Stormwater Management to Prevent Pollution and Contribute to Water Supply

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SERDP • ESTCP SYMPOSIUM
25 YEARS OF ESTCP
2019 | Enhancing DoD's Mission Effectiveness

Resilient water supplies

Office of Governor
GAVIN NEWSOM

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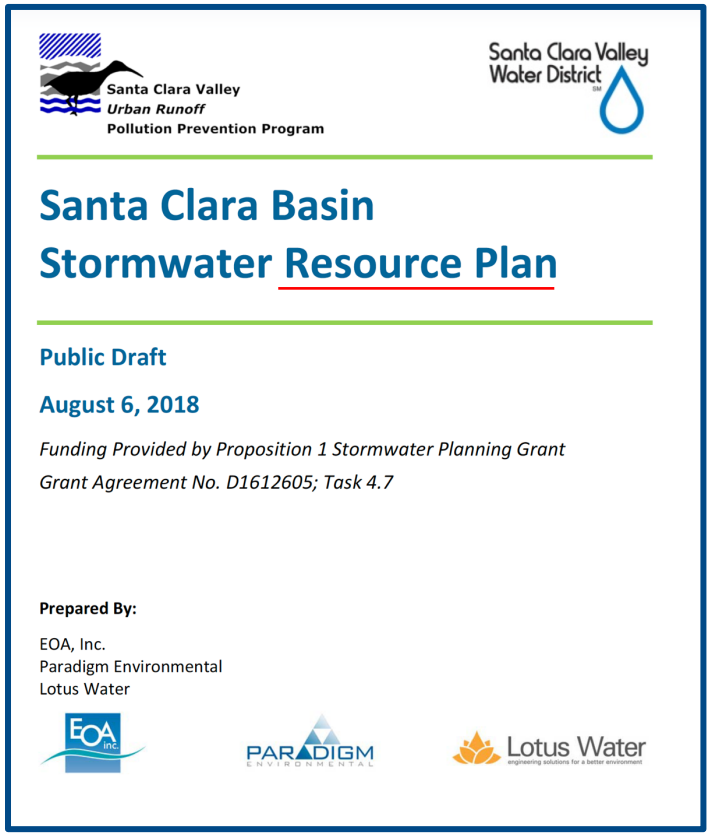
Governor Newsom Directs State Agencies to Prepare Water Resilience Portfolio for California

Published: Apr 29, 2019

… prioritize multi-benefit approaches, embrace innovation and new technologies, encourage regional approaches, …

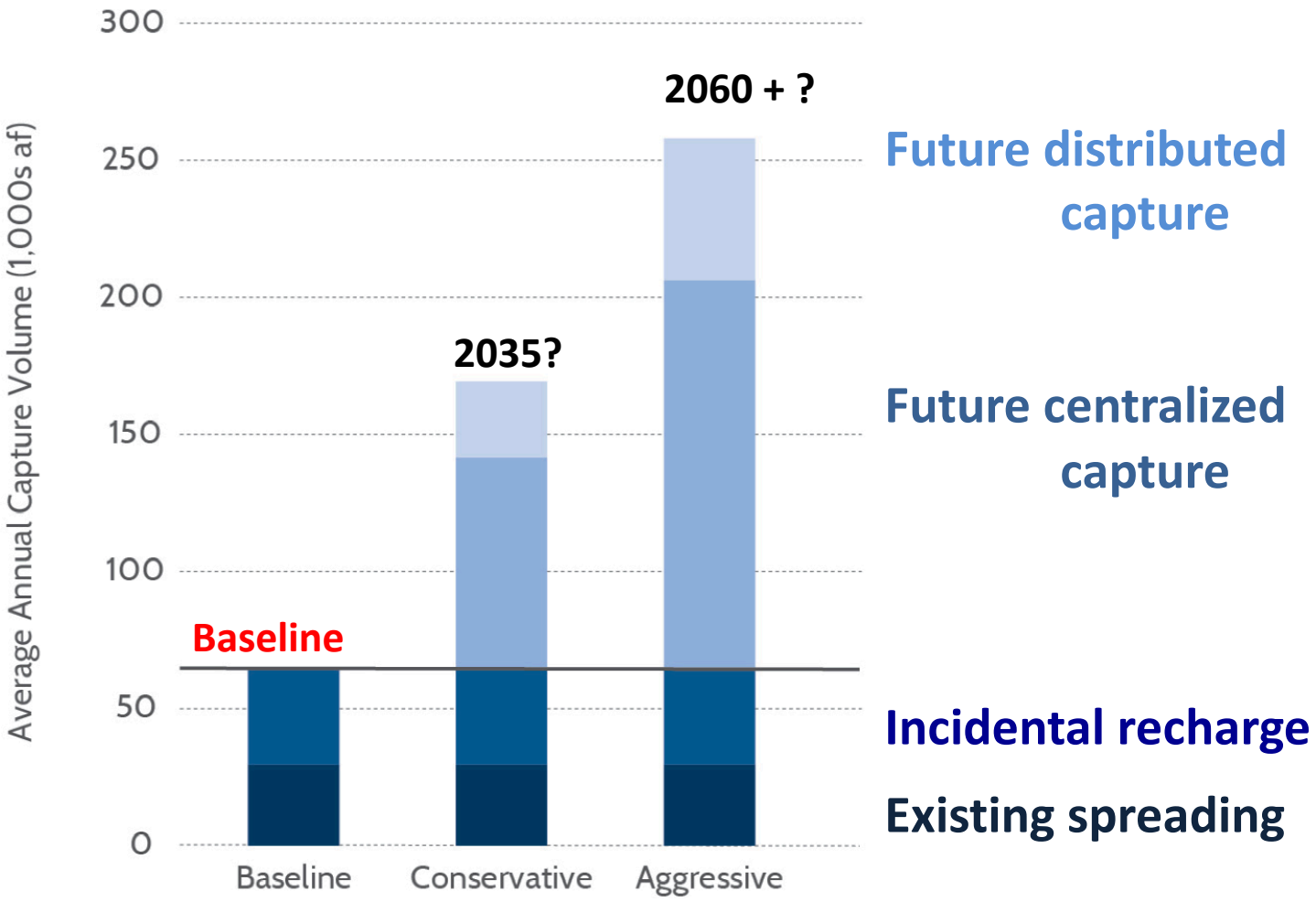
Los Angeles vs Bay Area

City of Los Angeles additional stormwater capture potential
68,000 – 114,000 AFY by 2035



There exists thousands of public parcels and public right-of-way segments across the County … e.g.,
22 high priority locations, 940 AFY

Los Angeles' Stormwater Capture Master Plan



An aggressive path *this century* could add nearly 200,000 afy from today's baseline (SWCMP, 2015)

Co-benefits = implementable solutions

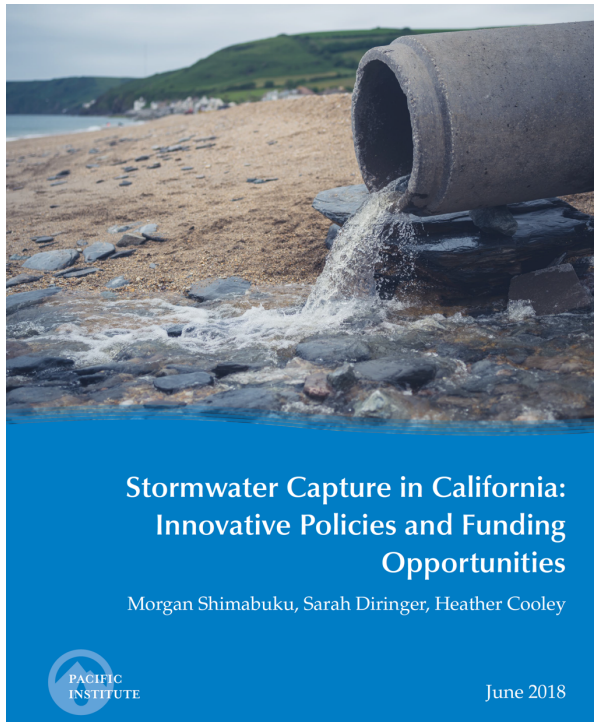
"Protect Our Beaches"

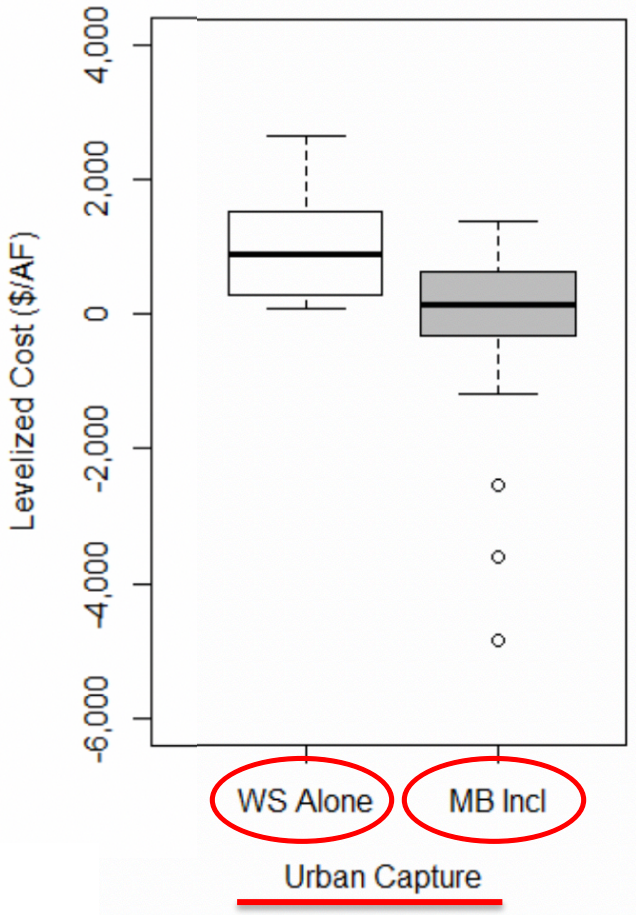
"City Environment Better for All"

Co-benefits = implementable solutions

Courtesy D. Pettijohn, LADWP

Quantifying co-benefits



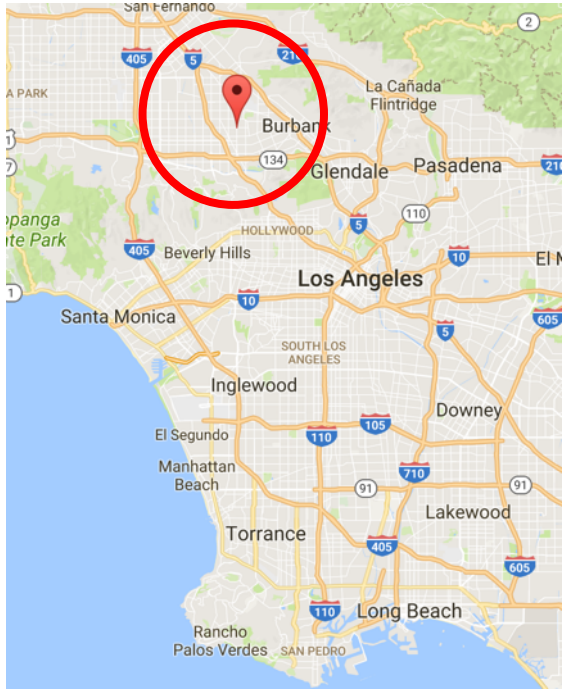


"Continue research to characterize the full cost and full benefits of stormwater capture projects."

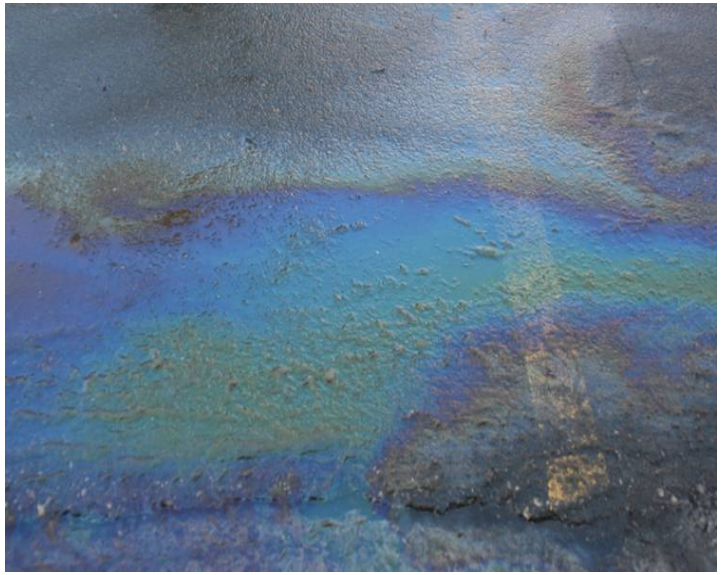
Co-benefits ~ $900-1000/AF less costly than considering water supply benefits alone

Diringer et al., under review

Rory M. Shaw Wetlands Park, Los Angeles



A question of contaminants



Pathogens

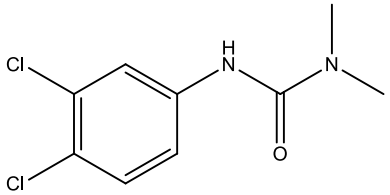
E. coli, enterococci

Urban-use biocides

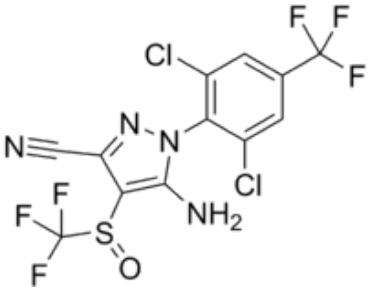
diuron, triazines, pyrethroids, fipronil

Vehicle-related compounds

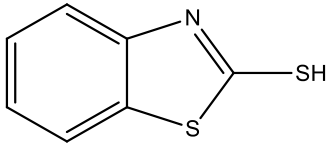
PAHs, benzothiazoles & alkylphenols (rubber) benzotriazoles (anti-freeze)



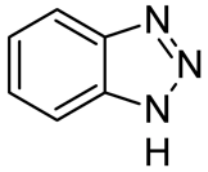
Diuron



Fipronil



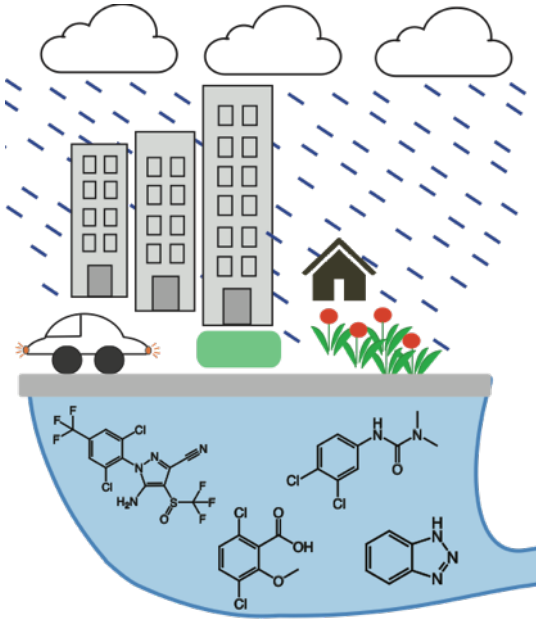
Mercaptobenzothiazole



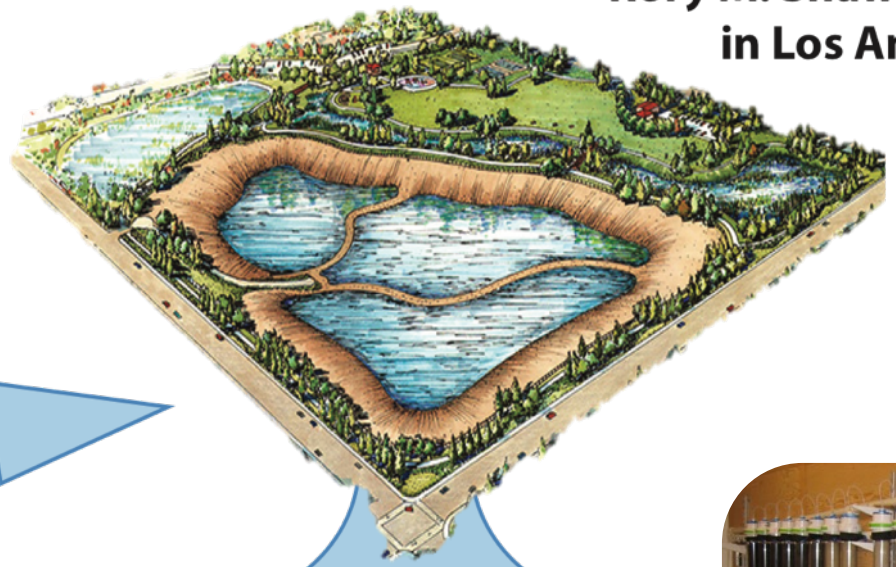
Benzotriazole

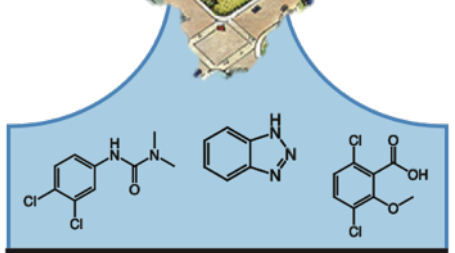
LeFevre et al., *ES&T,* 2015, 49: 10959; Wolfand et al., *ES&T*, 2019, 53(7): 3634; Spahr et al., *Env. Sci.: Wat. Res. & Tech*., 2019

Biochar-amended infiltration systems



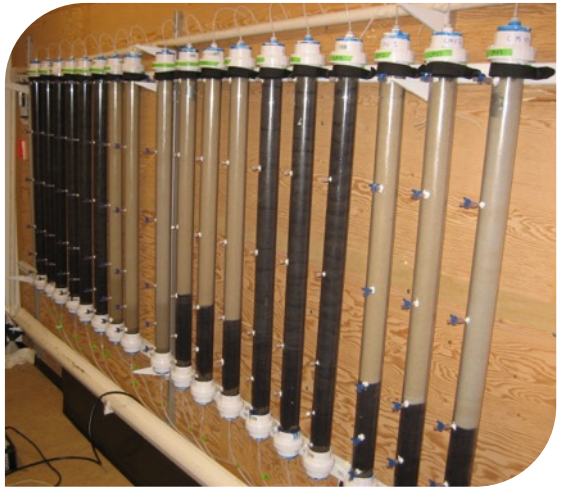
Future
Rory M. Shaw Wetlands Park
in Los Angeles, CA





Biochar-amended biofilter

AQUIFER



(1) Amount of biochar?

(2) Infiltration rate?

(3) Biotransformation?

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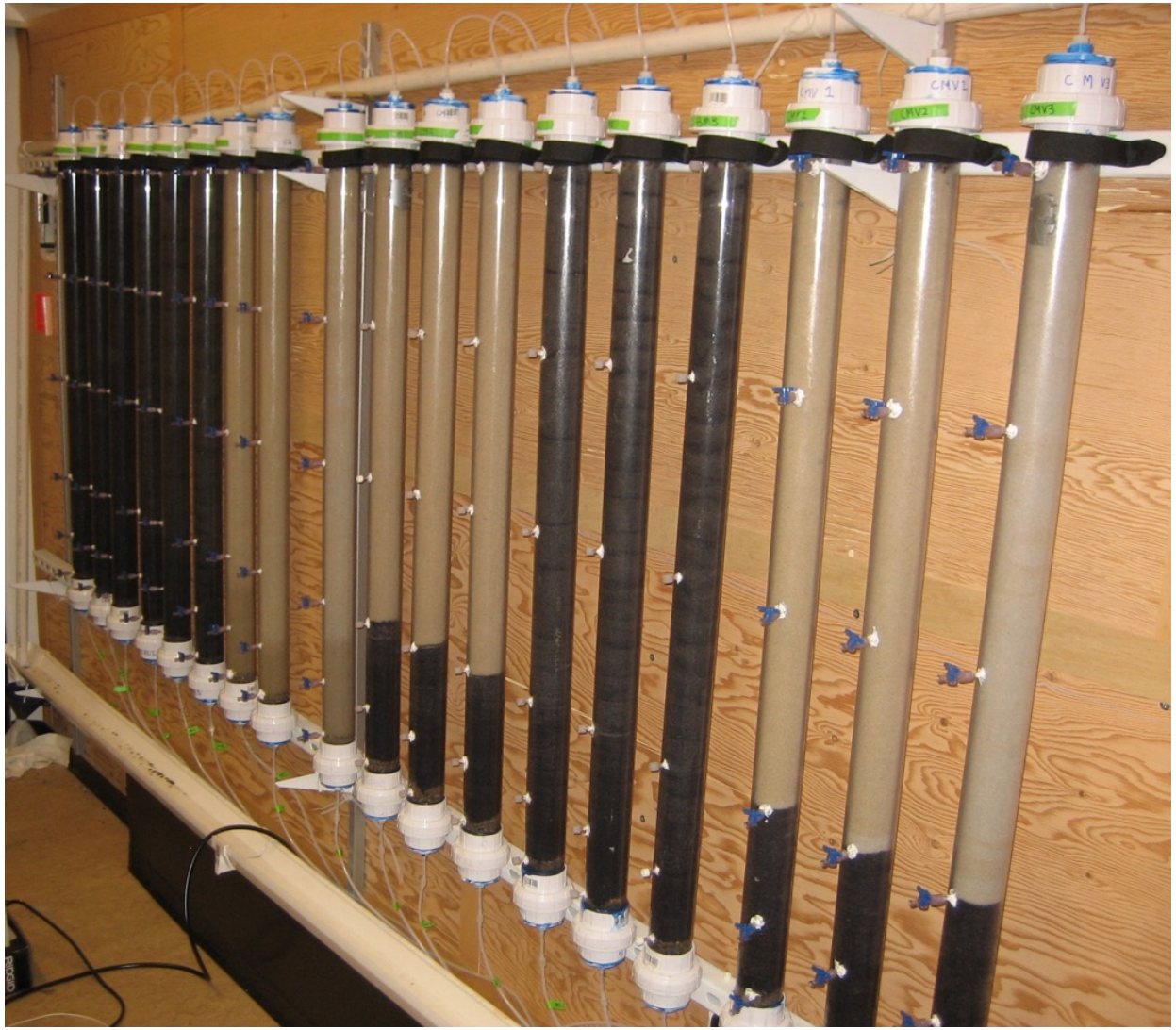
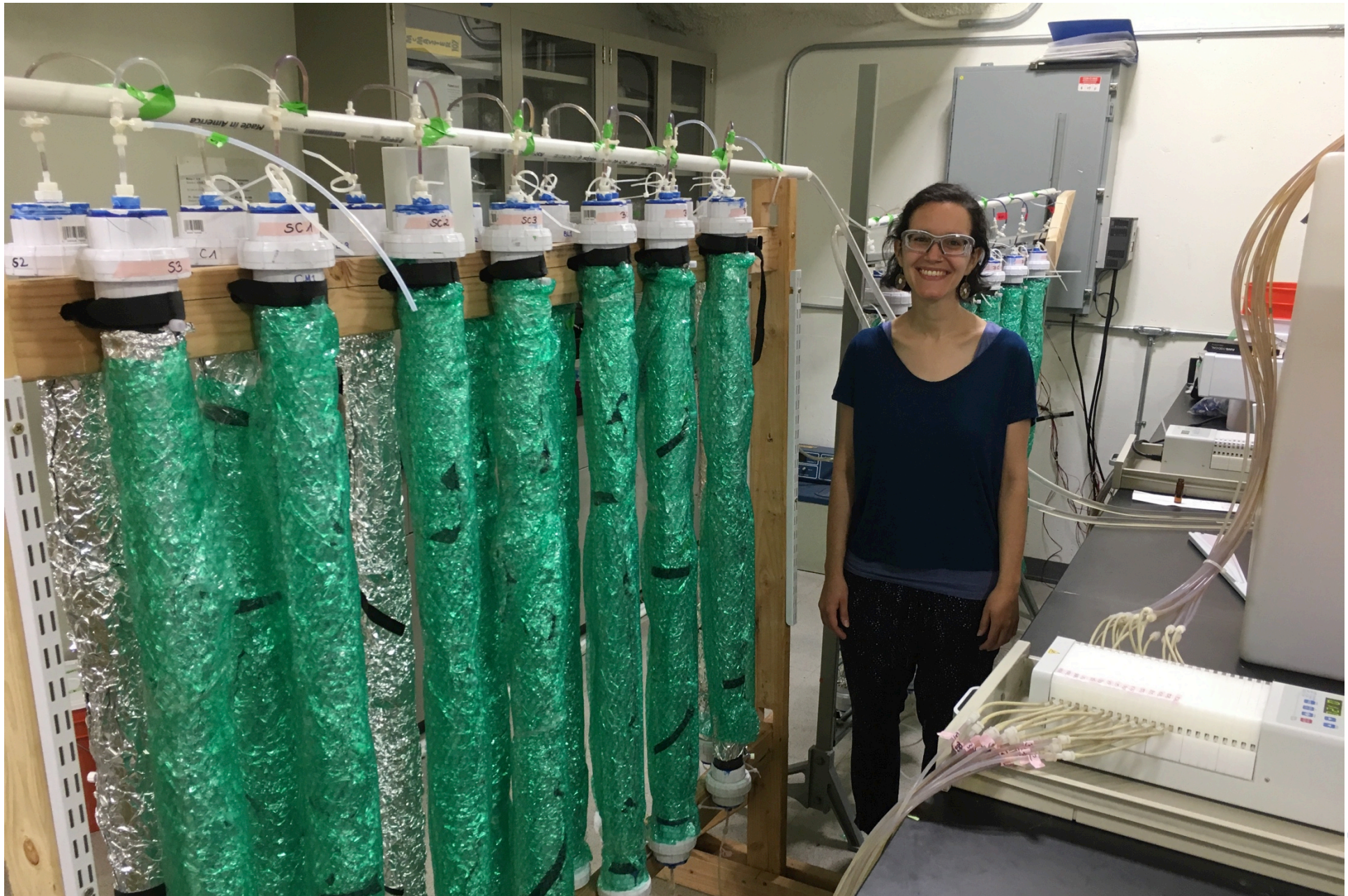
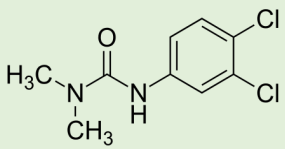
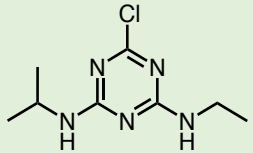
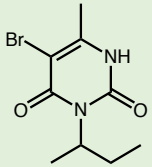
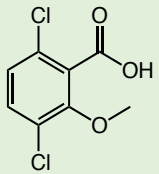
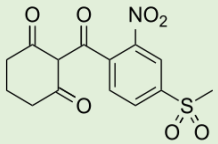
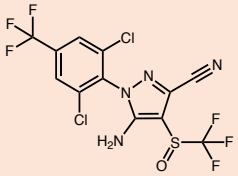
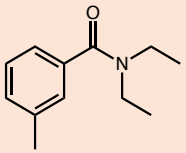
Conditioning filter materials in Los Angeles

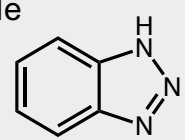
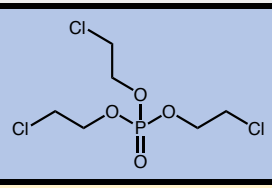
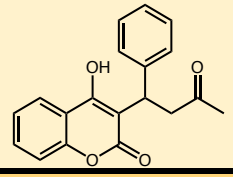
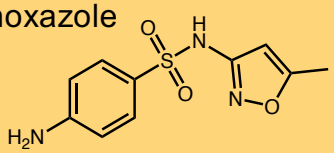
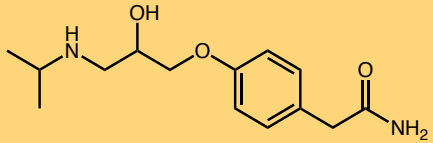
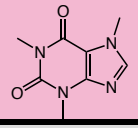
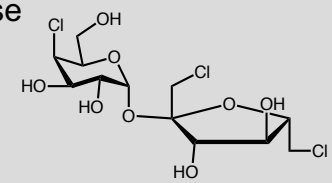


Challenge tests with columns brought back to Stanford



Hydrophilic trace organic contaminants – challenge tests

			log Kow
Herbicides	Diuron		2.7
	Atrazine		2.6
	Bromacil		2.1
	Dicamba		-0.4 (pH 7) *anionic*
	Mesotrione		-1 (pH 7) *anionic*
Insecticides	Fipronil		3.8
	DEET		2.5

			log Kow
Corrosion inhibitor	1H-Benzotriazole		1.4
Flame retardant	TCEP		1.4
Rodenticide	Warfarin		0.9 (pH 7) *anionic*
Pharmaceuticals human and veterinary drugs	Sulfamethoxazole		0.1 (pH 7) *anionic*
	Atenolol		0.2 (pH 7) *cationic*
Wastewater indicator	Caffeine		0.2
Artificial Sweetener	Sucralose		-1

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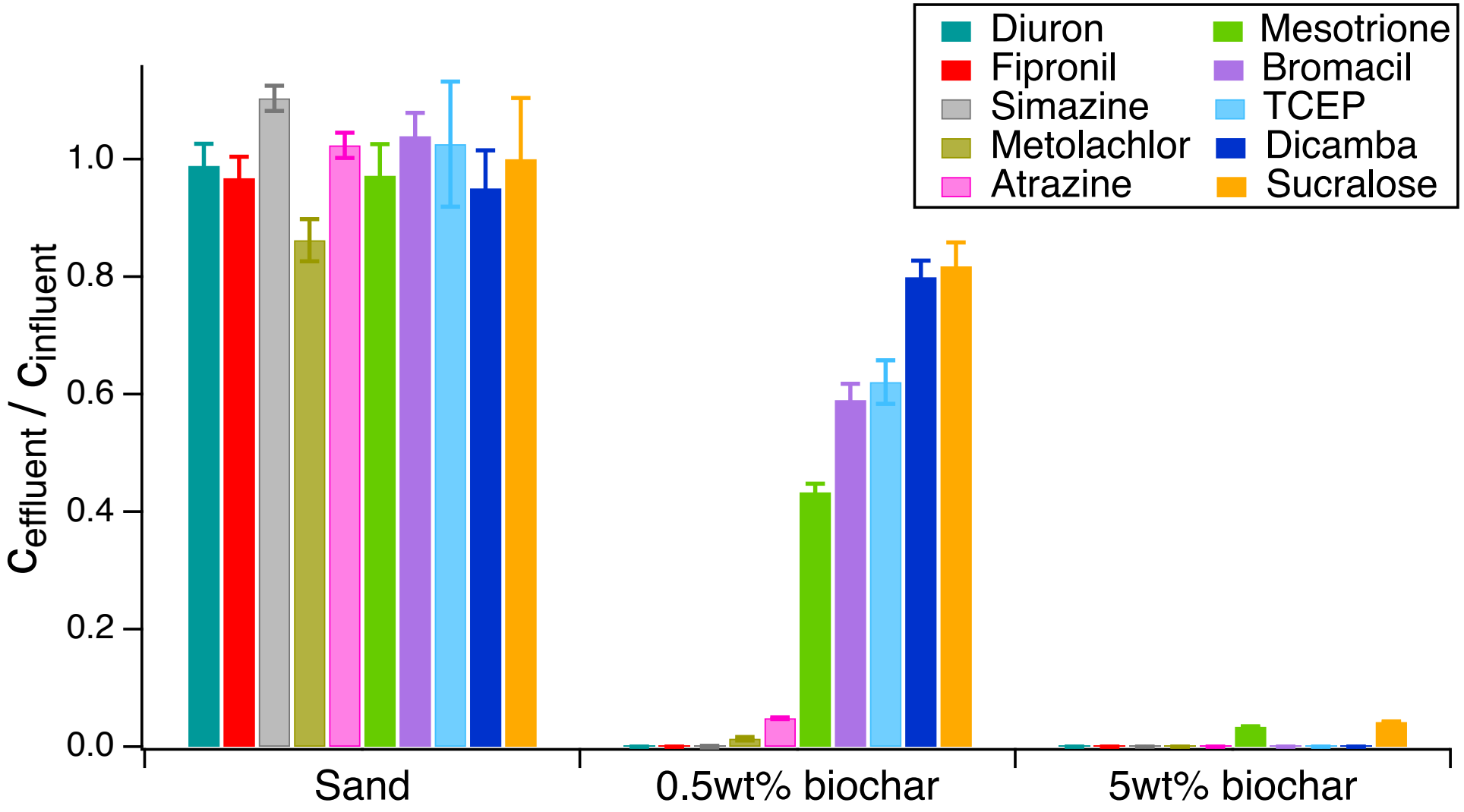
Challenge tests — 500 pore volumes



It's possible to use more biochar, perhaps 70 vol % with sand

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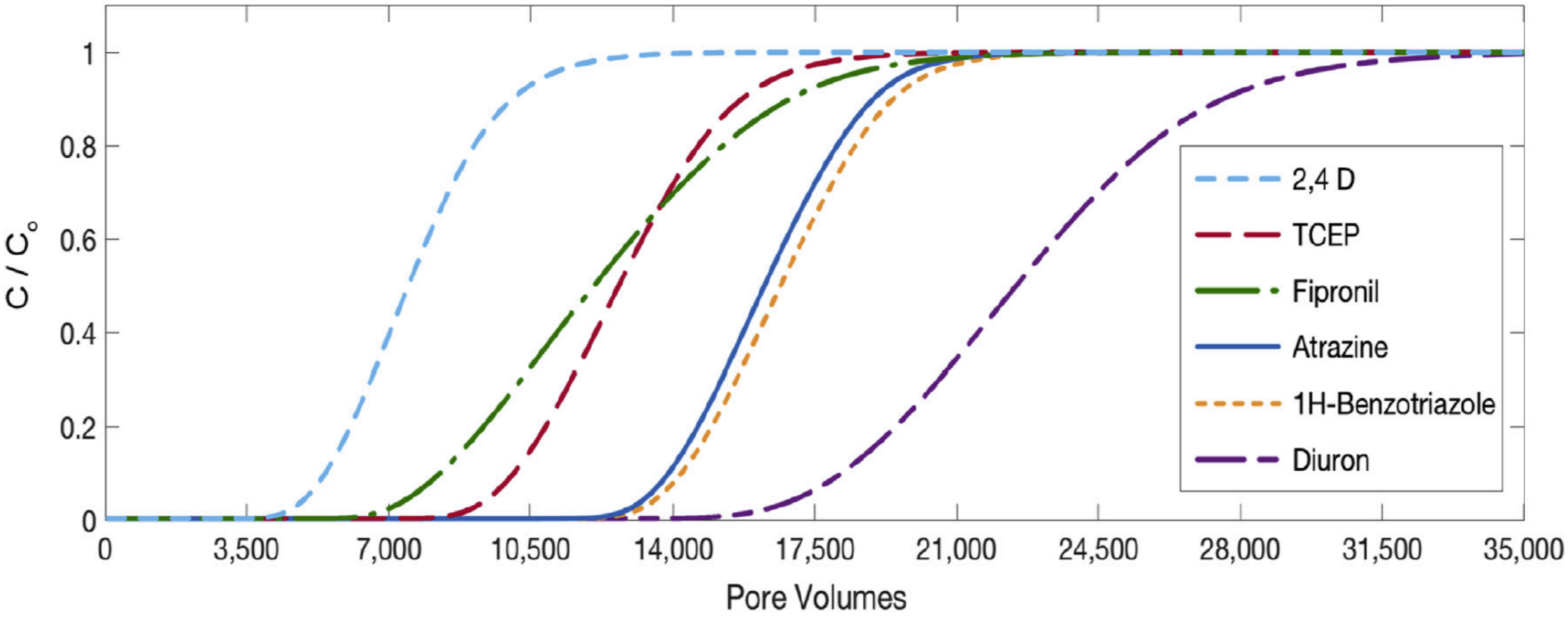
Prediction with 33 wt% biochar



Case study of Santa Rosa, CA

With particle removal and controlled flow, the system could last several years or more before biochar replacement

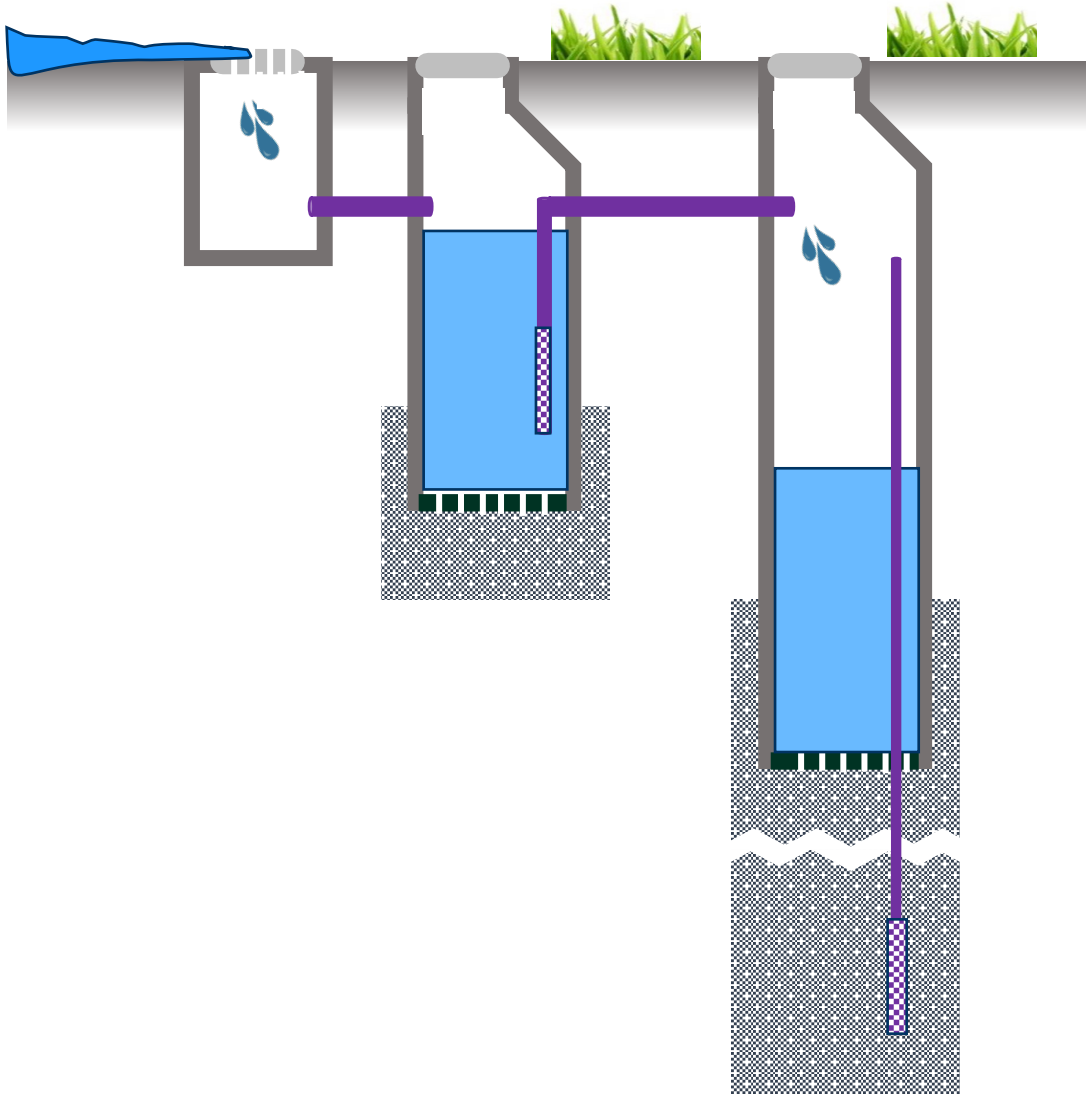
Ashoori, et al., *Water Res., 154,* pg 1-11, 2019

Stormwater recharge in distributed systems

Sun Valley Neighborhood Los Angeles (near Burbank airport)

Goleta Street at Laurel Canyon Blvd.

Laurel Canyon Blvd. Dry Wells (stormwater recharge in distributed systems)

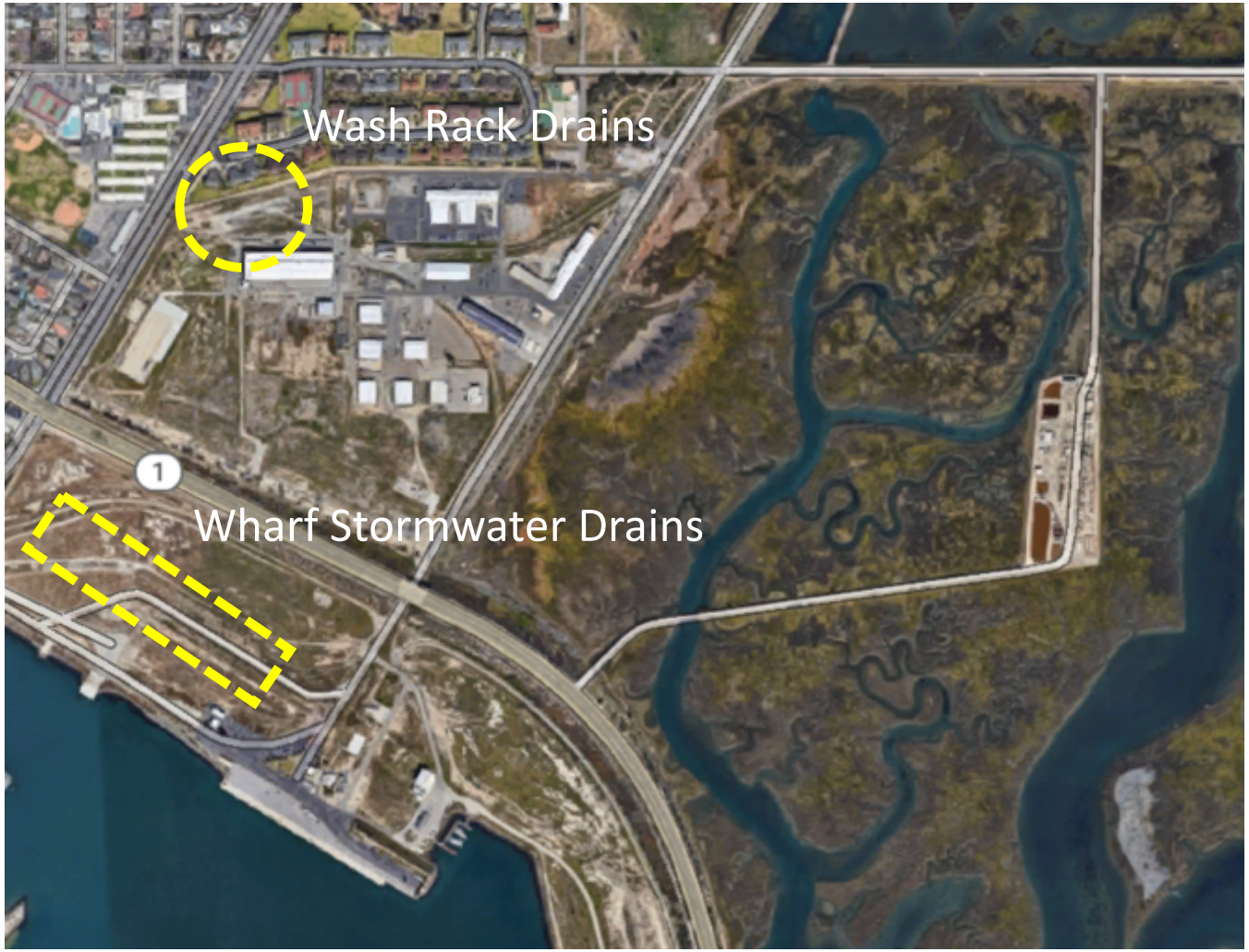


Laurel Canyon Blvd. dry wells

"Removal of contaminants in a dry well using a hybrid treatment system of adsorption & advanced oxidation."

Rapid flow geomedia biofilters for DoD

Naval Weapons Station Seal Beach (NWSSB)



Jeff McGovern,
Env. Compliance Supervisor
NWSSB, Seal Beach, CA

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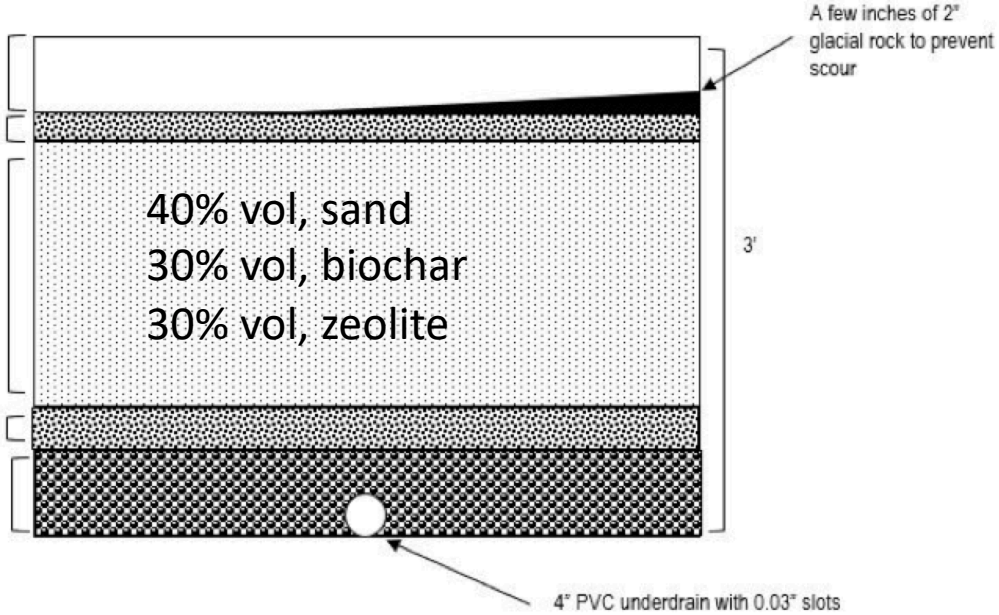
Rapid flow geomedia biofilters for DoD

Sand + biochar or regen. AC + zeolite

Flow rates typical for infiltration basins

Model media size and mix to predict performance & reduce system footprint

Related ReNUWIt project



Sand, biochar & zeolite; Nikki Fitzgerald, CSM

ReNUWIt
Re-inventing the Nation's URBAN WATER INFRASTRUCTURE

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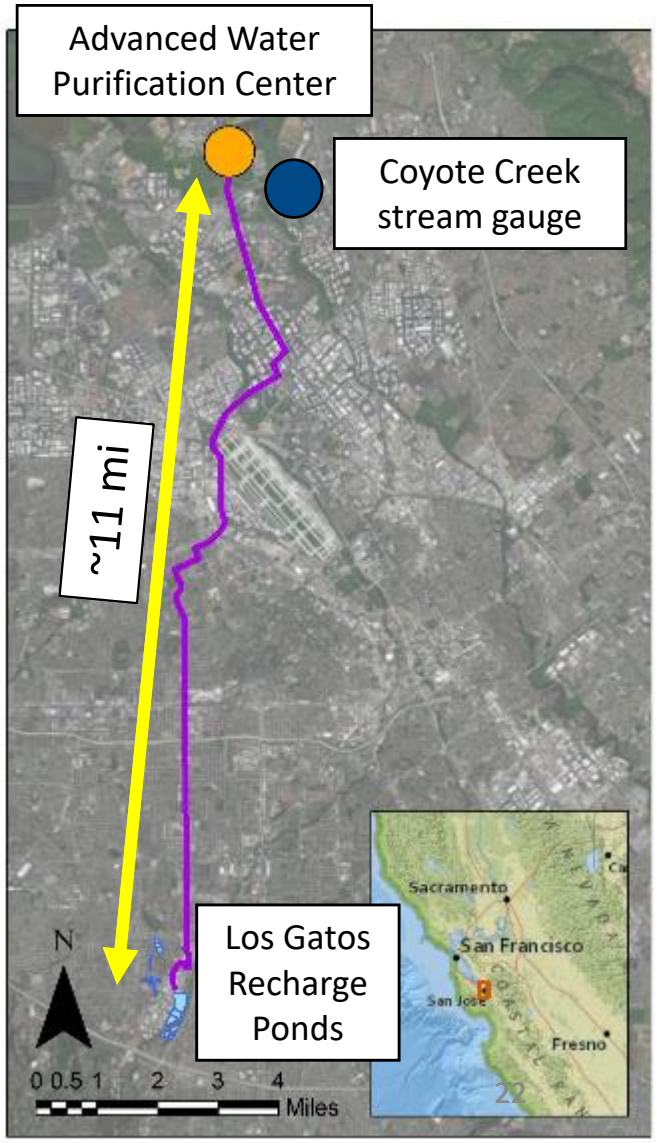
Leveraging infrastructure

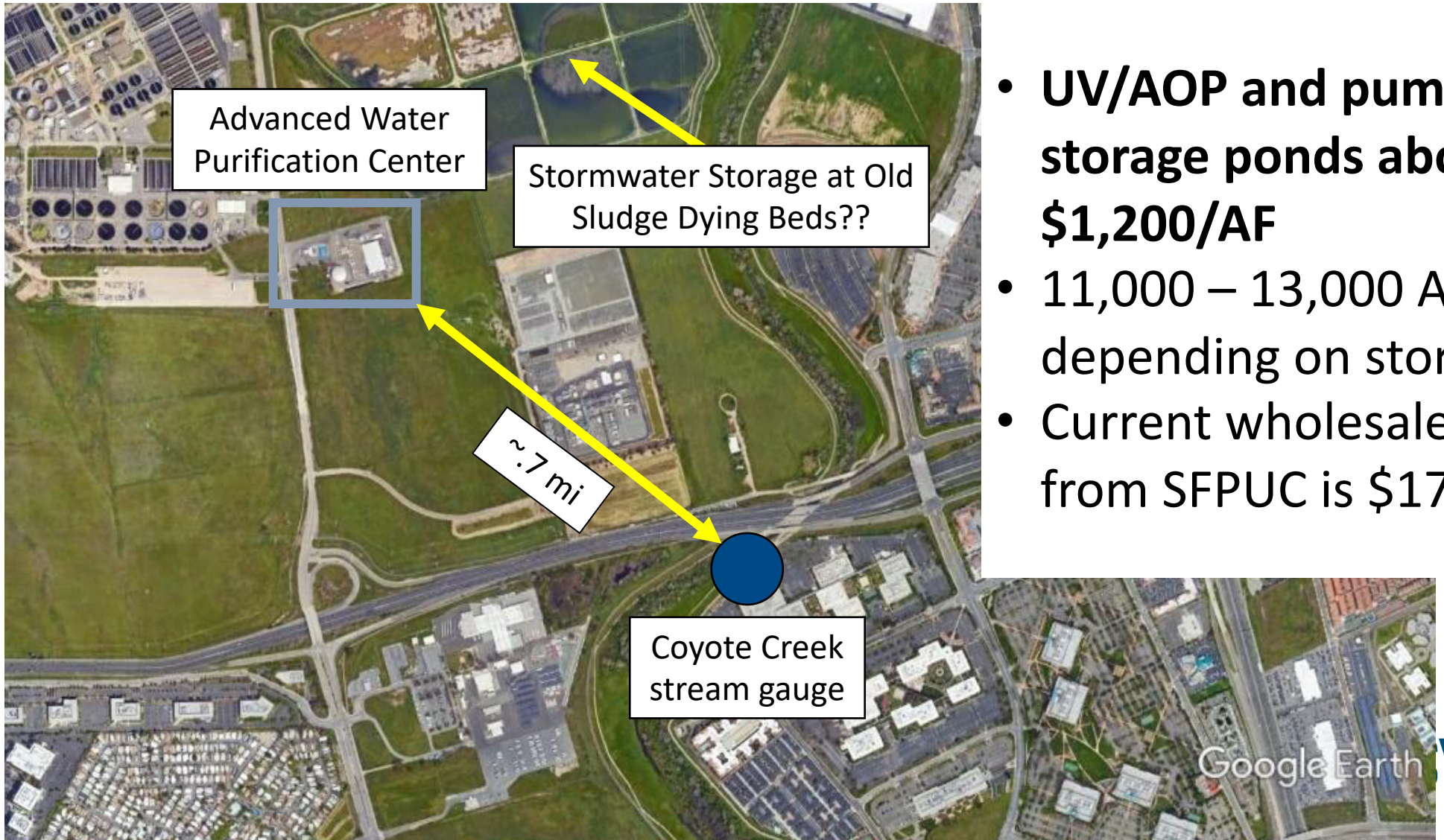


Potential pipeline drawn for illustrative purposes

- Case study of Valley Water
- Hydrologic analysis
- Treatment options
  - UV/AOP, …. ….
- Storage options

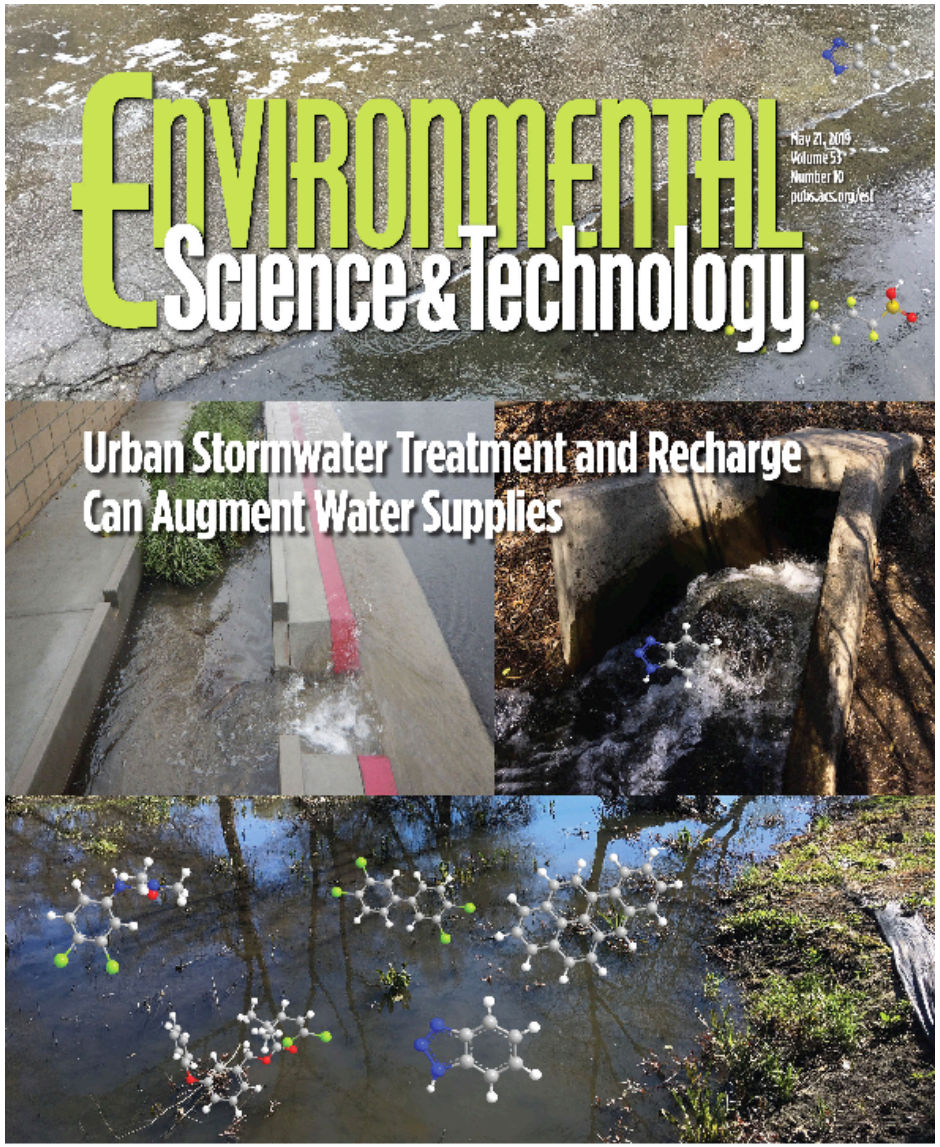
Bradshaw et. al., *ES&T,* 2019 53(6): 3128

Leveraging infrastructure



- **UV/AOP and pumping to storage ponds about $1,200/AF**
- 11,000 – 13,000 AFY depending on storage
- Current wholesale rate from SFPUC is $1786/AF

Trends in stormwater use



- Push for resilient water supplies
- Water quality benefits
- Regional assessments
- Leveraging existing infrastructure
- Quantifying co-benefits
- Financing stormwater use

Luthy, et al., *ES&T*, 2019, 53(10): 5534