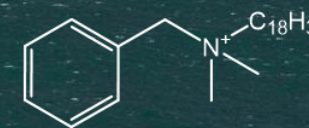
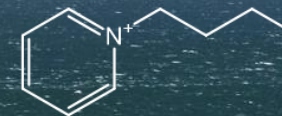
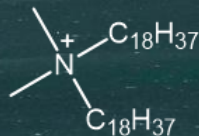


QACs in San Francisco Bay



Miguel Méndez, Diana Lin, Rebecca Sutton

BAPPG Meeting
08/02/23



QACs: Sources and Impacts

- In use since late 1930s in industrial, agricultural, and consumer products
 - **Antimicrobial**, antistatic, and surfactant properties
- Common in household products
- Known toxicity to aquatic species
- May contribute to the development of antibiotic resistance



EPA United States Environmental Protection Agency

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Pesticide Registration CONTACT US SHARE f t

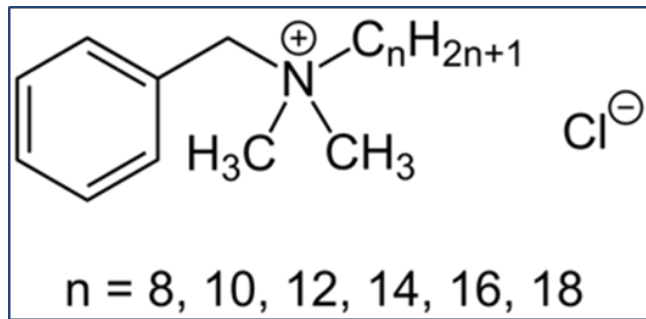
Pesticide Registration Home

About Pesticide Registration

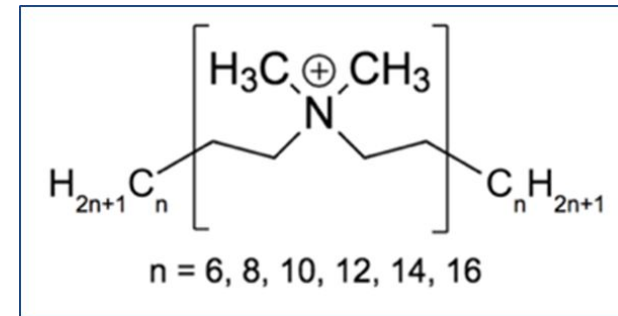
List N: Disinfectants for Use Against SARS-CoV-2 (COVID-19)

Classes of QACs

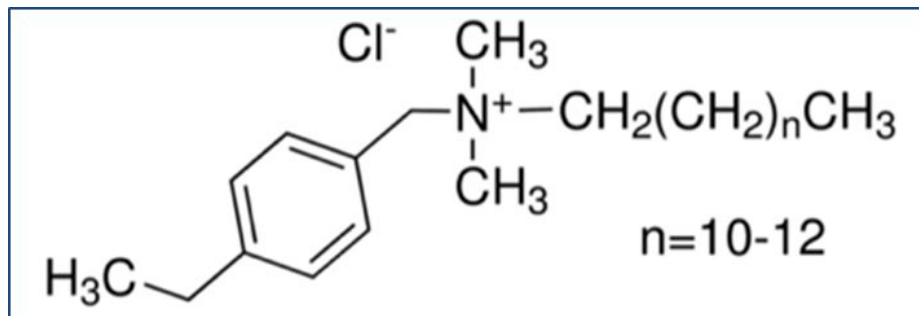
Benzalkyldimethylammonium compounds
(BACs)



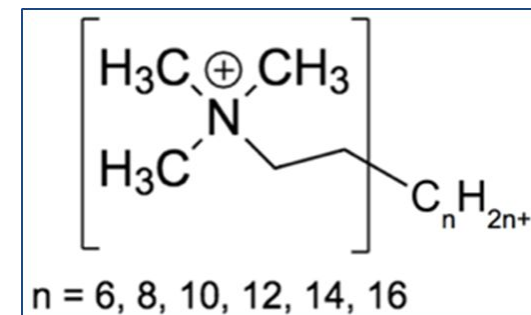
Dialkyldimethylammonium compounds
(DADMACs)



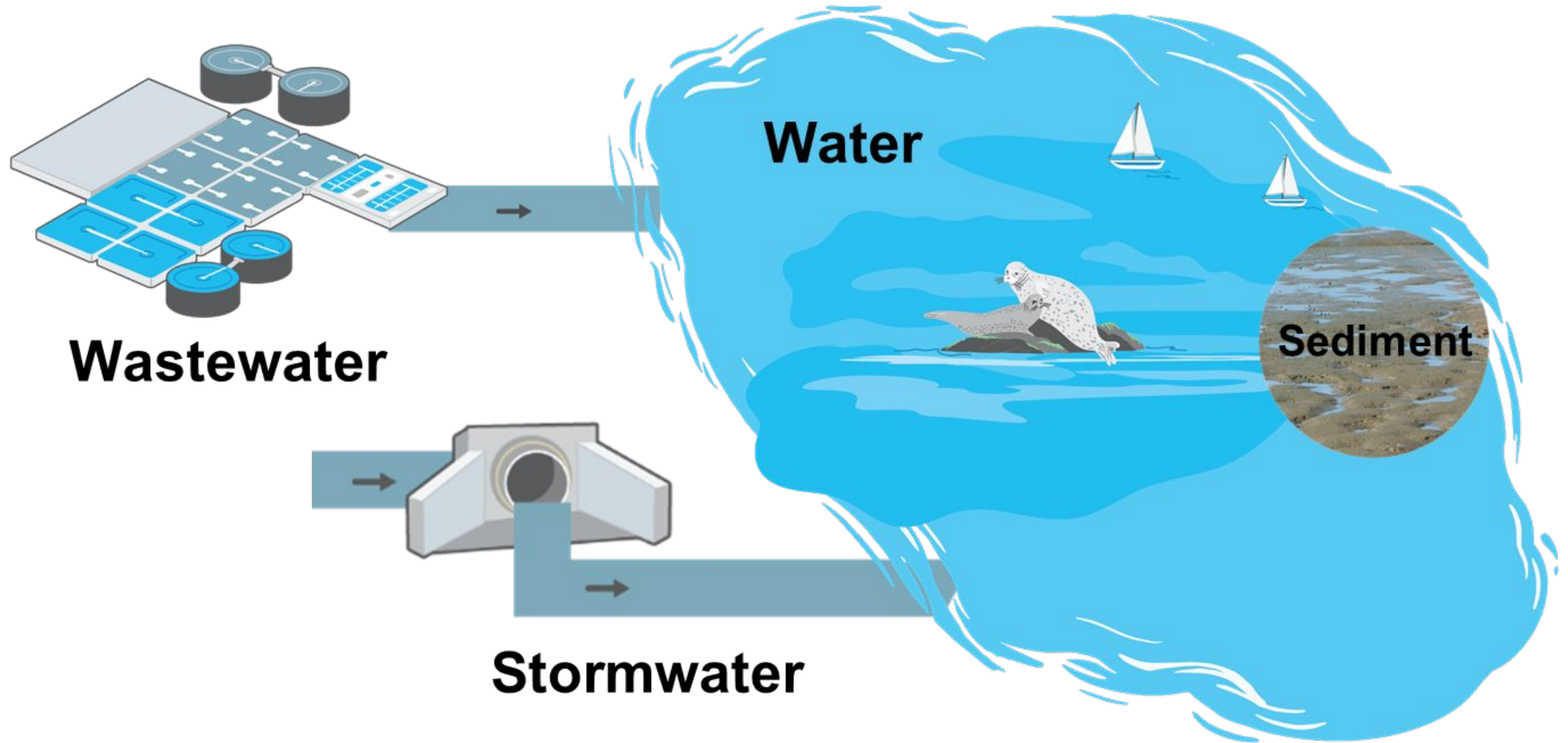
Ethylbenzylalkylammonium compounds
(EtBACs)



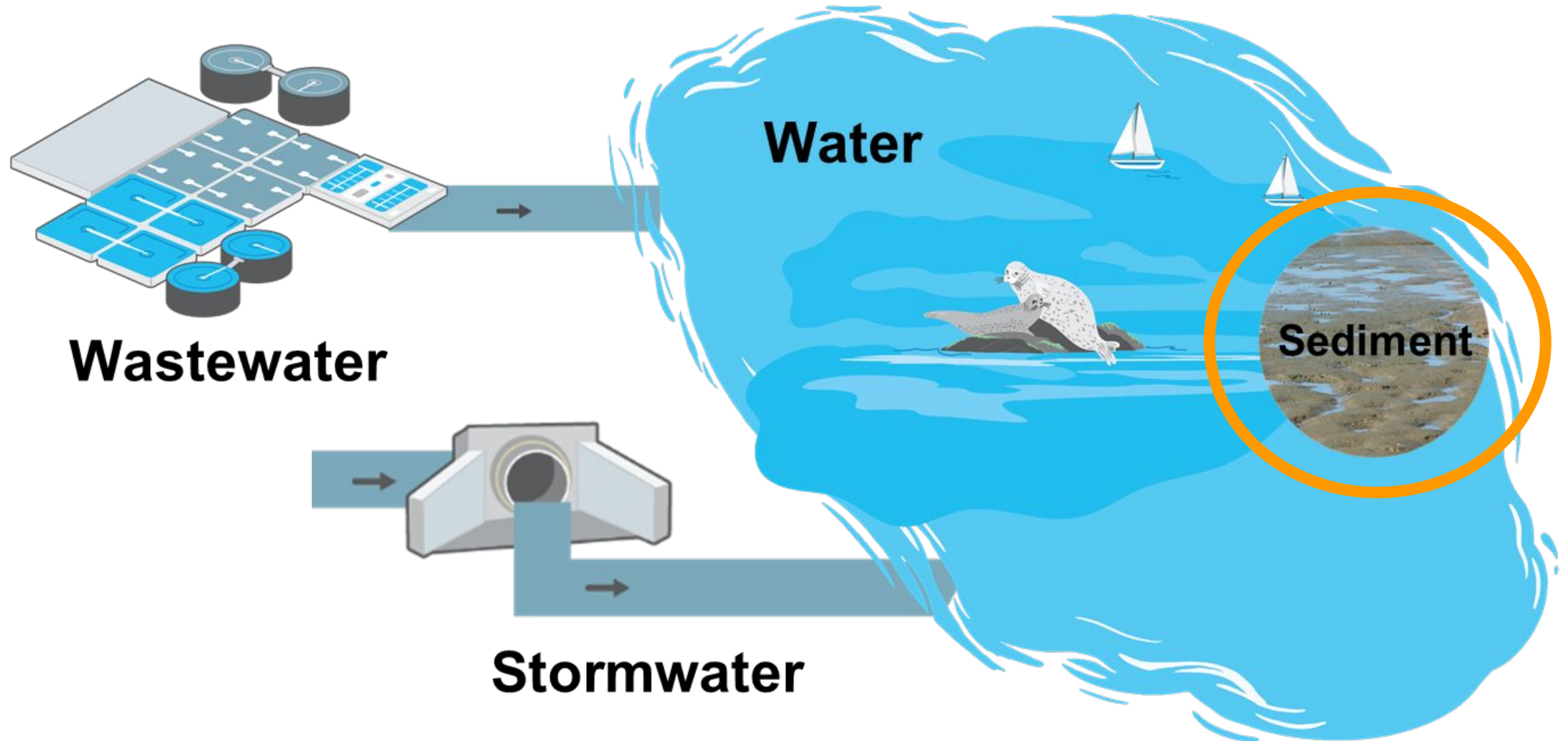
Alkyltrimethylammonium compounds
(ATMACs)



Monitoring **QACs** in San Francisco Bay

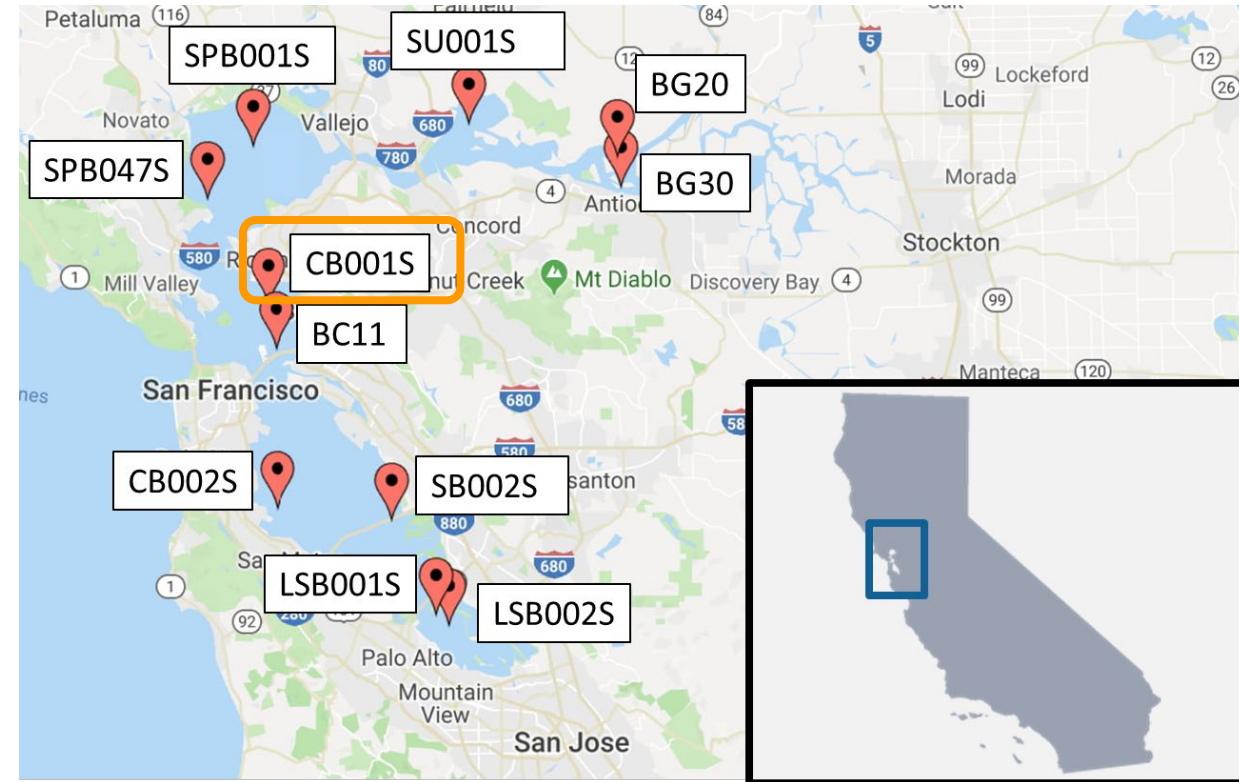


Monitoring **QACs** in San Francisco Bay



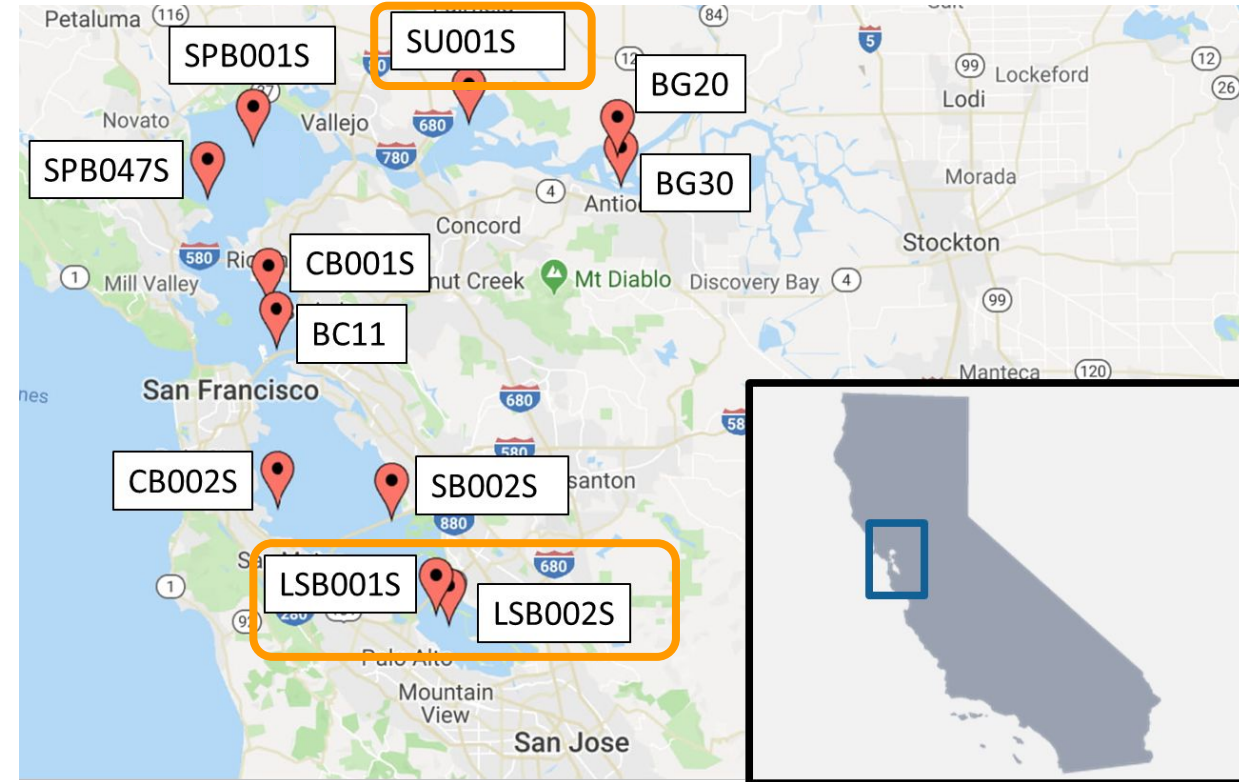
QACs in Sediment: Study Design

- 2018 Pro-bono study by Dr. Bill Arnold of University of Minnesota
 - 11 sites across the Bay for surface sediment
 - 14 target analytes
 - 15 analytes for suspect screening
- Includes Sediment Core (2011) from Central Bay Site
 - Time dated by ^{210}Pb using isotope dilution
 - Spans roughly 60 years from (~1951-2009)
 - Same Analysis



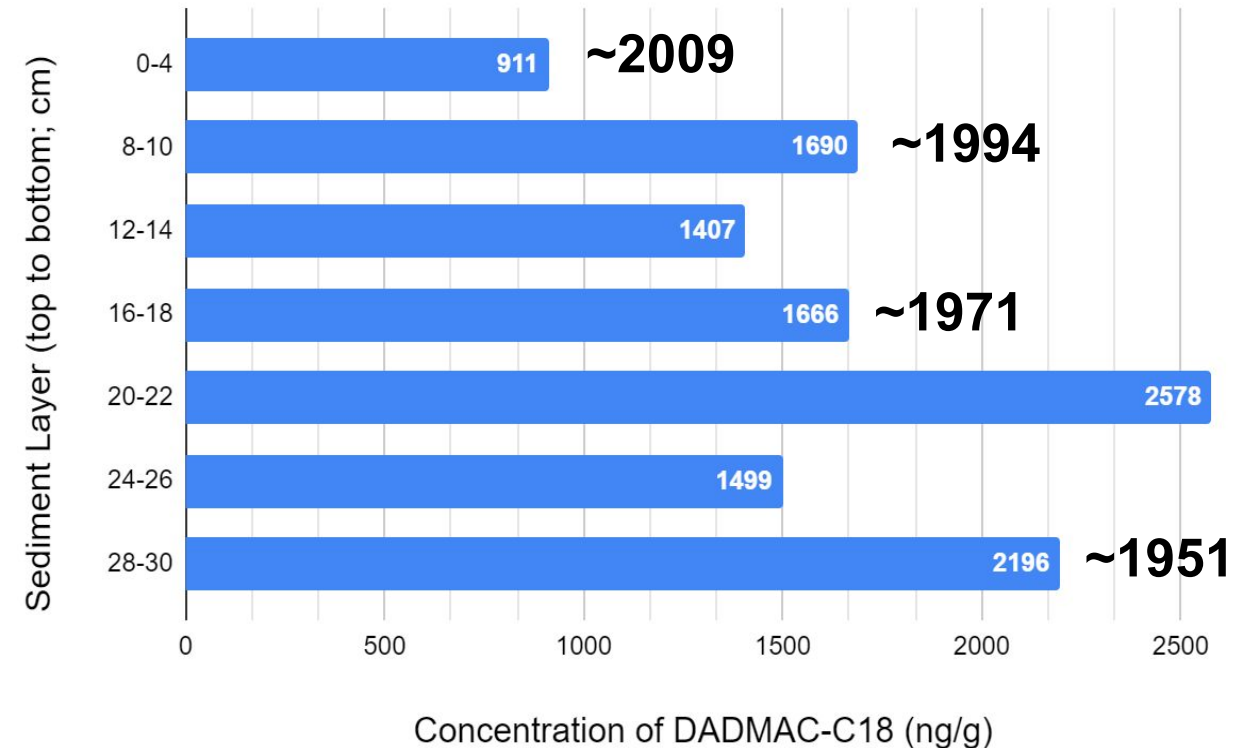
QACs in Surface Sediment: Results

- 9 Target QACs detected
 - 8 *suspect screening* analytes found
 - C18-BAC and C10-DADMAC were most detected (9 sites)
 - C18-DADMAC had highest concentrations
 - Low recovery rates
 - Range: ND - 832 ng/g dw
 - Average (ND = 0): 258 ng/g dw
- Grizzly Bay and LSB had highest sum concentrations
 - Range: 1073 - 1358 ng/g dw
 - Average (ND = 0): 519 ng/g dw



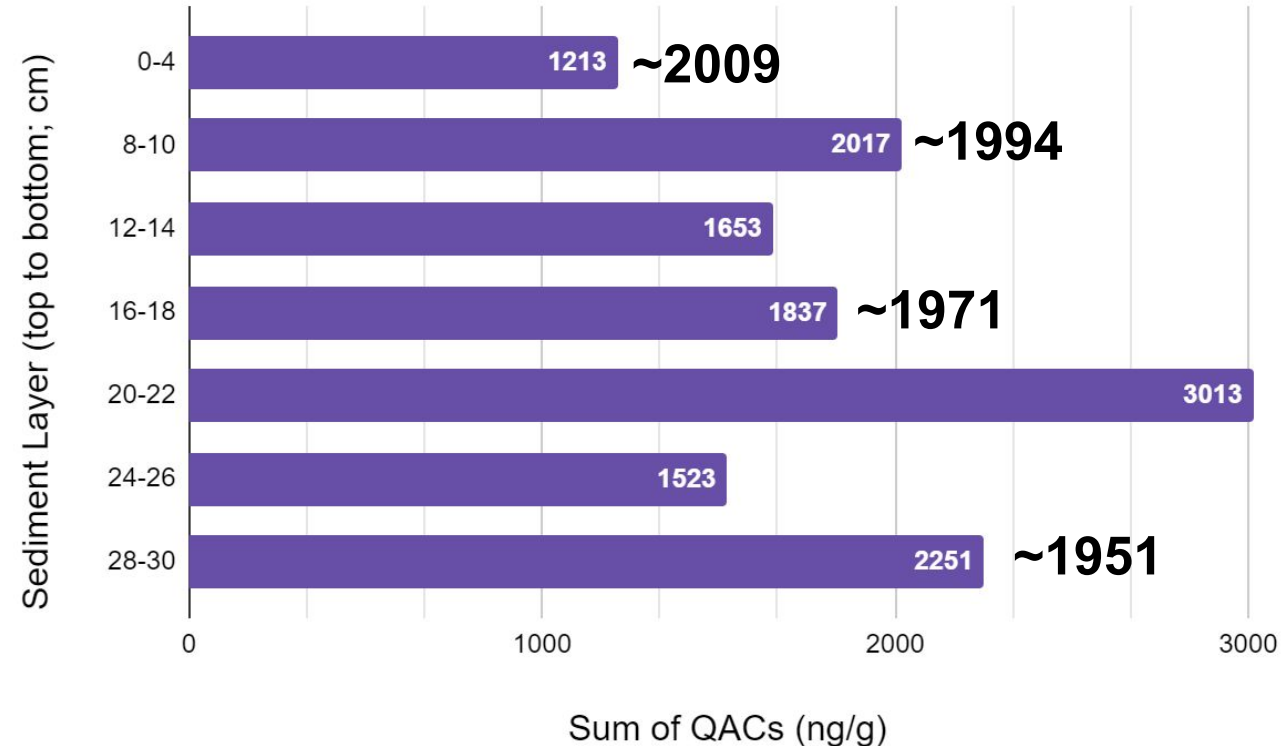
QACs in Sediment Core: Results

- 8 Target QACs detected
 - 7 suspect screening analytes found
 - C18-BAC and C18-DADMAC detected at all sites
 - C18-DADMAC had greatest concentrations (nearly ~50X greater than C18-BAC)



QACs in Sediment Core: Results

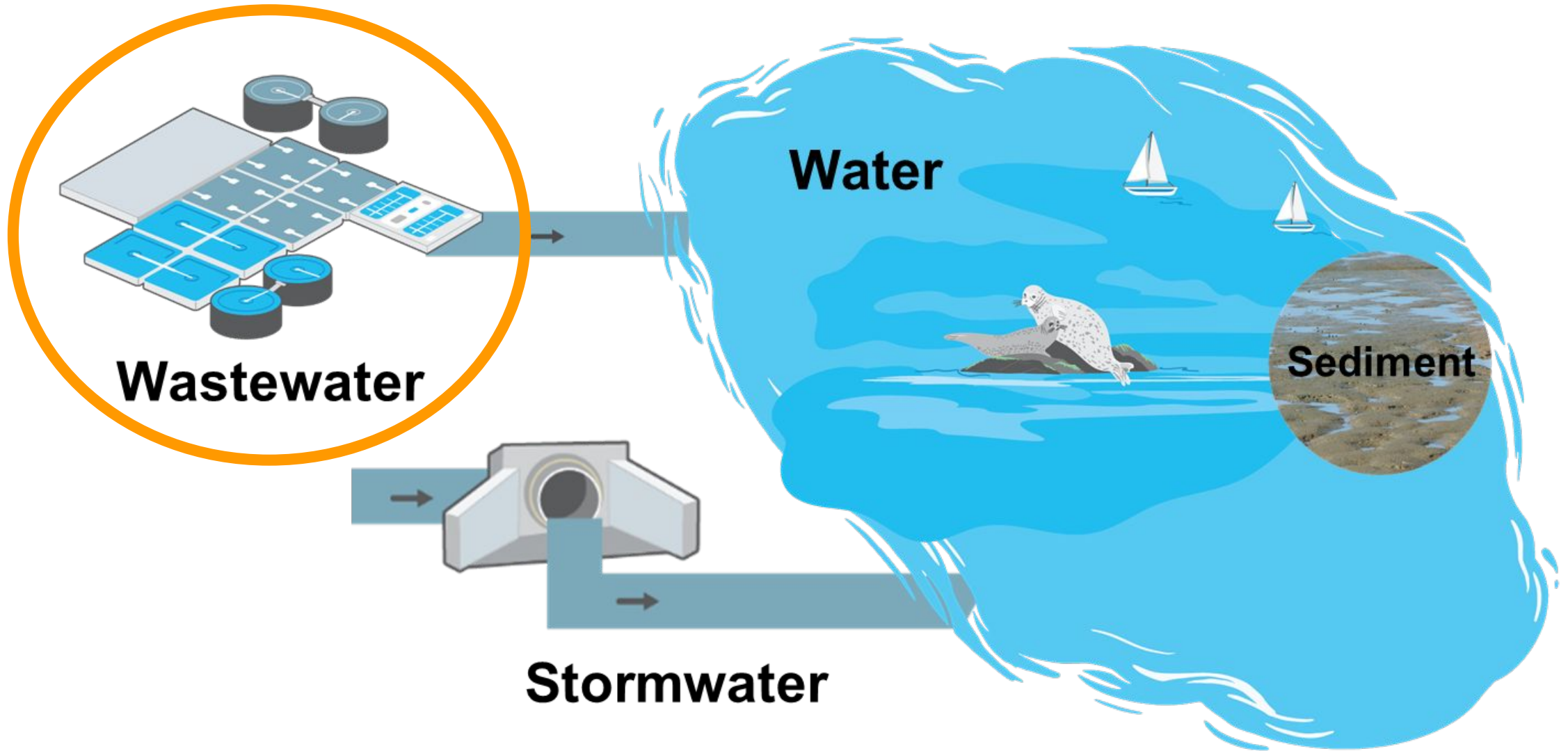
- 8 Target QACs detected
 - 7 *suspect screening* analytes found
 - C18-BAC and C18-DADMAC detected at all sites
 - C18-DADMAC had greatest concentrations (nearly ~50X greater than C18-BAC)
- The sum concentration of QACs profile with depth suggests a declining temporal trend in sediment



QACs in Sediment: Main Takeaways

- QACs detected across the Bay
 - C18-DADMAC driving sum concentrations of QACs though they may be declining over time
 - Highest concentrations in Lower South Bay and Grizzly Bay
 - Better toxicity thresholds needed to assess impacts to the Bay
- The sum concentration of QACs profile with depth suggests a declining temporal trend in sediment
- Continued sampling and analysis of QACs
 - North Bay margins (Analysis in progress)
 - Sediment Cruise 2023

Monitoring **QACs** in San Francisco Bay



QACs in Wastewater: Study Design

- Motivation to understand presences of QACs and impact of COVID-19 on loads
- Combined 4 year (2020-2023) between RMP and NSF funded grant from Dr. Bill Arnold
 - 3 POTWs in SF Bay
 - Influent, effluent, and biosolids
 - Collected quarterly beginning in the second quarter of 2020
 - Few archive samples
 - At least 22 target analytes

POTW	10 Year AVG Flow (MGD)	Key features
<i>Plant X</i>	20	Tertiary Treatment; Gravel/sand/ anthracite filters, UV disinfection
<i>Plant Y</i>	84.3	Tertiary Treatment w/ Denitrification; Gravel/sand/ anthracite filters, Cl ₂
<i>Plant Z</i>	54	Secondary Treatment; Aq. ammonia used in disinfection, aeration with O ₂ , Cl ₂

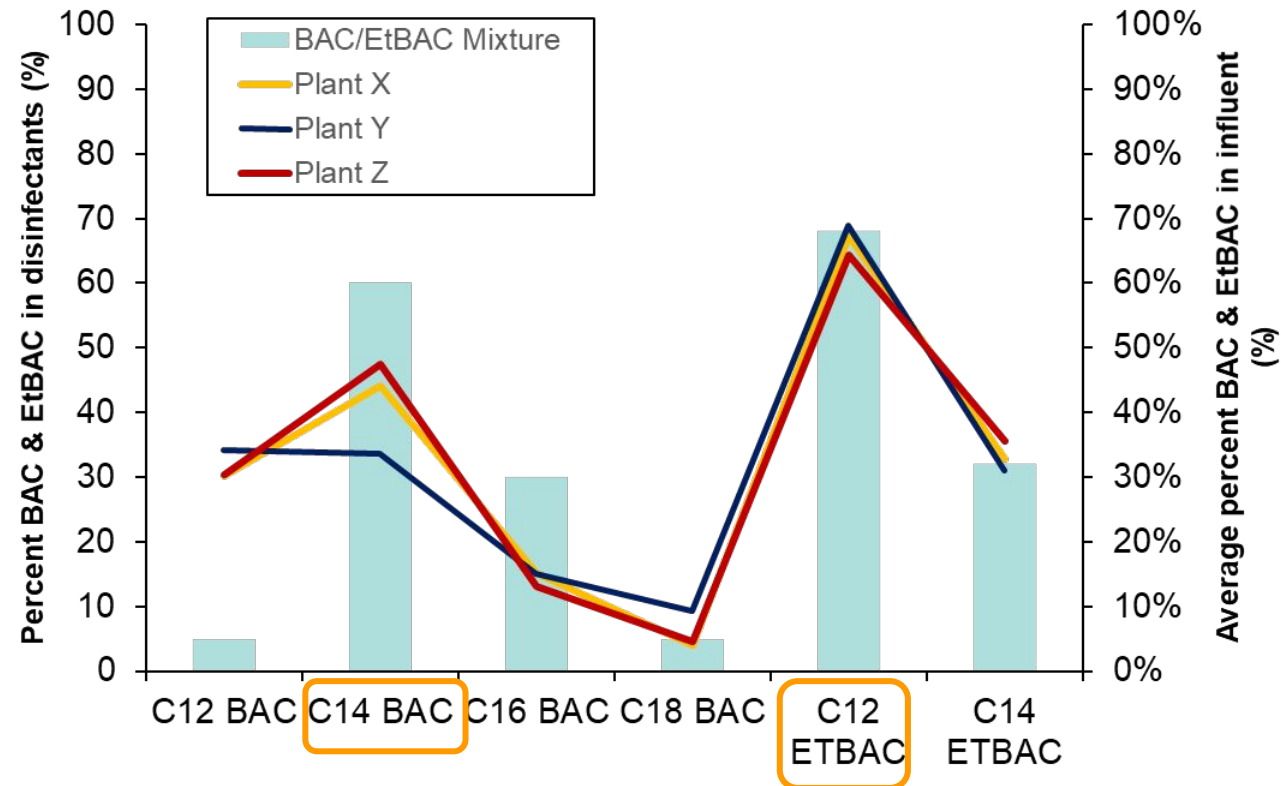
QACs in Wastewater: Preliminary Results

- Several QACs detected across all matrices
 - Average removal from liquid effluent >97% in all plants

POTW	10 Year AVG Flow (MGD; 2012-22)	Key features	Avg. influent [QAC]Tot (µg/L)	Avg. effluent [QAC]Tot (µg/L)	Average percent removal (%)	Avg. biosolid [QAC]Tot (mg/kg dry wt.)
<i>Plant X</i>	20	Tertiary Treatment; Gravel/sand/ anthracite filters, UV disinfection	71 ± 54	1.2 ± 1.7	98 ± 3	230 ± 110
<i>Plant Y</i>	84.3	Tertiary Treatment w/ Denitrification; Gravel/sand/ anthracite filters, Cl ₂	27 ± 17	0.31 ± 0.25	98 ± 1	140 ± 50
<i>Plant Z</i>	54	Secondary Treatment; Aq. ammonia used in disinfection, aeration with O ₂ , Cl ₂	53 ± 24	1.2 ± 0.6	97 ± 3	500 ± 375

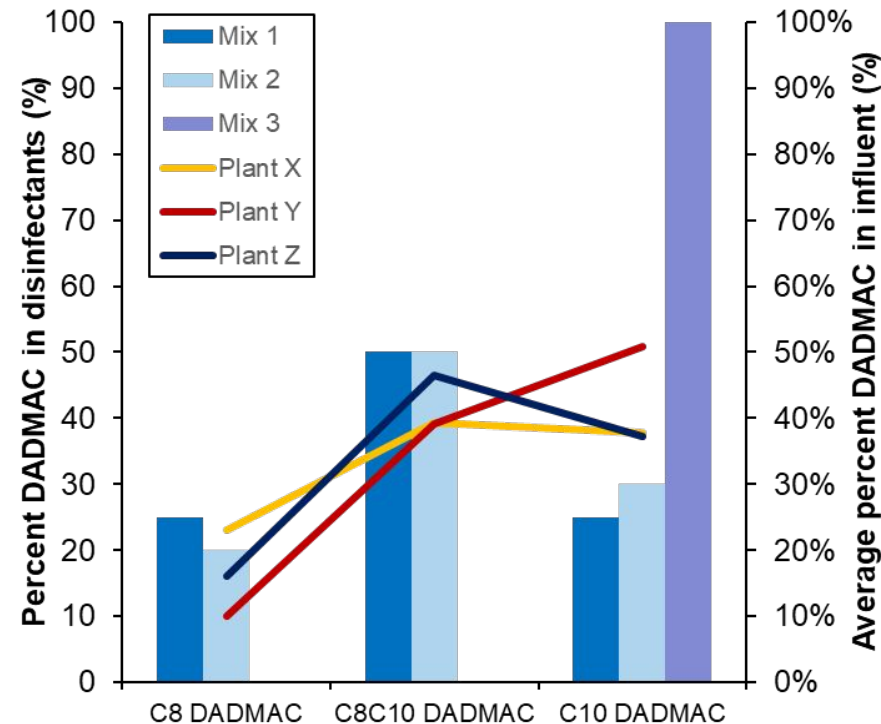
QACs in Wastewater: Preliminary Results

- QACs detected in the highest concentrations in influents are those used in disinfectants



QACs in Wastewater: Preliminary Results

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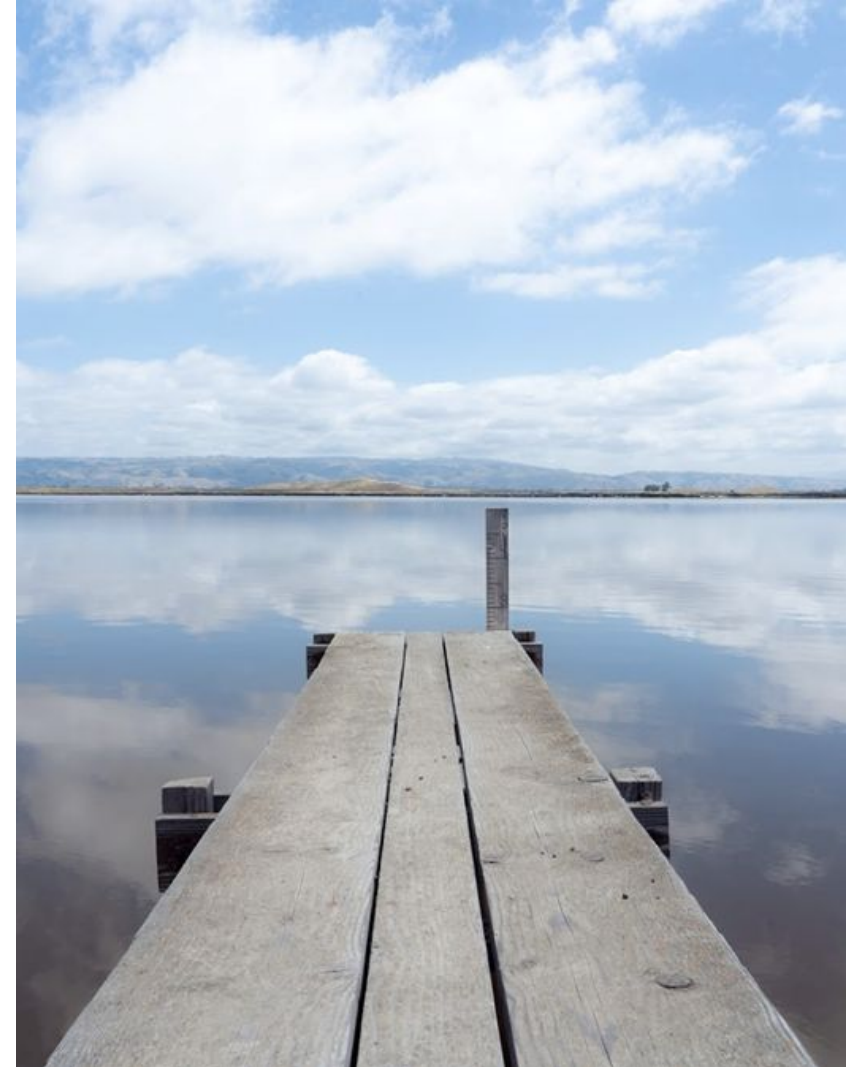


QACs in Wastewater: Preliminary Results

- QACs found in effluent and biosolids at the highest concentrations are different than those in influent
 - C8/10-DADMAC detected at highest concentrations in both matrices
 - C12 BAC found to be high in biosolids samples
 - Some variety across facilities
 - May indicate degradation happening throughout the treatment process

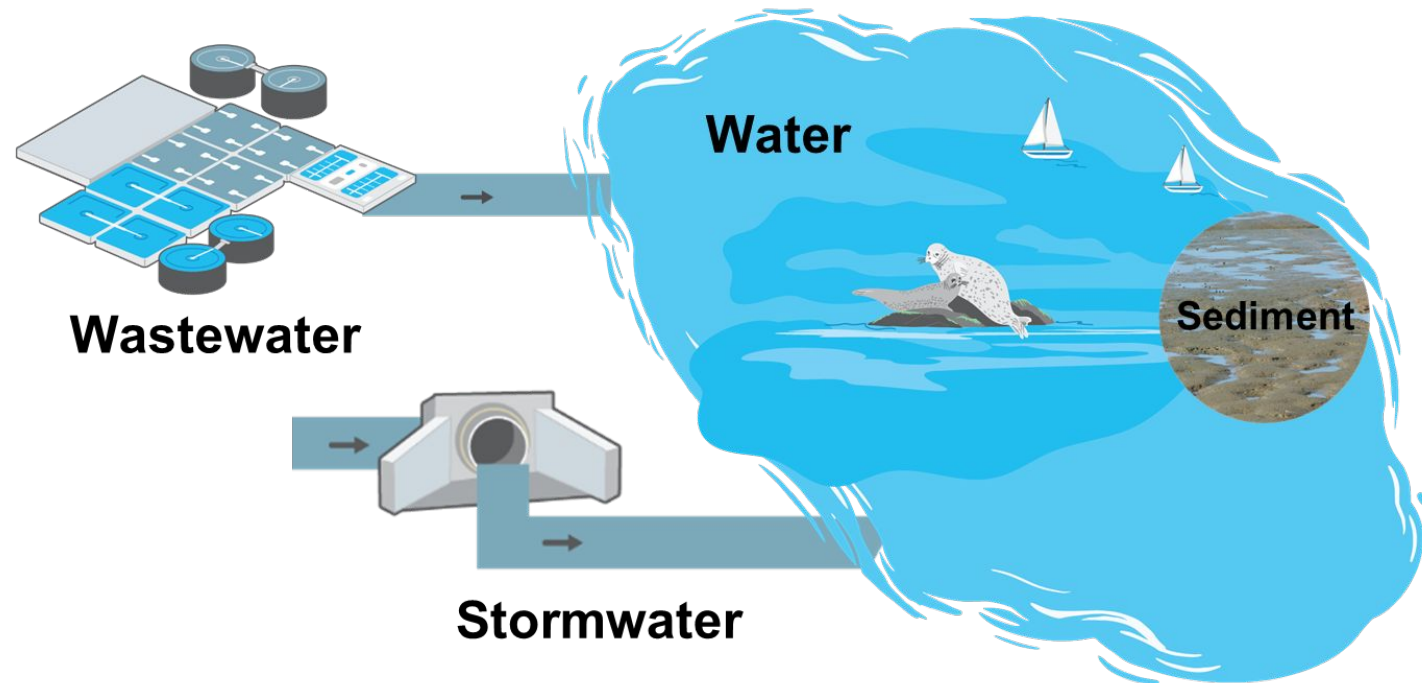
QACs in Wastewater: Main Takeaways

- QACs detected across POTW influent, effluent, and biosolids
 - Different fingerprint across matrices
 - QACs found in influent are those also found in disinfectant mixtures
- Ongoing monitoring and analysis
 - Update current analysis with more data



Upcoming Work

- Analysis of stormwater and Bay water samples (ongoing)
- Bay Water (Summer 2023)



Acknowledgements

- Dr. William Arnold, Anna Mahony, and Arnold Lab



- SFEI Staff
- Participating POTWs and staff

For More Information



Information on Alternative Disinfectants:



Safer COVID-19 cleaning products and disinfectants

- rebeccas@sfei.org
- miguelm@sfei.org

Recent Review Article in [ES&T](#)