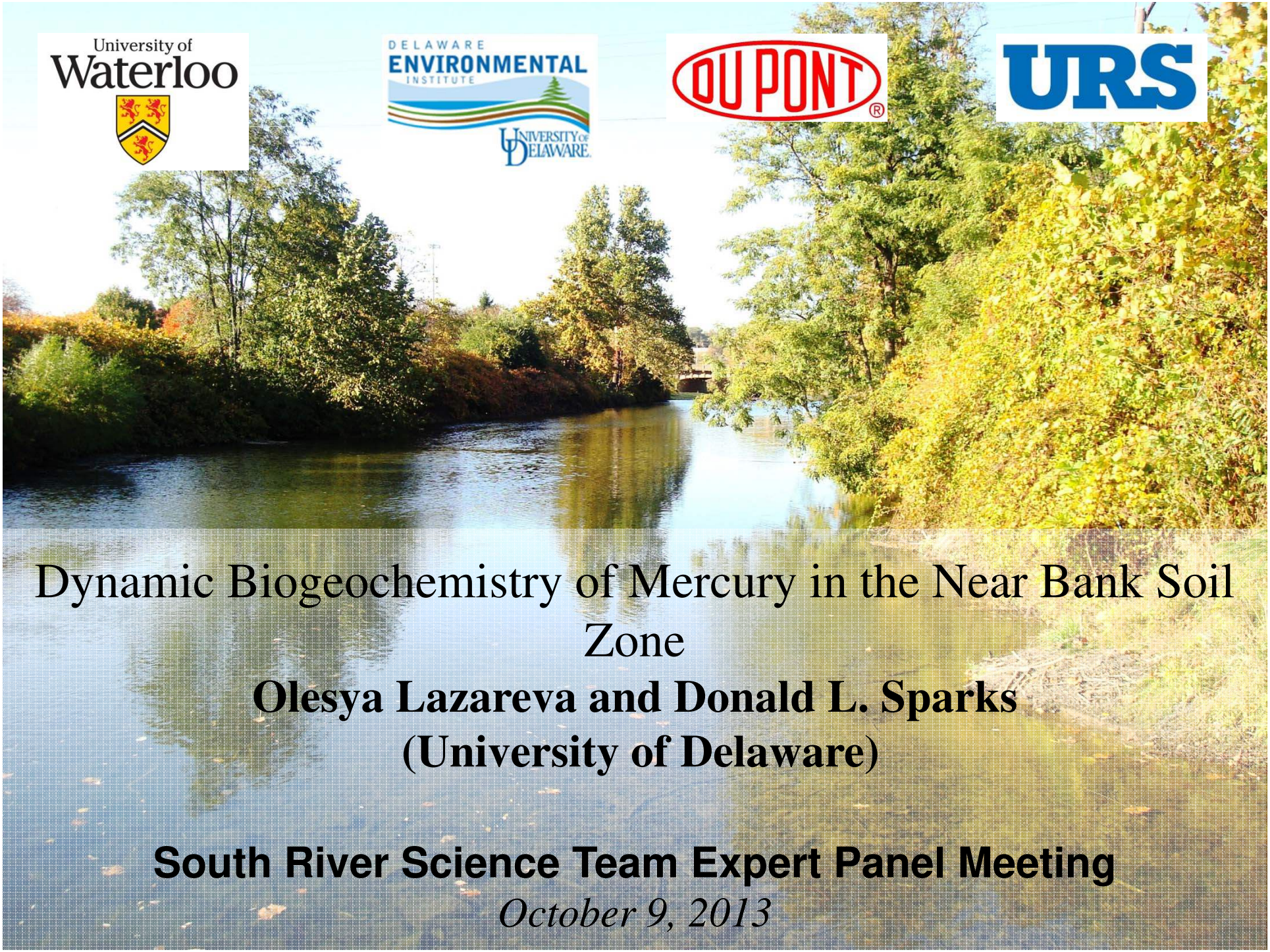


Dynamic Biogeochemistry of Mercury in the Near Bank Soil Zone

Olesya Lazareva and Donald L. Sparks

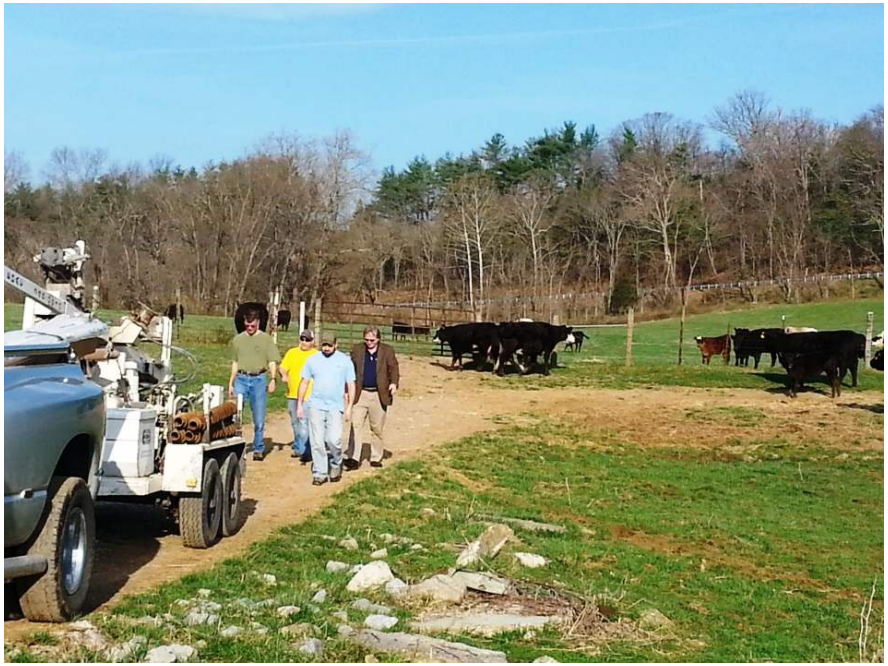
(University of Delaware)

South River Science Team Expert Panel Meeting

October 9, 2013

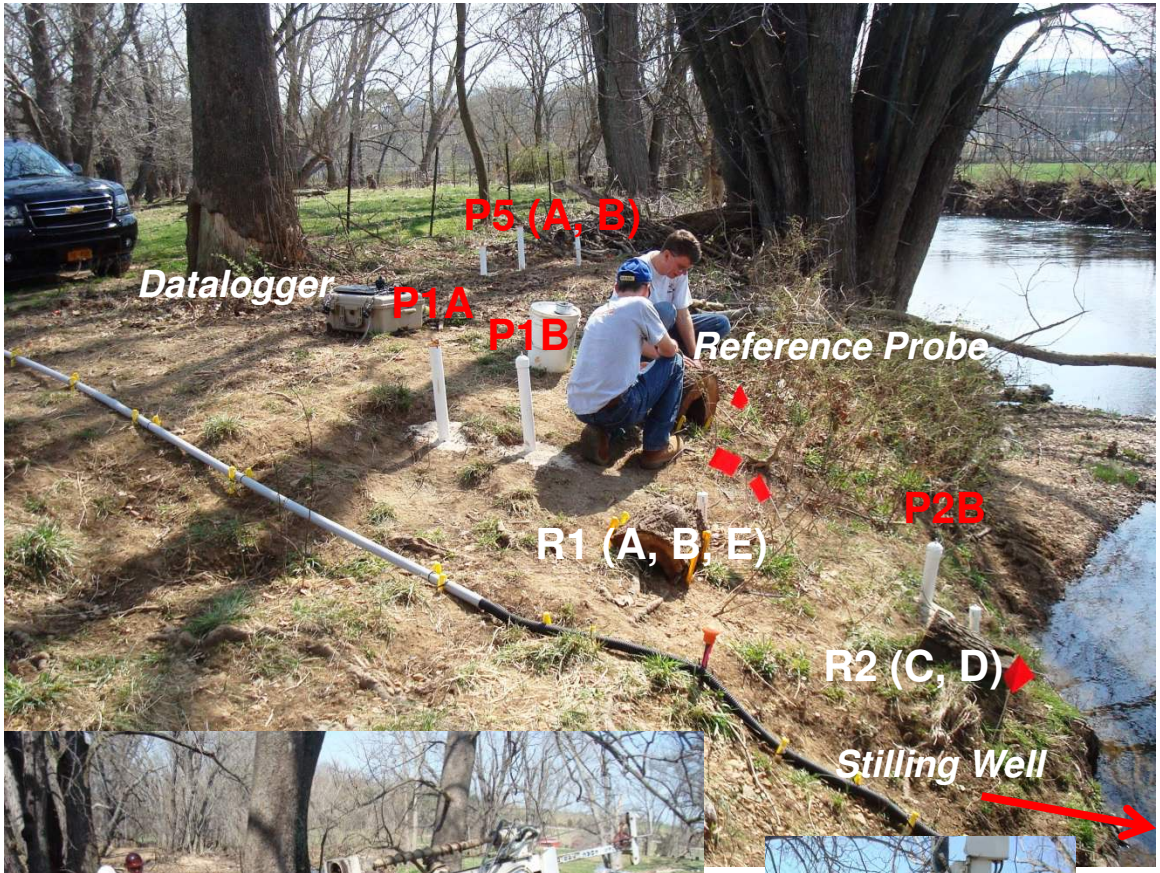
Program Update at RRM 3.5, South River, VA

- Collected and analyzed 6 soil cores including duplicates (57 soil samples total)
- Installed redox, soil moisture/temperature probes and pressure transducers (water level, temperature and conductivity)
- Downloaded and analyzed continuous data set for about 5 months
- Installed, developed and sampled piezometers and stream water



Soil Sampling and Installation of Sensors: February 2013

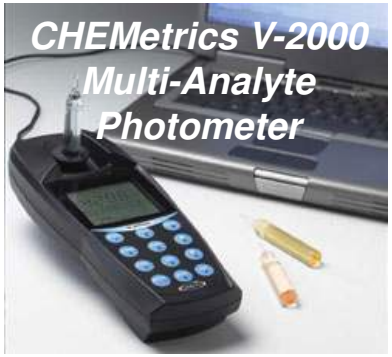
Installation of Sensors and Piezometers: April-May 2013



Water Sampling: July 2 and October 1, 2013

Collected and field filtered (0.45 um) water samples from piezometers and stream for:

- MeHg
- THg
- DOC
- Fe, Mn, Na
- Alkalinity
- Ammonia-N
- Total P
- $\delta^{18}O$ and δD
- Anions (SO_4, Cl, NO_3, NO_2, PO_4)

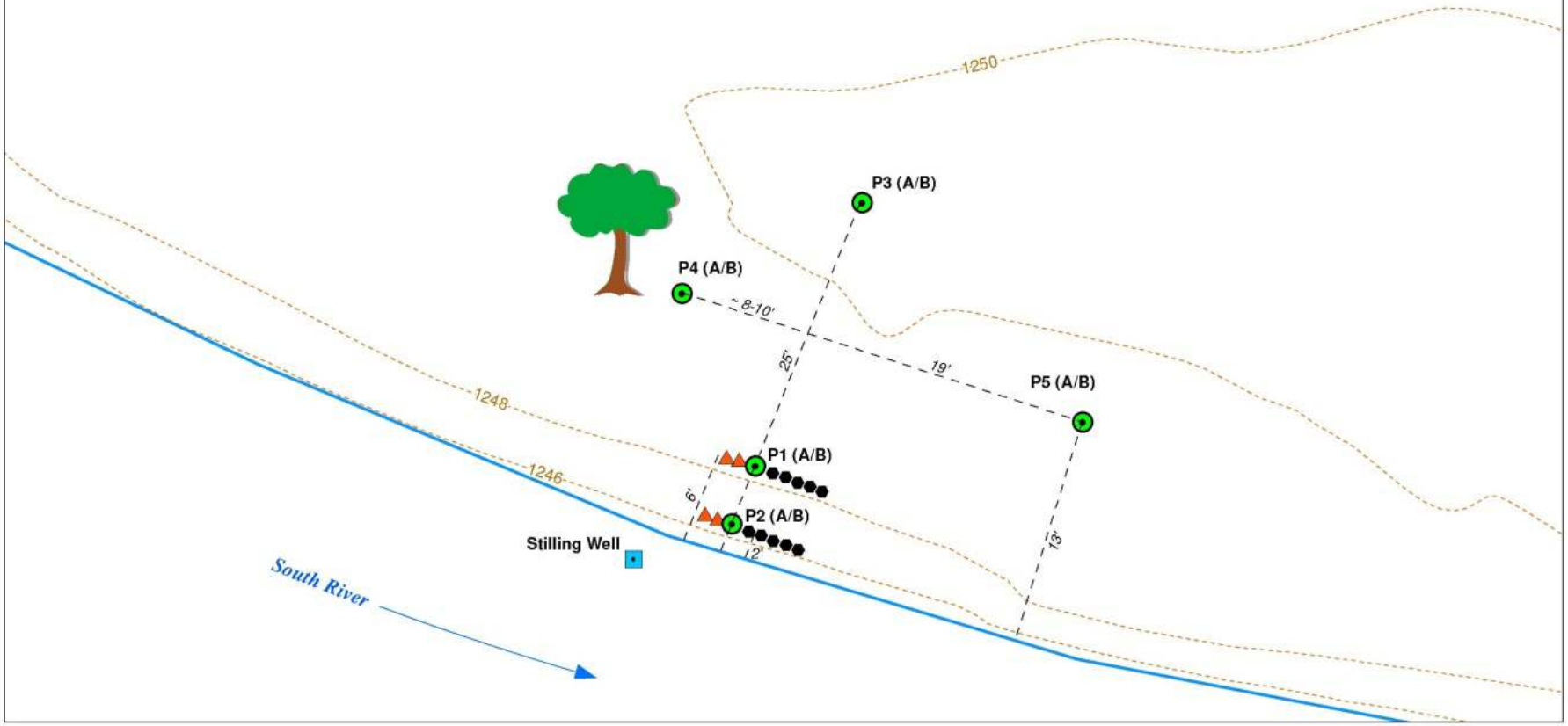


Samples	Date	Time	pH	Temp	Cond	ORP	DO	S^{2-}	Fe^{2+}	Mn
				°C	mS/cm	mV		mg/L		
Stream	7/2/2013	7:10 PM	7.8	20.5	0.2	-69.6	7.3	0.1	0.0	
Stream	10/1/2013	5:10 PM	8.1	18.9	0.3	-67.6	11.9	0.1	0.1	0.1
P2-B	7/2/2013	5:26 PM	6.9	17.6	0.4	-62.0	2.4	0.1	4.3	
P2-B	10/1/2013	no water								
P1-B	7/2/2013	5:56 PM	7.1	15.9	0.3	-56.0	2.0	0.1	3.6	
P1-B	10/1/2013	1:30 PM	6.9	19.0	0.4	-113.1	2.9	0.3	7.1	6.0
P3-A	7/2/2013	4:05 PM	6.9	18.0	0.9	-111.7	3.2	0.1	28.4	
P3-A	10/1/2013	no water								
P3-B	7/2/2013	3:00 PM	7.0	16.8	0.5	-68.9	1.5	0.1	7.1	
P3-B	10/1/2013	11:00 AM	6.9	18.2	0.5	-118.2	4.9	0.1	11.7	3.3
P4-B	7/2/2013	4:41 PM	7.3	16.8	0.5	-110.3	2.0	0.1	0.9	
P4-B	10/1/2013	4:00 PM	6.9	18.9	0.5	-106.1	6.2	0.1	4.0	4.9
P5-B	7/2/2013	6:27 PM	7.1	15.4	0.5	-108.9	0.5	0.4	6.4	
P5-B	10/1/2013	5:10 PM	7.0	19.2	0.4	28.3	-110.1	0.2	12.3	4.0

* Majority of shallow wells were dry

Note:
Piezometers are to be constructed in pairs of shallow (flood bank deposits) and deep (coarse substrate), at distances from the stream of +2', +6', and +25' (P1 through P3), and at lateral distances of ~ 8-10' and 19' from a position +13' from the stream bank (P4 and P5). This will enable monitoring of hydraulic response in both types of deposits and assessment of formation permeability from a) dampening in exposure with distance and b) delay in response with distance.
Flow field will be assessed by multiple pairs of triangulations:
P5/P3/P4, P2/P5/P3, P2/P5/P4, P2/P4/P1, P2/P1/P5, P1/P5/P4

Index Map Not to Scale



URS

Legend

- Stilling Well
- Piezometer
  - Shallow (bank)
  - Deep (coarse)
- Soil Matrix Probe
- UD Redox Probe
- Topo Contours (2ft CI)
- South River Shoreline

E. I. du PONT de NEMOURS & COMPANY
South River Project
PROJECT NO. 18986019

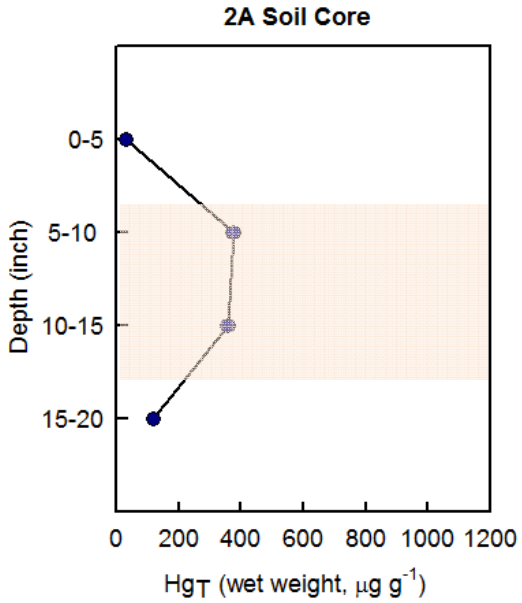
0 5 10 20 Feet
1 inch = 10 feet

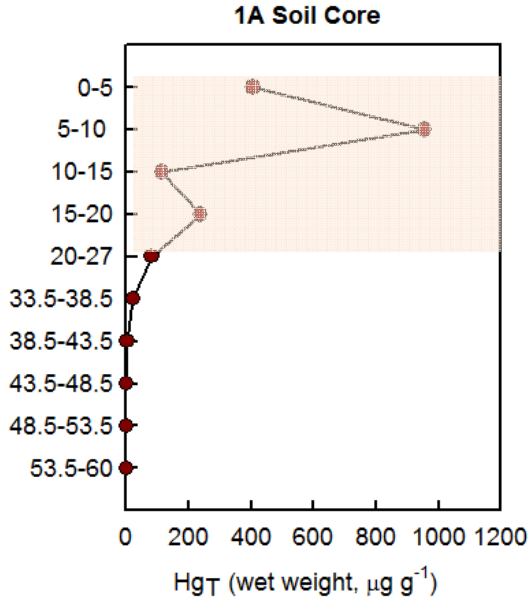
N

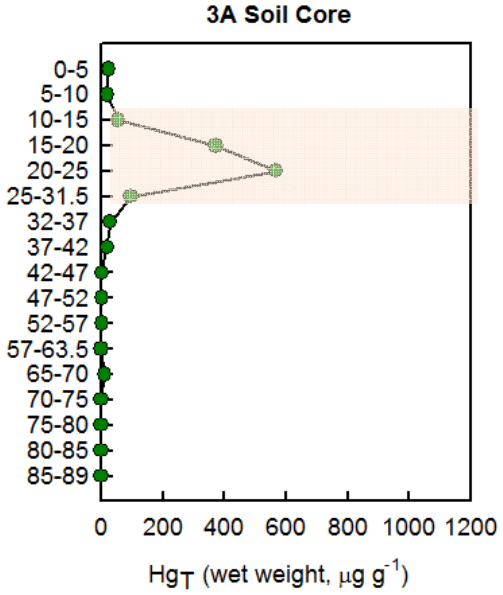
Figure X
Topo Plan

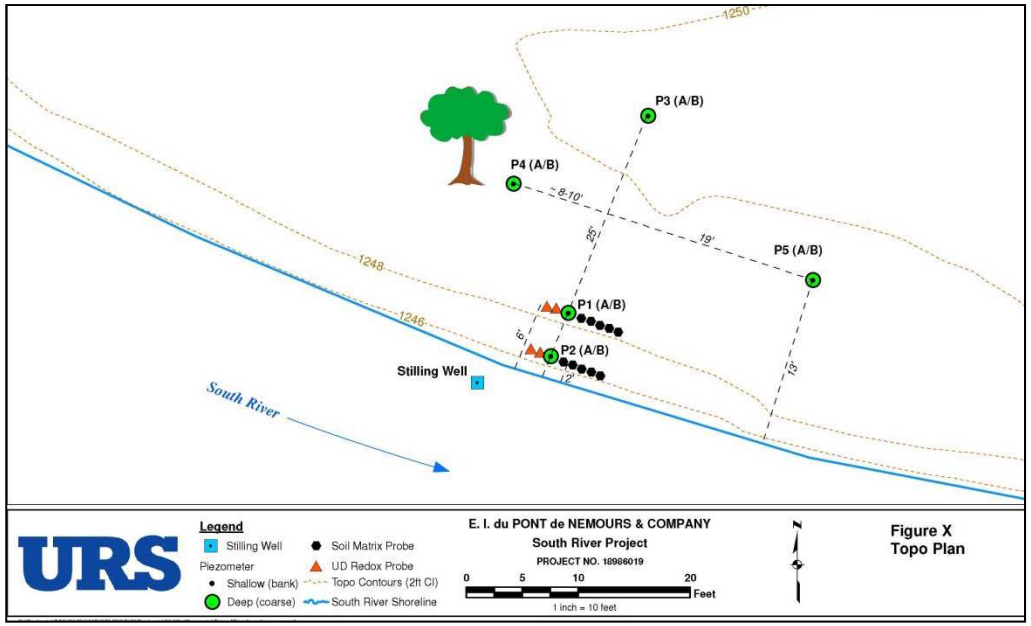
S:\Projects\IMS\DUPONT\STHRIVER\Projects\ShiftlotProperty\Topo Plan Landscape.mxd

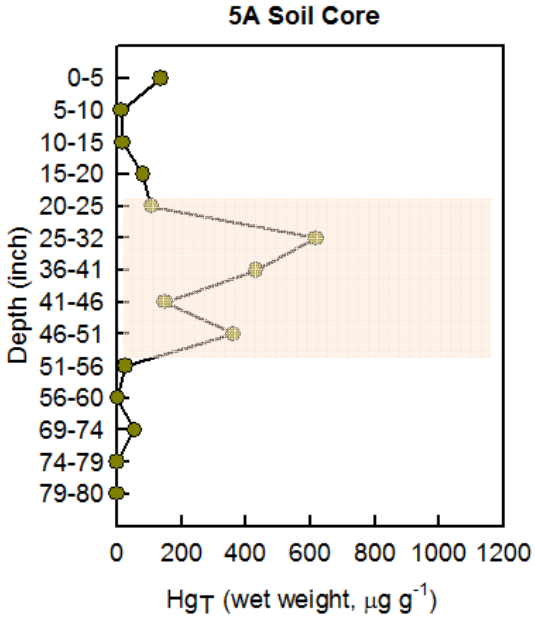
Total Hg Concentration in Soils at 3.5 RRM



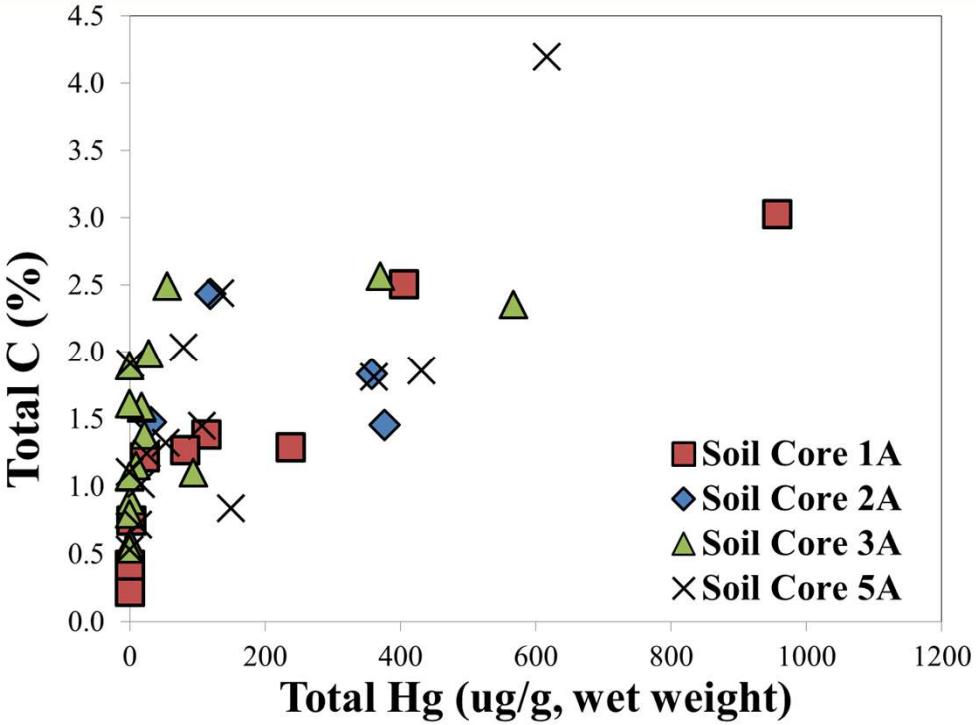


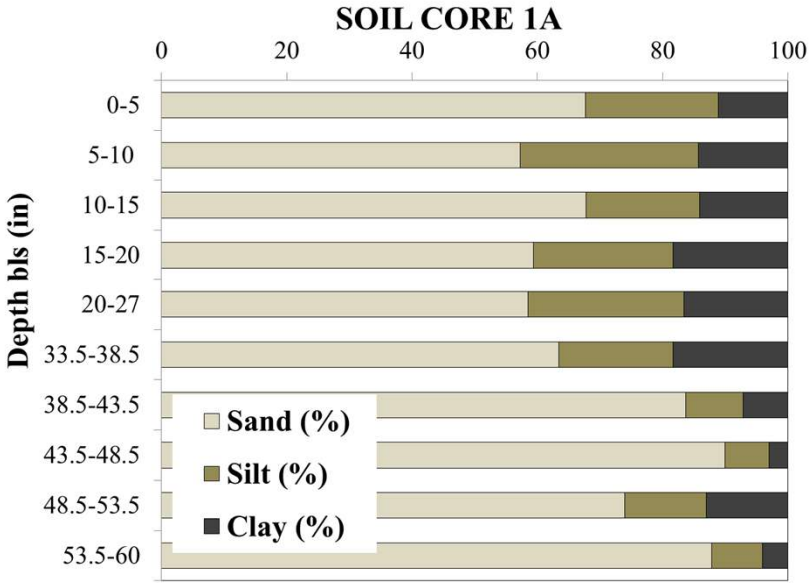


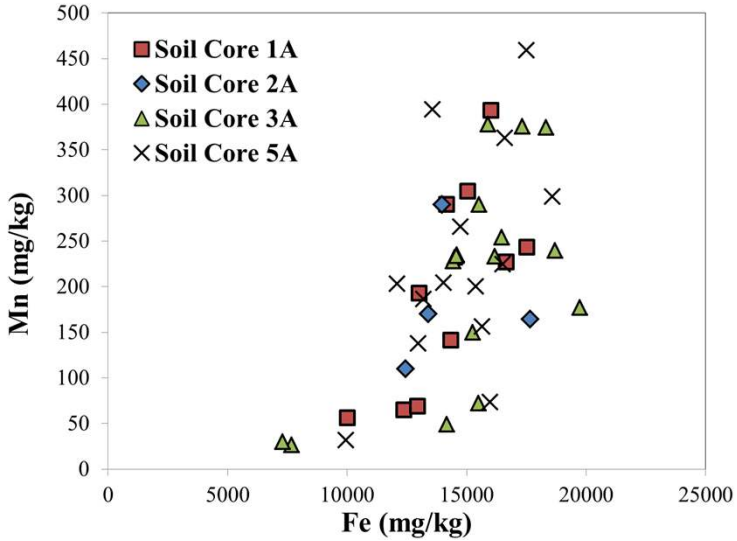




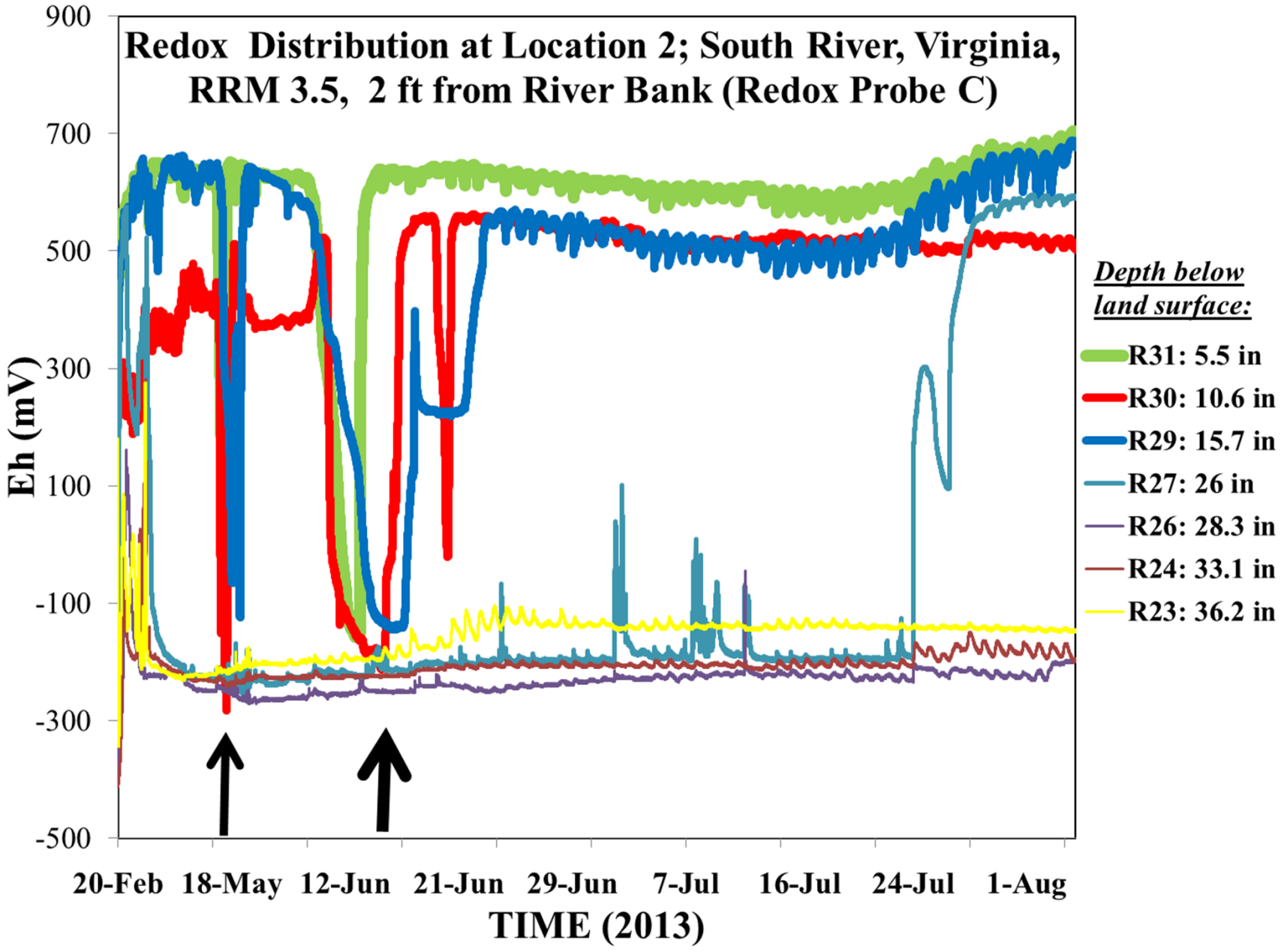
Soil Chemistry



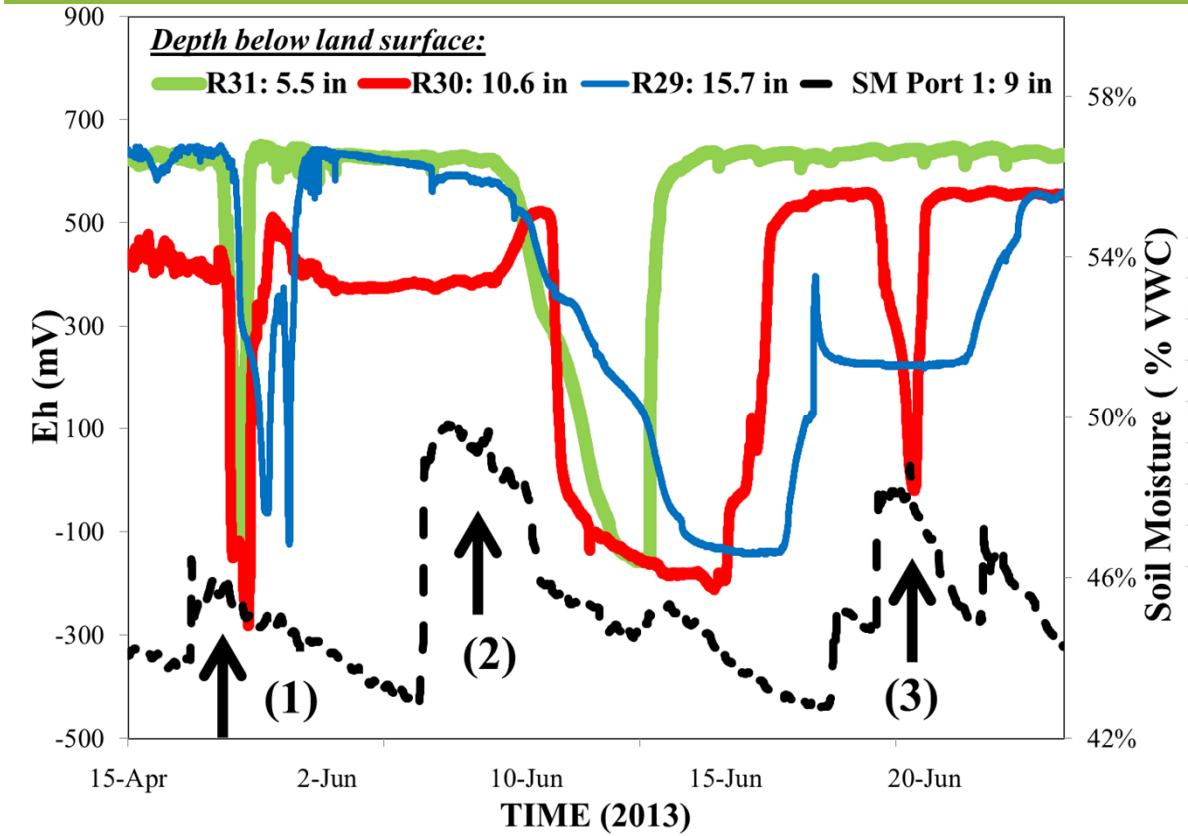




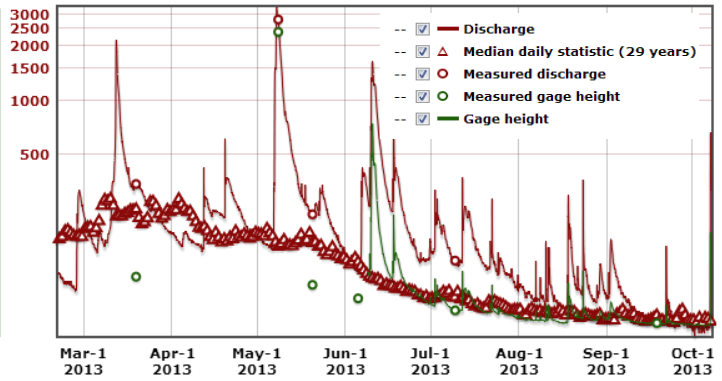
Redox and Soil Moisture: Location 2 at 3.5 RRM; 2 ft from River Bank

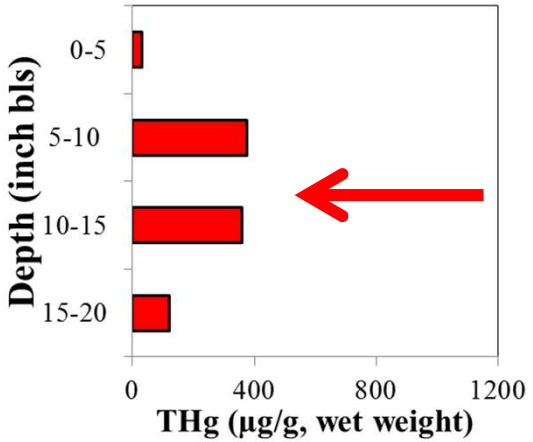


Redox and Soil Moisture: Location 2 at 3.5 RRM; 2 ft from River Bank



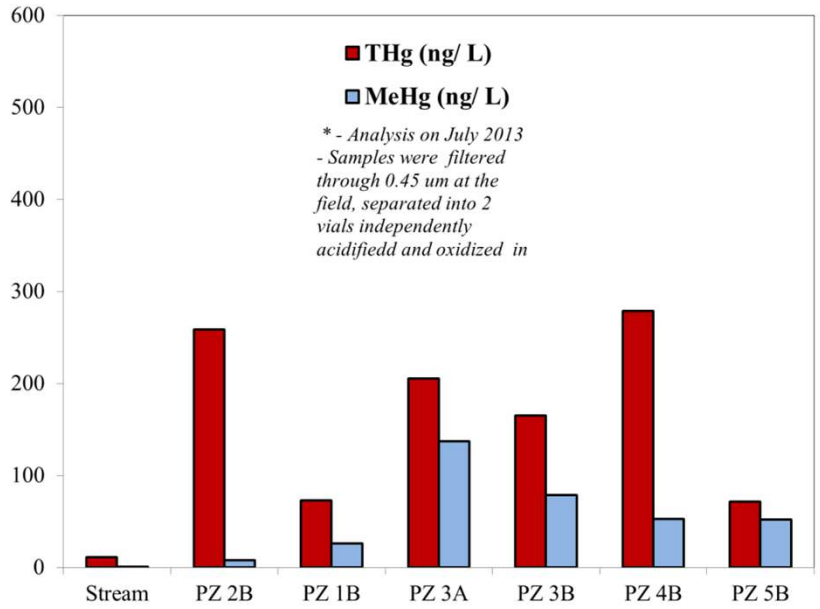
USGS 01626850 SOUTH RIVER NEAR DOOMS, VA

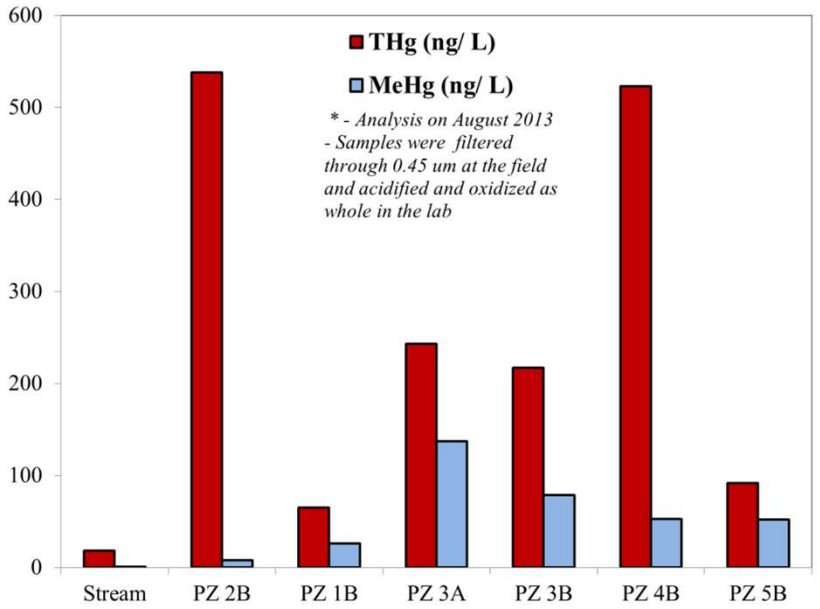




- Arrows indicate a substantial change in soil moisture followed by a drastic redox response due to heavy rainfall and overbank flooding (1, 2 and 3).
- Strong precipitation on May 8 caused sharp and short redox gradient for several days; Less severe precipitation starting June 11 facilitated more sustained response of the redox change, although the redox dropped to the comparative levels.
- There is a defined lag in redox response depending on soil depth.
- Steady rainfall and slow soil saturation causing the prolonged redox response in June could be more effective in Hg mobilization/MeHg production but this have to be verified with the additional water sampling.

Preliminary Water Chemistry Including Hg and MeHg in Piezometers and Stream: Sampling on July 2, 2013 at 3.5 RRM





Sample ID	Cl-	Total P	SO_4^{2-}	NO_3^--N	NO_2^--N	Fe	Na	Mn	NH_3	T Alk
				mg/L						mg$CaCO_3$/L
Stream	8.1	0.1	9.1	0.8	0.4	0.0	5.8	0.0	0.1	94
PZ 2B	10.0	0.1	8.5	0.3	0.4	4.8	9.0	2.6	0.4	185
PZ 1B	9.1	0.1	5.8	0.3	0.4	3.7	5.5	1.4	0.4	174
PZ 3A	53.4	0.1	29.7	0.3	0.4	24.1	23.0	5.0	2.7	423
PZ 3B	12.0	0.1	4.4	0.3	0.4	7.7	9.9	2.6		265
PZ 4B	9.5	0.1	9.3	0.3	0.4	0.5	7.4	1.2	0.1	185
PZ 5B	19.4	0.1	6.2	0.3	0.4	9.6	13.8	5.0	0.4	303


Thank you!