

Nereda® Aerobic Granular Sludge Demonstration

Bay Area Clean Water Agencies

June 7th 2017



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Agenda

- Nereda[®] Aerobic Granular Sludge
- Technology Overview
- Bay Area Piloting and Demonstration Opportunities
- Discussion

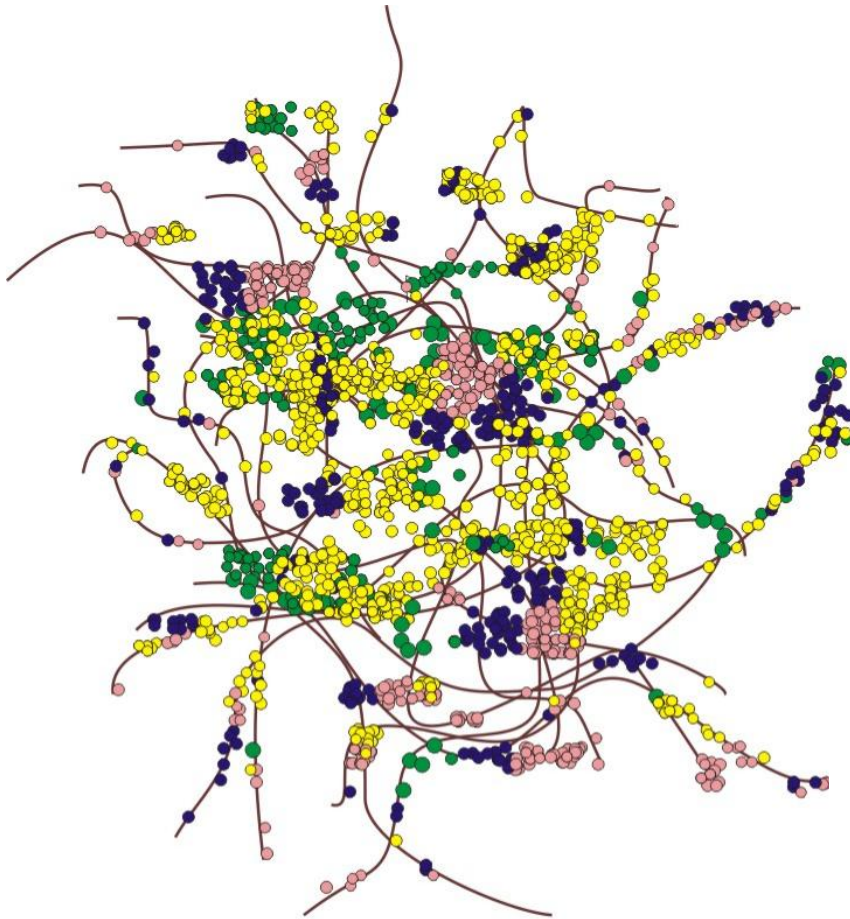
Aerobic Granular Sludge



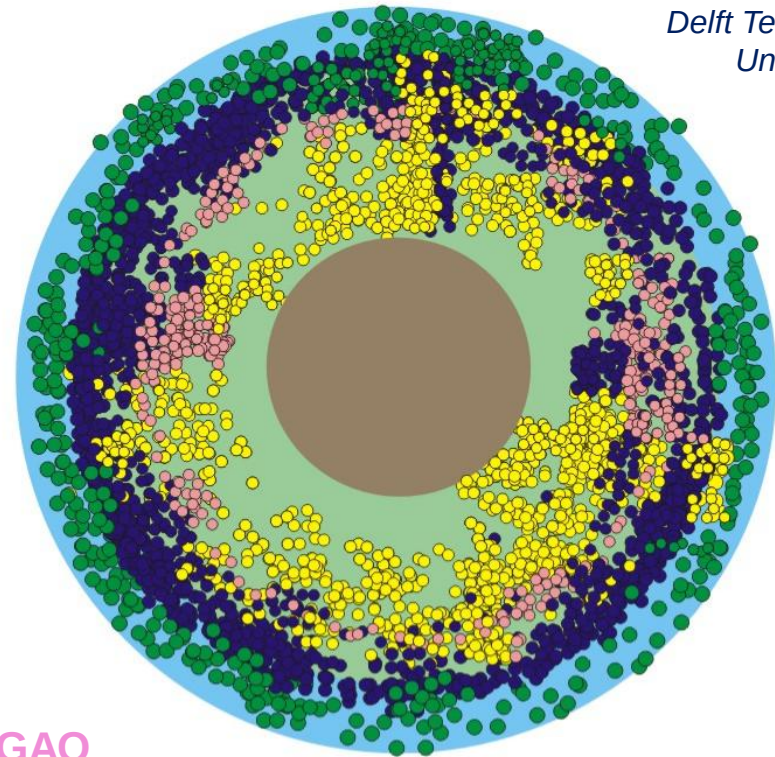
**Dense Granules =
Settle in <5 mins**

Suspended & Granular – The Difference

Picture Courtesy
Delft Technical
University



Conventional Activated Sludge
Mixed Microbial Community



PAO / GAO
Denitrifiers
Nitrifiers

Anaerobic
Anoxic
Aerobic

Aerobic Granular Sludge
Layered Microbial Community

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Nereda® BNR Performance - EPE WWTP, Netherlands



Nereda® BNR Performance - EPE WWTP, Netherlands

Parameter	Performance verification campaign March - May 2012 (flow proportional)		
	Influent mg/l	Effluent mg/l	Removal
COD	879	27	96.9%
BOD	333	< 2	> 99.4%
N _{Kj}	77	1.4	98.1%
NH ₄ -N	54	0.1	99.8%
N _{total}		< 4	> 94.7%
P _{ortho}	5.8	< 0.1	> 98.2%
P _{total}	9.3	0.3	97.2%
Suspended Solids	341	< 5	> 98.5%
40% lower power consumption			

Benefits of Aerobic Granular Sludge

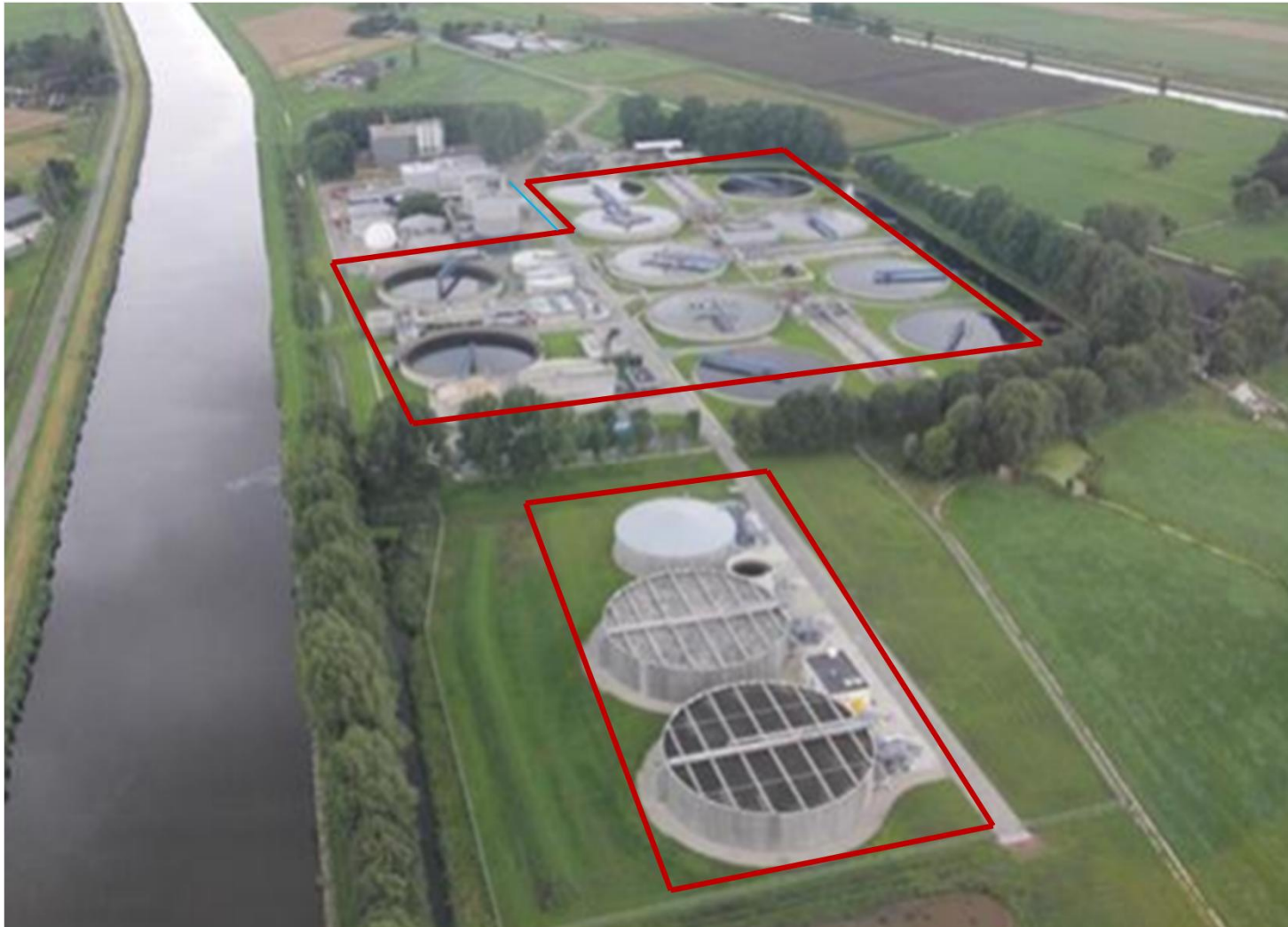


- 75% Less Space
- 40% Less Energy



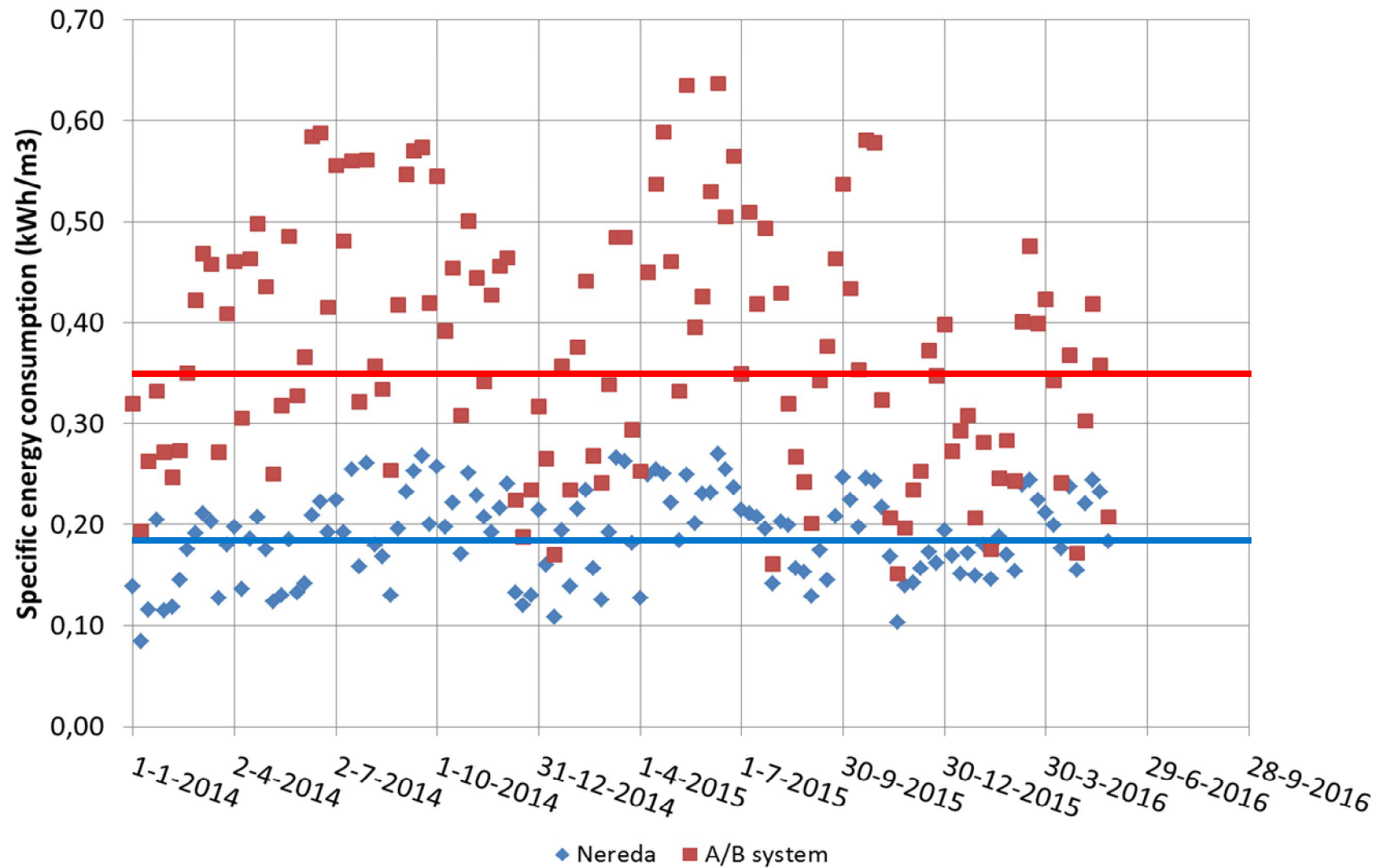
Garmerwolde, NL WWTP Nereda

Footprint Advantage – 75% Footprint Reduction



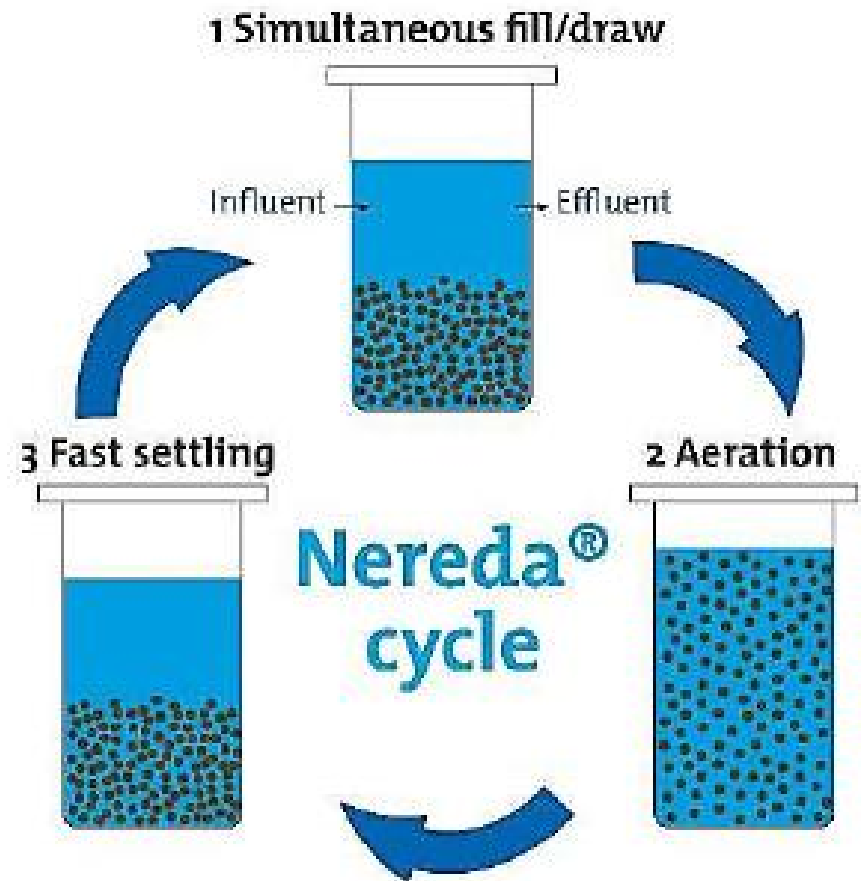
Garmerwolde, NL WWTP Nereda

Energy Advantage – >40% Energy Reduction



Nereda® SBR Process Cycle

- Simple one-tank concept
- No clarifiers
- No moving decanters
- No mixers
- Extensive biological COD, TN & TP removal
- Low energy consumption
- Easy operation
- Compact



Full Scale Nereda® Plants in Design & Operation Around the World

	Daily average flow (MGD)	Peak flow (MGD)	Startup
Vika, Ede (NL)	0.07	0.07	2005
Cargill, Rotterdam (NL)	0.18	0.18	2006
Fano Fine Foods, Oldenzaal (NL)	0.10	0.10	2006
Smilde, Oosterwolde (NL)	0.13	0.13	2009
STP Gansbaai (RSA)	1.32	2.54	2009
STP Epe (NL)	2.11	9.51	2011
STP Garmerwolde (NL)	7.93	26.63	2013
STP Vroomshoop (NL)	0.40	2.54	2013
STP Dinxperlo (NL)	0.82	3.61	2013
STP Wemmershoek (RSA)	1.32	3.96	2013
STP Frielas, Lisbon (PT)	3.17	3.17	2014
STP Ryki (PL)	1.40	2.73	2015
Westfort Meatproducts, IJsselstein	0.37	0.37	2015
STP Clonakilty (IRL)	1.29	3.97	2015
STP Carrigtwohill (IRL)	1.78	5.35	2015
STP Deodoro, Rio de Janeiro (BR)	22.82	38.80	2016
STP Jardim Novo, Rio Claro (BR)	0.47	11.18	2016
STP Hartebeestfontein (RSA)	1.32	7.93	2016
STP Kingaroy (AUS)	0.71	2.85	2016
STP Ringsend SBR Retrofit 1 Cell, Dublin (IRL)	21.66	42.80	2016
STP Highworth (UK)	0.37	1.27	2016
STP Cork Lower Harbour (IRL)	4.83	11.60	2016
STP Simpelveld (NL)	0.97	5.99	2016
STP Ringsend Capacity Upgrade, Dublin (IRL)	30.91	58.58	2019
STP Alphach (CH)	3.70	11.70	2017
STP Österröd, Strömstad (S)	0.99	2.28	2017
STP Tatu, Limeira (BR)	15.06	22.14	2016
STP São Lourenço, Recife (BR) 1st phase	5.04	10.61	2016
STP São Lourenço, Recife (BR) 2nd pahse	6.64	10.61	2024
STP Jaboatão, Recife BR) 1st phase	28.97	73.47	2017
STP Jaboatão, Recife BR) 2nd phase	40.81	73.47	2025
STP Jardim São Paulo, Recife (BR)	5.16	37.15	2017
STP Jardim São Paulo, Recife (BR)	20.64	37.15	2025
STP Utrecht (NL)	14.53	83.69	2018
STP Faro-Olhão (PT)	7.44	24.99	2018

Modular Upgrades Possible

Ringsend, Dublin Ireland, 2019 - Expansion and Upgrade



Flows	
Average Flow (MGD)	Peak Flow (MGD)
115	159

- Retrofit SBR – in stages
- High salinity

Original Activated Sludge:

- $TN < 20 \text{ mg/l}$
- Poor settling

Nereda Conversion:

- $TN < 10 \text{ mg/l}$
- TP reduction
- No increase in tankage
- Increased MLSS to 8-15 g/l

Summary

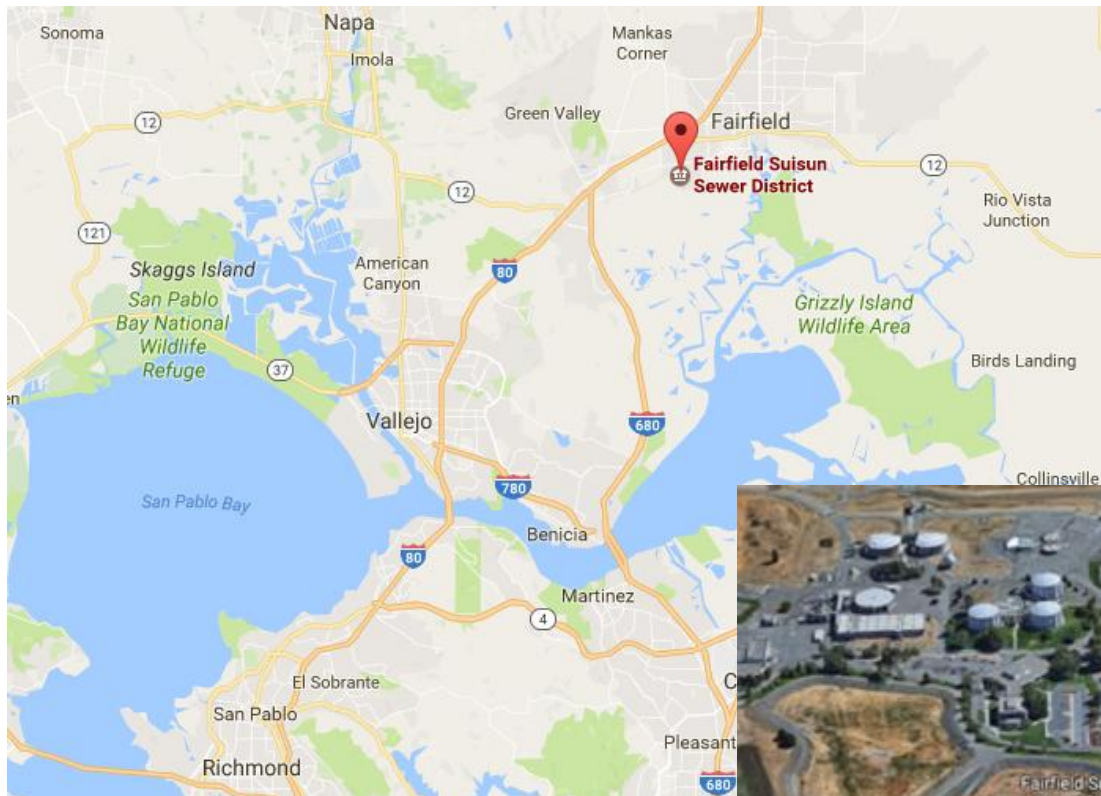
- Aerobic granular sludge technology shows tremendous promise for compact, cost-effective BNR plants
- Demonstrated successfully at full scale...*but not in USA.*
- Multiple issues worthy of evaluation through a piloting and demonstration program
 - Confirm performance & efficiency over a range of and flows/loads
 - Peak Flow management
 - Stress Testing – Vary WW Characteristics C:N:P ratio
 - Stress Test Controls
 - Conversion of shallow tanks (<18ft SWD)
 - Build regulatory understanding and confidence

Nereda Collaboration Partner Fairfield-Suisun Sewer District (FSSD)



Goal – Secure partners & funding support to move forward

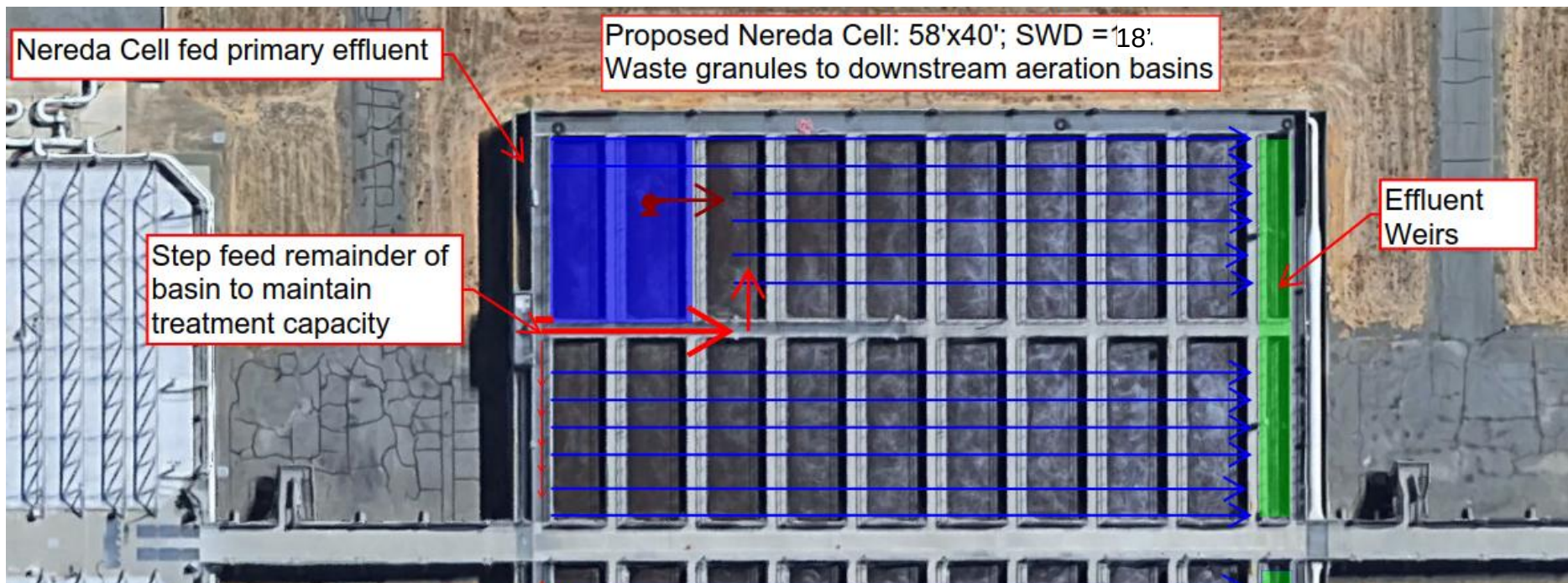
- **Piloting this year**
- Full Scale Demonstration in collaboration with the Water Research Foundation next year -- \$100K of support plus “Good Housekeeping Seal”



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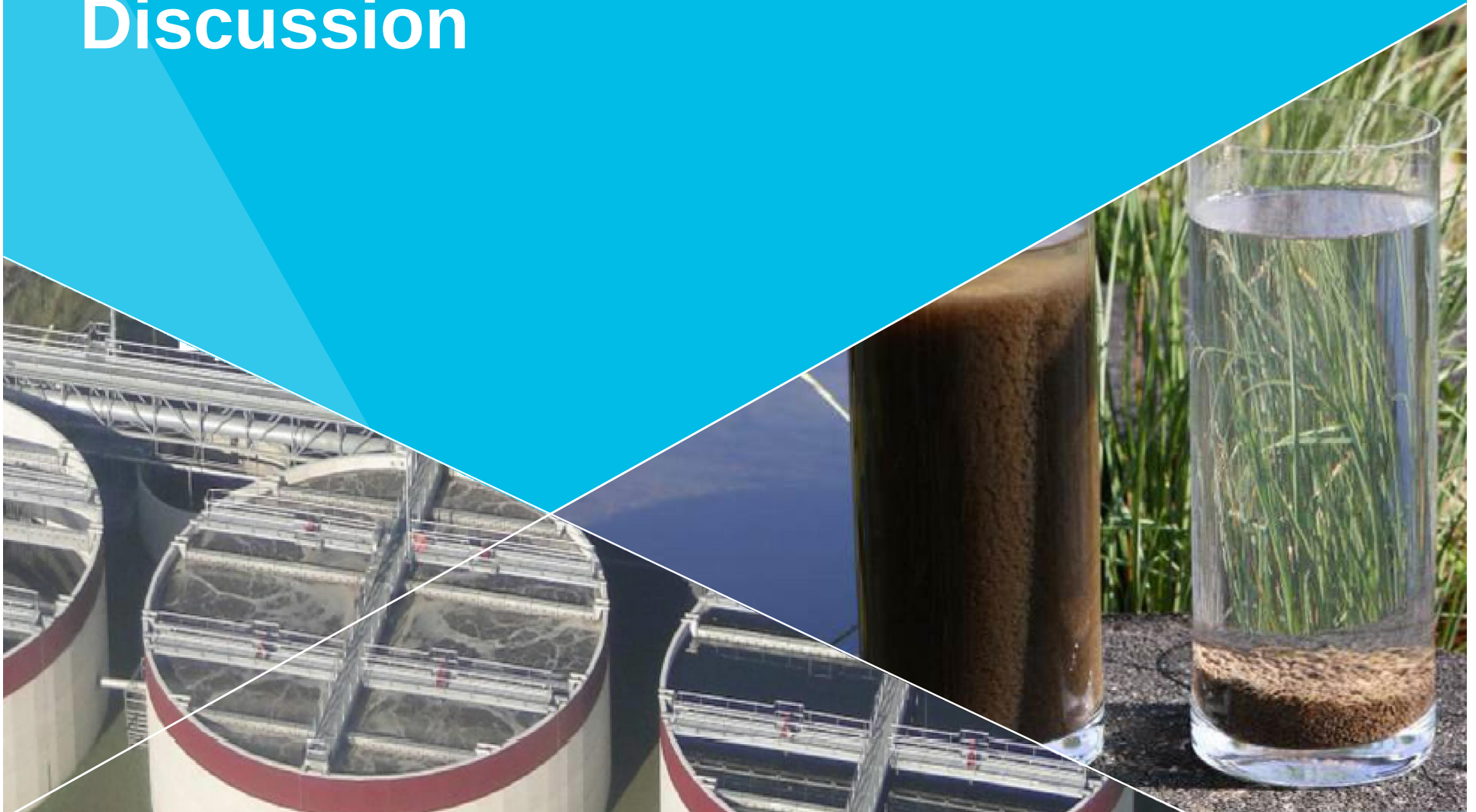
Piloting and Demonstration @ Fairfield-Suisun Sewer District (FSSD)

- Working out details for piloting this year
- Royal Haskoning/DHV / Aqua Aerobic to provide pilot skid



- Demonstration – Utilize Zones in existing Aeration Basin
 - Commercial Equipment from Aqua Aerobics
 - Installation Details Scoped with Contractor

Discussion



Thank You

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June 7th 2017



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