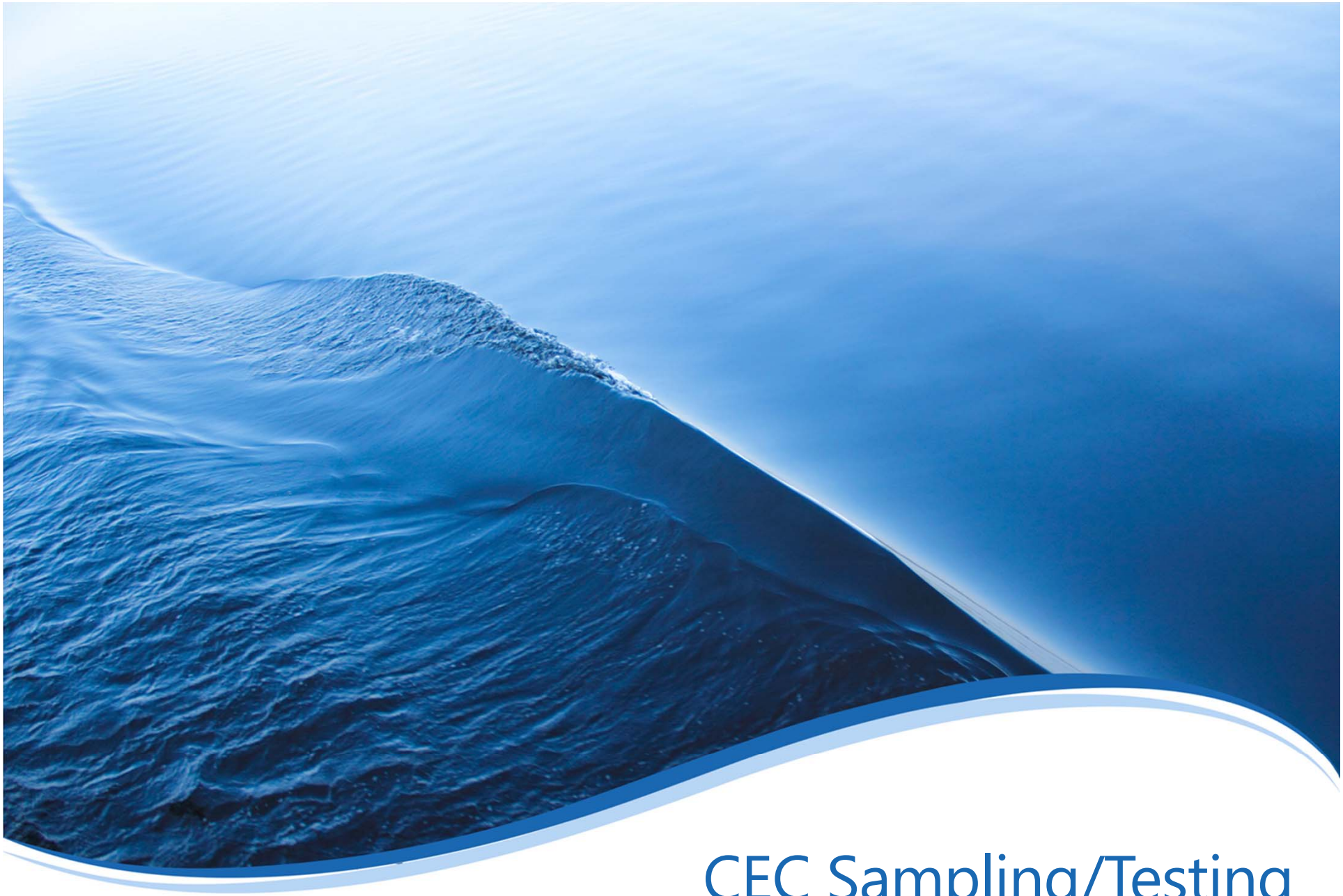


CEC Sampling/Testing

High opposition to potable reuse in City of Santa Cruz

"Unless and until there is much more rigorous, science-based regulation of contaminants of emerging concern in recycled wastewater destined for potable reuse, …, we cannot rely on either Federal or State regulations to protect people who would be drinking and bathing in it."

Vocal Anti-Reuse Activist, Santa Cruz, 2015

Specific concerns raised about CECs

Treatment Technologies TM addressing pathogens and CECs developed in Sept 2015

Table 1.1 Example of Trace Pollutant Removal by Different Advanced Treatment Trains[3]
Groundwater Replenishment Feasibility Study
Soquel Creek Water District

Constituent	Concentrations, ng/L								
				Treatment Train 1			Treatment Train 2		
	Health Criteria	MRL[1]	Secondary effluent	O_3 effluent	BAC effluent	UV photolysis effluent	MF filtrate	RO permeate	UV- H_2O_2 effluent
Atenolol	4,000	3	292	<MRL[a]	<MRL	<MRL	NT[2]	<MRL	<MRL
Carbamezapine	10,000	1	194	<MRL	25	21	NT	<MRL	<MRL
DEET	200,000	6	45	<MRL	<MRL	<MRL	NT	<MRL	<MRL
Estrone	320	31	<MRL	<MRL	<MRL	<MRL	NT	<MRL	<MRL
Meprobamate	200,000	3	380	158	178	170	NT	<MRL	<MRL
PFOA	400	9	12	10	35	22	NT	<MRL	<MRL
PFOS	200	8	<MRL	<MRL	<MRL	<MRL	NT	<MRL	<MRL
Primidone	10,000	7	4,100	525	323	186	NT	7	75
Sucralose	150,000,000	77	24,800	17,200	19,700	21,700	NT	<MRL	<MRL
TCEP	5,000	77	<MRL	<MRL	<MRL	<MRL	NT	<MRL	<MRL
Triclosan	2,100,000	8	128	<MRL	<MRL	9	NT	<MRL	<MRL

Notes:
(1) MRL = method reporting limit.
(2) NT = not tested.
(3) Trussell et al., 2015.

CEC Removal with Advanced Treatment TM developed in Oct 2015

Table 5 Summary of Final Product Water and Soquel Creek Altivo and Sells Wells CEC Monitoring Results
Groundwater Replenishment Feasibility Study
Soquel Creek Water District

Constituent	Common Use	Health Screening Level[1,2] (ng/L)	MRL - Detection Limit (ng/L)	Finished Water Concentrations from Effluent Treated (MF/RO/UV AOP) (ng/L)				Soquel Creek Source and Treated Water Concentrations[5] (ng/L)			
				Lake Huron[7]	WBMWD[3]	OCWD[3]	Clean Water Services, OR	Sells Well	Disinfected	Altivo Well	Disinfected
Acetaminophen	Analgesic	350,000	5		ND	ND		ND	ND	ND	ND
Atenolol	Beta Blocker	70,000	1		ND	ND	<25			ND	ND
Atrazine	Herbicide	1,000					<10			ND	ND
Azithromycin	Antibiotic	3,900	10		ND	ND					
Bisphenol A	Plasticizer	35,000	1		140	ND	<50	ND	ND	ND	ND
Caffeine	stimulant/additive	350	1	<10	16	ND		ND	ND	ND	ND
Carbamazepine	Anti-convulsant	1,000	1	<1.0	ND	ND	<10	269	586	9	9
DEET	Insect Repellent	2,500	1	2.2	1.3	ND	<25			ND	ND
Diclofenac	Anti-inflammatory	1,800	1	<1.0	ND	ND					
Diethylstilbestrol	Synthetic Estrogen	NA	1		ND	ND					
Dilantin	Intermediate synthetic compound	1,000	1[5]	<1.0							
17-β Estradiol	Natural Steroid Hormone	1	1	<1.0	ND	ND					
Epitestosterone	Natural Steroid Hormone	NA	1		ND	ND					
Estriol	Natural Steroid Hormone	350	1		ND	ND				ND	ND
Estrone	Natural Steroid Hormone	350	1	<1.0	ND	ND				ND	ND
17α-Estradiol	Synthetic Hormone	350	1		ND	ND				ND	ND
17α-Ethinyl Estradiol	Contraceptive	280	1		ND	ND				ND	ND
Fluoxetine								0.53	ND	ND	ND
Gemfibrozil	Anti-cholesterol	45,000	1	1.1	ND	ND	<10			ND	ND
Hydrocodone				<1.0						ND	ND
Ibuprofen	Anti-inflammatory	40,000	1	<1.0	ND	ND	<25				
Iopromide	Contrast Media	750,000	1	<1.0	ND	ND					
Iohexol	Contrast Media	720,000	1		ND	ND					
Meprobamate	Anti-anxiety	280,000	1	<1.0	ND	ND	<10				
Musk Ketone	Fragrance additive	350,000	1				<10				
Naproxen	Anti-inflammatory	220,000	1	<1.0	ND	ND	<10				
NDMA	Disinfection Byproduct	10[6]	2								
Nonylphenol	Industrial Chemical	500000[3]	1		ND	ND		ND	2630	ND	ND

Nanoparticles Memo developed in Feb 2013

PROJECT MEMORANDUM

To:	Taj Dufour, Ron Duncan	**Office:**	
Copies To:	Tracy Clinton, Lydia Holmes, Andrew Salveson		
From:	Eva Steinle-Darling, Ph.D, Curtis Feronti	**Office:**	WCO
Date:	February 3, 2016	**Project No.:**	9963A.00
Subject:	Nanoparticle Literature Review		

This memorandum was drafted in response to a specific request from the Soquel Creek Water District (SqCWD) regarding nanoparticles. The SqCWD wanted to know the latest information on nanoparticles as they pertain to potable water reuse projects. Nanoparticles are not regulated for potable water reuse projects (or potable water projects, for that matter). In conversations with the State of California Division of Drinking Water (DDW) in January 2016, the DDW defined their position on nanoparticles, which is that existing regulations are protective of public health and that there is no intent to regulate nanoparticles. With that said, DDW will continue to evaluate the issue.

CECs were found in Santa Cruz supplies

CITY OF SANTA CRUZ WATER DEPARTMENT

2015 - 2016 Constituents of Emerging Concerns Sampling Results

All Results in nanograms per Liter (1 part per trillion = 0.000000001 gram per Liter)

Results reflect only detected compounds -- analysis included testing for 96 Constituents of Emerging Concern

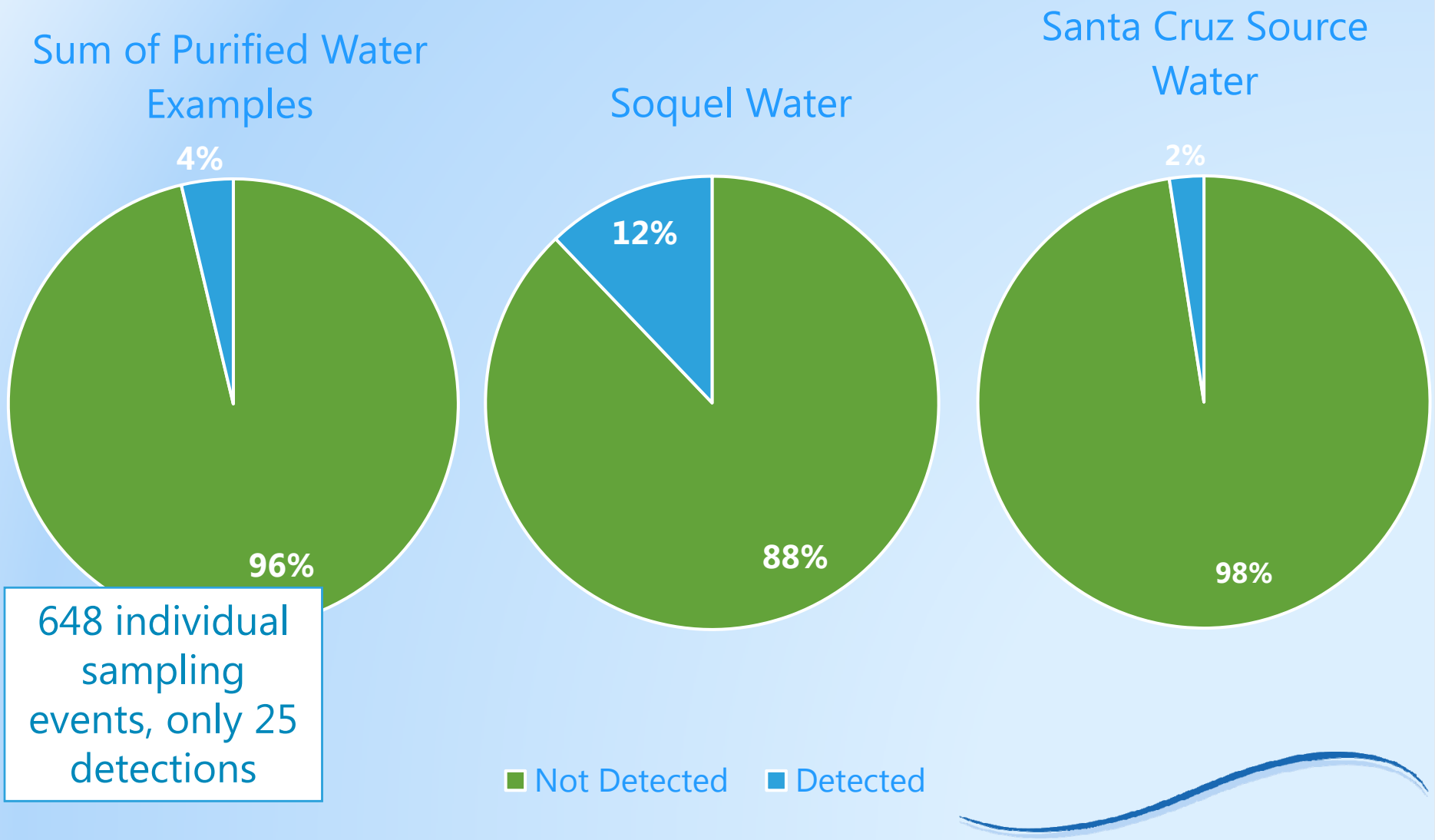
y sample collection)	9/01/15: 1st quarter					11/02/15 First Flush		12/15/15: 2nd quarter					3/01/16: 3rd quarter					4/07/16: High steady flow					6/07/16: 4th quarter					
	GHWTP (treated water)	SLR @Felton	SLR @Tait	North Coast Composite	Loch Lomond	SLR @Felton	SLR @Tait	GHWTP (treated water)	SLR @Felton	SLR @Tait	North Coast Composite	Loch Lomond	GHWTP (treated water)	SLR @Felton	SLR @Tait	North Coast Composite	Loch Lomond	GHWTP (treated water)	SLR @Felton	SLR @Tait	North Coast Composite	Loch Lomond	GHWTP (treated water)	SLR @Felton	SLR @Tait	North Coast Composite	Loch Lomond	Raw Blend (treatment plant influent)
Detected Analytes																												
2,4-D						28																						
Acesulfame- K	55	170	130			150	140		98	99			57	100	94				21	54		24	61	95	89			68
Atenolol						34	44	16		10			8.3	5.7	9.9		5.1											
Atrazine									6.2																			
Azithromycin														68														
Bezafibrate							15																					
BPA (bisphenol A)						14																						
Caffeine						270																						
Cyanazine							11		96	24	7.5	17			7.7													
Diethanolamine (DEA)																										10		9.6
DEET		30				32	13		12														20	27	33			44
Ibuprofen						63																						
Iohexal							34	13	27			15																
Iopromide						120																						
Isobutylparaben						13																						
Methylparaben						470																						
Naproxen						29																						
Quinoline																			12									
Sucralose		110					230						150	300	280				150	160								190
Theophylline										41																		

SqCWD has tested own source waters and found CECs

Constituent	Health Screening Level (ng/L)	MRL - Detection Limit ng/L	Soquel Creek Source Water Concentrations(ng/L)			
			Sells Well	Treated	Altivo Well	Treated
Bupropion	NA	1	1.4	ND	ND	ND
Tetrachloroethylene	5,000	0.2	17.1	ND	NT	NT
Venlafaxine	NA	0.1	0.6	ND	ND	ND
Tramadol	NA	1	NT	NT	10	ND
Perfluorohexanoic acid (PFHxA)	NA	1	NT	NT	0.1	0.2
Bromoform	7,000	1	545	679	ND	ND
Caffeine	350	1	ND	ND	ND	ND
Carbamazepine	1,000	1	269	586	9.1	9.0
Fluoxetine	3,900	0	0.5	ND	ND	ND
Nonylphenol	500,000	1	ND	2,630	ND	ND
Sulfamethoxazole	350,000	1	ND	ND	8.4	8.2

Notes:
NT = not tested
ND = non detect

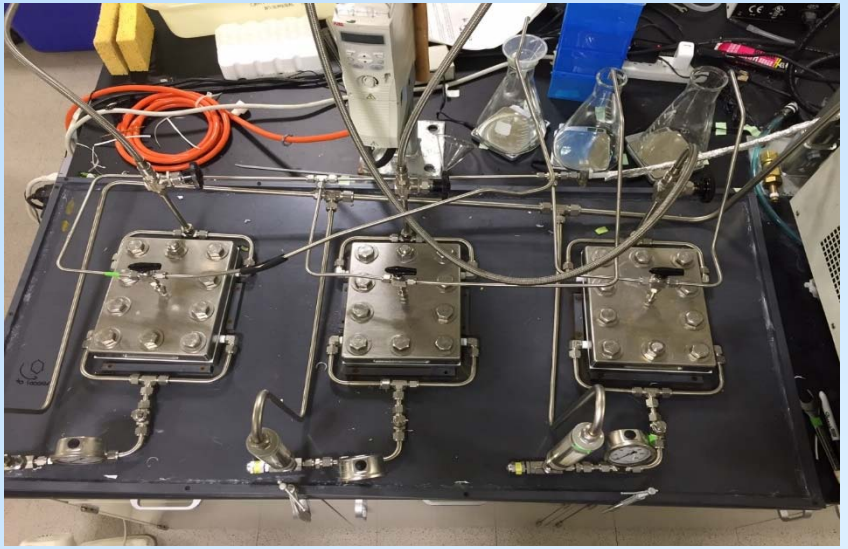
Overall, CECs have similar presence in purified water and in local drinking water



648 individual sampling events, only 25 detections

Board still concerned about CECs ….
So decided to sample and test SC WWTP

- Sample at Santa Cruz Secondary Effluent (2 samples)
- One effluent sample to be treated through MF/RO/ UVAOP at bench scale



- Test at Eurofins for over 200 compounds listed in Title 22 IPR requirements for periodic monitoring. (CECs, MCLs, and unregulated contaminants including: secondary MCLs, Notification Levels (NLs), and additional CECs).

Bench and pilot work intends to build upon other studies and demonstrate purification locally

Bench-Scale Demonstration:

- Measurement of CECs in Santa Cruz Secondary Effluent
- Bench-scale purification using MF, RO, and UV AOP
- Measurement of CECs in purified water

Benchtop work is a starting point….

- Eventually plan to develop a full scale pilot to demonstrate safety of potable reuse to the community
- Searching out funding

Questions?

carollo
Engineers...Working Wonders With Water®