

Hydrology and Water Quality Impacts of Loblolly Pine (*Pinus taeda*) and Switchgrass (*Panicum virgatum*) Intercropped Systems in Upland Southeastern Forested Watersheds

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Background

- ▶ Increased energy demand ^[1]
- ▶ Biofuels as alternative energy sources
 - Replace fossil fuels ^[1]
 - Reduce dependency on foreign oil ^[1]
 - Self-sustaining ^[1]
 - The Energy Independence and Security Act of 2007 ^[2]
 - Ethanol
 - Advanced biofuels – switchgrass and soybeans



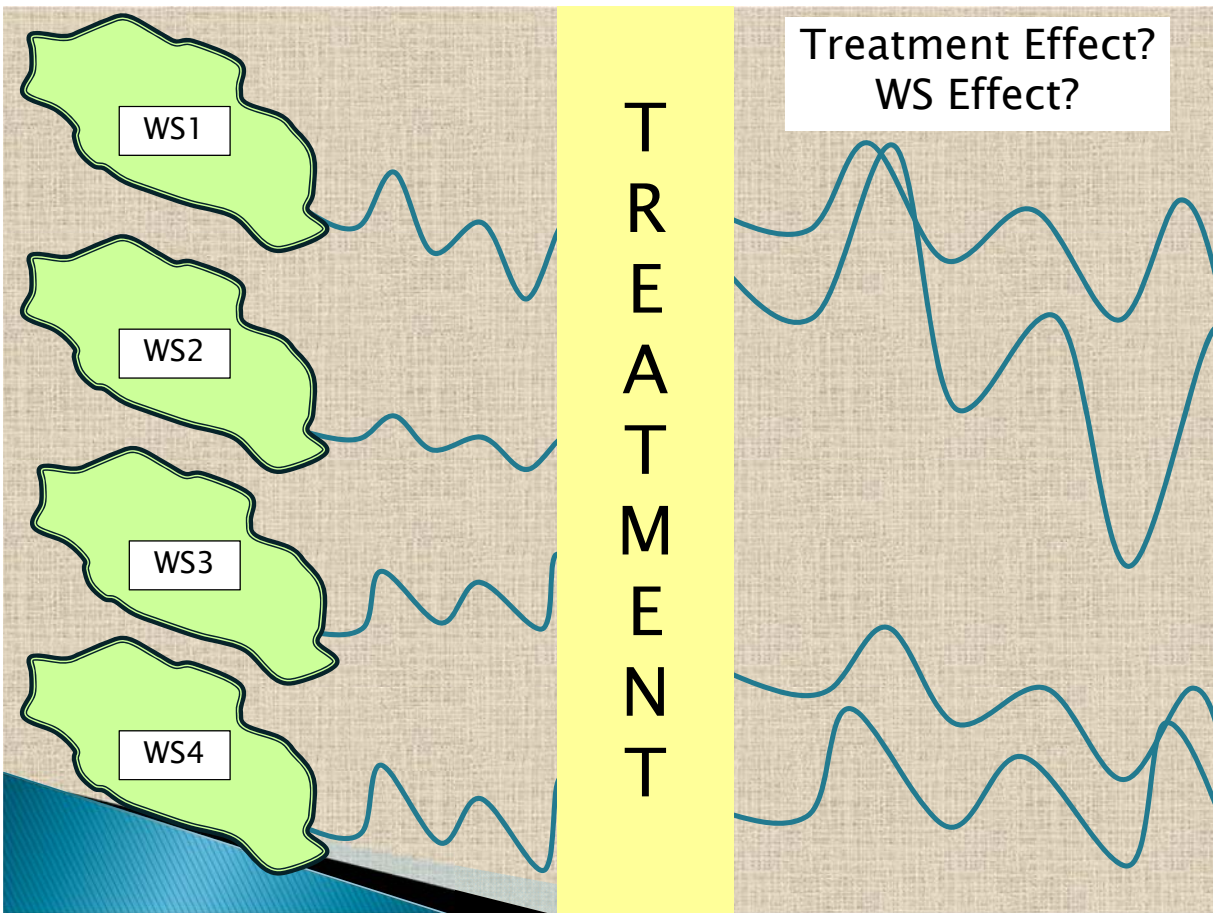
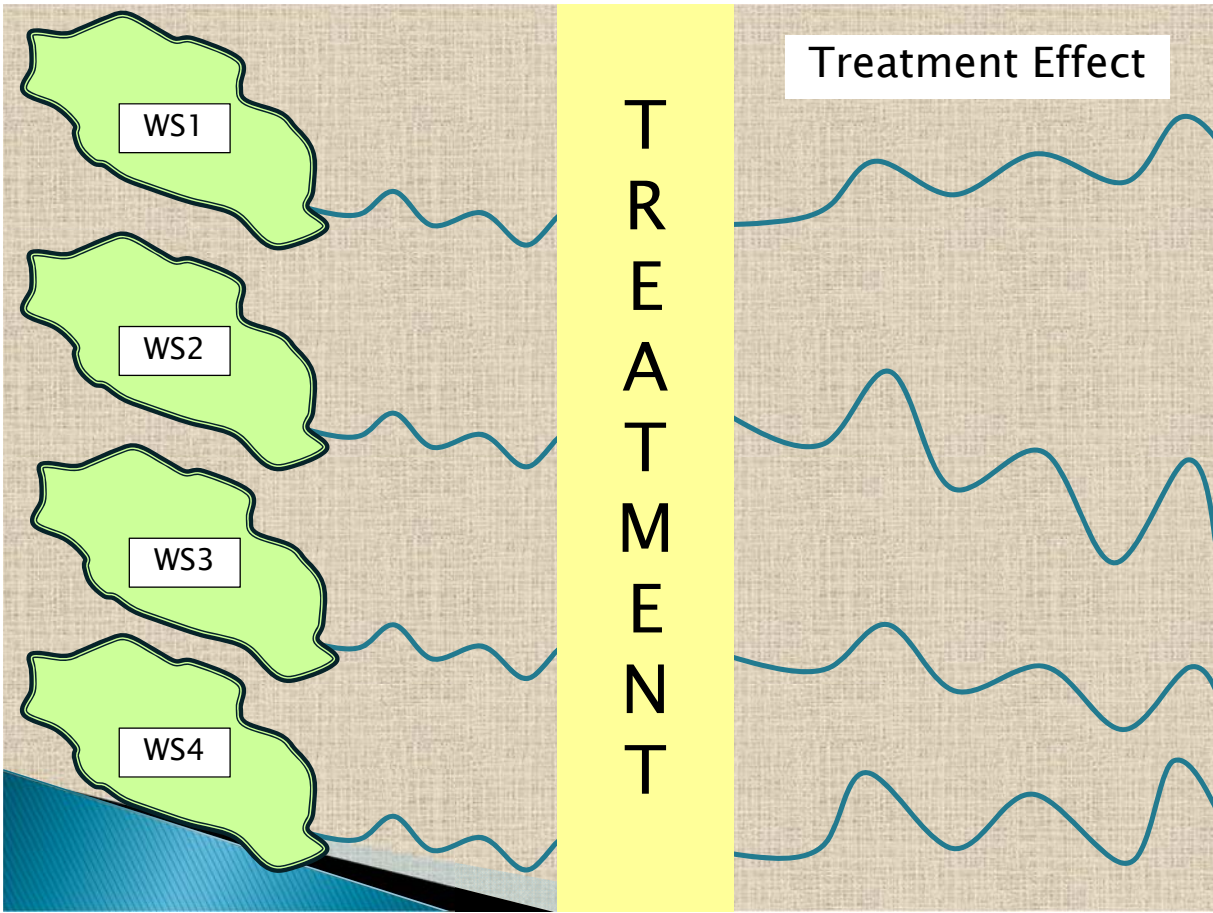
What is Biomass Intercropping?

- ▶ Competition with food crops ^[3]
- ▶ Not taking away potential agricultural land ^[3]
- ▶ Too much shade after 10 years ^[4]



Potential Problems

Crop Management	Potential Effects
Bare ground during establishment	Increase soil erosion and increase the amount of runoff from the site ^[5]
Fertilization	Potential nutrient leakage and increased nutrient loading ^[6]
Equipment traffic	Soil compaction and reduce infiltration which may increase the runoff from the site ^[4]



Project

- ▶ Catchlight Energy, LLC – joint venture between Weyerhaeuser Company and Chevron Corporation and by the Department of Energy
- ▶ Environmental Sustainability
 - Look at environmental effects of cellulosic biofuel growth in a forest setting
 - Hydrology, water quality, soil productivity, carbon, and wildlife research projects



Project

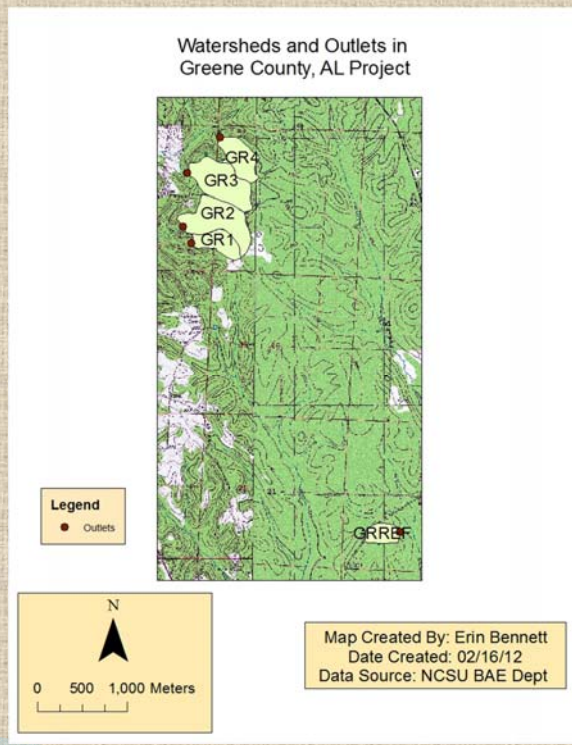
- ▶ 3 field regions: NC, MS, and AL
- ▶ 4 to 5 watersheds each having differing land cover treatments
 - Watersheds range from 20 to 40 ha



Site

- ▶ Greene County, AL
- ▶ 5 watersheds and 5 different land cover treatments
- ▶ Initially (March 2010–March 2012) the first four watersheds were young pine stands with undergrowth and the fifth watershed is a 18 year reference pine stand (GRREF)
- ▶ In March 2012 the treatments were implemented:

GR1	Pine w/ undergrowth
GR2	Thinned pine w/ switchgrass intercropped
GR3	Age 0 pine w/ switchgrass intercropped
GR4	Switchgrass only
GRREF	Reference stand



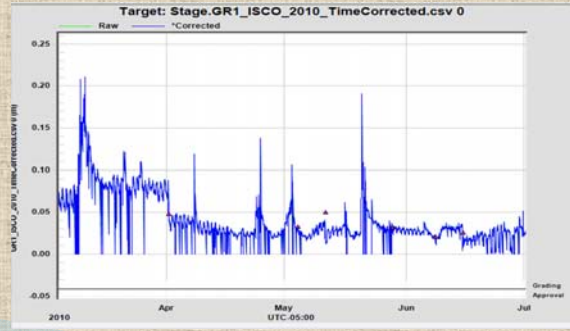
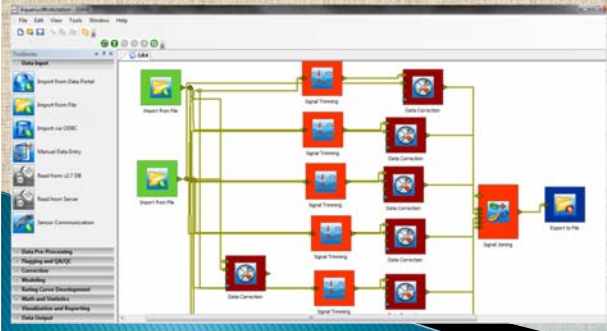
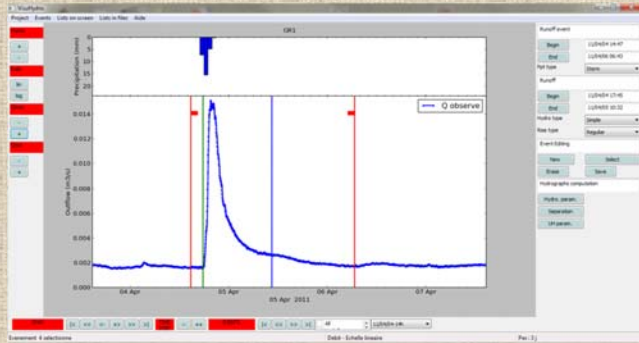
Data Collection

- ▶ Wooden Flumes
- ▶ Velocity (2 min)
- ▶ Stage (2 min)
- ▶ Weather (15 min)
- ▶ Flow Proportional Composite Sampling
 - NO_3^- , NH_4^+ , TKN, TSS, TP, DOC, and DIC



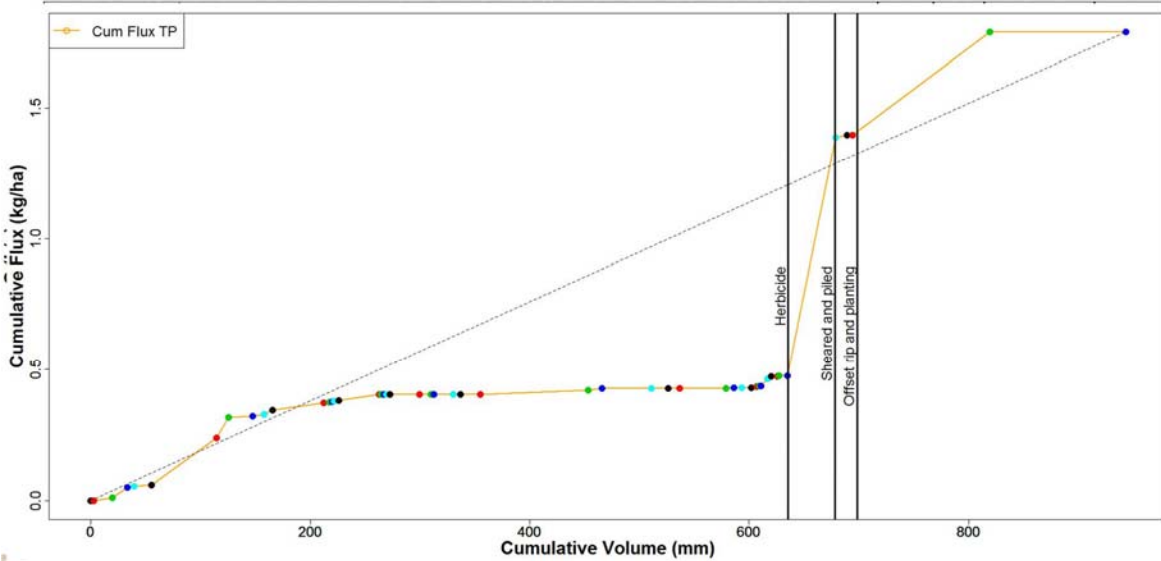
Software

- ▶ AQUARIUS software [11]
- ▶ R Statistical Software
- ▶ VisuHydro [12]
- ▶ Excel
- ▶ SAS



Methods

1. Beginning of event
2. Beginning of runoff

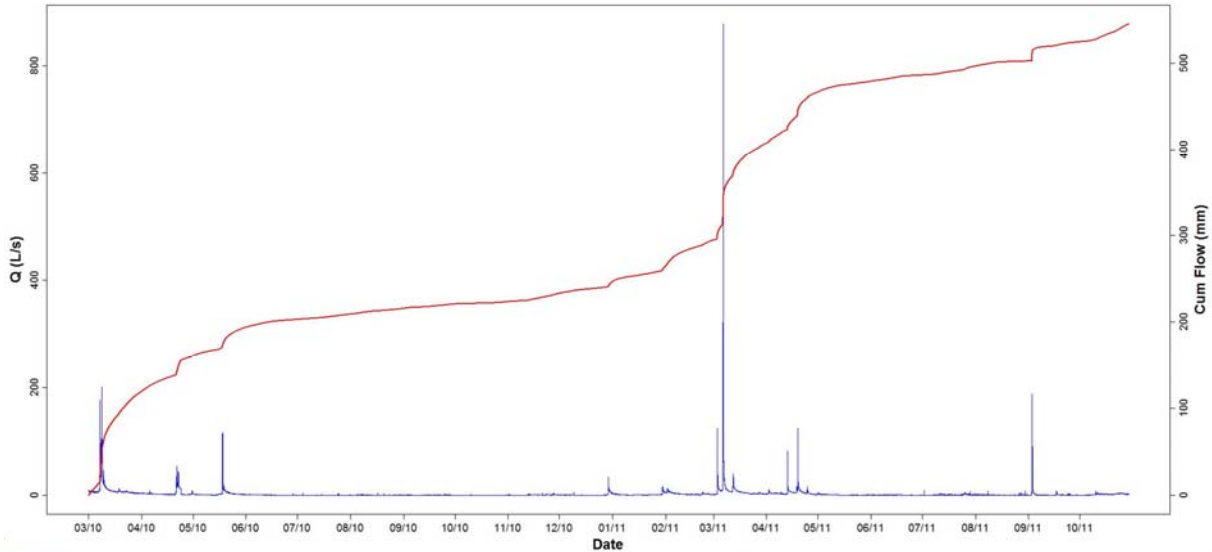


Cumulative Loading

Cumul Loading vs. Cumul Volume

Correcting Hydrology Data

GR3

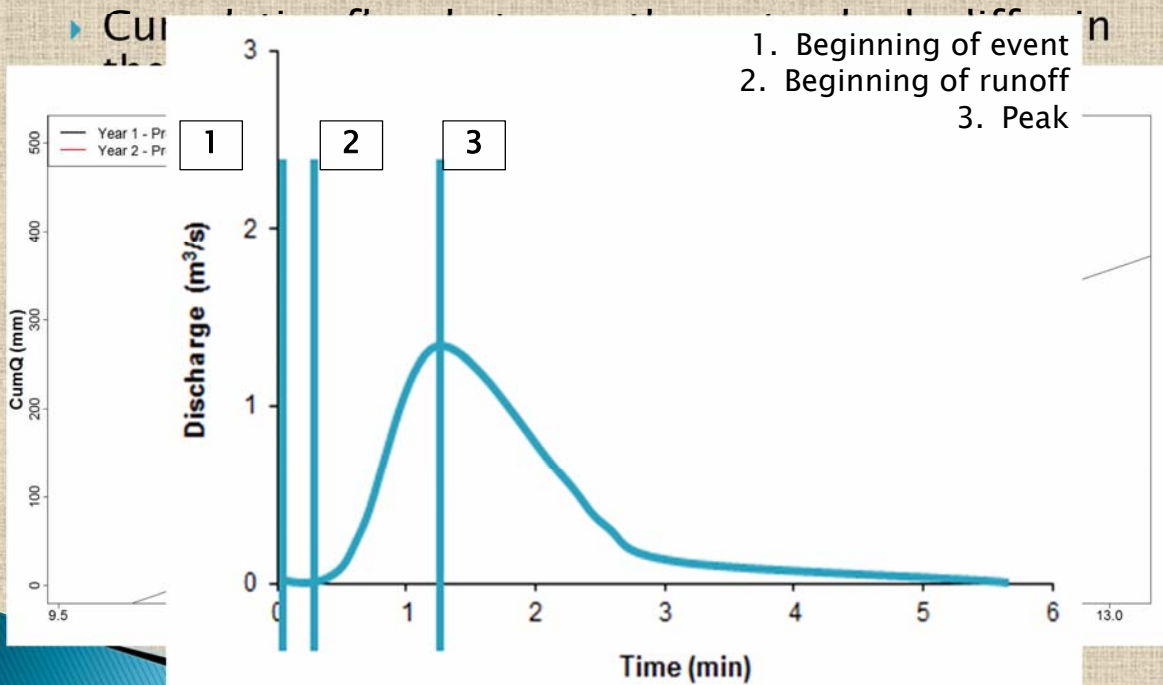


Pre-treatment (Year 1)

Pre-treatment (Year 2)

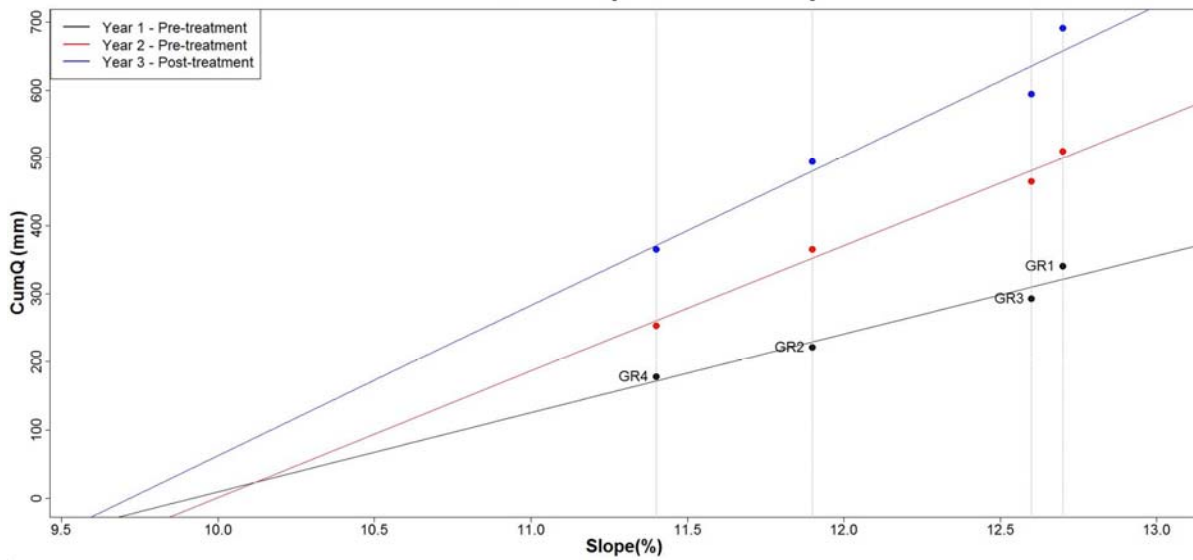
Post-treatment (Year 3)

Pre-treatment



Results – Hydrology – Pre vs. Post-treatment

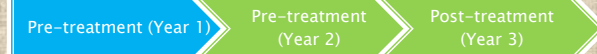
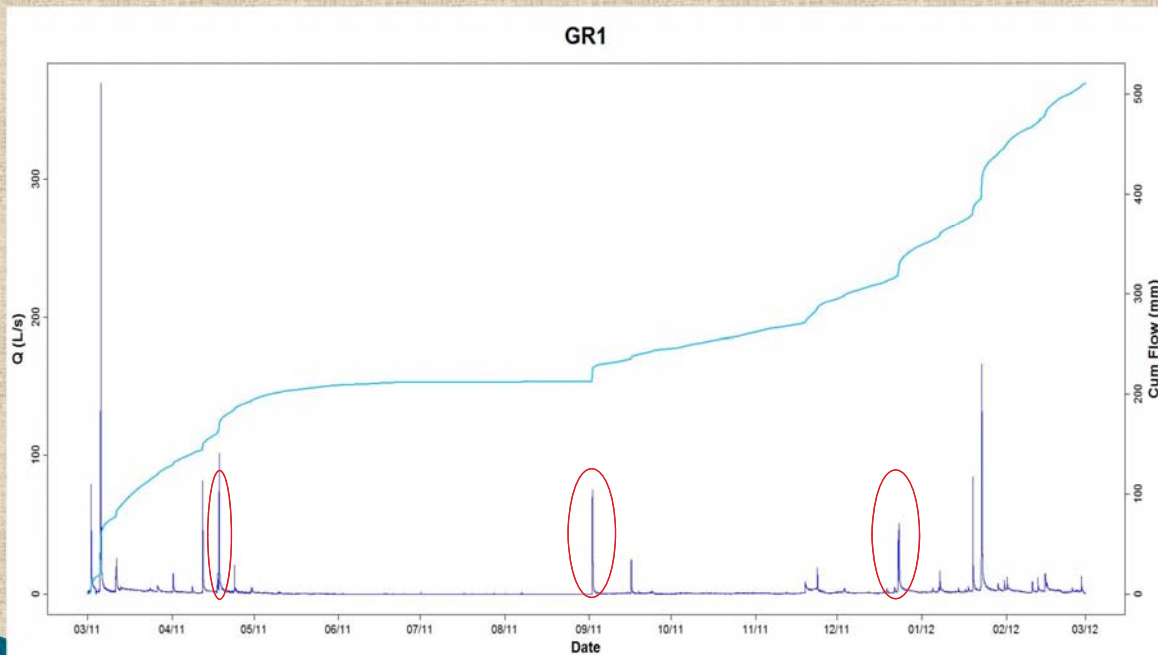
CumQ vs. Slope Relationship



GR1	Pine w/ undergrowth
GR2	Thinned pine w/ switchgrass intercropped
GR3	Young pine w/ switchgrass intercropped
GR4	Switchgrass only
GRREF	Reference stand

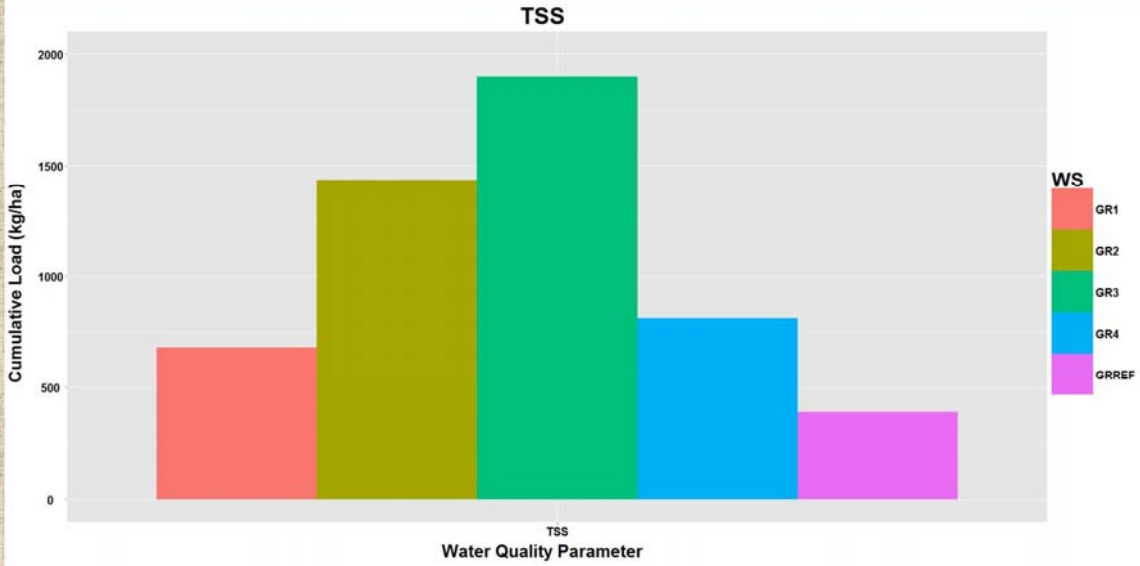


Flashiness: Pre vs. Post-treatment



Results – Water Quality – Pre vs. Post-treatment

Post-treatment: March 2012 – Mar 2013

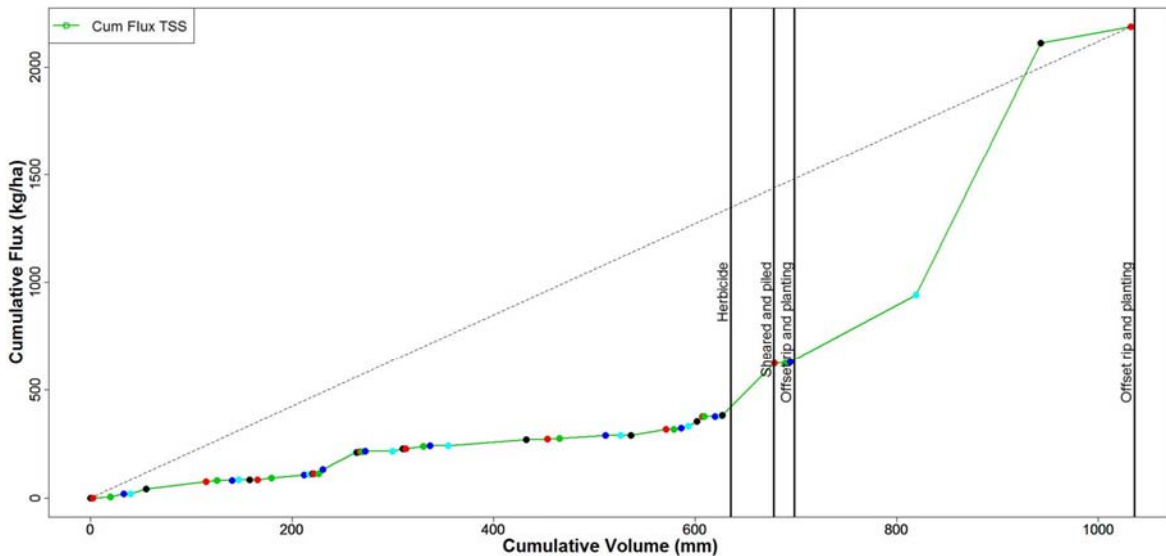


GR1	Pine w/ undergrowth
GR2	Thinned pine w/ switchgrass intercropped
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GRREF	Reference stand



Results – Water Quality – Pre vs. Post-treatment

GR3 2011-01-19 - 2013-03-12



GR1	Pine w/ undergrowth
GR2	Thinned pine w/ switchgrass intercropped
GR3	Young pine w/ switchgrass intercropped
GR4	Switchgrass only
GRREF	Reference stand



Conclusions – Hydrology and WQ

- ▶ No treatment effect for the watersheds.
- ▶ The more precipitation and larger the watershed slope the more flow out of the watersheds.
- ▶ There was a WQ loading increase and the hierarchy changed between pre and post-treatment.
- ▶ There were changes in the temporal dynamics of exports as a function of volume due to management practices.

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- [12] VisuHydro. Robert Lagacé, Université Laval, Québec, Canada.

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Any Questions?

