Federal Way S. 356th Street Project: Effectiveness of Retrofit and Expansion

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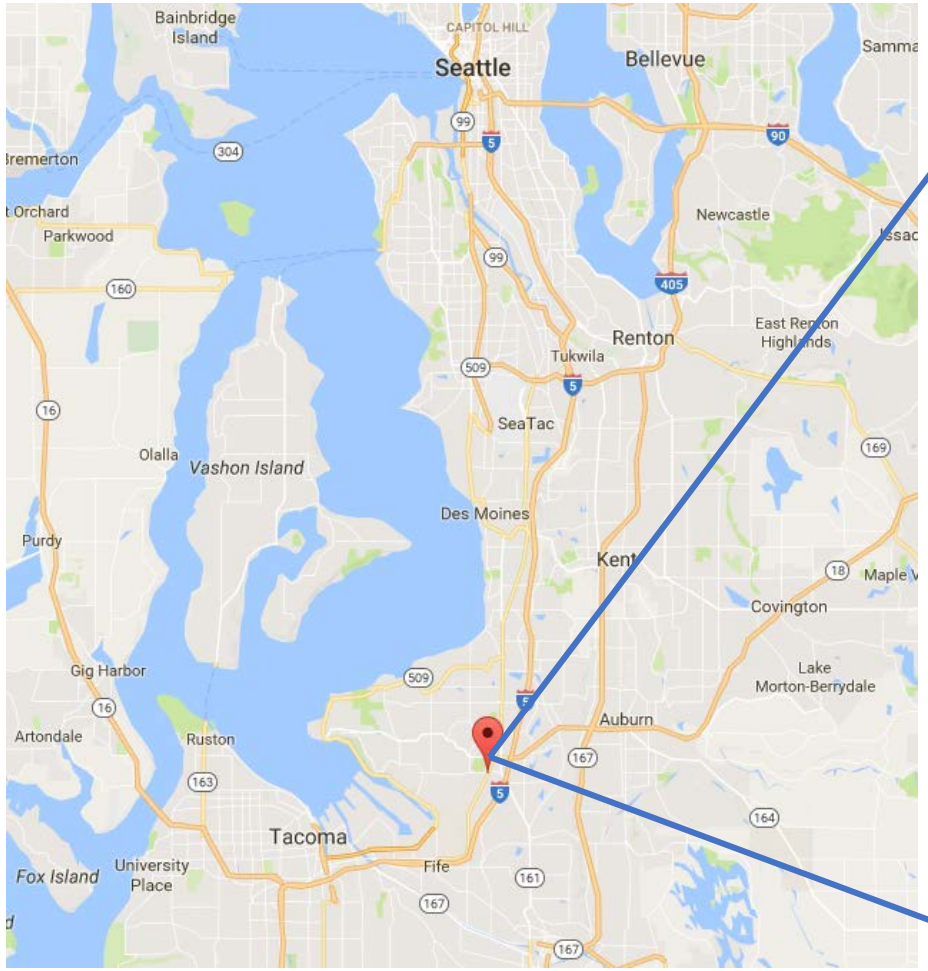
SAM Stormwater Action Monitoring

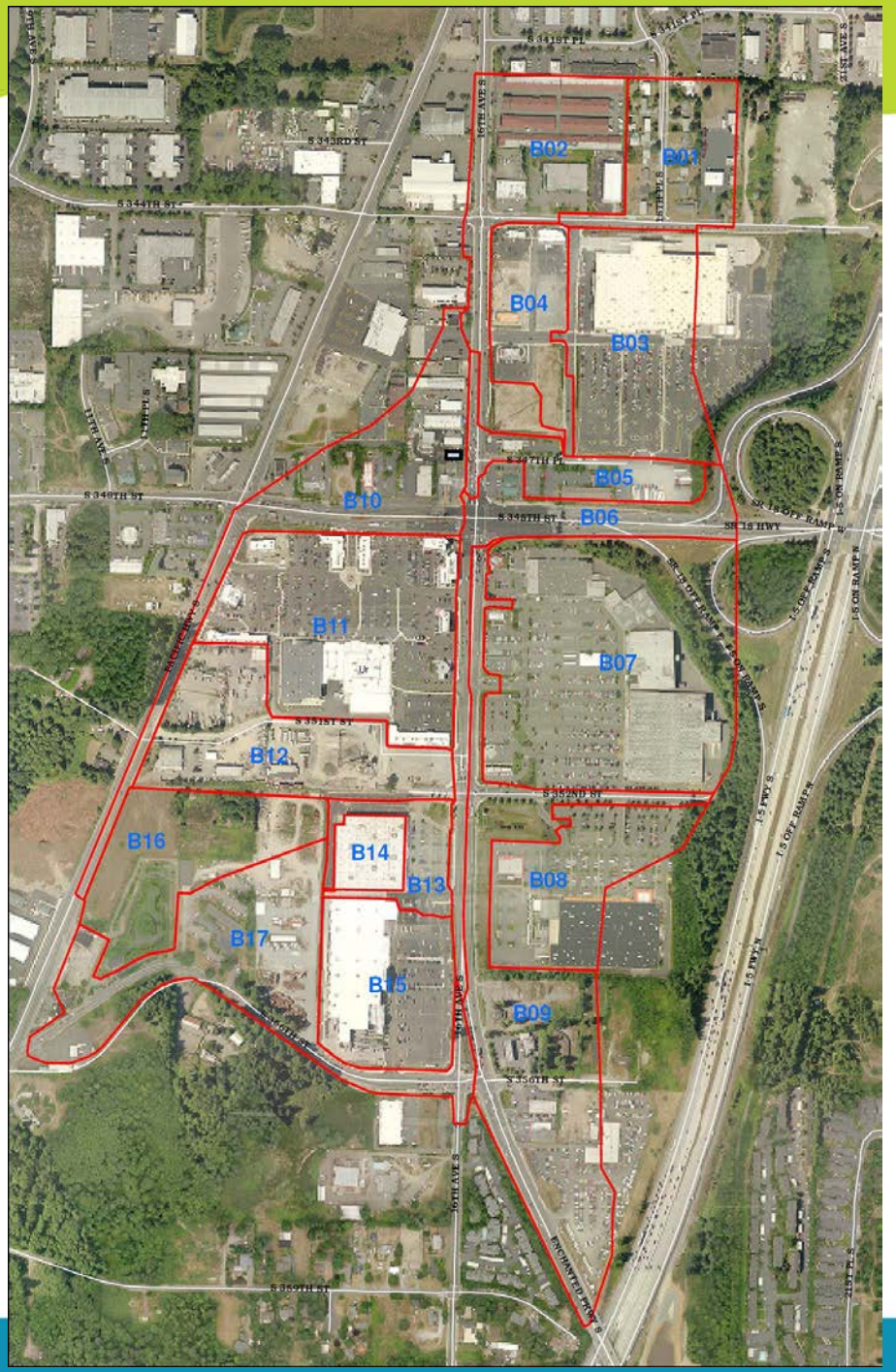
Effectiveness Study

Did retrofit and expansion improve flow control and treatment?



S. 356th Street Detention Facility

- Built in 1997 to treat runoff from 189-acre basin
  - combined detention and stormwater treatment wetland (“wetland”)
- Expanded in 2014
- In-series “wetland” to increase treatment
- 2 bioretention facilities to treat previously untreated runoff from 22-acre basin



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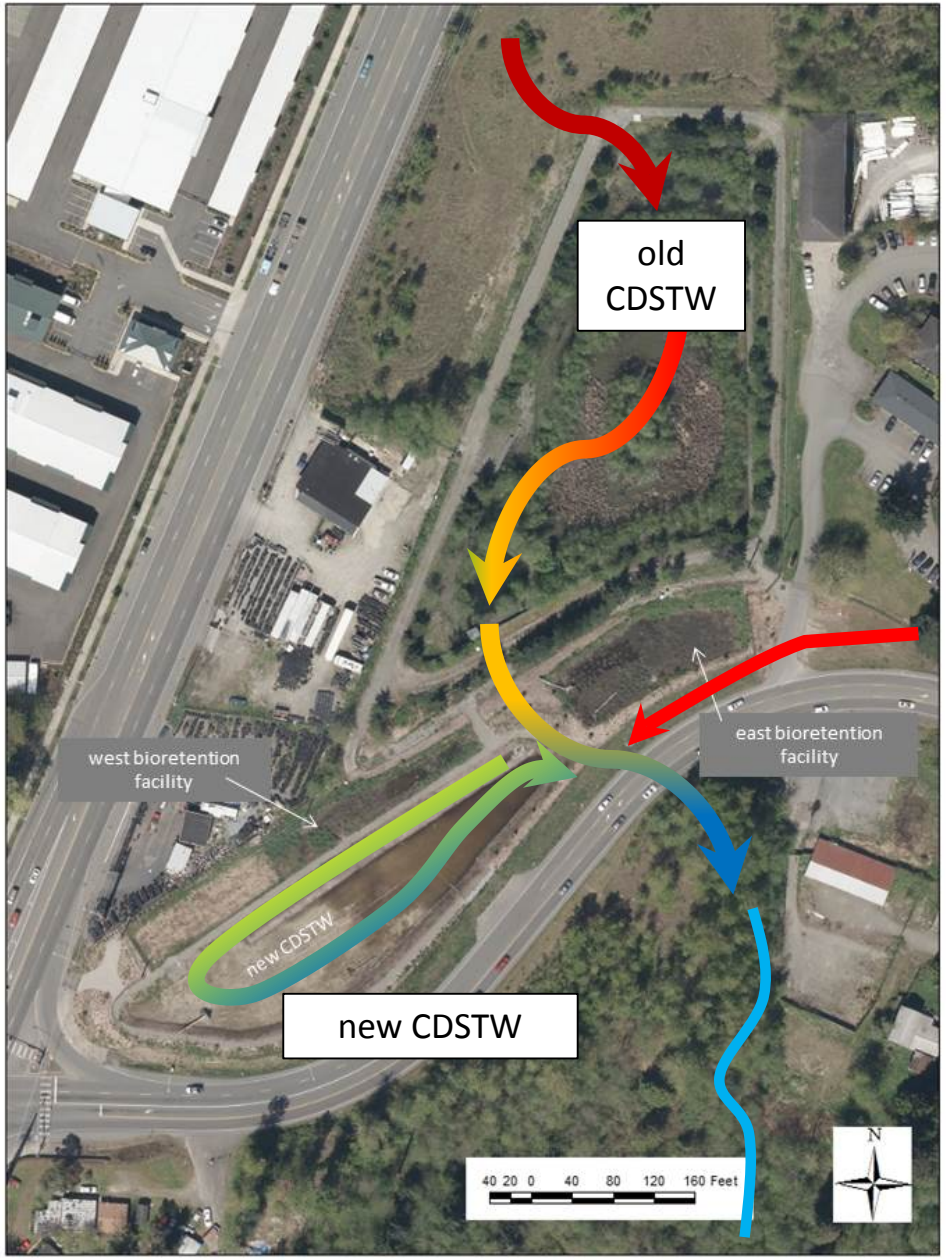
Effectiveness Study

New “wetland”

- Increase capacity
- Unlined, but infiltration limited



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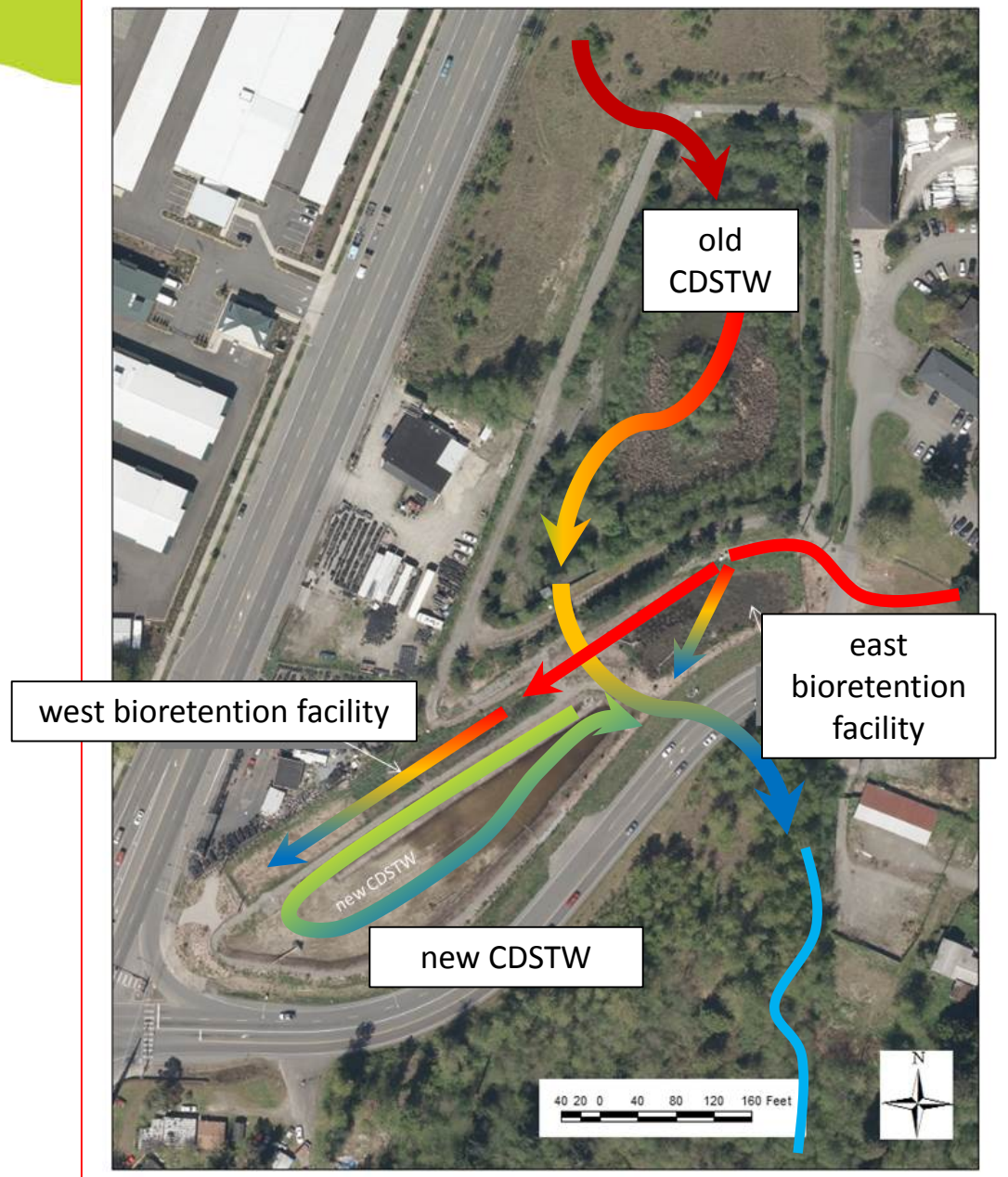


Bioretention facilities

- New capacity
- Underdrained
  - East: drains quickly
  - West: drains slowly

Untreated In

Treated Out

- East bioretention facility
- West bioretention facility
- Wetland complex

Receiving waters:
North Fork West Hylebos Creek

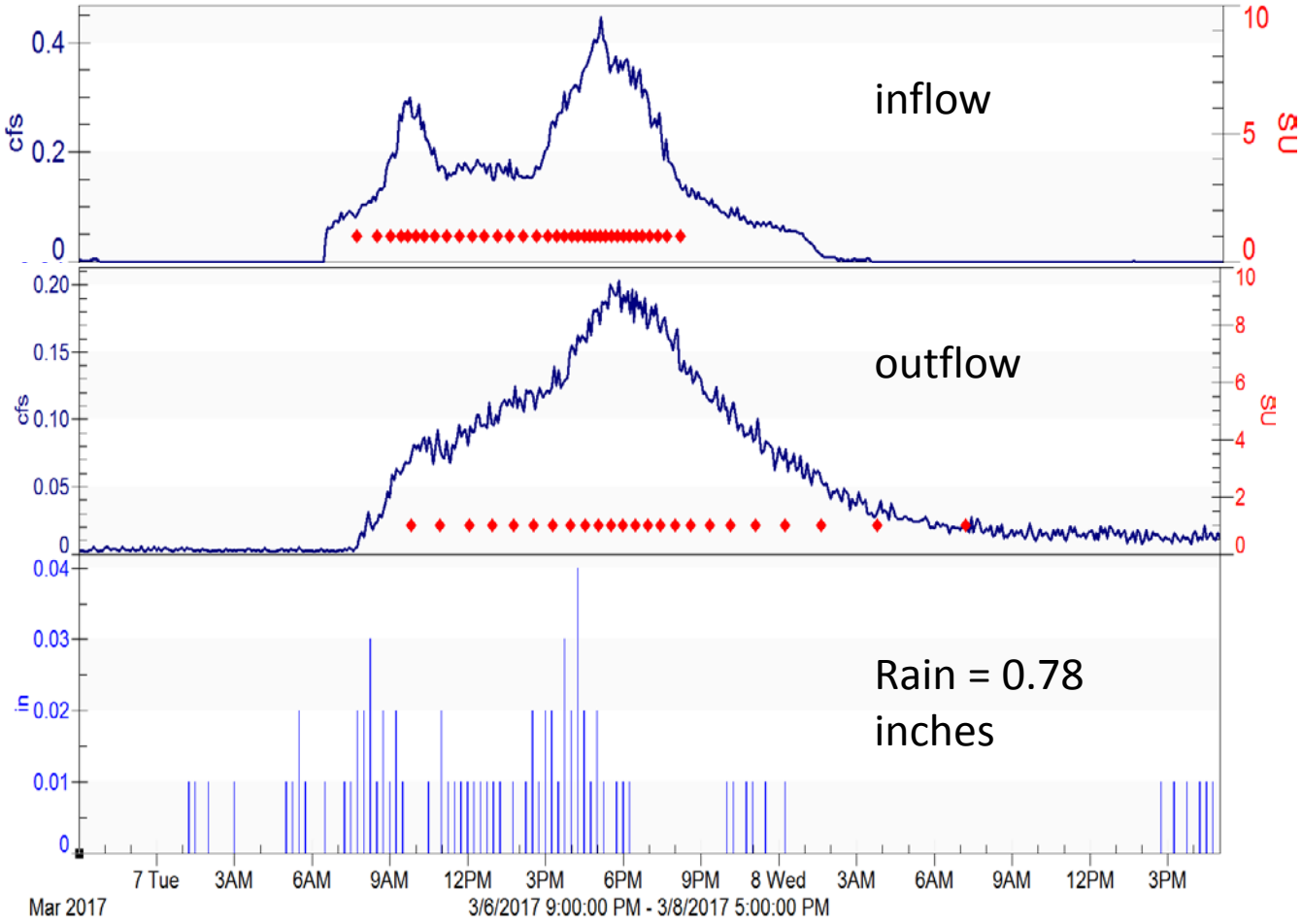
Sampling

- Flow at 7 locations
- 18 storms sampled for TSS, metals, nutrients, PAHs
- 10 storms for PCBs, fecal coliforms
- 6 storms for toxicity

- Pre- and post-retrofit turbidity and temperature data

Flow Monitoring Results

- Flow-weighted composite sampling successful
- Reduction in peak flows and delay in peak timing at all facilities



Flow Monitoring Results continued

- But, less certainty in flow volume estimates
- Unclear extent of groundwater intrusion and/or infiltration

- Results focus on concentration changes rather than mass loadings

Treatment?

Concentrations in effluent vs. influent:

Significantly reduced

Somewhat reduced

Somewhat increased

Significantly increased

Caveats

- Pollutant concentrations in bioretention influent were lower than in wetland complex influent
- Bioretention soil mix was standard 60% sand/40% compost mix but it was 30 inches deep
- 90% of total flow is through the wetland complex

Pollutant	Bioretention Facility		Wetland Complex
	East	West	
Fecal Coliform			
TSS			
Turbidity			
Conductivity			

Take Home:

- System reduced total suspended solids (TSS) loads

Pollutant	Bioretention Facility		Wetland Complex
	East	West	
Zinc, total			
Zinc, dissolved			
Copper, total			
Copper, dissolved			
Lead, total			
Lead, dissolved		NC	
Cadmium, total	NC	NC	
Cadmium, dissolved	NC	NC	NC

Take Home:

- Mixed results, but complicated by low influent concentrations in bioretention facilities
- System reduced loads of total metals
- System source of dissolved metals

Pollutant	Bioretention Facility		Wetland Complex
	East	West	
Total PAHs			
Total PCBs			

Take Home:

- System reduced loads of PAHs and PCBs

Pollutant	Bioretention Facility		Wetland Complex
	East	West	
Total Phosphorus			
Orthophosphate P			
Total Nitrogen			
Nitrate + Nitrite N			
Ammonia N			

Take Home:

- Bioretention facilities: large source of N & P (~80% of total phosphorus load)
- Overall system is a source of all nutrients except ammonia

Study Conclusions

- Overall, effectiveness determined by wetland complex (90% of flow)
- Bioretention facilities are large sources of phosphorus and nitrogen (these should not be built as is in basins with nutrient concerns)
- Pre- and post-retrofit data indicate treatment improved

Lessons Learned

- Flow monitoring is very challenging.
- Anticipate delays.
- Groundwater may complicate matters.
- Some questions may be answered with cheap(er) continuous data.
- Urban basins are subject to change.

Questions?

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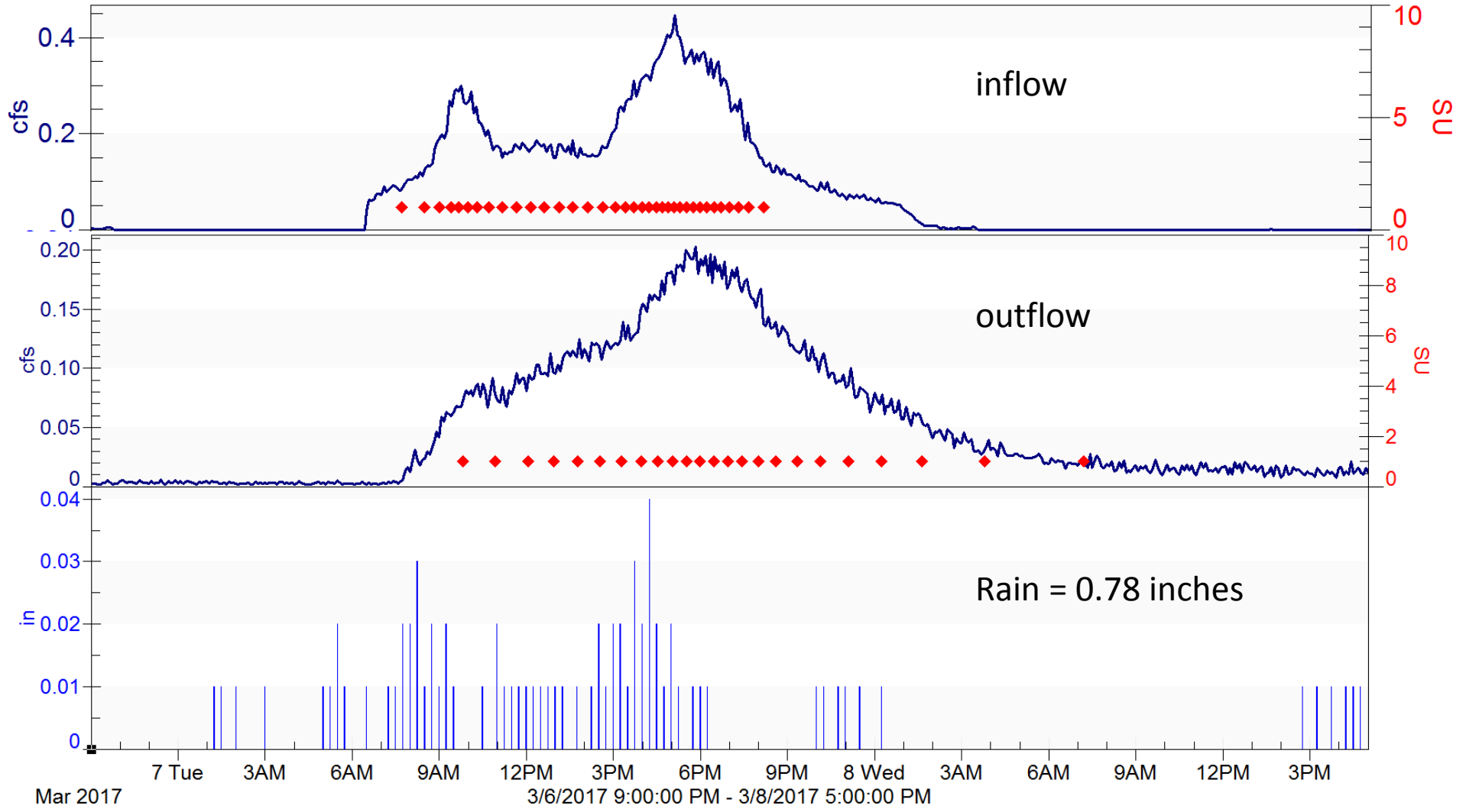
Example: Storm #10 East bioretention facility



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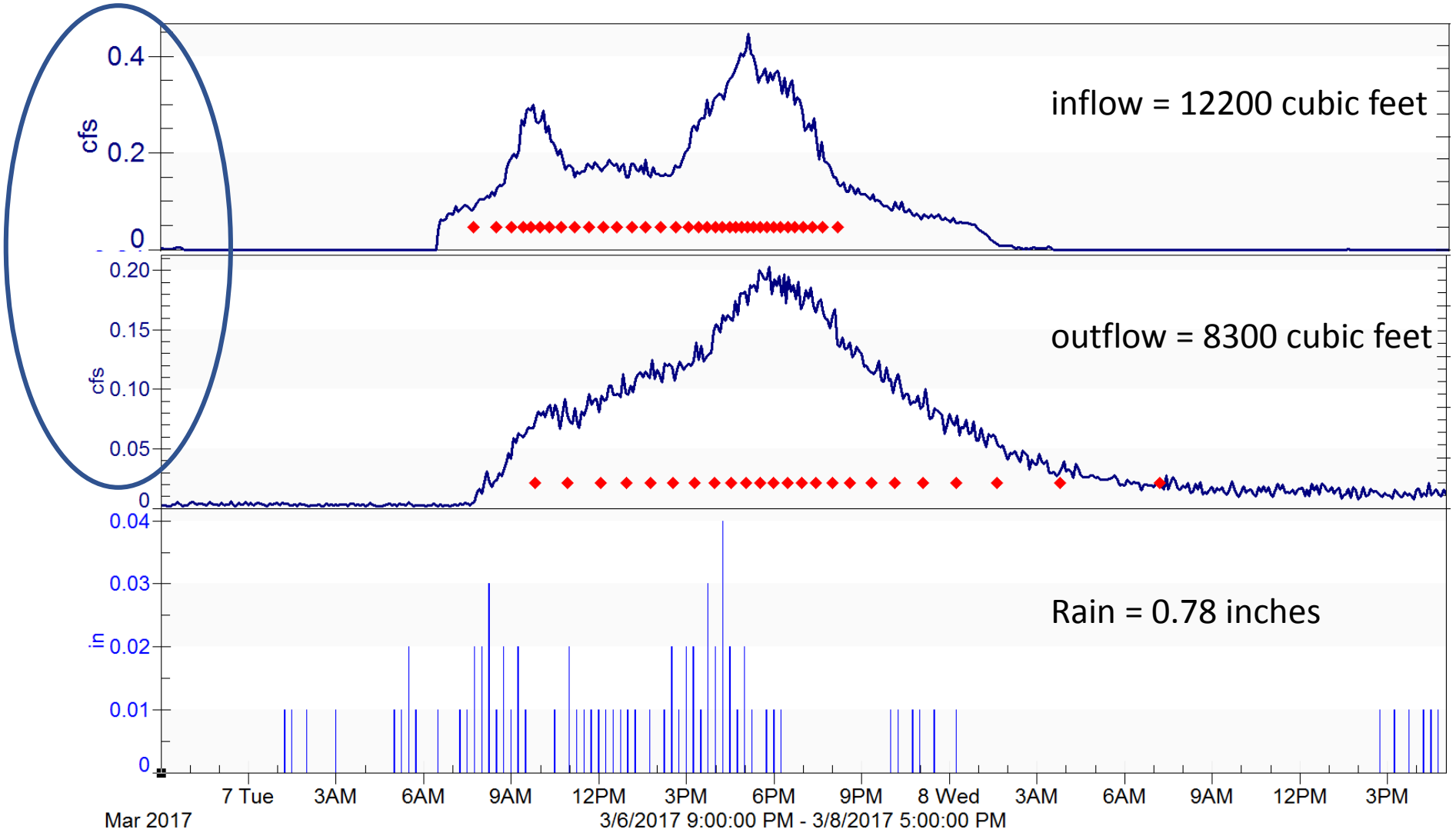

Example: Storm #10 East bioretention facility

reduced peak flows