29 June 2017

The State of Enhanced High-Rate Treatment in Ohio

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BUILDING A WORLD OF DIFFERENCE®

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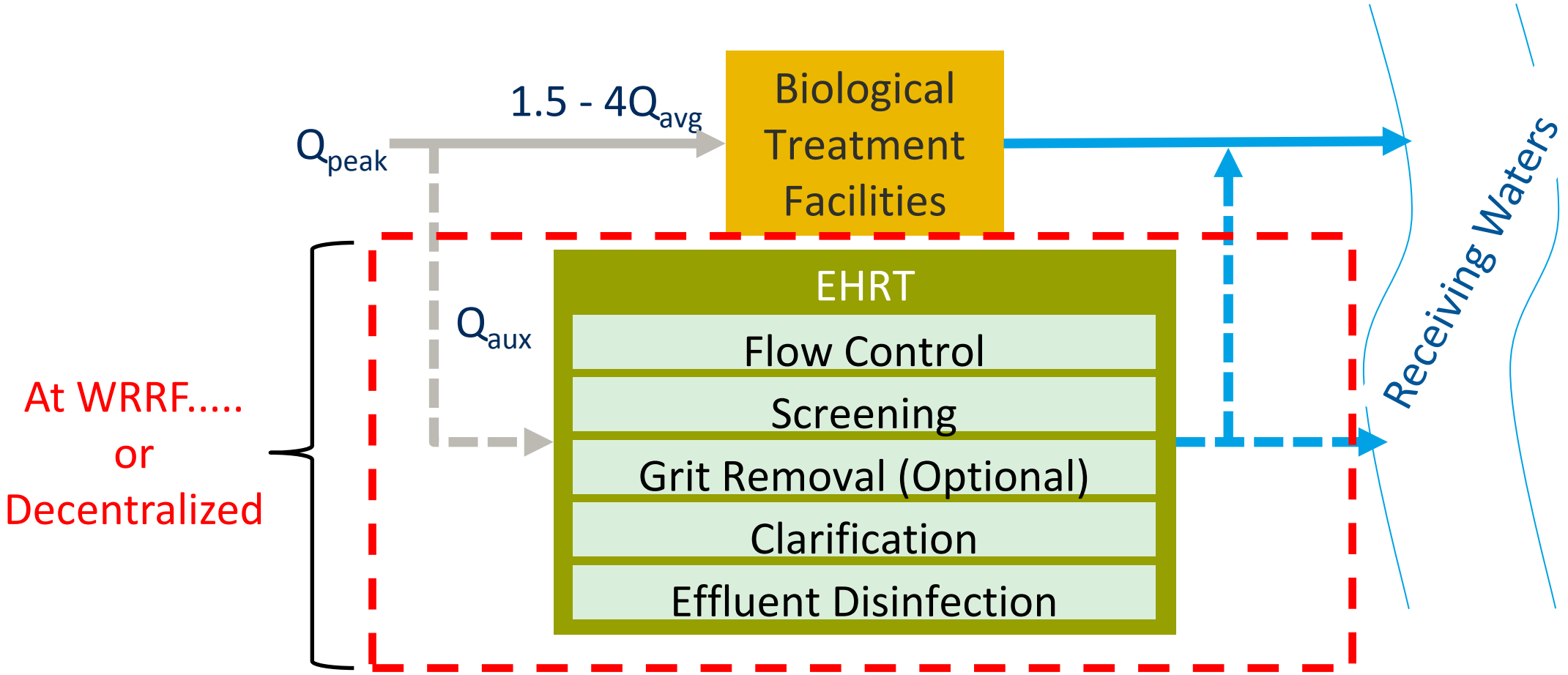
What is EHRT?

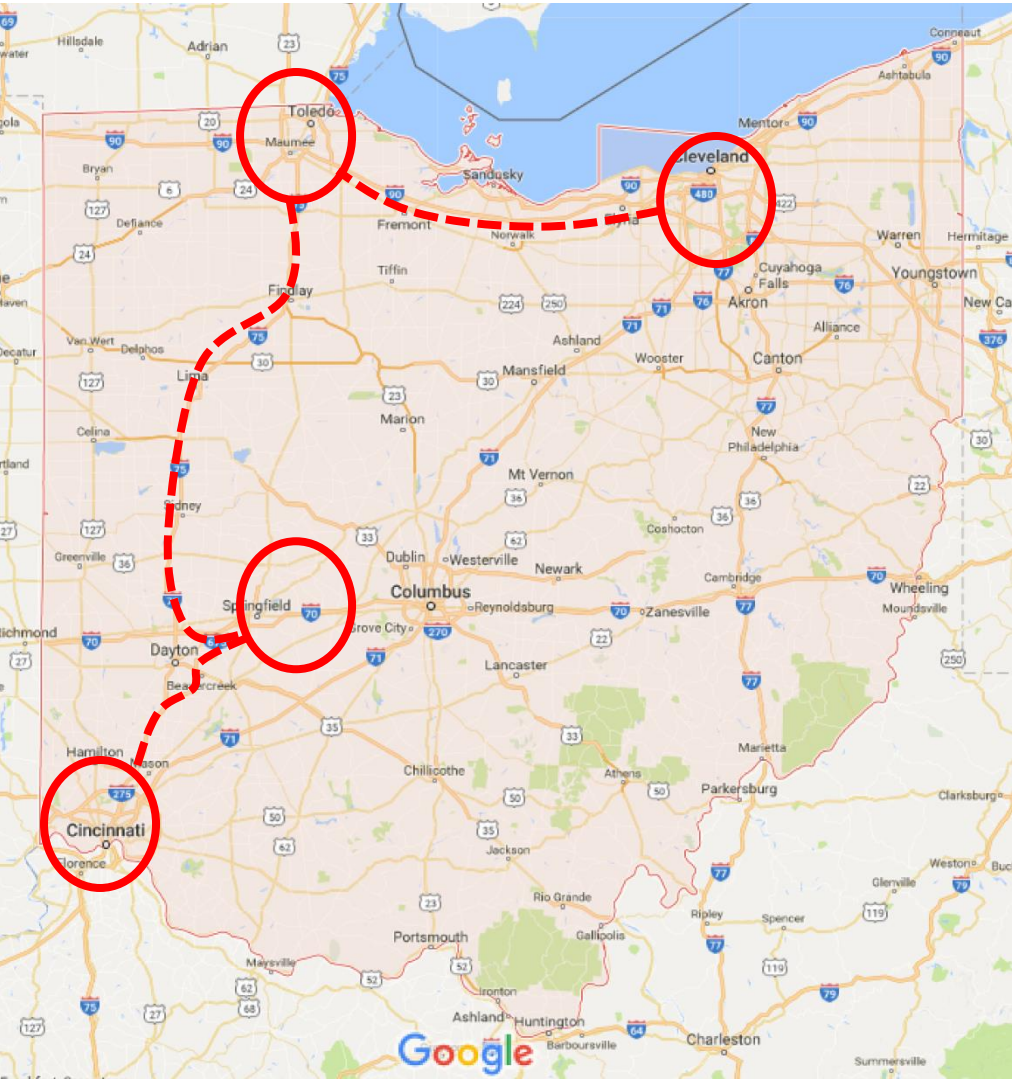
Settling-Based	Filtration-Based	Flotation-Based
1. **Conventional Settling** -Rectangular, Circular, Square, RTB, Shaft	1. **Shallow Granular Media**	1. **Conventional Floatables Removal** -Skimmers, Scum baffles
2. **Vortex (Swirl Concentrator)**	2. **Deep Granular Media**	
3. **Lamella Settler**	3. **Microscreens, Woven Media** -Salsnes Filter, Eco MAT™ Filter	2. **Dissolved Air Flotation (DAF)**
4. **Chemically Enhanced Settling**	4. **Floating Media** -MetaWater HRFS, BKT BBF-F	
a. Conventional Basin		
b. Sequencing Batch - e.g. ClearCove Flatline EPT		
c. Lamella Settler	5. **Pile Cloth Media** -Aqua-Aerobic Systems	3. **Polymer-aided DAF** -Various suppliers
d. Solids Contact / Recirculation - e.g. DensaDeg®, CONTRAFAST®	6. **Compressible Media** -Fuzzy Filter™, WWETCO FlexFilter™	
e. Ballasted Flocculation - Microsand (e.g. ACTIFLO®, RapiSand™) - Magnetite (e.g CoMag™)	7. **Fixed-Film Contact** -Biological Aerated Filter (BAF), BioFlexFilter™	4. **Biocontact + DAF** -Captivator®
5. **Suspended Growth Contact** -BIOACTIFLO™, BioMag™, Bio-CES		

Primary Removal Equivalent * | Small Footprint (High-Rate Treatment) | Enhanced Removal

* If coagulation/flocculation provided, HRT → EHRT (in some cases)

Augment Existing WRRF with EHRT

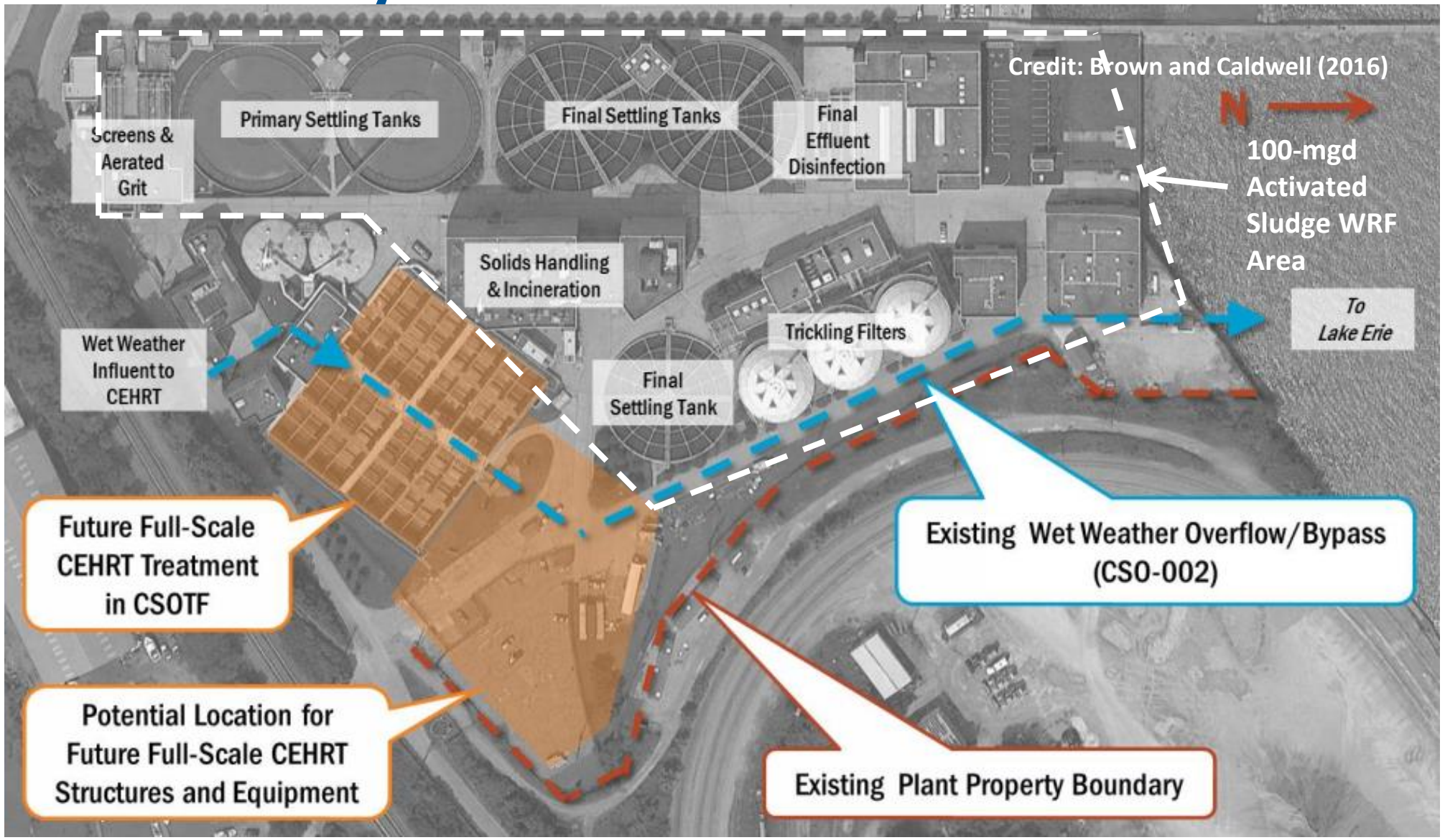




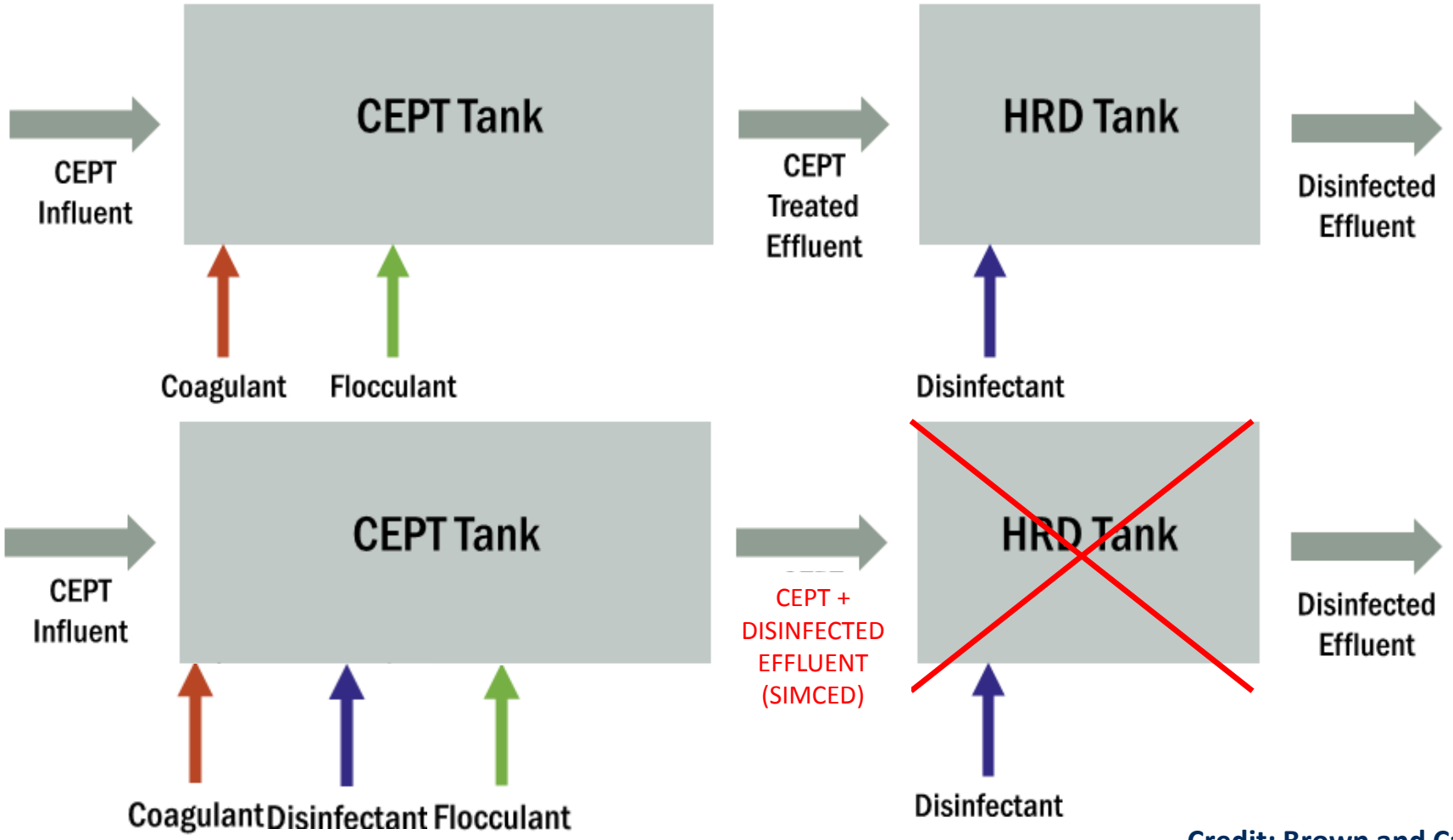
ROAD TRIP!

- NEORSD - Chemically Enhanced Primary Treatment + High Rate Disinfection
- Toledo - High Rate Clarification
- Springfield - High Rate Filtration
- Cincinnati - Chemically Enhanced Settling & Emerging Technologies Piloting

NEORSD Westerly WWTC & Full-Scale CEHRT Plan

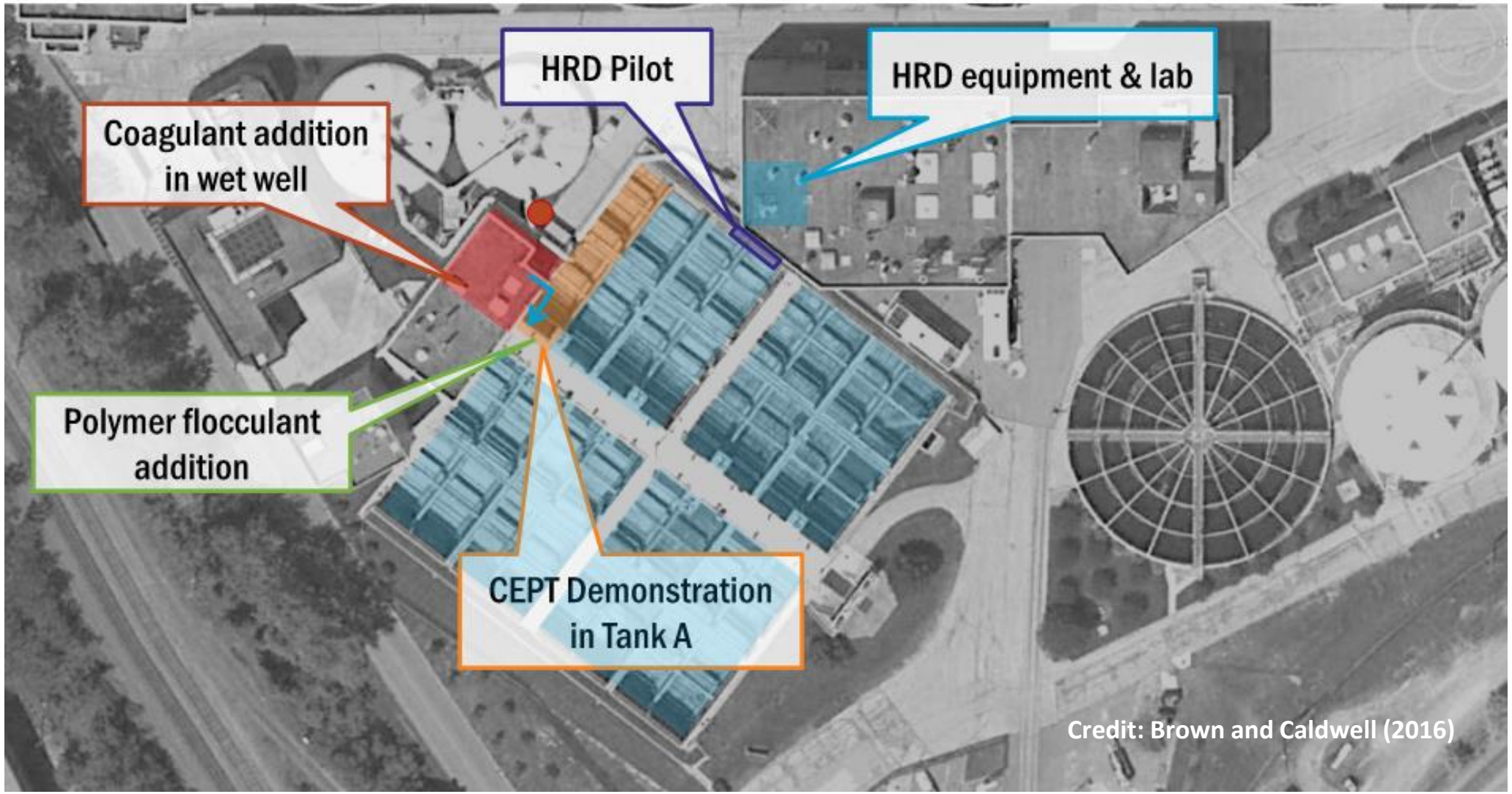


SIMCED Trial Included



Credit: Brown and Caldwell (2016)

NEORSD – Westerly CEHRT Pilot Plan



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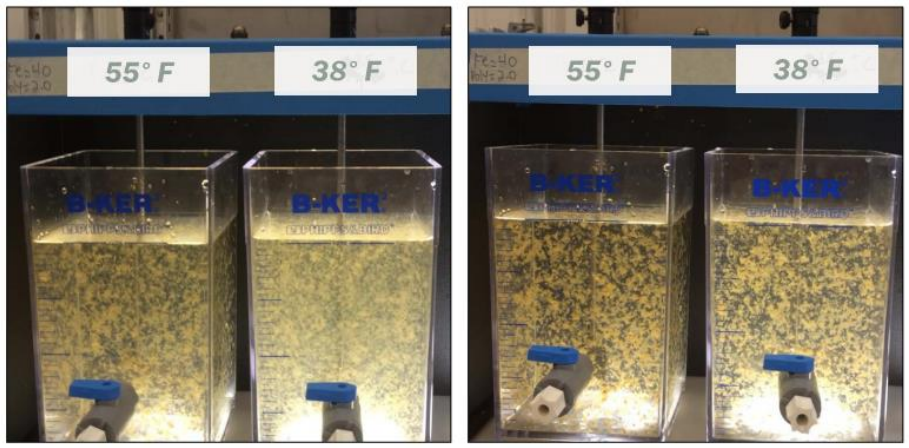
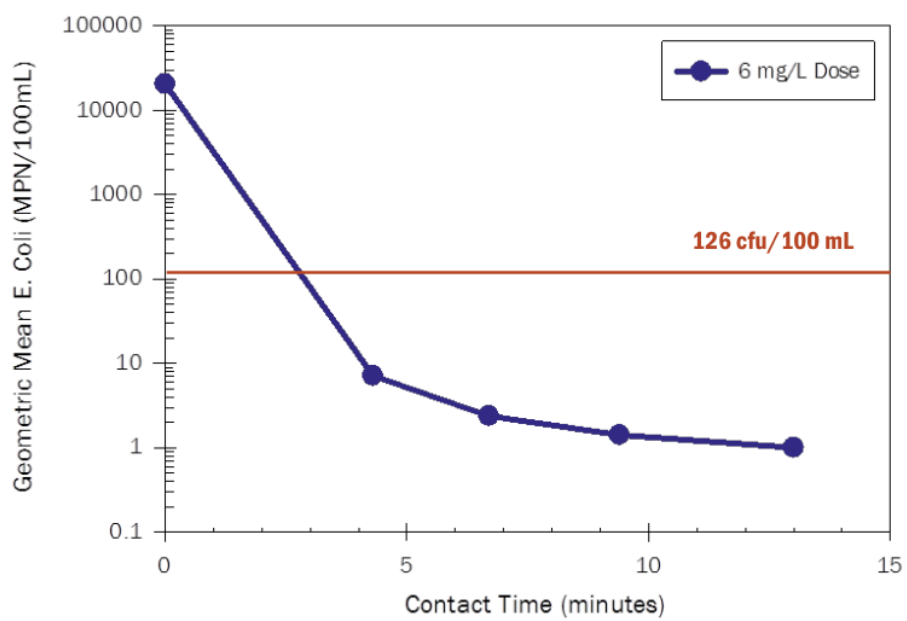




Credit: Brown and Caldwell (2016)

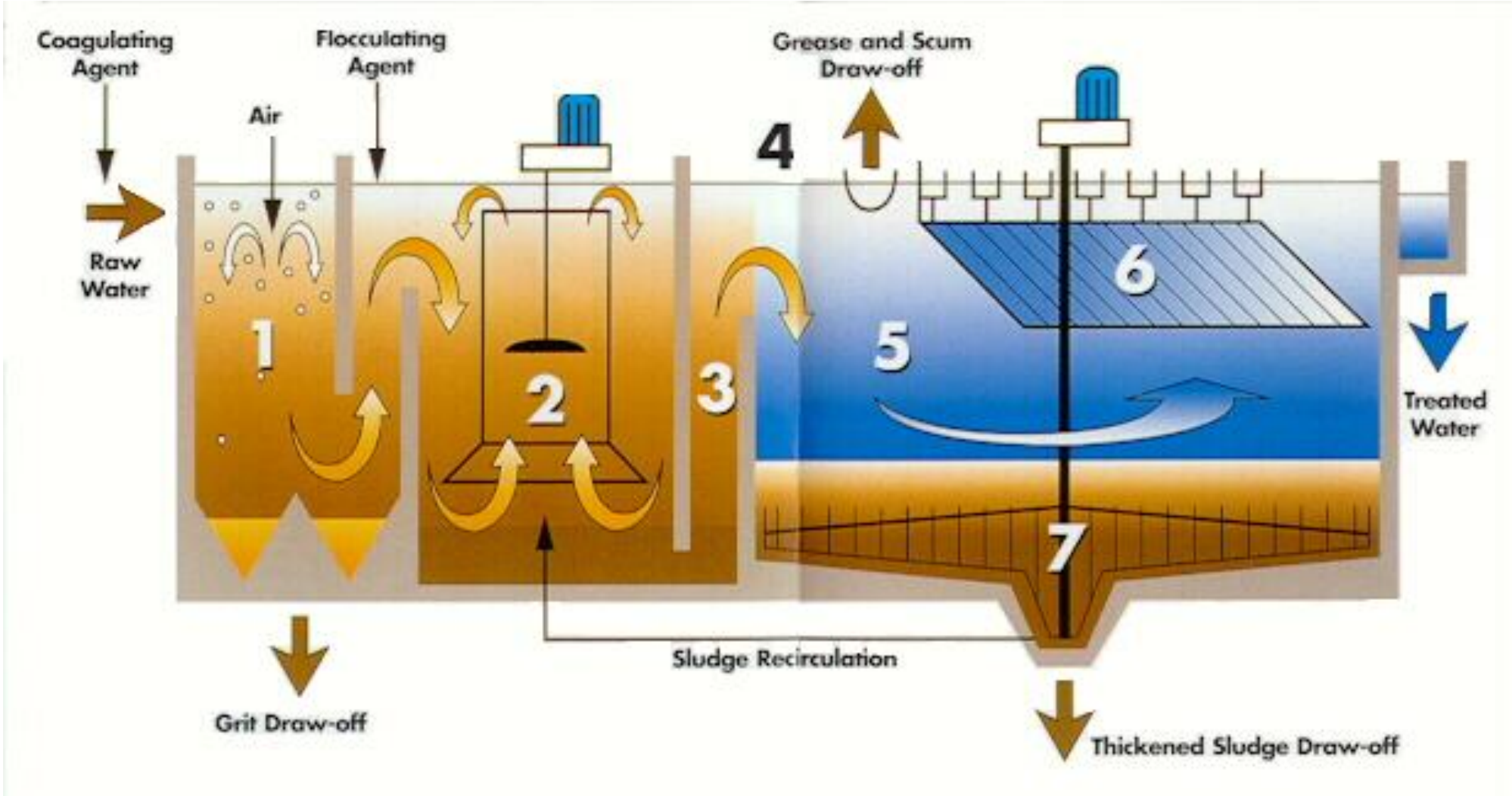
Major Findings

- Successful CEPT operation at SOR of 10,500 gpd/sf
- Consistent CEPT effluent TSS of <30 mg/L achieved over wide range of operations
- Simultaneous CEPT and HRD in single tank with no reduction in TSS removal performance

CEHRT successful at achieving NEORSD CD goals over wide range of operating conditions


232 mgd EHRT Facility
Vortex Grit Removal
HRC - Ballasted Flocculation
Reaeration
Chlorination
Dechlorination
195 mgd
Activated
Sludge WRF
25 MG
Storage Basin
Toledo Bay View WRF

High Rate Clarification with Solids Recirculation




232-mgd in ~130’ x 270’
Central Gallery
Process Piping
Sludge Pumping
3 DensaDeg ® Units
3 DensaDeg ® Units
Polymer Feed
Tanks and
Pumps
Coagulant
Feed Tanks
and Pumps

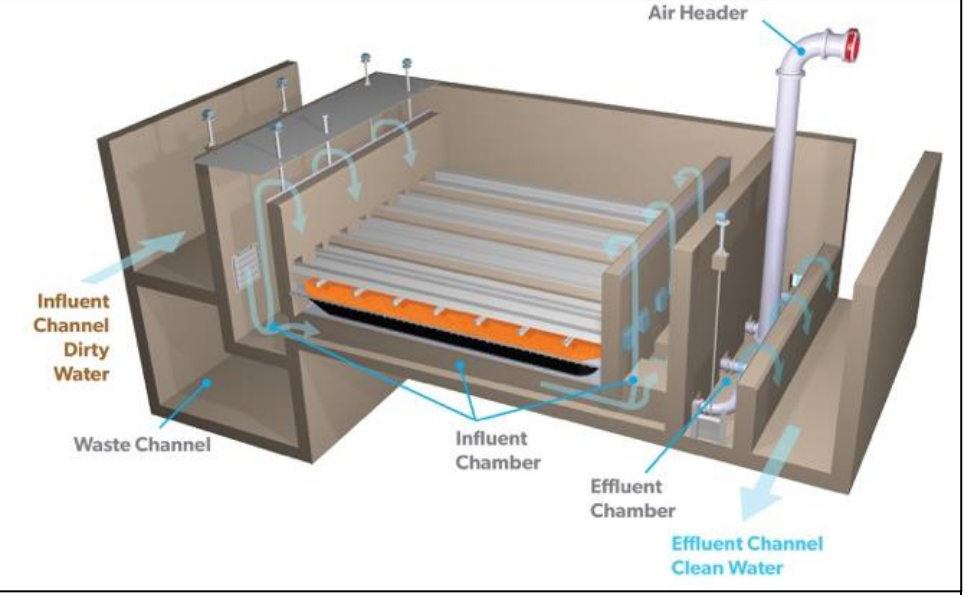
Performance of Toledo EHRT

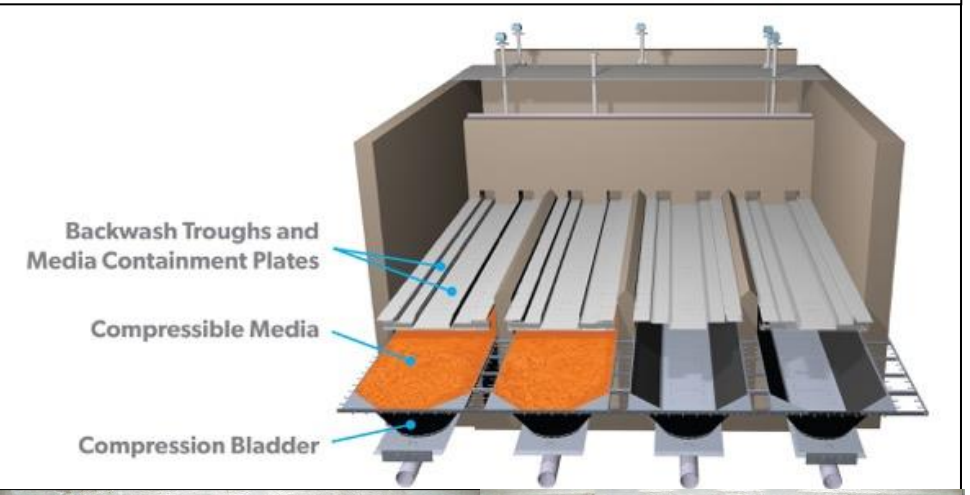
Operating Mode		Influent Concentration		Effluent Concentration		Percent Removal	
	Pollutant	Range mg/L	Average mg/L	Range mg/L	Average mg/L	Range %	Average %
Primary & Excess Flow Treatment (Units 2-6)	Ammonia	1.8 – 3.2	2.4	1.8 – 3.1	2.4	<0 – 22	0
	TKN	2.9 – 12.9	6.3	2.0 – 7.0	4.5	5 – 64	28
	CBOD	20 - 77	42	10 – 27	16	22 – 82	54
	Suspended CBOD	10 - 66	31	2 – 21	9	12 – 93	64
	TSS	19 - 440	131	9 - 66	18	<0 – 97	74
	Total P	0.6 – 2.1	1.1	0.2 – 0.5	0.2	64 – 90	79

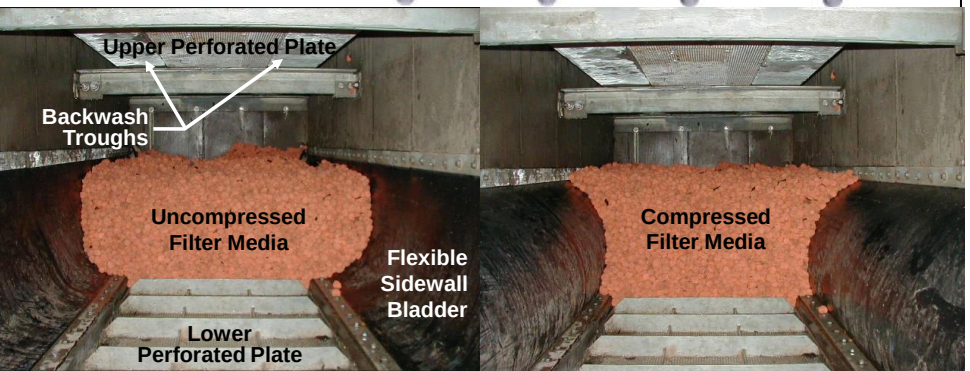
Excellent TSS and Phosphorus Removal

Springfield WWTP

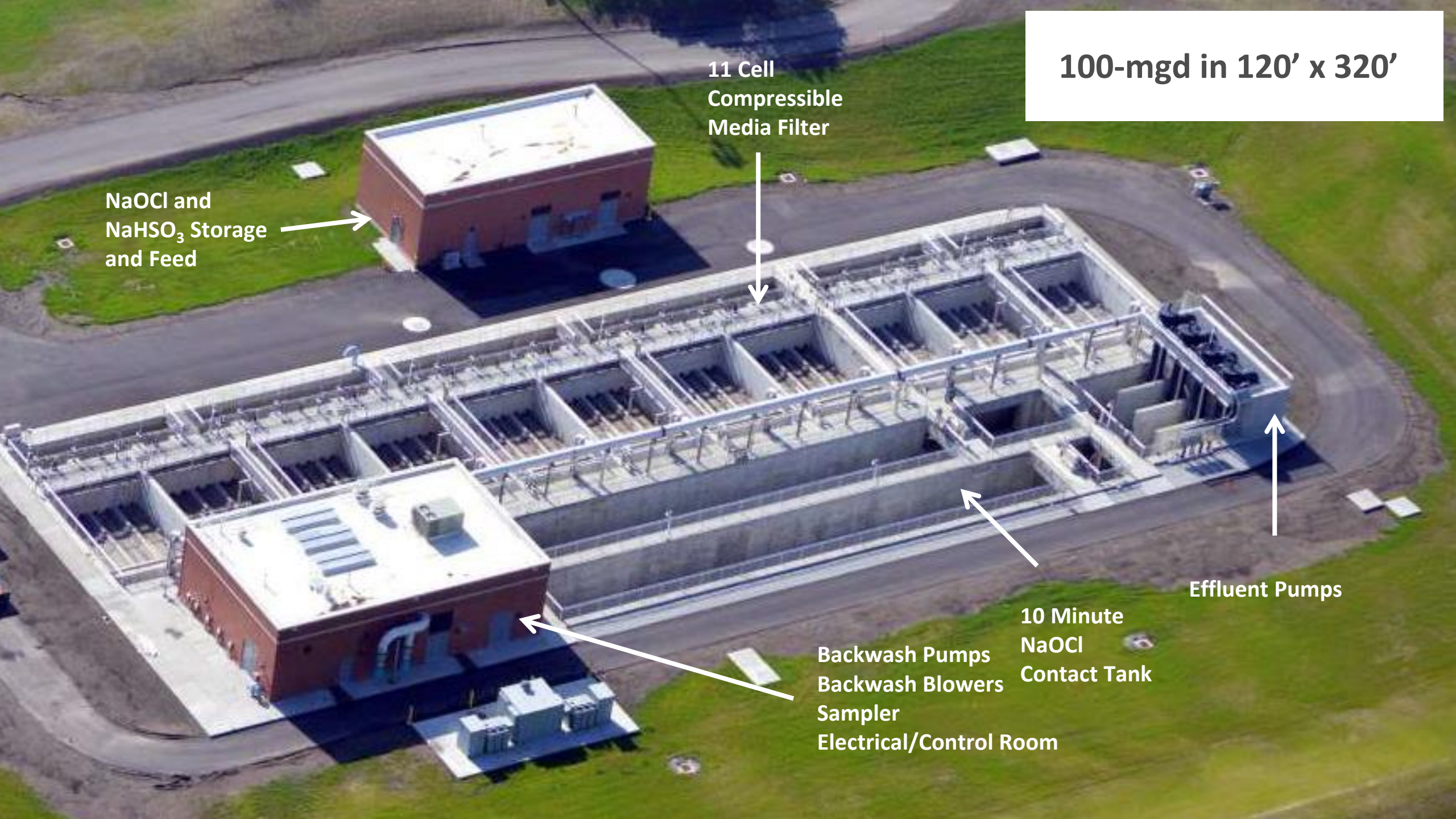
Compressible Media Filtration







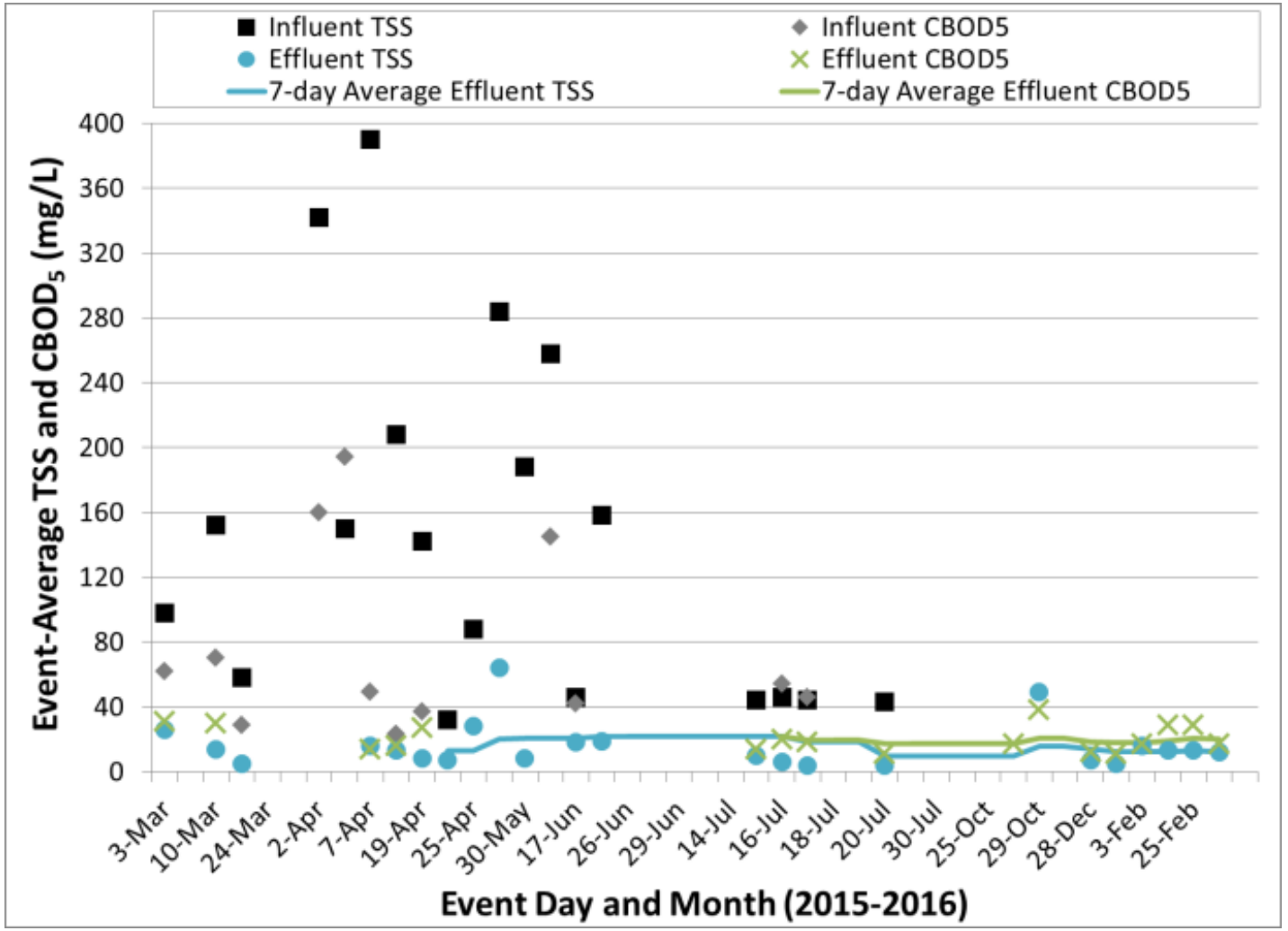
- Synthetic fibers bundled together into ~1.5” spheres
- ~30” bed depth
- Porosity altered by compression
- Removal down to 4 microns
- 10+ year filter media life


100-mgd in 120’ x 320’
11 Cell
Compressible
Media Filter
NaOCl and
$NaHSO_3$ Storage
and Feed
Effluent Pumps
10 Minute
NaOCl
Contact Tank
Backwash Pumps
Backwash Blowers
Sampler
Electrical/Control Room

Performance of Springfield EHRT

Effluent Averages *		
TSS	mg/L	16
$CBOD_5$	mg/L	21
NH_3-N	mg/L	2.5
TP	mg/L	0.6
DO	mg/L	8.7
TRC **	mg/L	0.02
E. Coli	#/100 mL	56

* 42 events 3/3/15 – 5/12/16
** NaOCl avg dose = 4 mg/L

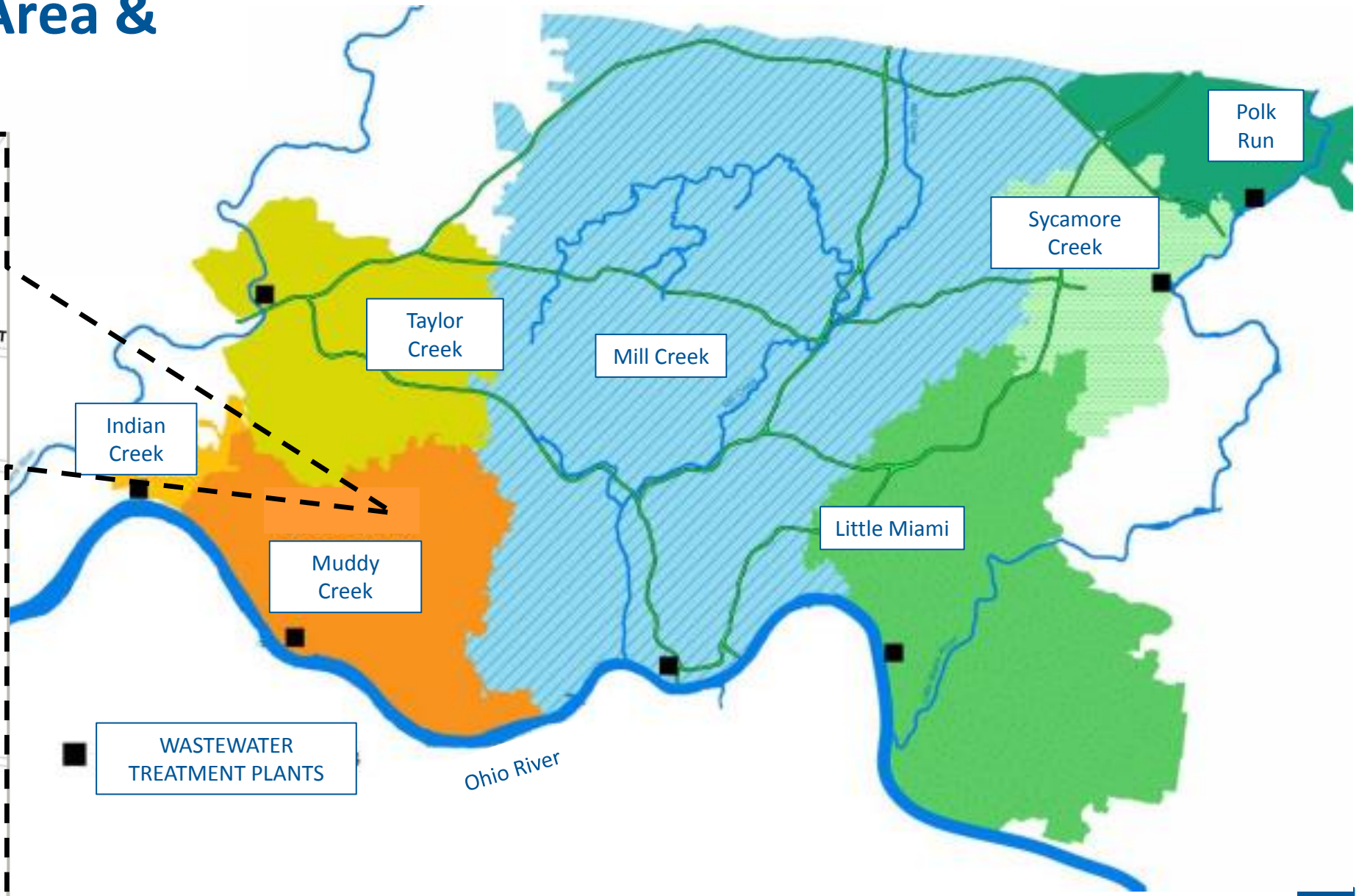


Excellent Effluent Quality and Disinfection

MSDGC EHRT – Chemically Enhanced Sedimentation

Tony Yee, PE & Jared Hutchins, PE

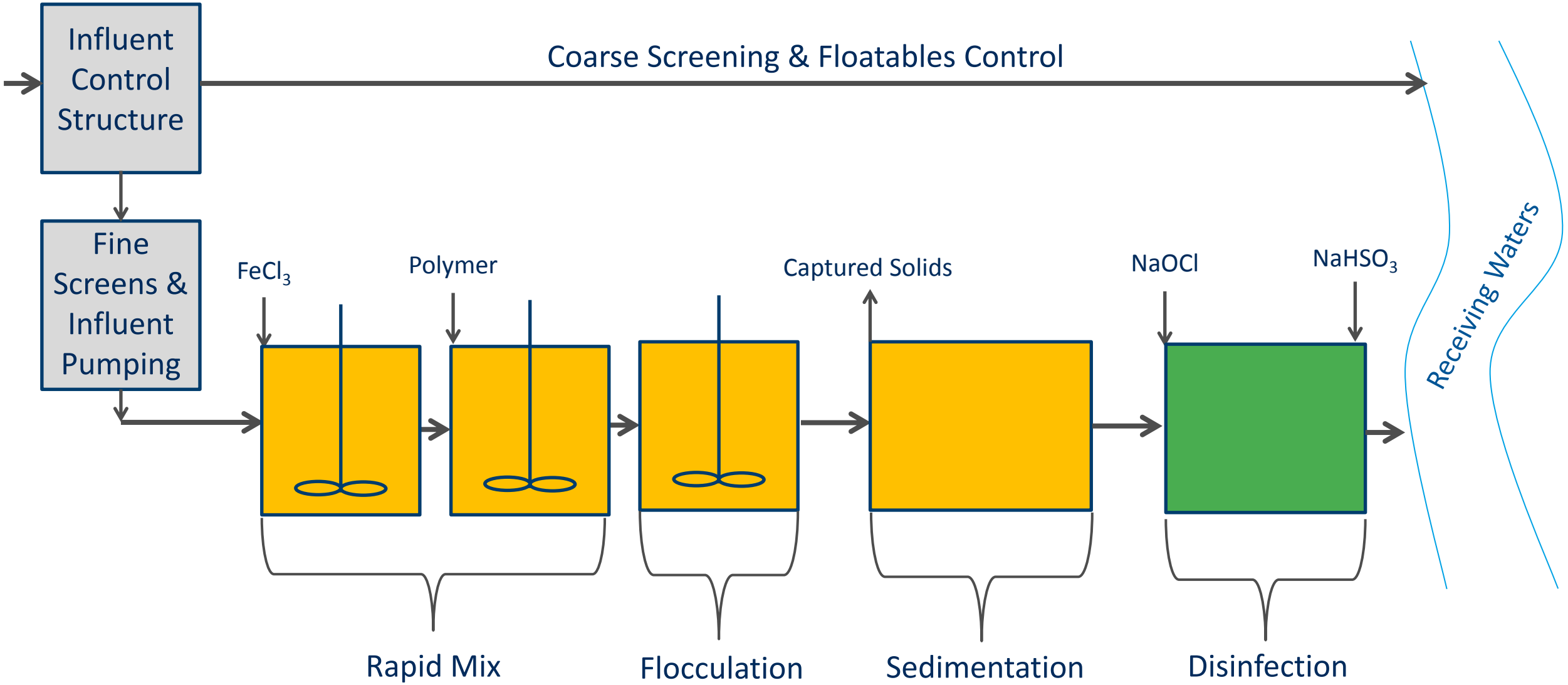
MSDGC Service Area & CSO 522



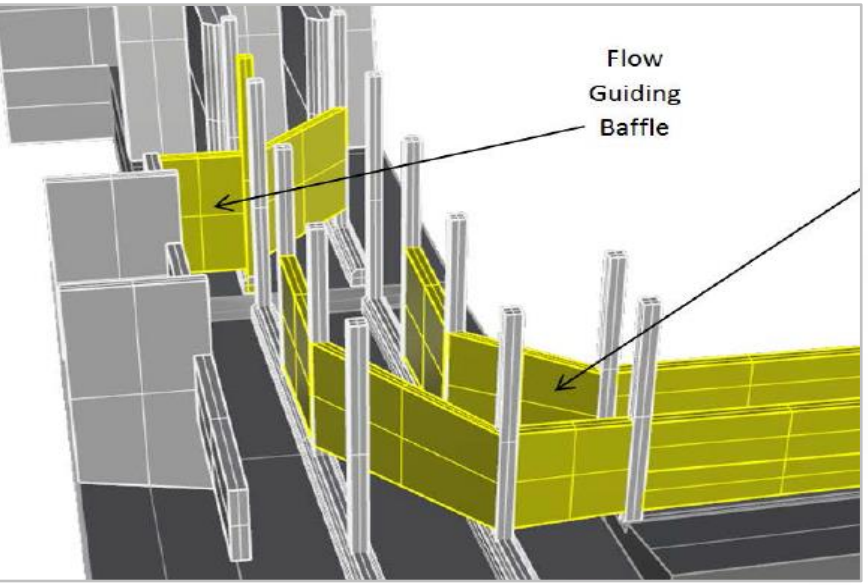
Combined Sewer Overflow 522

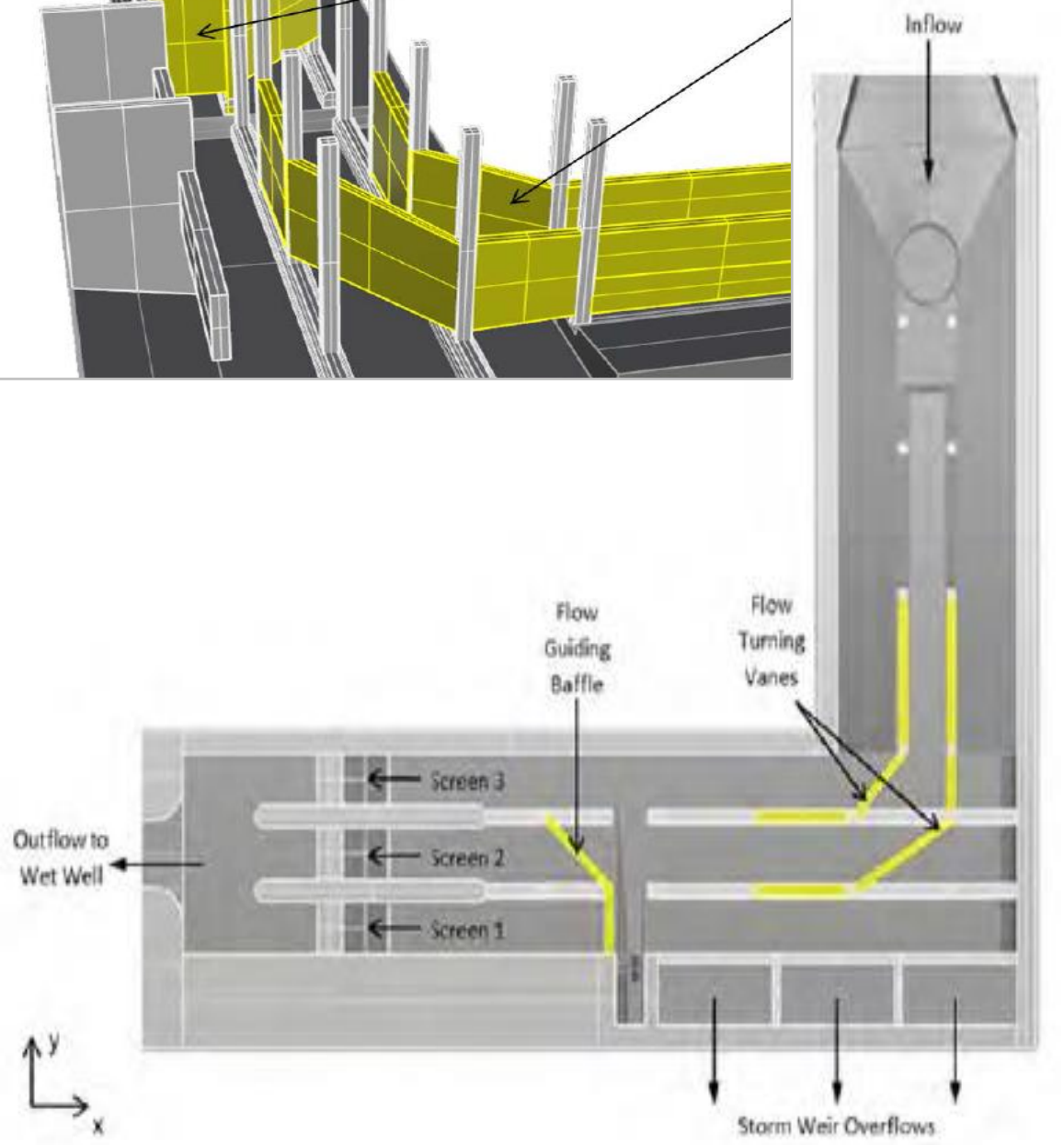
- Highly active CSO
- Community priority due to sewer debris and odors in residential setting
- Wide range of flows up to 1,400-mgd
- Targeted for Demonstration EHRT in Phase 1 WWIP

WWEHRTF Process Schematic



106-mgd in ~150’ x ~250’

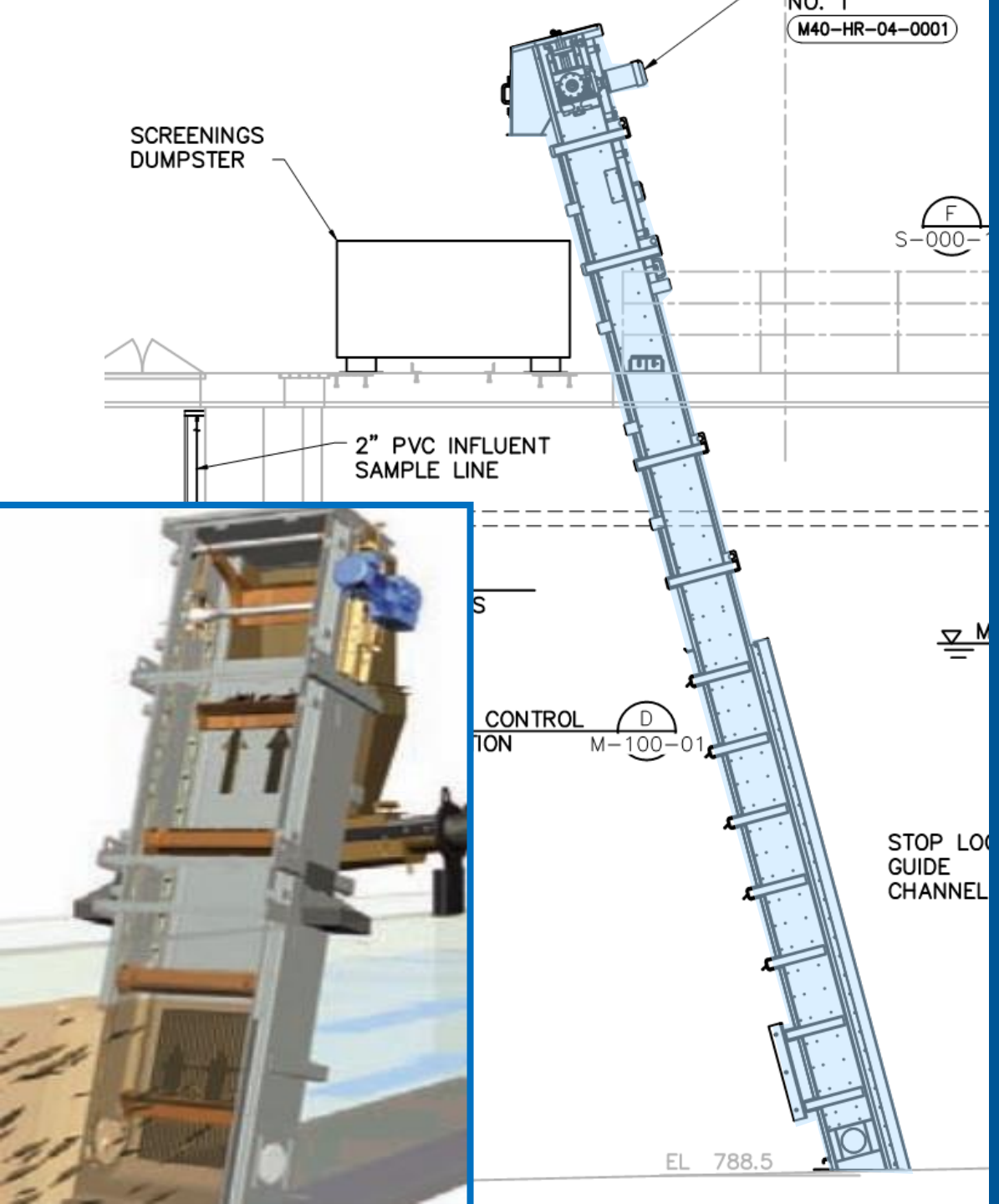




Influent Control Structure

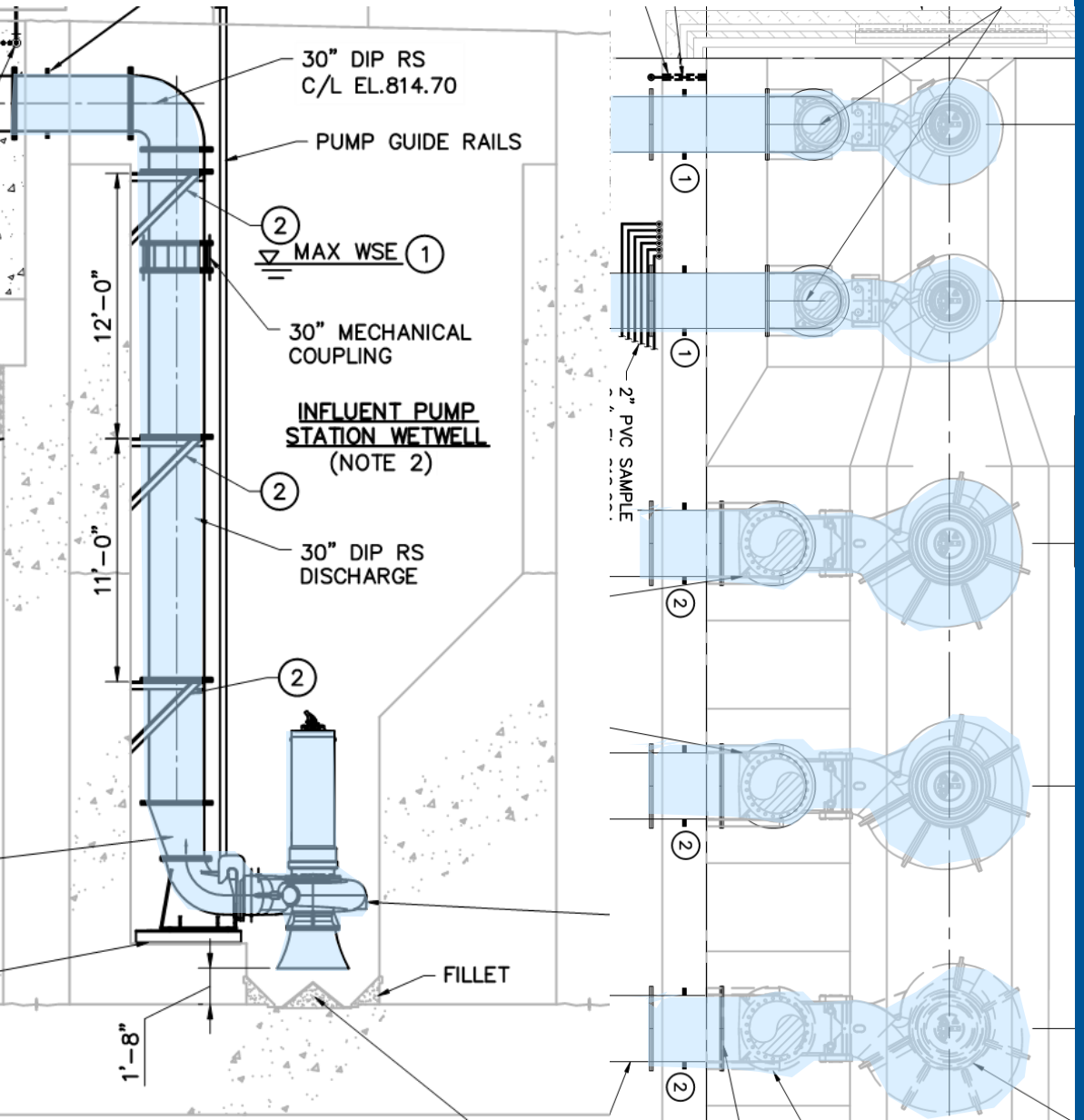
- Dissipate energy
- Direct flows into facility up to peak treatment capacity, and release excess flows to creek
- Promote solids clean-up post event for odor control
- No dry weather flow
- Provides coarse screening and floatables control

Influent Fine Screens



- Chain and Rake
- ½" Aperture Size
- 2 x 53 mgd
- 40% Blinding Factor
- Direct Discharge to Screenings Container

Rugged Screening Equipment for High Leaf Loads



Influent Pump Station

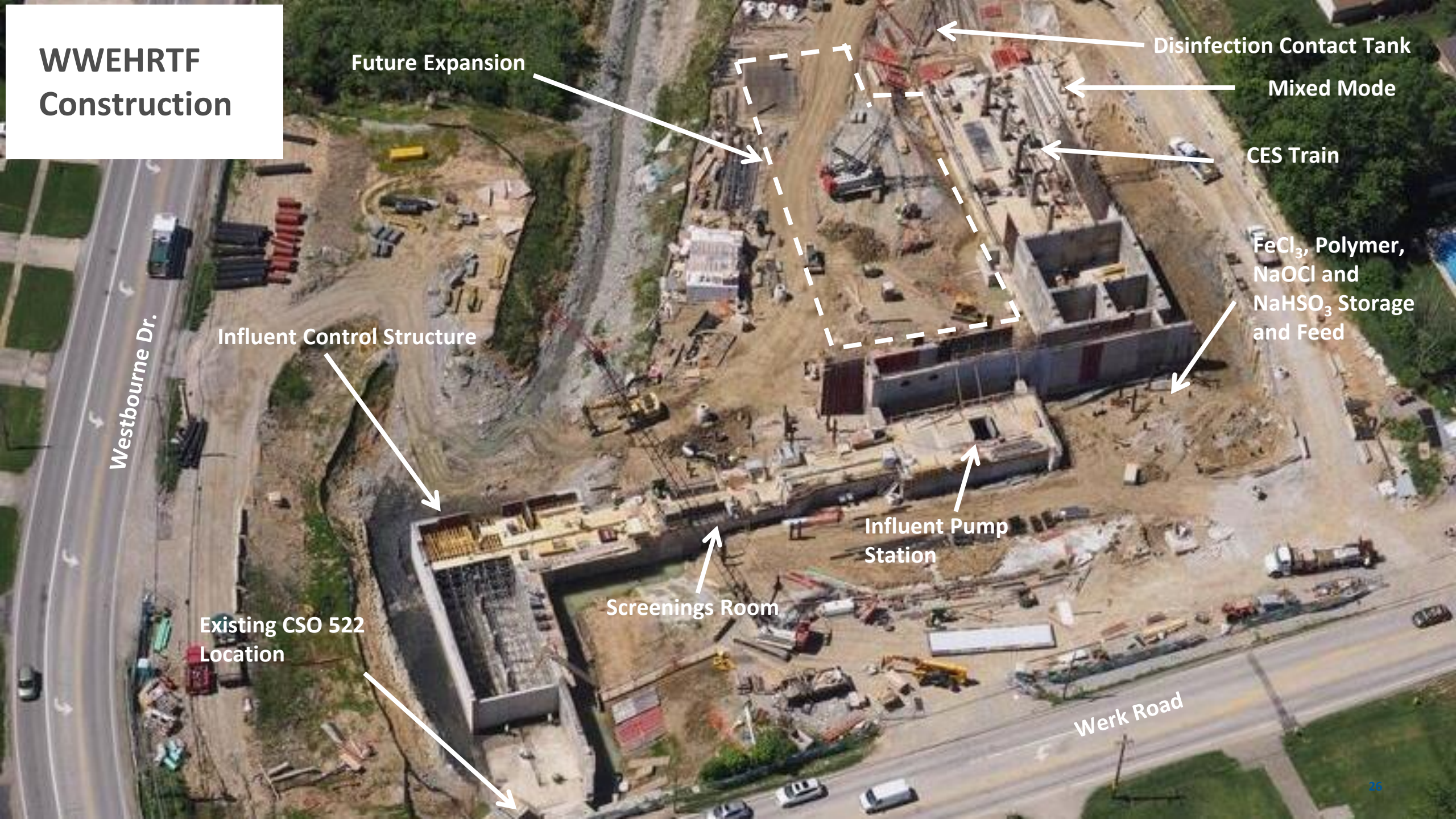
- Submersible, non-clog
- Two large (35-mgd), two small (18-mgd), spare slot for 5th pump
- Level-controlled, adjustable speed
- Trench-style wetwell

Delivers flow to CES and Disinfection

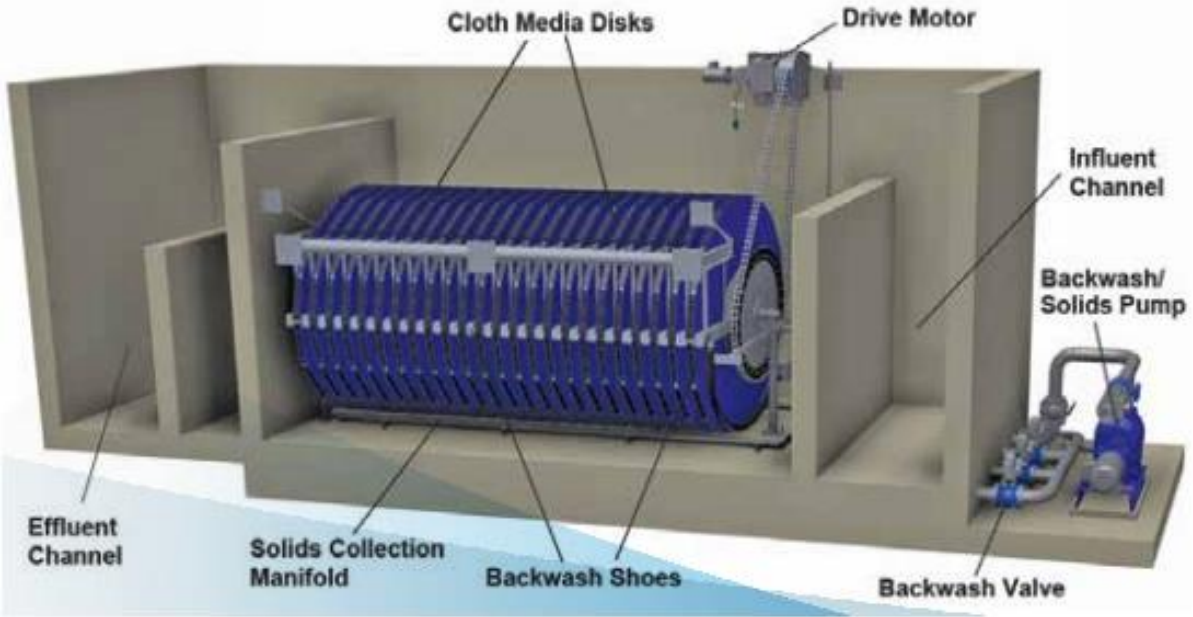
CES and Disinfection/Dechlorination

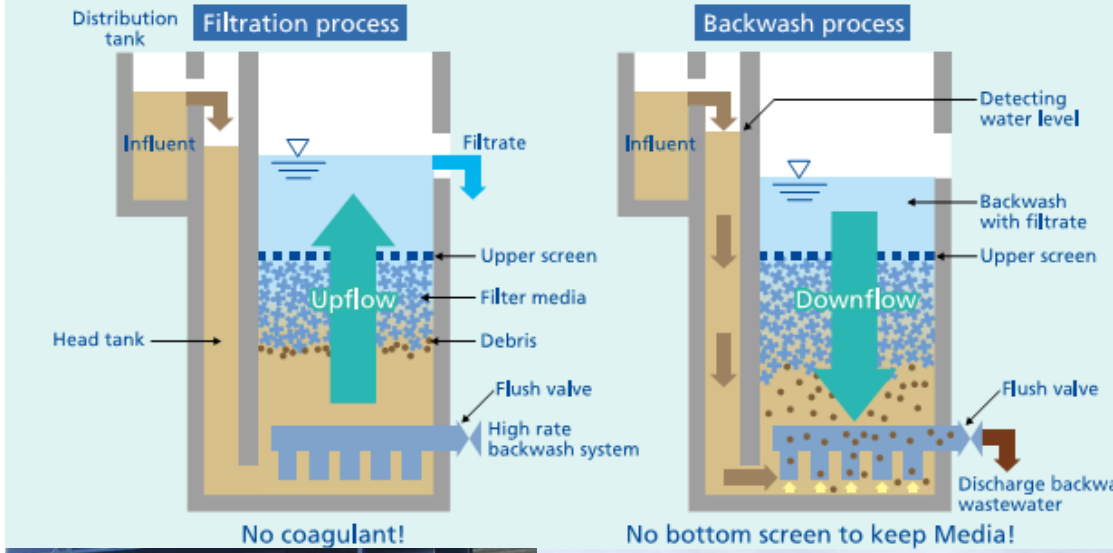
- Individual, enclosed rapid mix, flocculation, sedimentation and disinfection zones
- Sedimentation 3:1 L:W, SOR 7,000 gpd/sf @ 35-mgd
- Disinfection 15 min CT @ 35-mgd, 10 min @ 53-mgd
- Mixed mode channel for fine screening and disinfection only

WWEHRTF Construction



Emerging EHRT Technologies Pilot





Emerging EHRT Technologies Pilot Results

Pile Cloth Media

- 2.5 to 6.7 gpm/sf HLR
- Avg. effluent TSS 18 mg/L
- Avg. TSS removal 77%
- Relatively constant and effective TSS removal across wide range of events

Floating Media

- 16.9 to 27.6 gpm/sf HLR
- Avg. effluent TSS 56 mg/L
- Avg. TSS removal 51%
- More variable TSS removal during pilot study

Both systems appear capable of TSS removal at full-scale EHRT

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