Mercury removal through Green Stormwater Infrastructure: Results from case studies around the SF Bay

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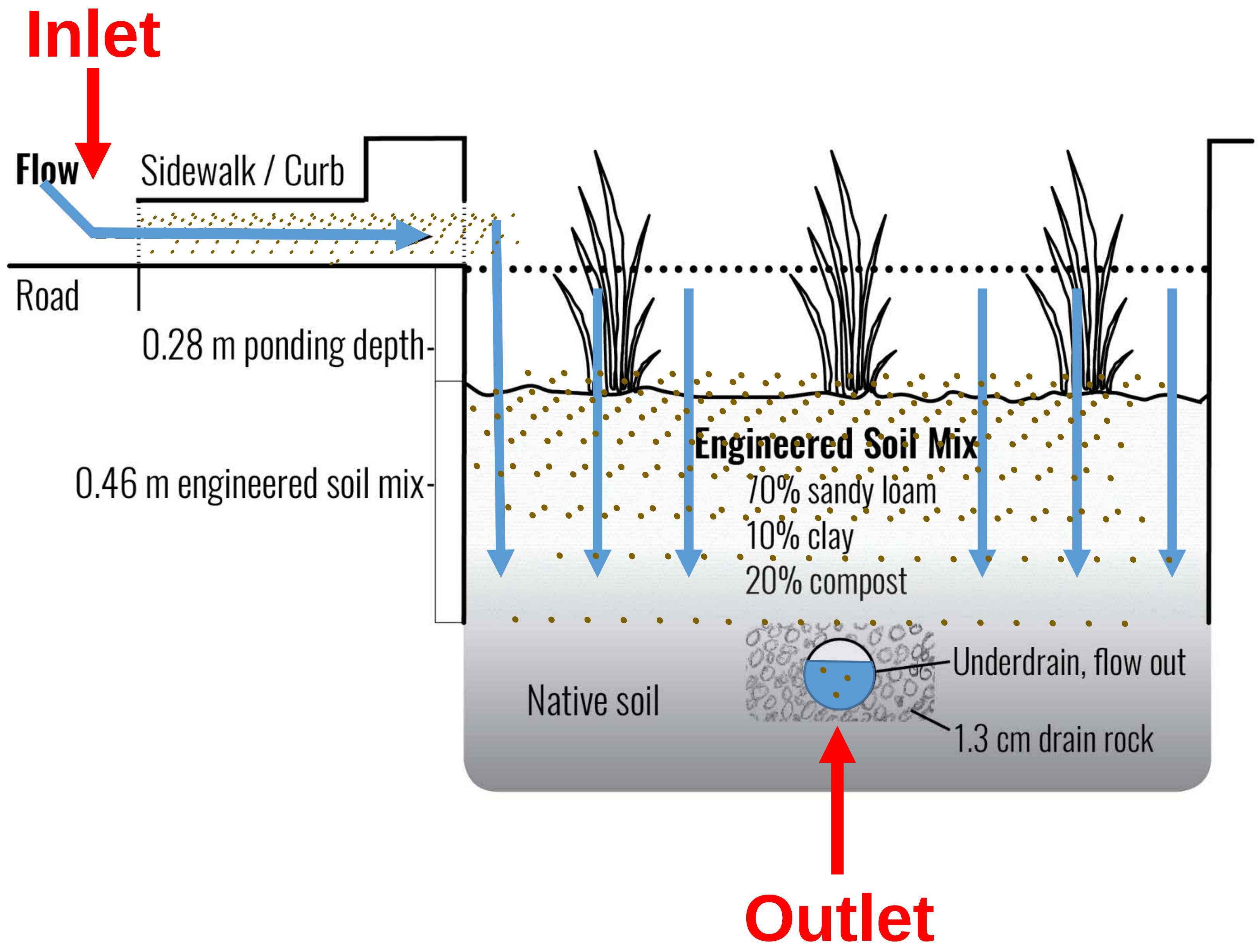
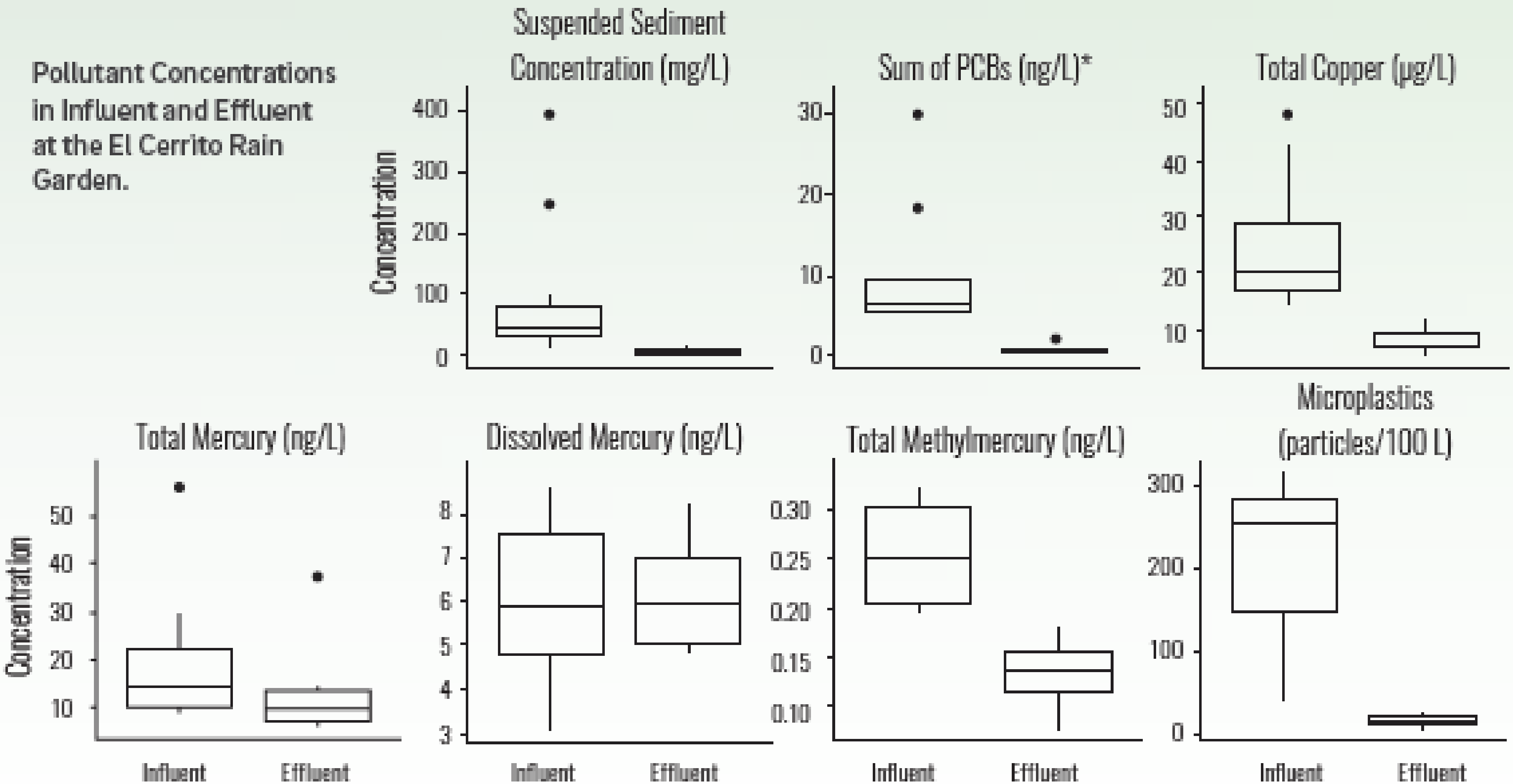
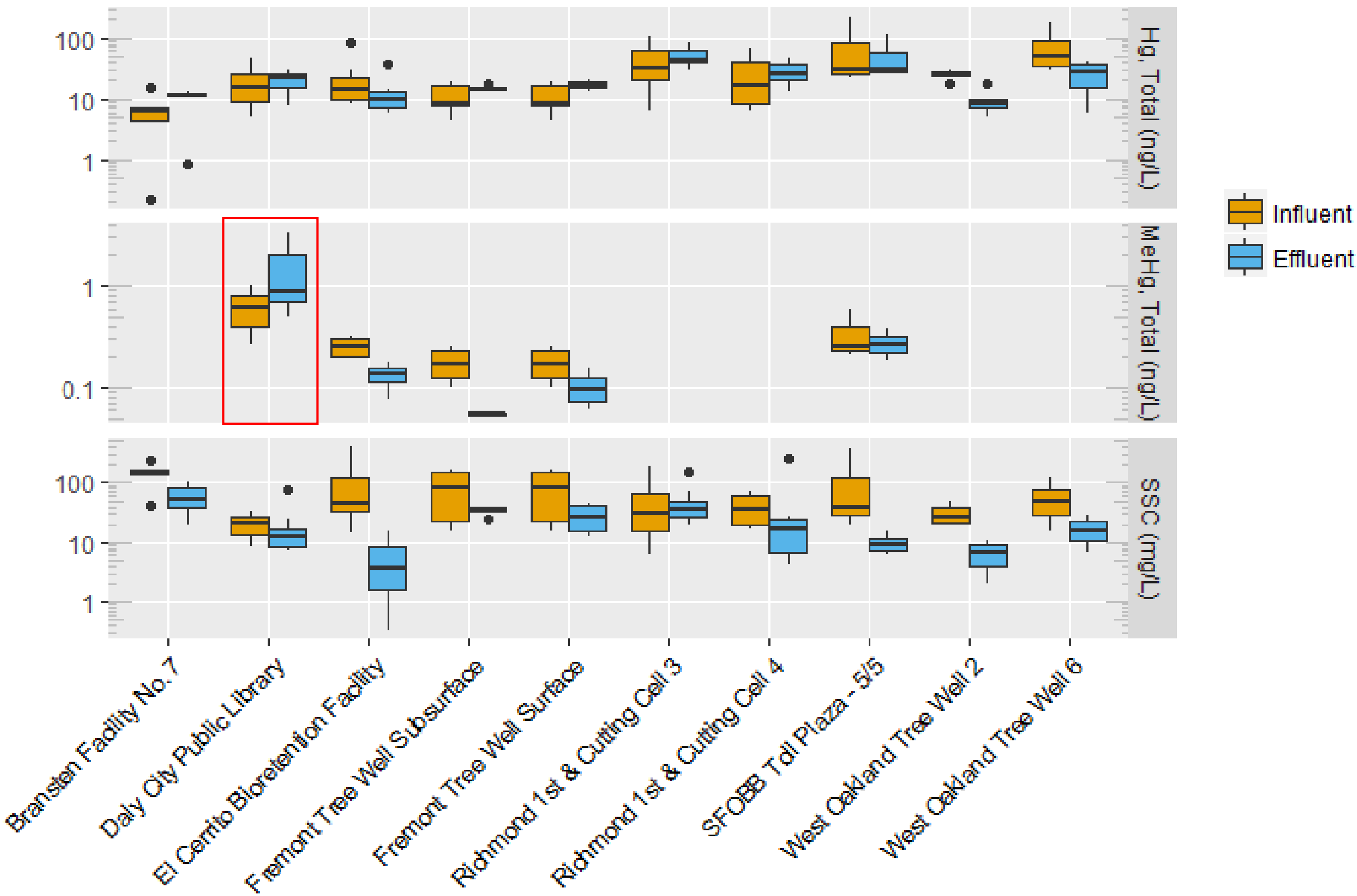
Presentation to DTMC January 14, 2020


Inlet
Flow
Sidewalk / Curb
Road
0.28 m ponding depth
0.46 m engineered soil mix
Engineered Soil Mix
70% sandy loam
10% clay
20% compost
Native soil
Underdrain, flow out
1.3 cm drain rock
Outlet

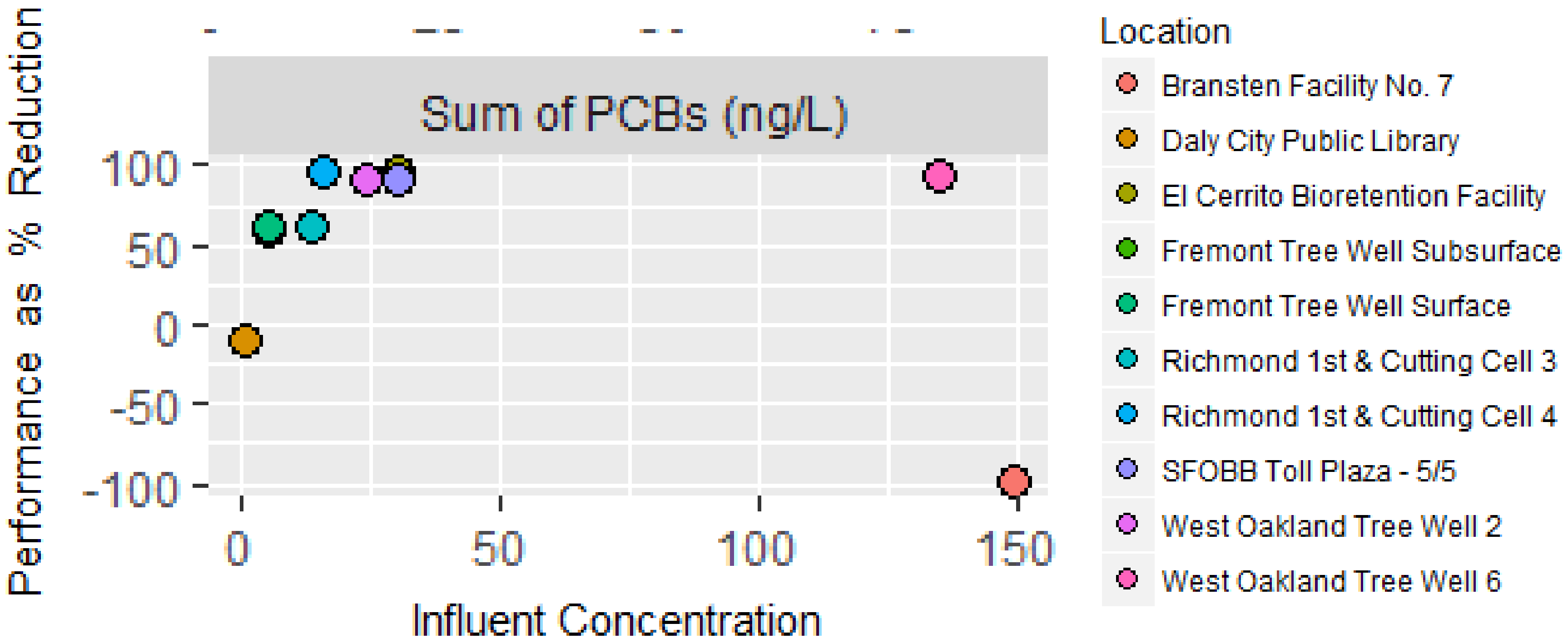
Pollutant Concentrations in Influent and Effluent at the El Cerrito Rain Garden.





100
10
1
Hg, Total (ng/L)
1
0.1
MeHg, Total (ng/L)
100
10
1
SSC (mg/L)
Bransten Facility No.7
Daly City Public Library
El Cerrito Bioretention Facility
Fremont Tree Well Subsurface
Fremont Tree Well Surface
Richmond 1st & Cutting Cell 3
Richmond 1st & Cutting Cell 4
SFOBB Toll Plaza - 5/5
West Oakland Tree Well 2
West Oakland Tree Well 6
Influent
Effluent

Site	SSC (mg/L)	PCBs (ng/L)	TOC (mg/L)	HgD (ng/L)	HgT (ng/L)	MeHg (ng/L)	CuD (ug/L)	CuT (ug/L)	Pb (ug/L)
El Cerrito Bioretention Facility	95%	96%	-8%	-25%	44%	48%	45%	68%	85%
SFOBB Toll Plaza - 5/5	93%	92%			38%	23%	-301%	-59%	80%
West Oakland Tree Well 2	79%	92%	-30%		61%				88%
West Oakland Tree Well 6	72%	94%	14%		67%				78%
Bransten Facility No. 7	59%	-100%	-6%	-25%	-47%				55%
Daly City Public Library	1%	-11%		33%	8%	-130%		78%	31%
Fremont Tree Well Subsurface	61%	59%		-161%	-34%	69%	11%	44%	
Fremont Tree Well Surface	68%	61%		-284%	-48%	42%	0%	38%	
Richmond 1st & Cutting Cell 3	7%	61%	-276%		-11%				37%
Richmond 1st & Cutting Cell 4	-30%	96%	-449%		-5%				43%



Sum of PCBs (ng/L)
Performance as % Reduction
100
50
0
-50
-100
0
50
100
150
Influent Concentration
Location
Bransten Facility No. 7
Daly City Public Library
El Cerrito Bioretention Facility
Fremont Tree Well Subsurface
Fremont Tree Well Surface
Richmond 1st & Cutting Cell 3
Richmond 1st & Cutting Cell 4
SFOBB Toll Plaza - 5/5
West Oakland Tree Well 2
West Oakland Tree Well 6

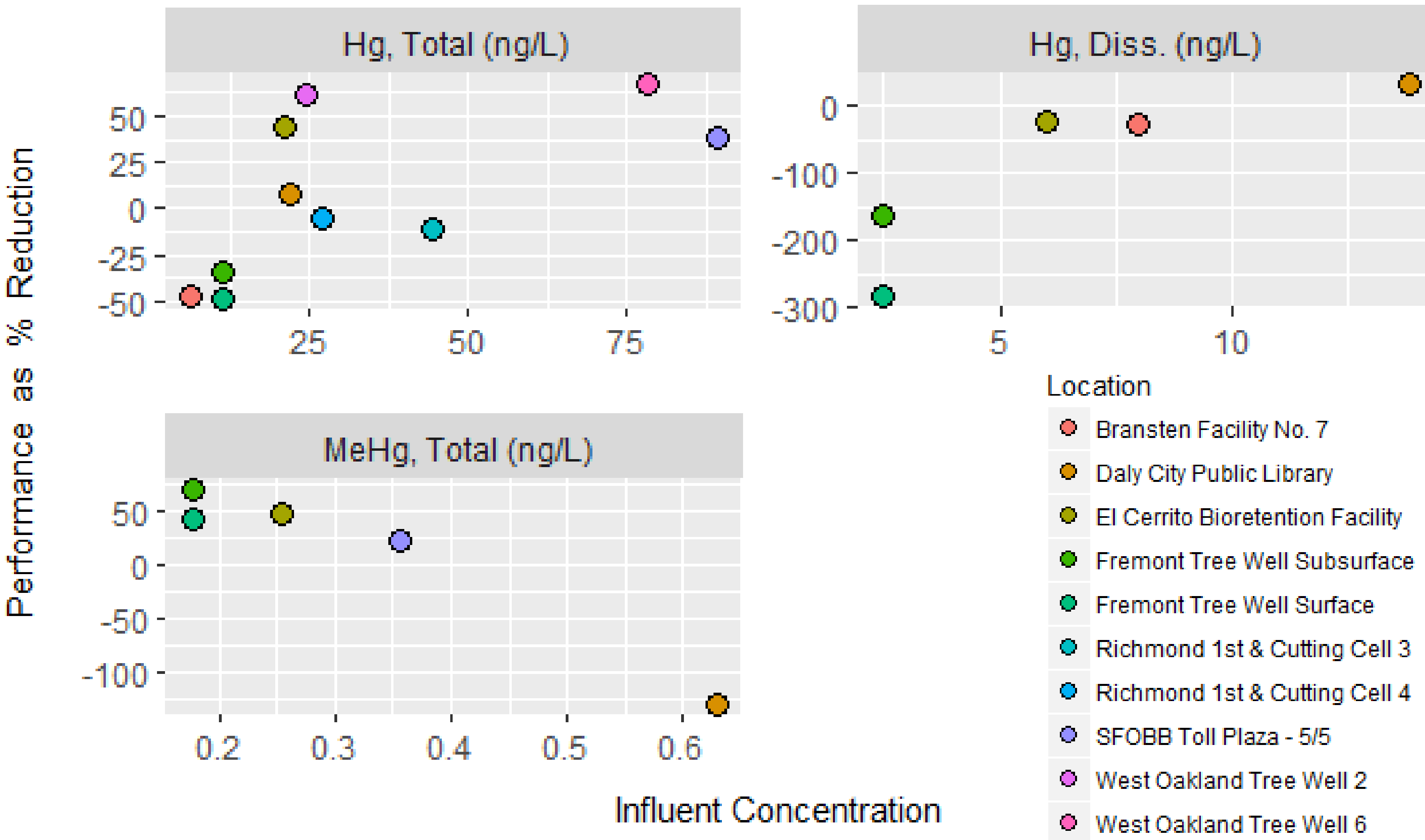
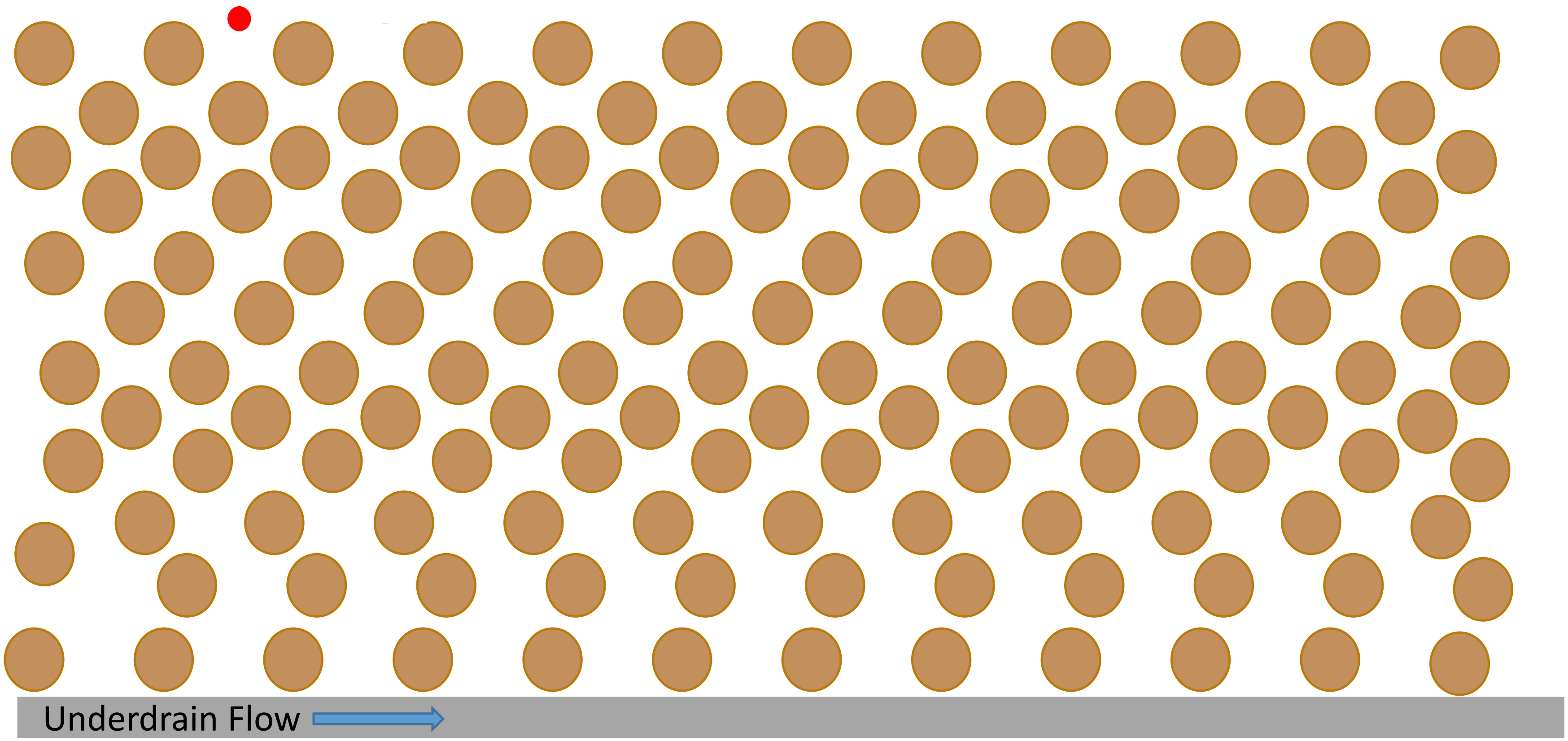


Figure 17. Performance as a function of influent concentrations.



Underdrain Flow

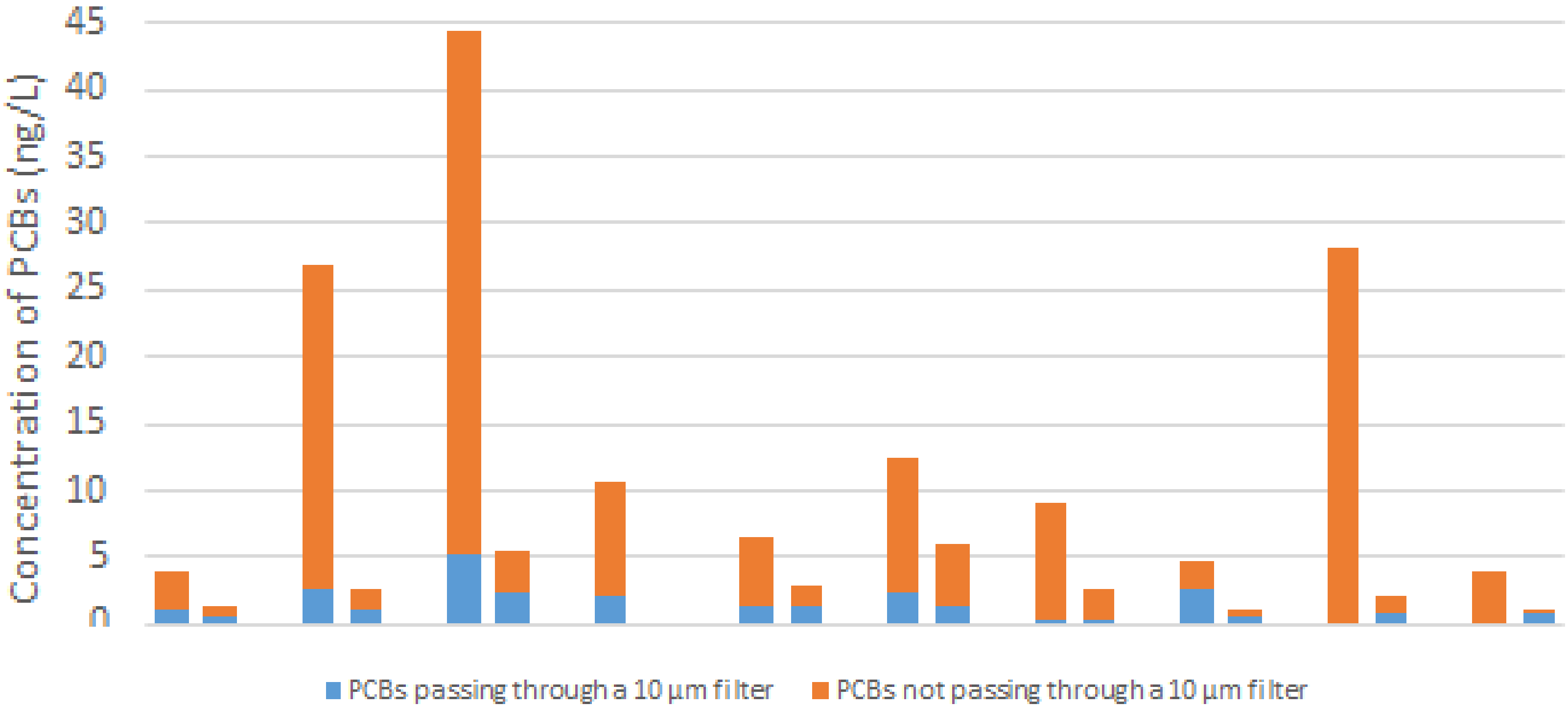


Figure 14: Concentrations of PCBs associated with smaller particles (<10 µm) and larger particles (≥10 µm) before and after treatment.

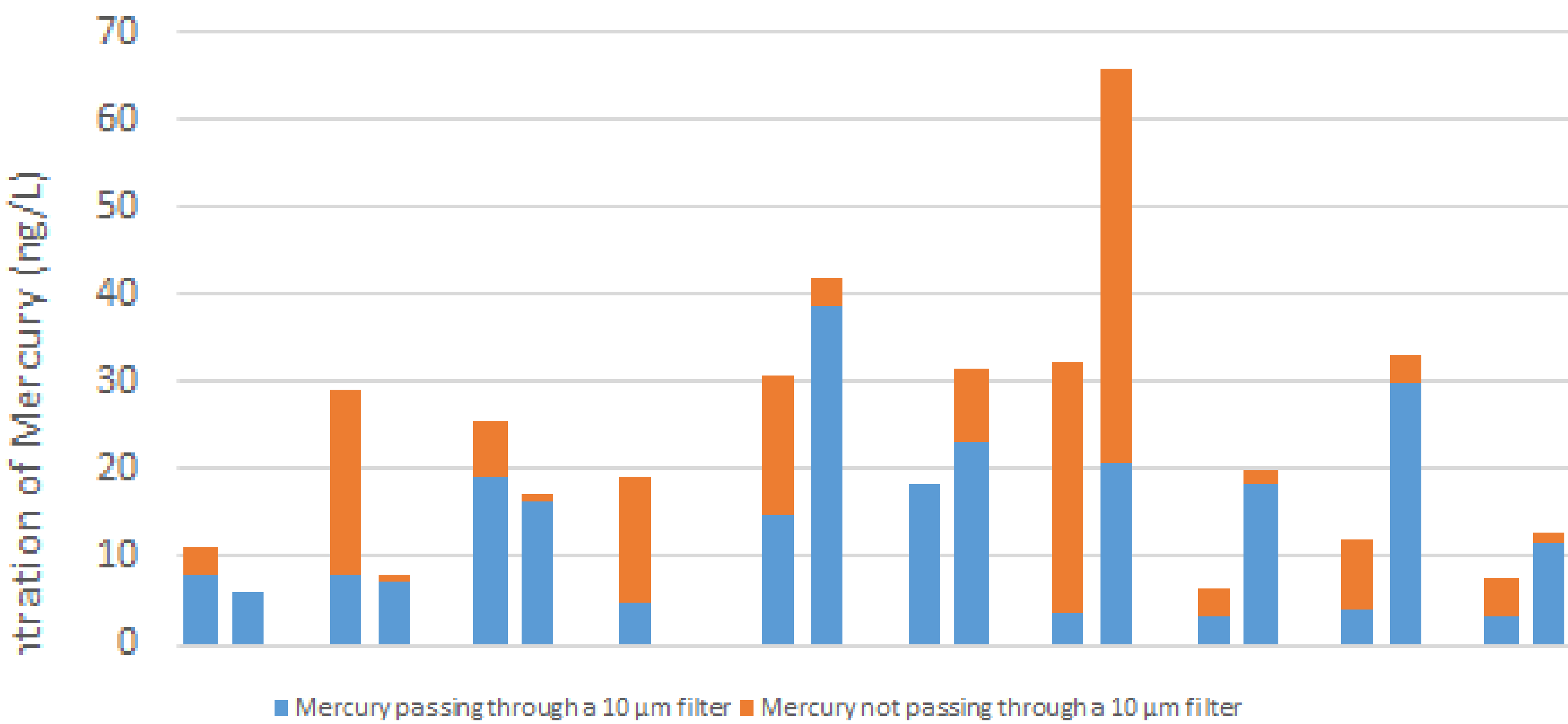


Figure 18: Concentrations of mercury on particles <10 µm and larger than ≥10 µm, both in the influent and effluent where measured.

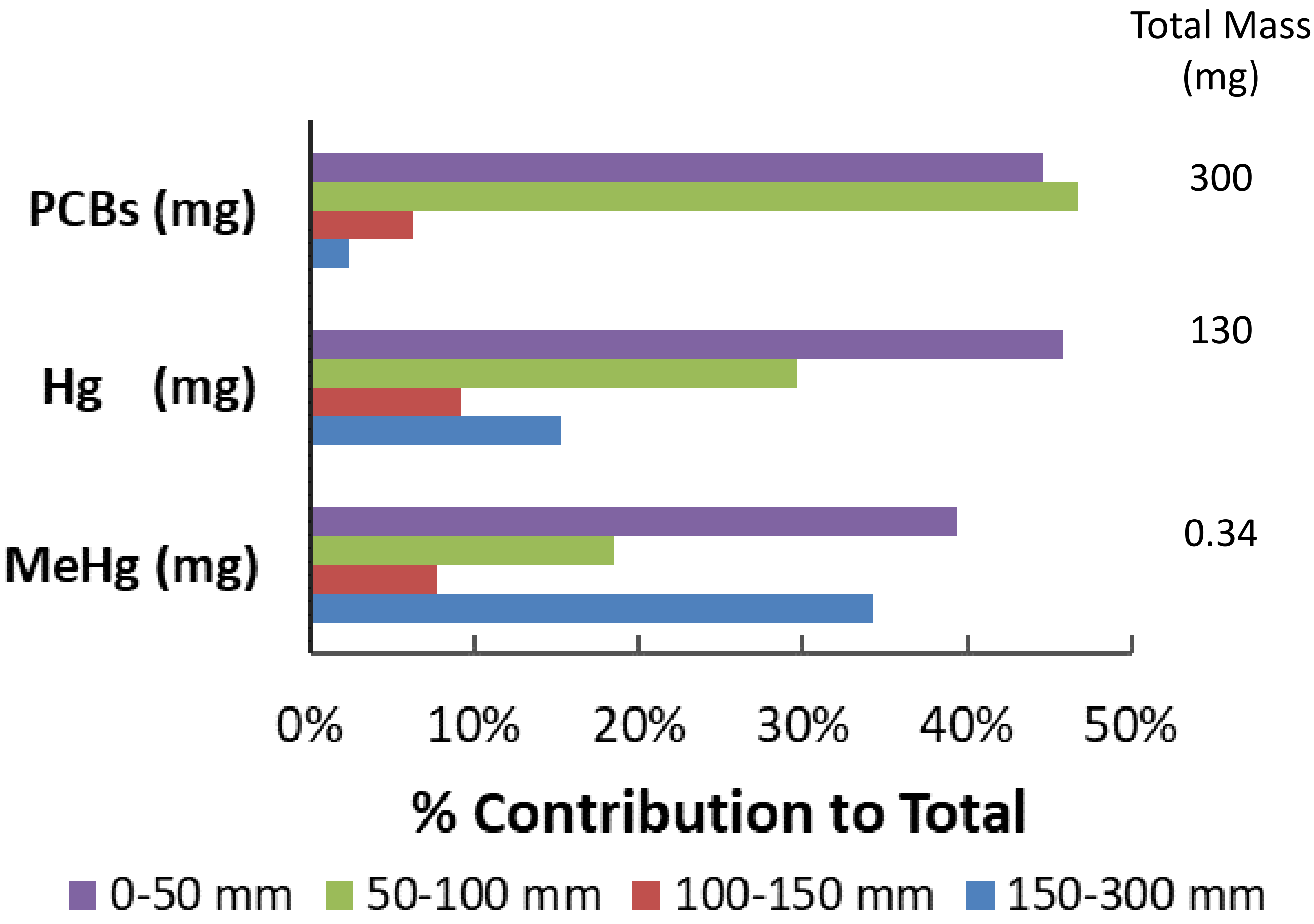


Figure 28. Estimation of mass (mg) of contaminants by depth throughout the entire rain garden (including both the inlets and the main bioretention unit by area).

Some results & hypotheses from the data

- Results for Hg capture range from a 67% reduction in mean concentrations to a 48% increase
- 23-69% reduction for MeHg (excepting outlier)
- No reduction of HgD
- Hg on smaller particles and less likely to filter out
- When Hg is reduced it is likely filtering out near the surface

Design Considerations

- Design to your target pollutants
- Prevent overflow/bypass of most Hg polluted runoff
- Depth
- Irrigation
- Underdrain recommended; submerged zone not recommended

We have a lot to learn!

Optimal layouts and media design

Trade-offs between pore size and volume infiltrated

Depth: how much more removal do you get with increasing media depth?

Irrigation: Will it really help and at what cost?

Can organic and pH amendments improve adsorption significantly?

Vegetation: How much Hg can be taken up via rhizostimulation and are there certain (GI-worthy) plants that are better than others?

Thank you!

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For more information regarding the presentation:
https://www.sfei.org/documents/bay-area-green-infrastructure-water-quality-synthesis