Impacts of Waynesboro Wastewater Treatment Plant Upgrades on South River

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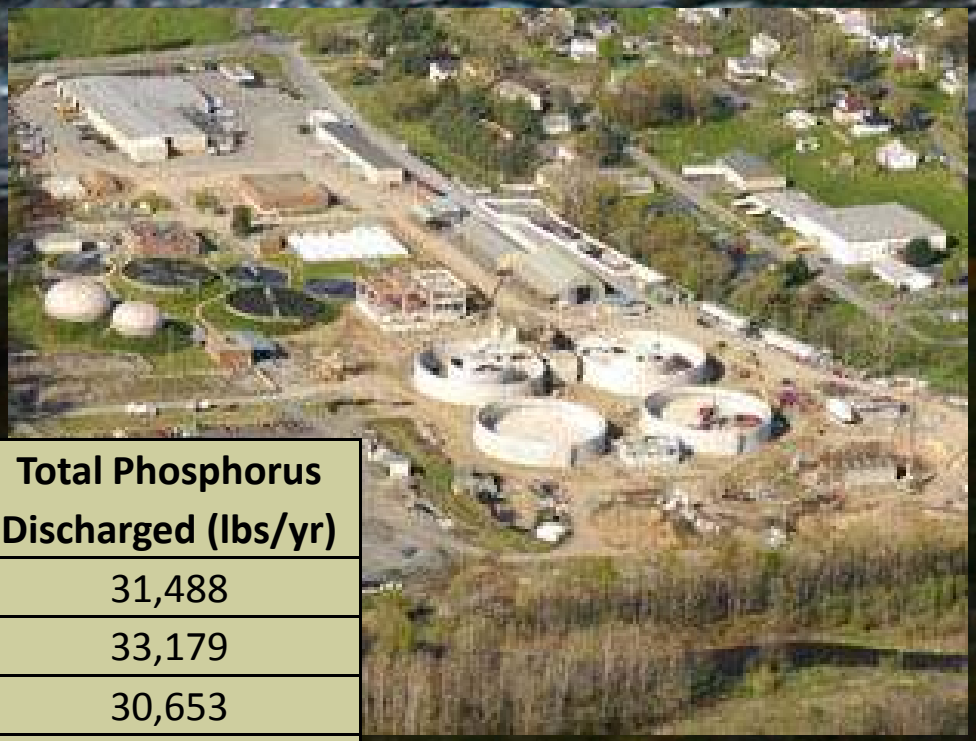
Waynesboro WWTP Upgrades

- Biological Nutrient Removal (BNR) installed
- Large reductions in nitrogen and phosphorus expected



Year	Total Nitrogen Discharged (lbs/yr)	Total Phosphorus Discharged (lbs/yr)
2007	156,602	31,488
2008	130,199	33,179
2009	131,121	30,653
Average (2007-2009)	139,307	31,773
Permit Limits for 2011	48,729	3,655
Anticipated Reduction (%)	65%	88%

Impacts on South River

- 4 sites chosen to bracket outfall (from 250 ft upstream to 1 mile downstream)
- Sites monitored during 6 week pre-upgrade period and 6 week post-upgrade period

Experimental Design

Schedule	Water Quality Analysis				Periphyton Analysis		
	DO, pH, Cond., Temp.	Cl, NO3, PO4, SO4, TP	TSS	THg (filt & unfilt), MeHg (filt & unfilt)	Biomass	Colonized THg, MeHg	Natural THg, MeHg
Prior to Upgrades							
Week 1	x	x					
Week 2	x	x			x		
Week 3	x	x					
Week 4	x	x	x	x	x		
Week 5	x	x					
Week 6	x	x	x	x	x	x	
After Upgrades							
Week 1	x	x					
Week 2	x	x			x		
Week 3	x	x					
Week 4	x	x	x	x	x		
Week 5	x	x					
Week 6	x	x	x	x	x	x	x
Samples	60	55	13	60	120	40	12
Parameters	4	4	1	4	1	2	2
Total Data Points	240	220	13	240	120	80	24
						Sum =	937

Algae Colonization

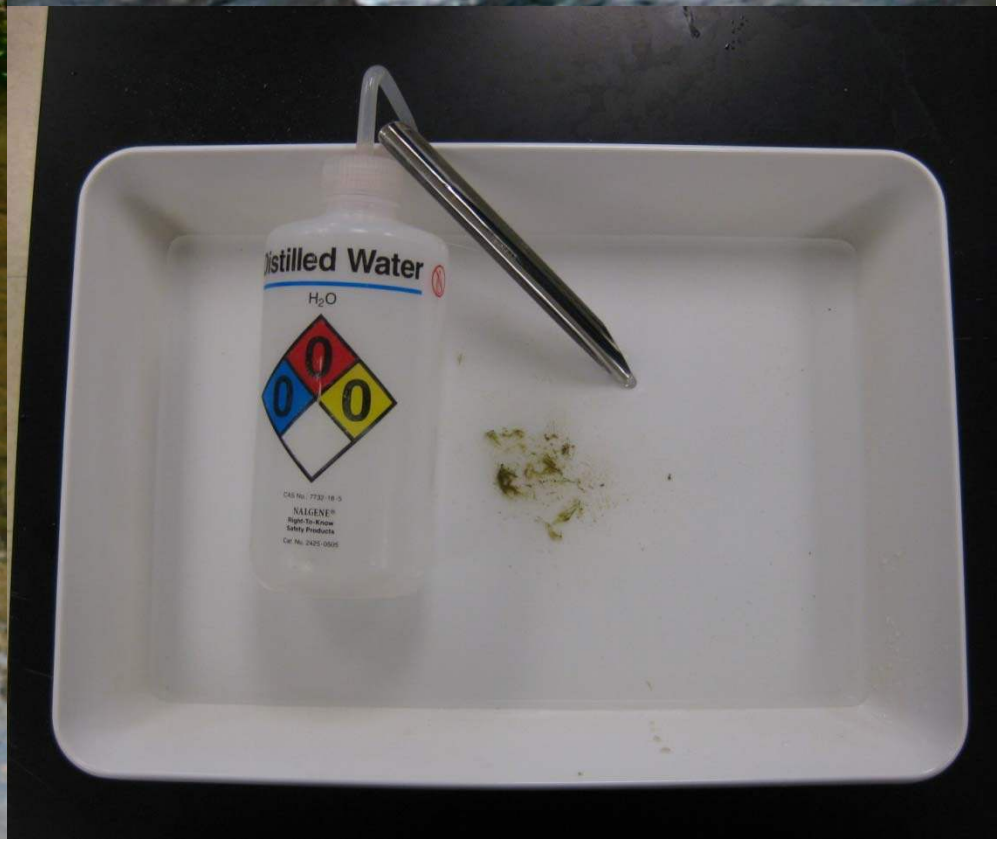
- 8 Replicate trays of 4 rocks placed at each site
- Rock sampled for biomass at 2, 4, and 6 weeks colonization

Biomass Sampling

- Fixed area sampled for biomass using cookie cutter, toothbrush, funnel, squirt bottle
- Scraped material processed for dry weight and ash-free dry weight

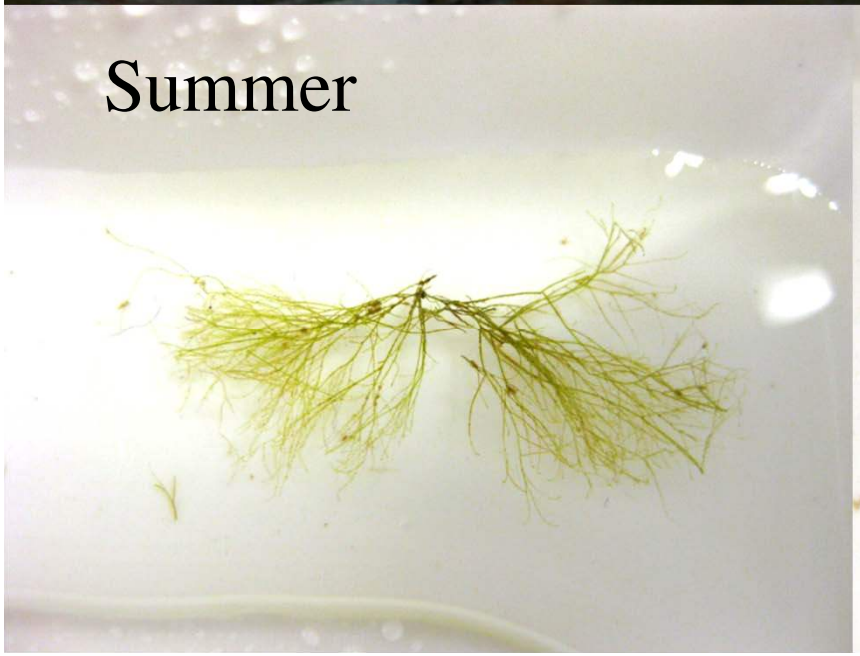
Mercury Sampling

- Attached algae scraped with stainless steel spatula
- Rinsed and sorted in plastic tray to remove sediment and macroinvertebrates

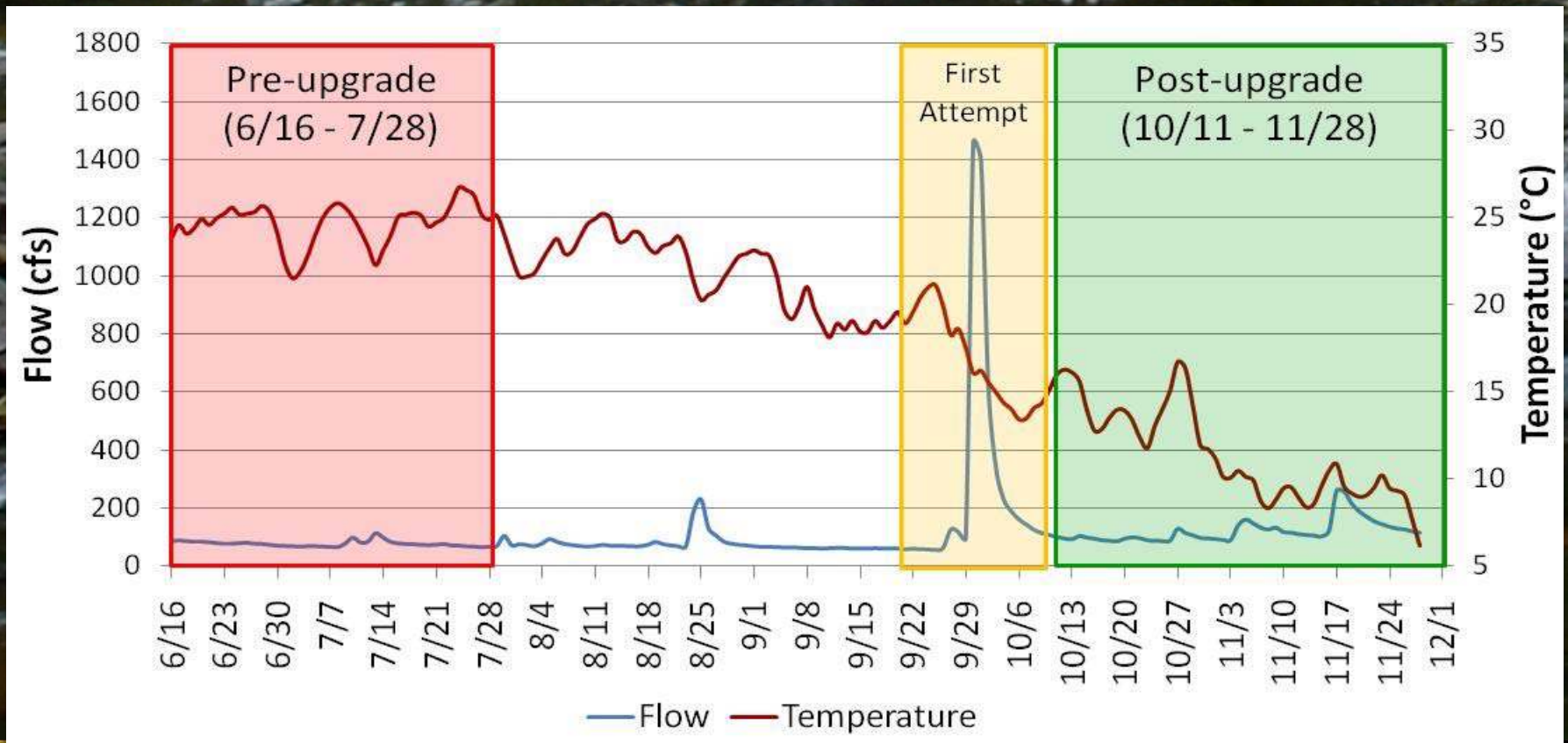


Mercury Sampling

- Goal was to just sample attached algae
- Composition of colonized algae in fall did not allow this separation
- Natural algae also sampled in fall



Monitoring Time Periods



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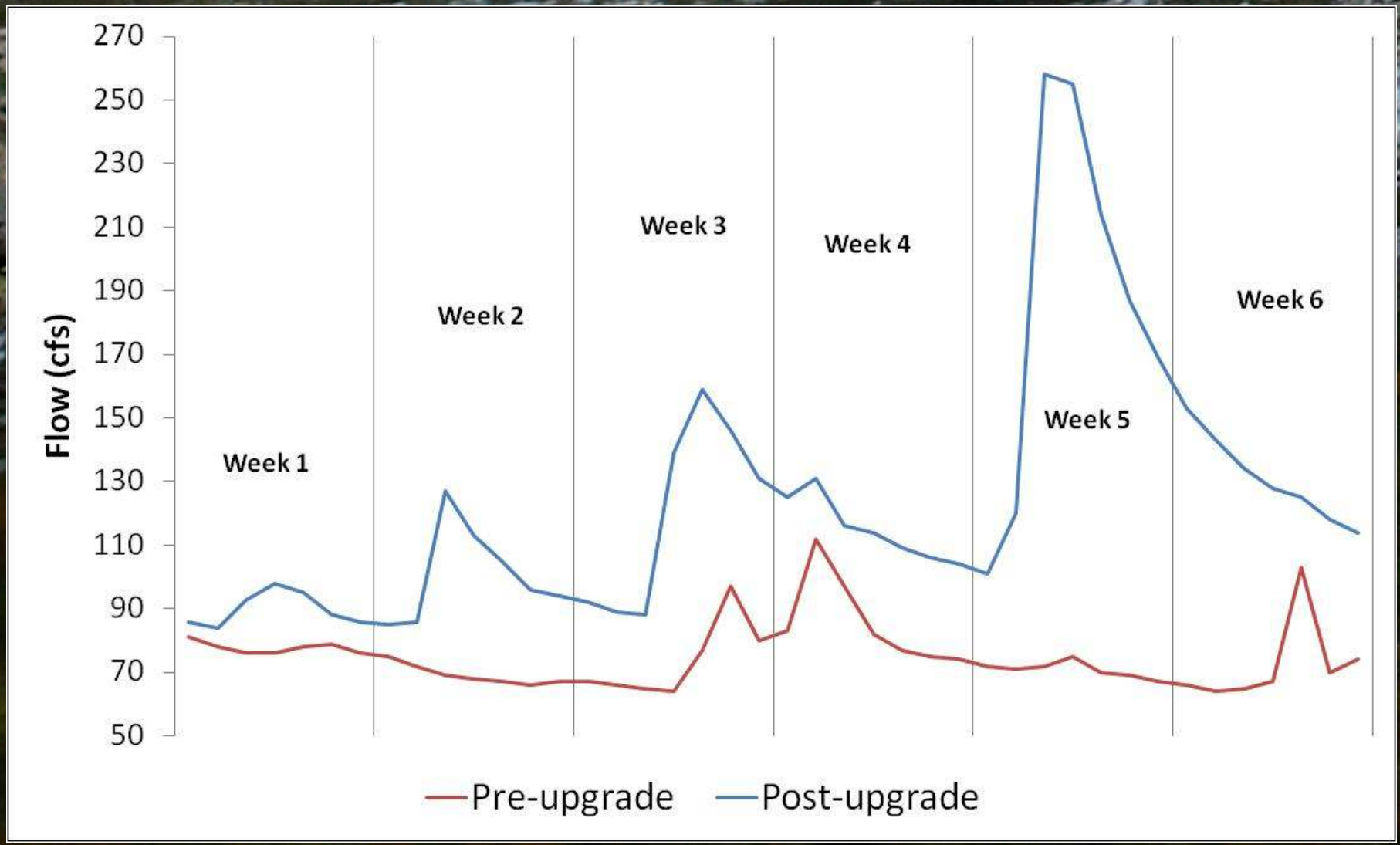
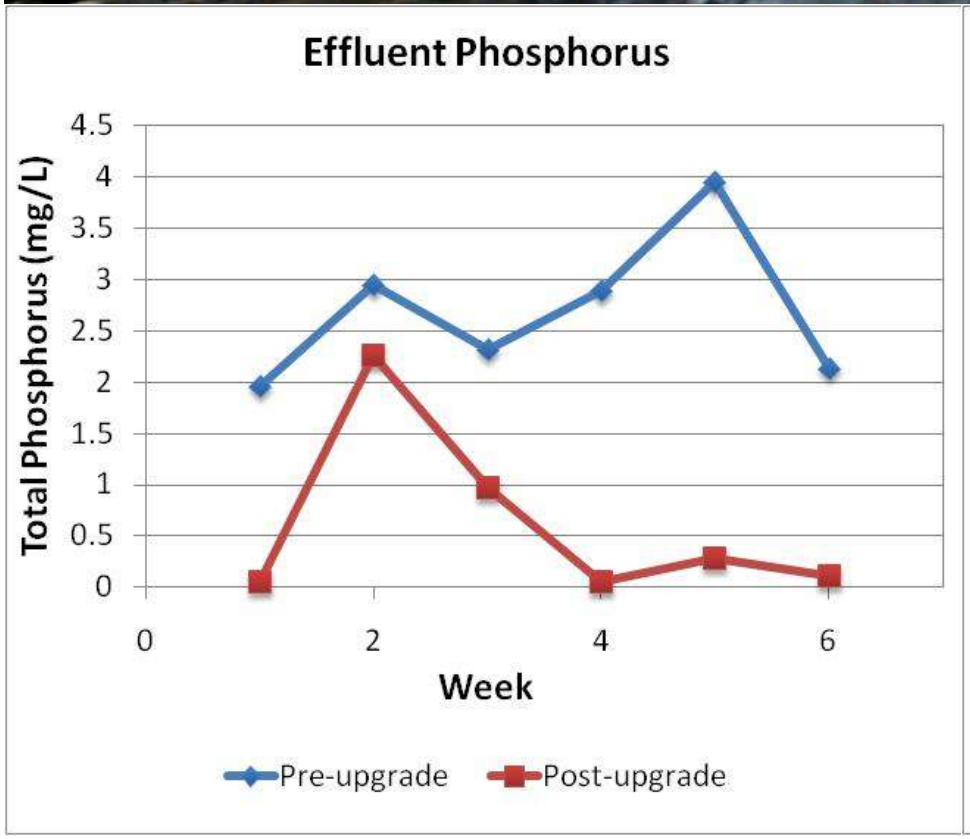
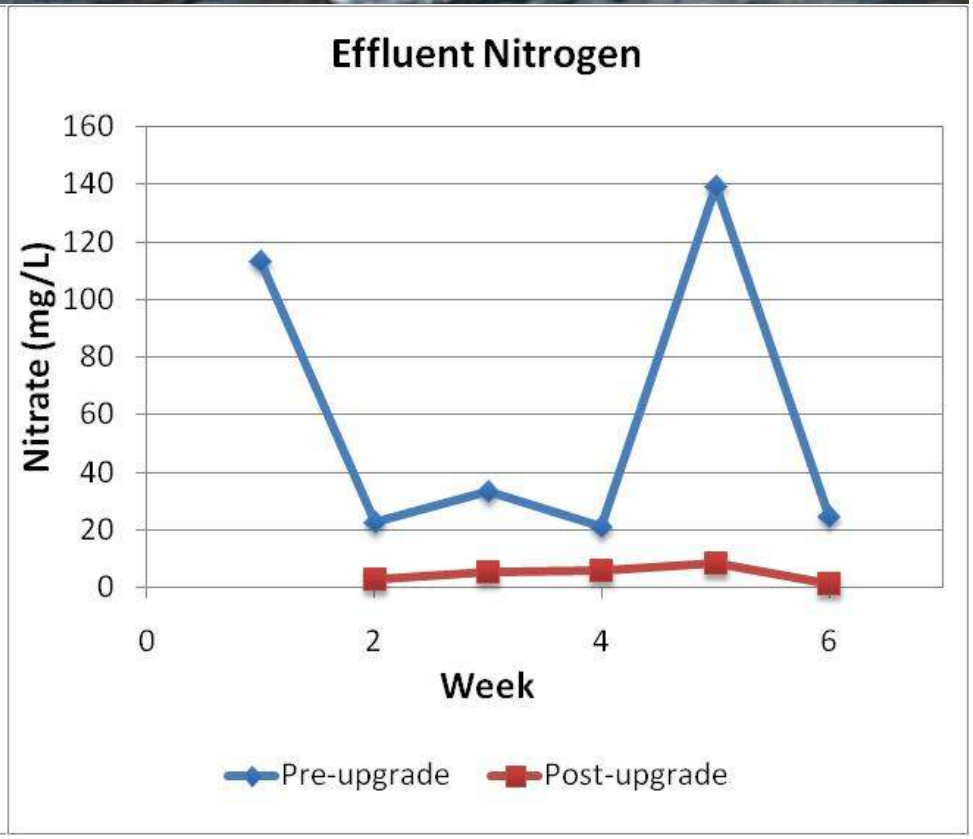


Nutrient Levels in Discharge

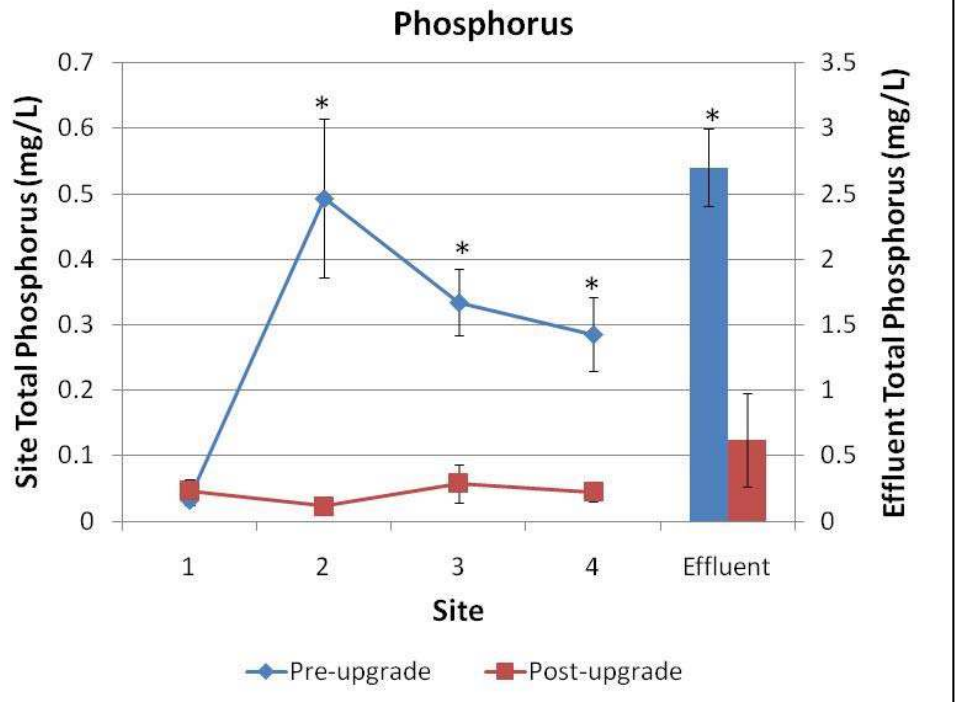
- Average phosphorus levels dropped 77% following upgrades (from 2.7 to 0.62 mg/L)
- Average nitrate levels dropped 92% following upgrades (from 59 to 4.7 mg/L)

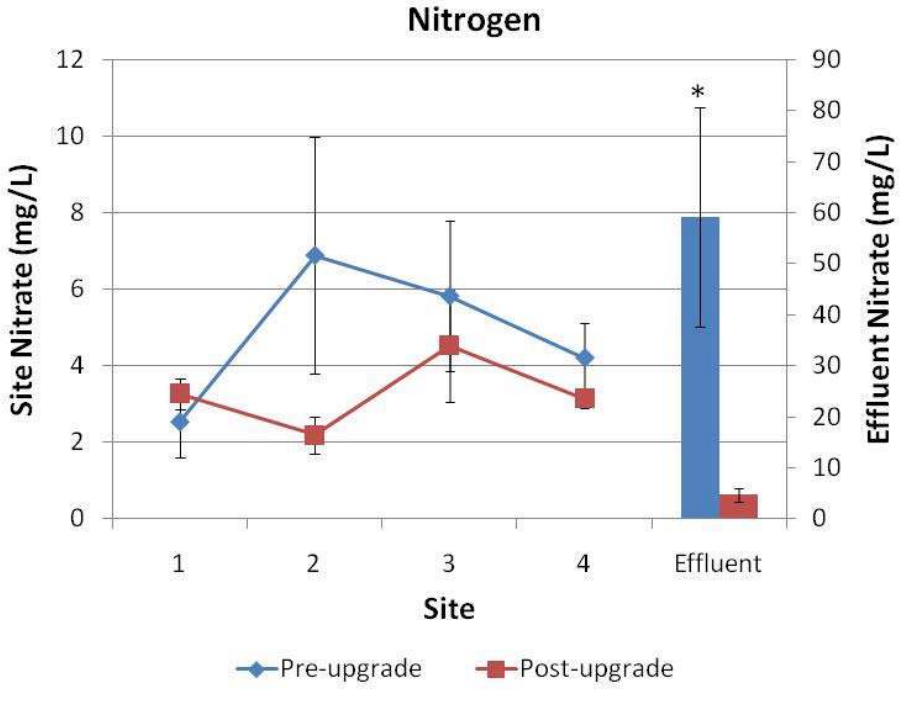




Nutrient Levels in South River

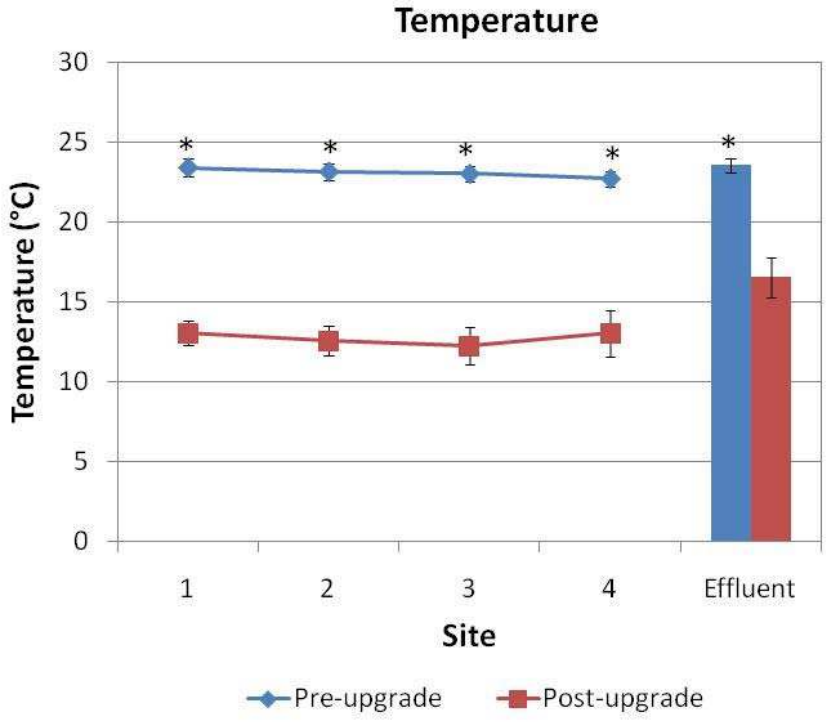
- Phosphorus levels decreased significantly by 83-84% at downstream sites
- Nitrogen levels decreased only 22-25% at downstream sites
- Nonpoint source contribution of nitrogen much larger than phosphorus

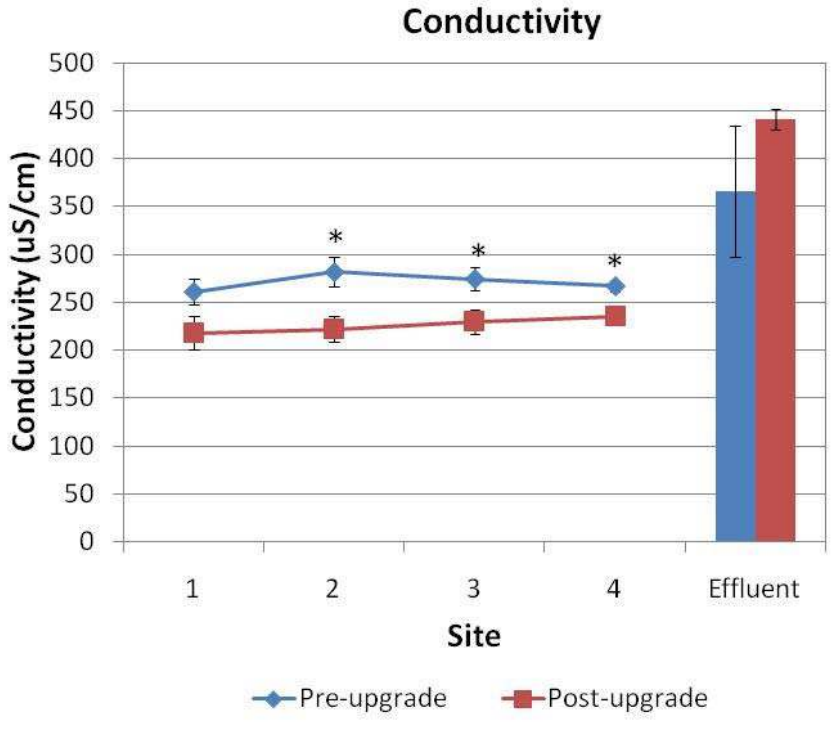




Water Quality in South River

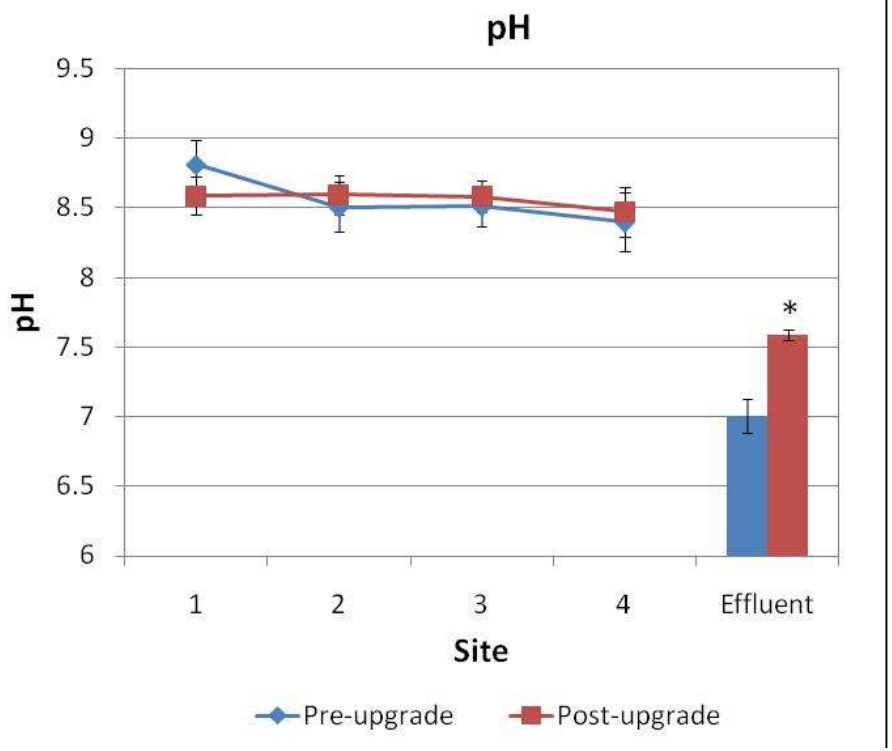
- Temperature obviously decreased due to the change in seasons
- Conductivity decreased due to increased flows and smaller relative groundwater contributions

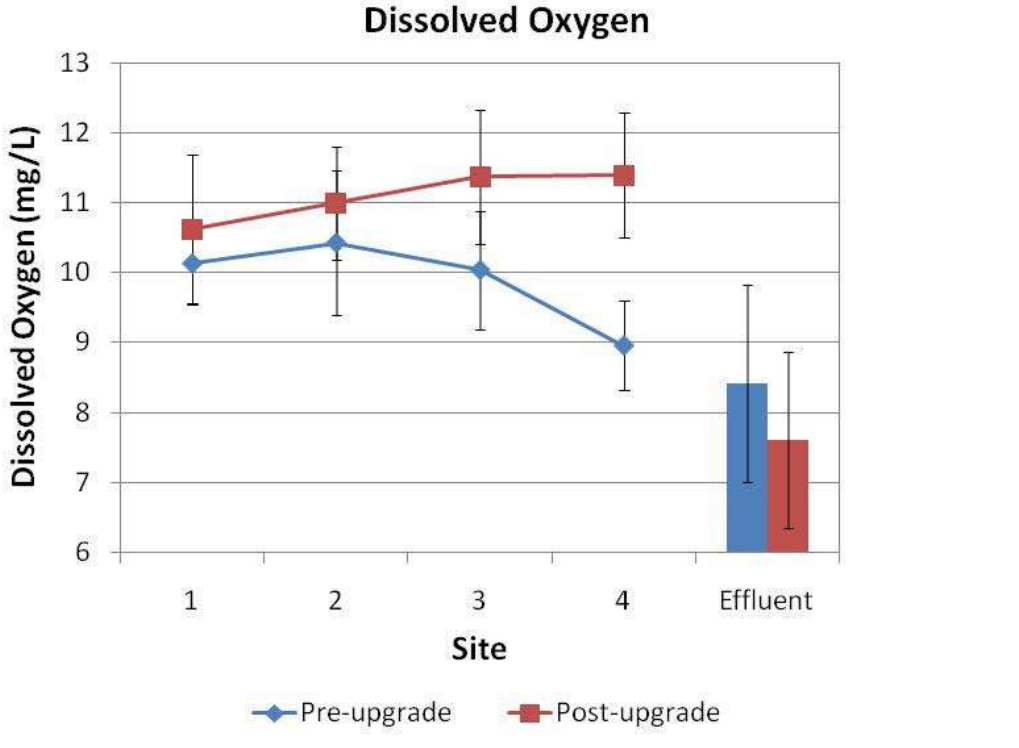




Water Quality in South River

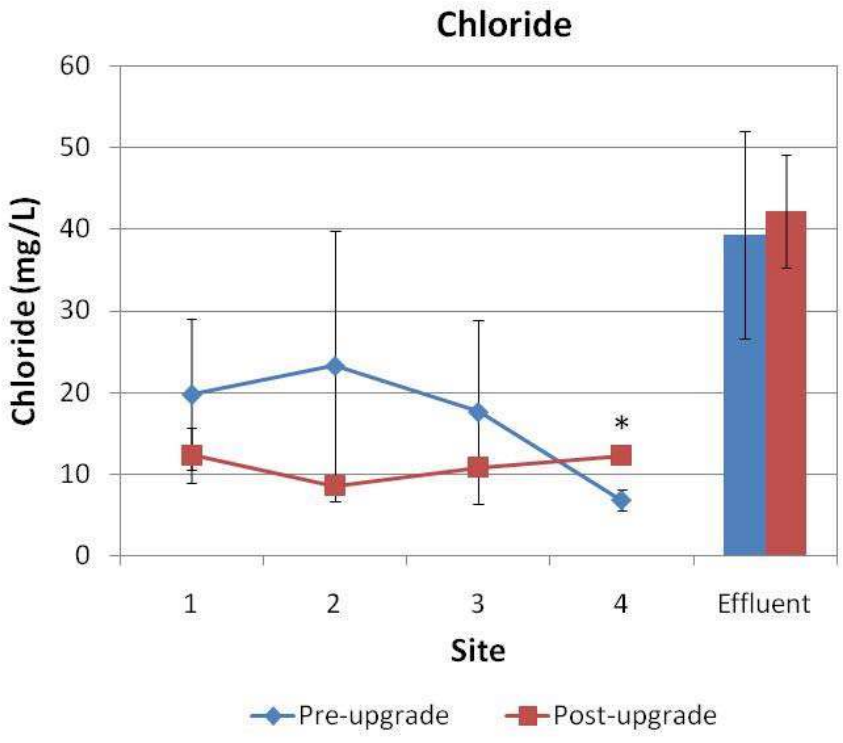
- pH increased in effluent, remained relatively constant in river
- Dissolved oxygen increased due to colder temperatures and improved treatment

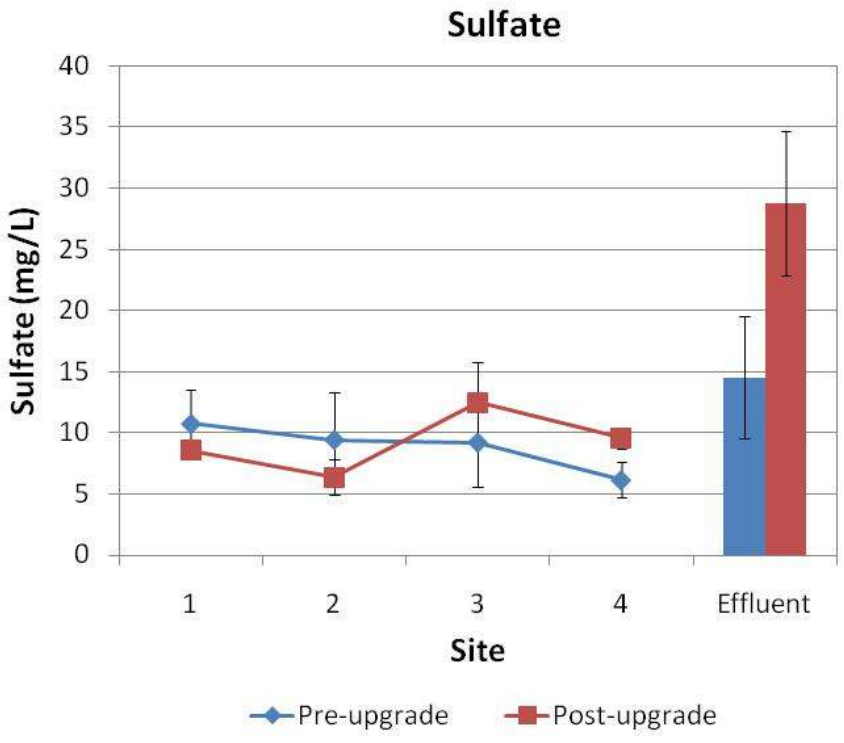




Water Quality in South River

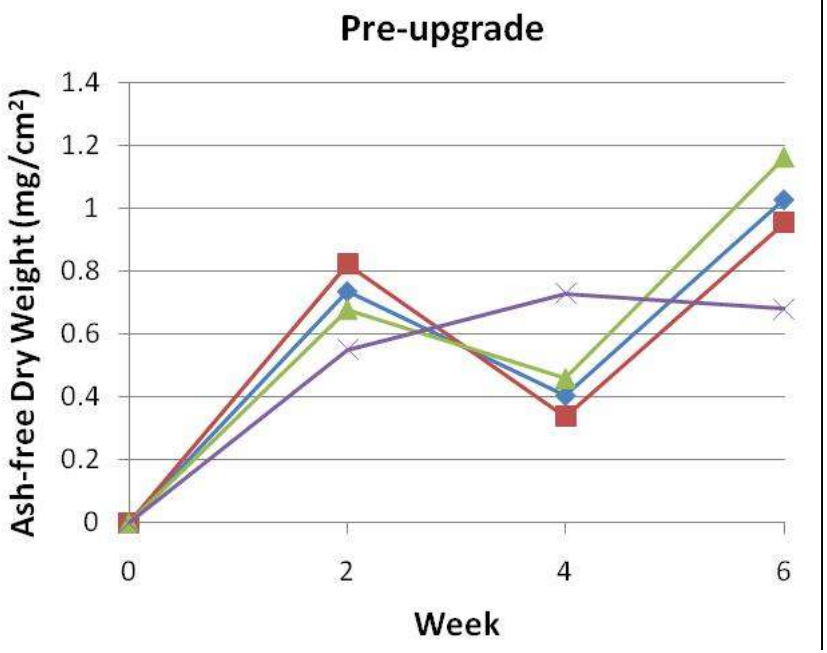
- Chloride was relatively consistent
- Sulfate was relatively consistent in the river, but increased in the effluent

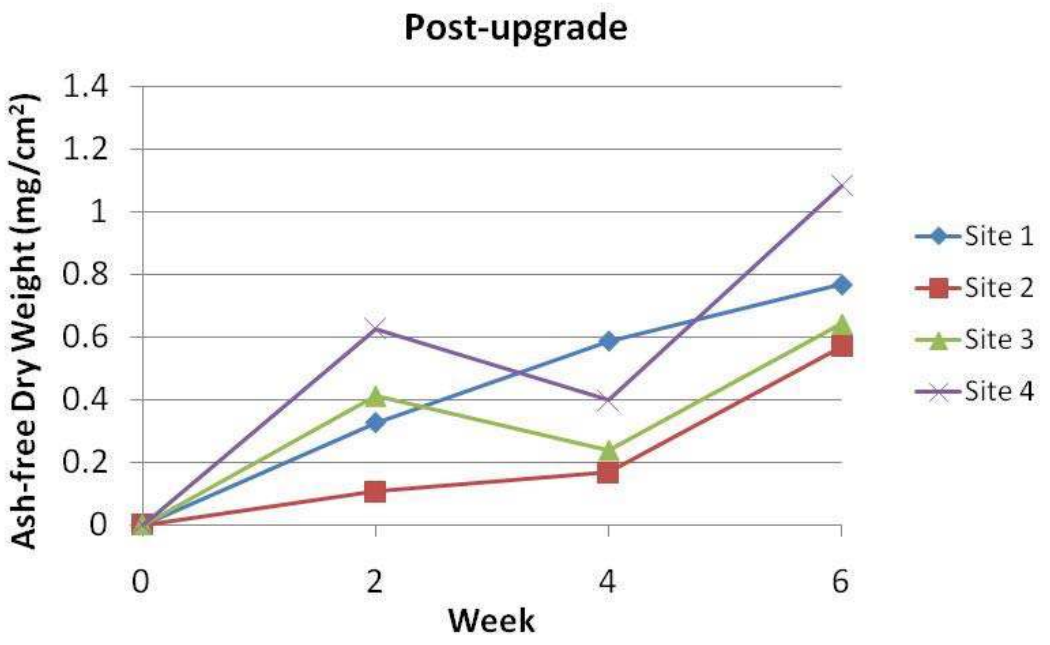




Periphyton Growth

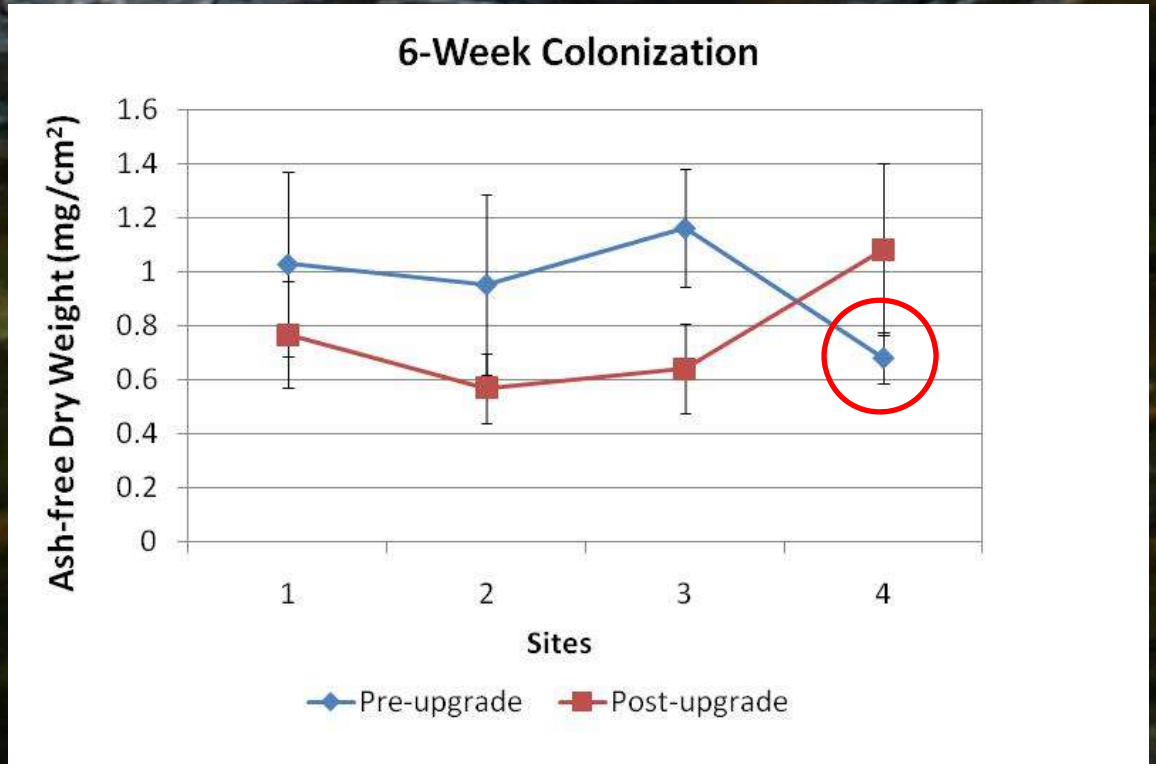
- Periphyton growth rates were slower in the fall after upgrades (0.12 mg/cm^2/wk versus 0.16)
  - Nutrient reduction and season
- Apparent decrease in periphyton biomass between week 2 and 4 in the summer
  - Possibly due to scouring from storm event





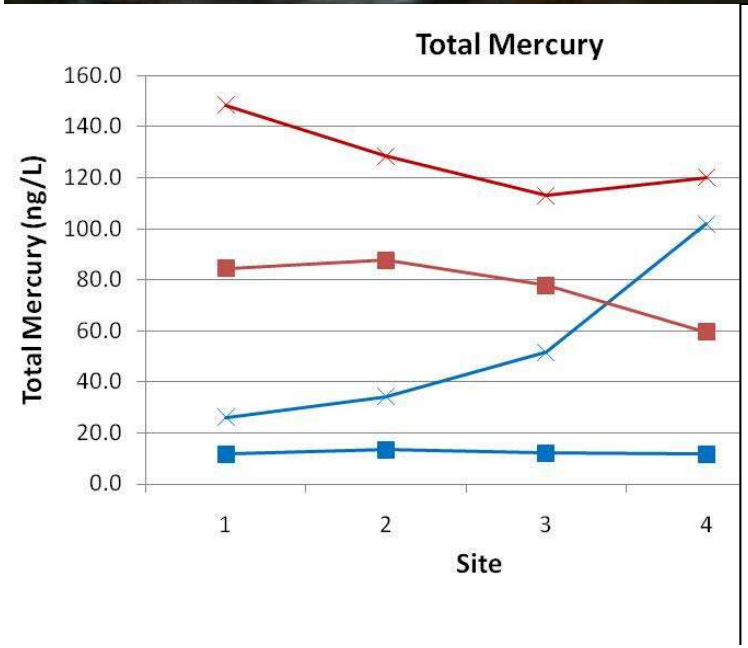
Periphyton Biomass

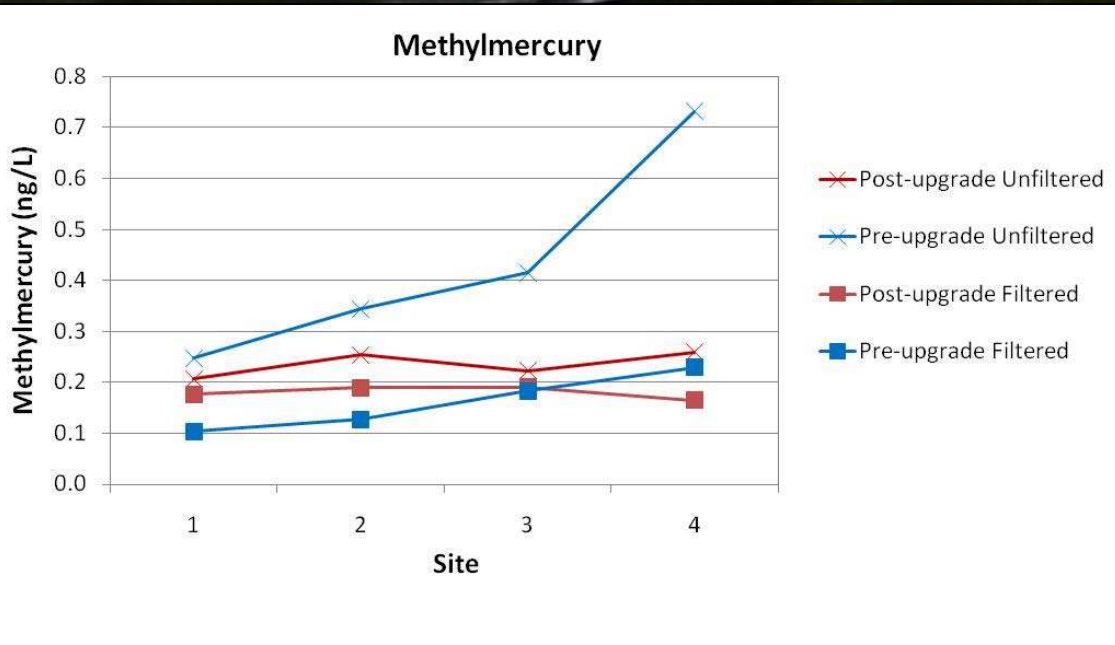
- Post-upgrade biomass after 6-wk colonization was slightly lower than pre-upgrade biomass
  - Likely due to temperature and seasonal effects, since similar differences were observed at Site 1 (unaffected by nutrient reductions)
- Site 4 results questionable due to vandalism



Mercury in Water Column

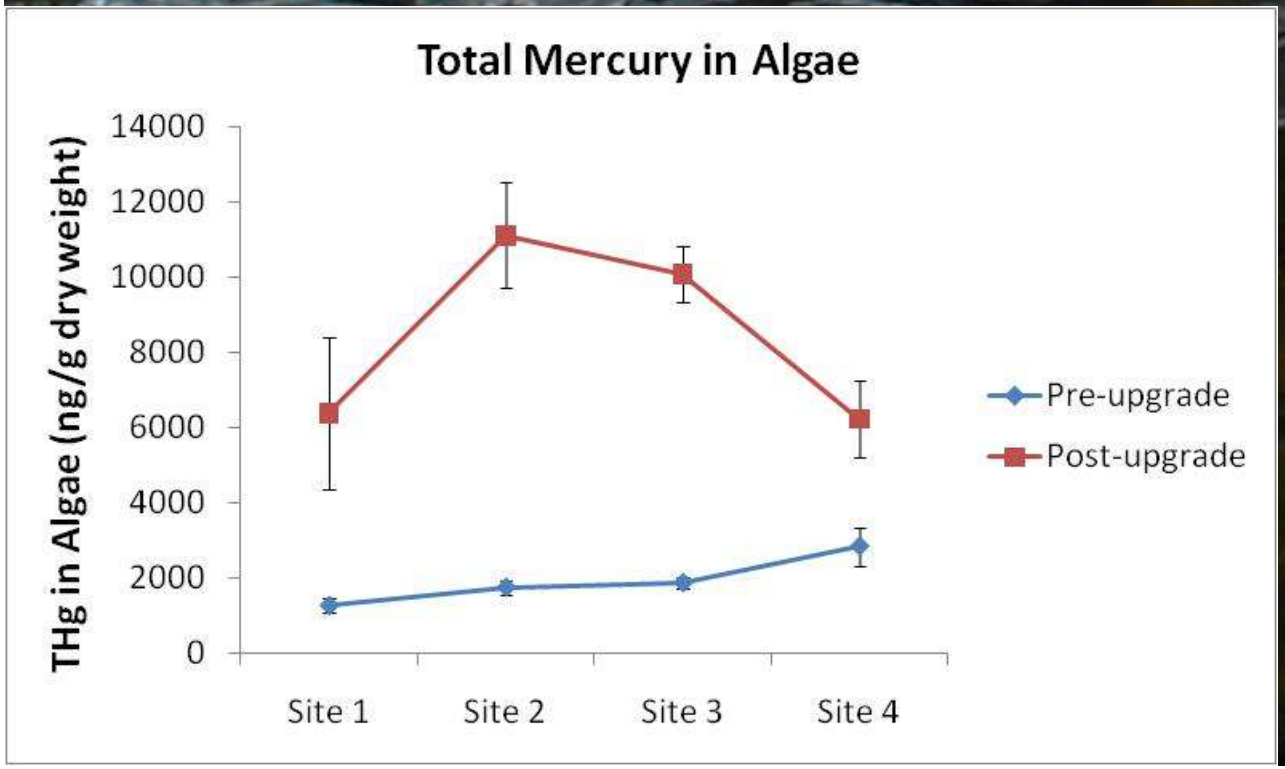
- Filtered and unfiltered total mercury in water column much higher in fall
  - Likely due to flow conditions
- Unfiltered methylmercury in water column lower in fall
  - Possibly due to nutrient effects, since Site 1 levels were similar





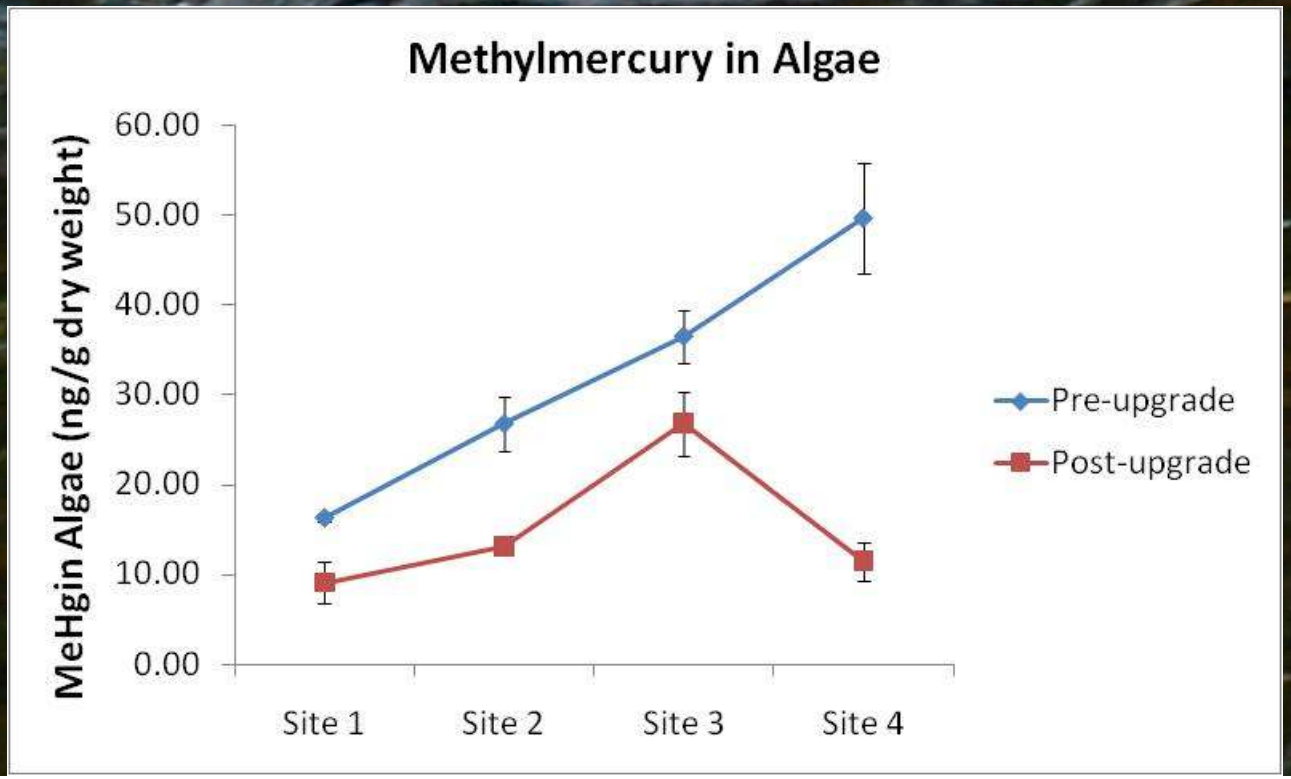
Mercury in Algae

- Total mercury in algae was much higher in the fall
  - Likely due to difference in algae that could be sampled
  - Inclusion of more sediment with fall sample



Mercury in Algae

- Methylmercury in algae was lower in the fall (post-upgrade)
  - Likely due to a combination of season and reduced nutrients
  - Pattern of continually increasing methylmercury concentrations downstream was not consistently observed post-upgrade



Conclusions

- Upgrades at the Waynesboro WWTP greatly reduced nutrient levels (nitrogen and phosphorus) in the effluent
- Upgrades significantly reduced downstream phosphorus concentrations in the river
- Nitrogen levels in the river were reduced to a lesser extent
  - Due to influence of background non-point sources of nitrogen

Conclusions

- Upgrades appeared to have little effect on periphyton biomass
  - Observed reductions most likely due to difference in season
  - Background non-point sources of nutrients high enough that nutrients are not limiting factor in periphyton growth
- Upgrades may have contributed to reduced methylation or methylmercury uptake in periphyton
  - Results confounded with seasonal effects
  - Differing pattern of downstream methylmercury levels was observed
- Study should be continued this summer to compare results within the same season