

PSI Process & Equipment



Pumping Services, Inc.
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Disk Filtration for Water Reuse

NYWEA Watershed Conference

Hotel Thayer

14 September 2012



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Outline

- Water reuse definition
- Water reuse in the US
- Experience in NYS
- Reuse treatment requirements
- Reuse treatment technology
- Disk filtration





What is water reuse?

- Reuse/reclamation/recycling
- Terms are not well defined
- *Recycling* implies re-use with or without treatment
- *Reclamation* implies treatment of water, whether or not the water is re-used
- Generally, *re-use* refers to **advanced treatment of municipal wastewater for a particular use**





Reuse Applications

- Urban: Landscape irrigation, toilet flushing
- Agricultural: Food crops, nurseries
- Industrial: Cooling water, boiler feed, plant service water
- Recreational: Golf course irrigation, swimming, boating
- Groundwater recharge
- Indirect and direct potable reuse (NYC Watershed?)





Water re-use in the United States

- WaterReuse Foundation National Database of Water Reuse (2008)
 - 1,221 Utilities have a record in the database
 - Texas 329, Florida 294, California 248
 - Arizona 97
 - North Carolina 65
 - Wisconsin 36
 - New Mexico 28
 - New Jersey 14
 - Florida and California together recycle more than a billion gallons per day





Water Re-use in New York State

- Nine municipal and Green Building reuse projects permitted under SPDES
 - Riverhead WWTP/ Indian Island Golf Course
 - Albany South WWTP/Empire Generating Co.
 - Oneida WWTP/Turning Stone Resort
 - Canton WWTP/Golf course
 - Battery Park City/Solitaire
 - Helena (57th St)





Water Re-use in New York State (contd)

- 3 golf course water reuse systems
- Rockland County (Western Ramapo) under construction (DBO)
- Delhi- golf course irrigation-
 - aborted due to improved P in NYC basin
- Water re-use in NYS will be driven by stringent N/P regulations, rate incentives, limited water supplies, improving technology, decreasing cost





Water Reuse in New York State Regulatory Framework

- Title 6 Water Efficiency and Reuse (2005)
 - Chapter 619
 - Article 15- Water efficiency and reuse
 - 15-0603 Reclaimed Water Feasibility Study to promote use of reclaimed water- Completed 2010
 - 15-0605 Standards for reuse and disposal of reclaimed wastewater
 - 15-0607 Utilization of reclaimed wastewater registry
 - Still a long way to go on regulations





Current Water Re-use standards

- Standards vary by jurisdiction and by intended use (Class)
- Classes include:
 - irrigation of edible and non-edible crops
 - public (golf course) vs. limited access (farm)
 - groundwater recharge
 - industrial and in-plant use
- Requirements for solids removal, filtration and disinfection
- Setbacks from wells, residences etc. may also apply



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Current Water Reuse Standards (contd)

State	Class	Use	Filtration	Disinfection
Florida	Slow rate land application, restricted access	Pastures, trees	TSS<10 mg/l	fecal coliform <200/100 ml
Florida	Slow rate land application, public access	Golf courses, residential lawns, edible crops	TSS<5 mg/l	TSS removal beyond 5 mg/l; fecal coliform 75% below detection limits
California	Disinfected tertiary	Irrigation of food crops, golf courses, recreation	Coag/filtration <2 NTU average, <5 NTU 95% of time; for membranes, turbidity<0.2 NTU 95% of the time and <0.5 ntu all the time	7 day median coliform <2.2/100 ml; chlorine or 5-log virus removal
New Jersey	Public access and edible crops	Golf courses, residential lawns, edible crops	TSS<5.0 and monitor turbidity; if UV, turbidity <2.0 NTU	Cl2 1.0 mg/l for 15 minutes, coliform <2.2/100 ml
Massachusetts	Urban reuse	Golf course and spray irrigation	Turbidity<2.0 NTU at all times, TSS<5.0 mg/l	Fecal coliform<14/100 ml
Arizona	Class A+	All uses	24 hr avg turbidity<2.0, never over 5.0	Fecal coliform<23/100 ml

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Technologies for Water Reclamation

(State of California Treatment Technology Report December 2009)

- Filtration:
 - Granular Media Filters
 - Other media types (Disk)
 - Membranes
 - Cloth Media Filters

- Disinfection:
 - UV
 - Pasteurization
 - Ozone/peroxide





Criteria for filter testing

- Hydraulic loading rate
- Influent and effluent turbidity
- Backwash water quantity
- Particle removal
- Headloss
- Pathogen rejection (Giardia and viruses)





Granular Media Filters

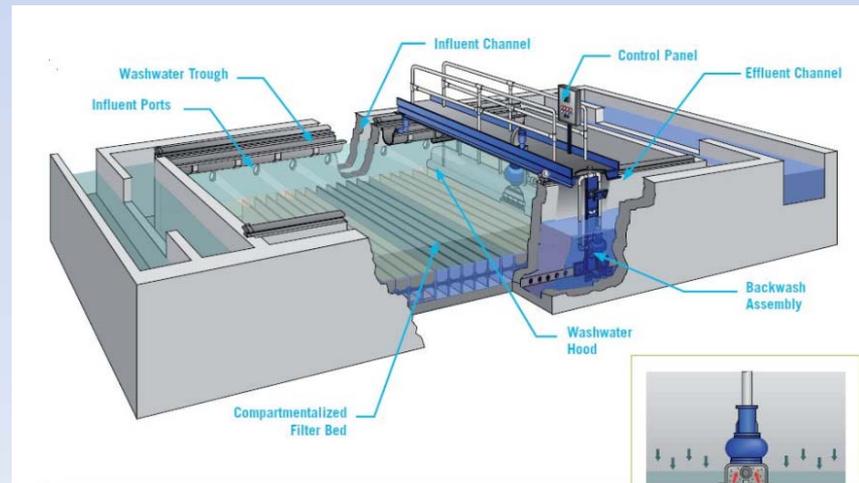
- Upflow Deep Bed Continuous Backwash
 - Dynasand[®], Supersand[®], Technasand[®], Astrasand[®], Centraflo[®] and many others
- Sand continuously moves from top of bed to bottom of bed with some form of washing
- Typically approved at 5 gpm/sf





Automatic Backwash Type (ABW) Filters

- Filter is divided into cells, backwash is continuous
- Shallow media depth 10-12 in
- Loading rates of 2 gpm/sf typically approved in California
- Typically approved at max. influent turbidity of 10 NTU in California
- May be used with or without coagulation





Other Media Types

- Fuzzy Filter
 - Compressible media provides variable effective pore size
 - Works through straining mechanism
 - Approved at 30 gpm/sf
 - Compression must be monitored and controlled
 - Coagulant provides optimal performance
 - Performance can degrade at higher influent turbidities





Other Media Types (cont)

- Media Wastewater Filter
 - Approved at 2.1 gpm/sf
 - Water is filtered through multi-layered microfiber cassettes
 - Simple operation, low backwash generation





Cloth Media Filter

- Cloth Filter
 - Cloth-covered disks filter wastewater
 - Operates under vacuum
 - Filter to waste after backwash
 - Approved at 6 gpm/sf in California





Disk Filter (Nova Ultrascreen)

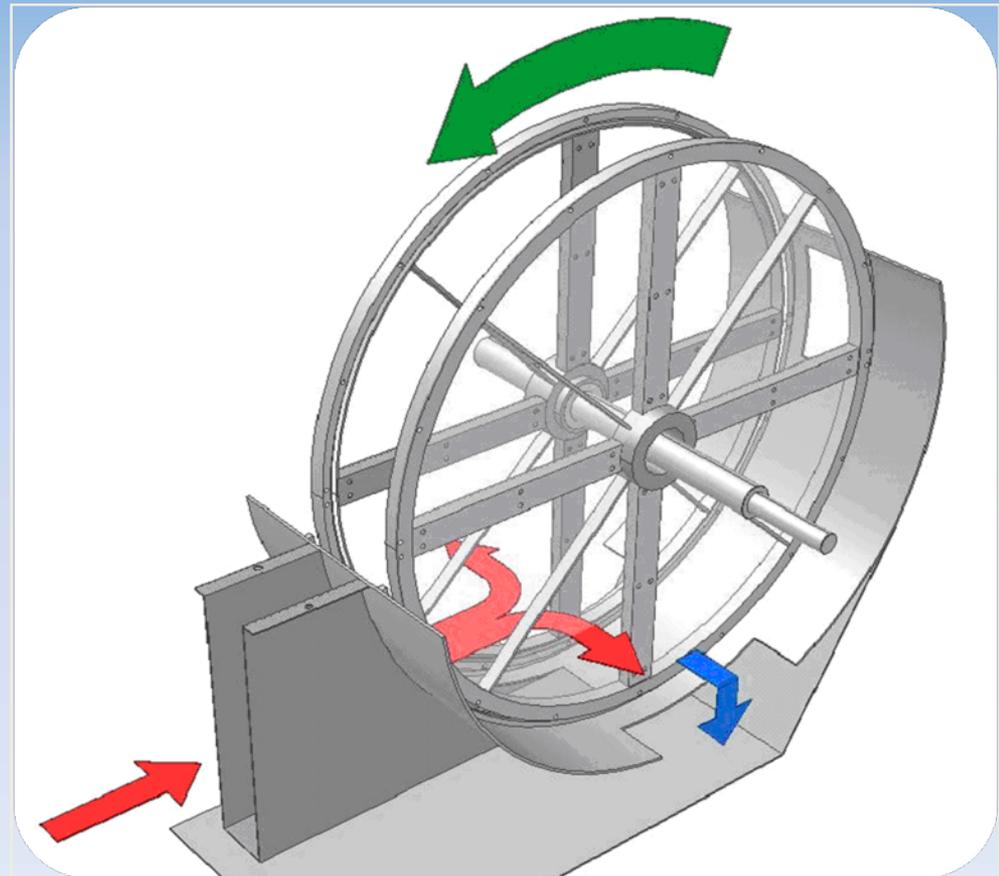
- Utilizes disks with stainless steel mesh
- Dynamic tangential filtration increases solids removal
- Approved up to 6 gpm/sf with a disinfection process that achieves 4-log virus inactivation
- Approved up to 16 gpm/sf with a disinfection process that achieves 5-log virus inactivation (i.e. UV, pasteurization, ozone)





Nova Ultrascreen Filter

- All stainless steel construction
- Influent flows in between the disks
- Drops into plenum by gravity
- Disks rotate to increase effective surface area
- Disks rotate at variable speed

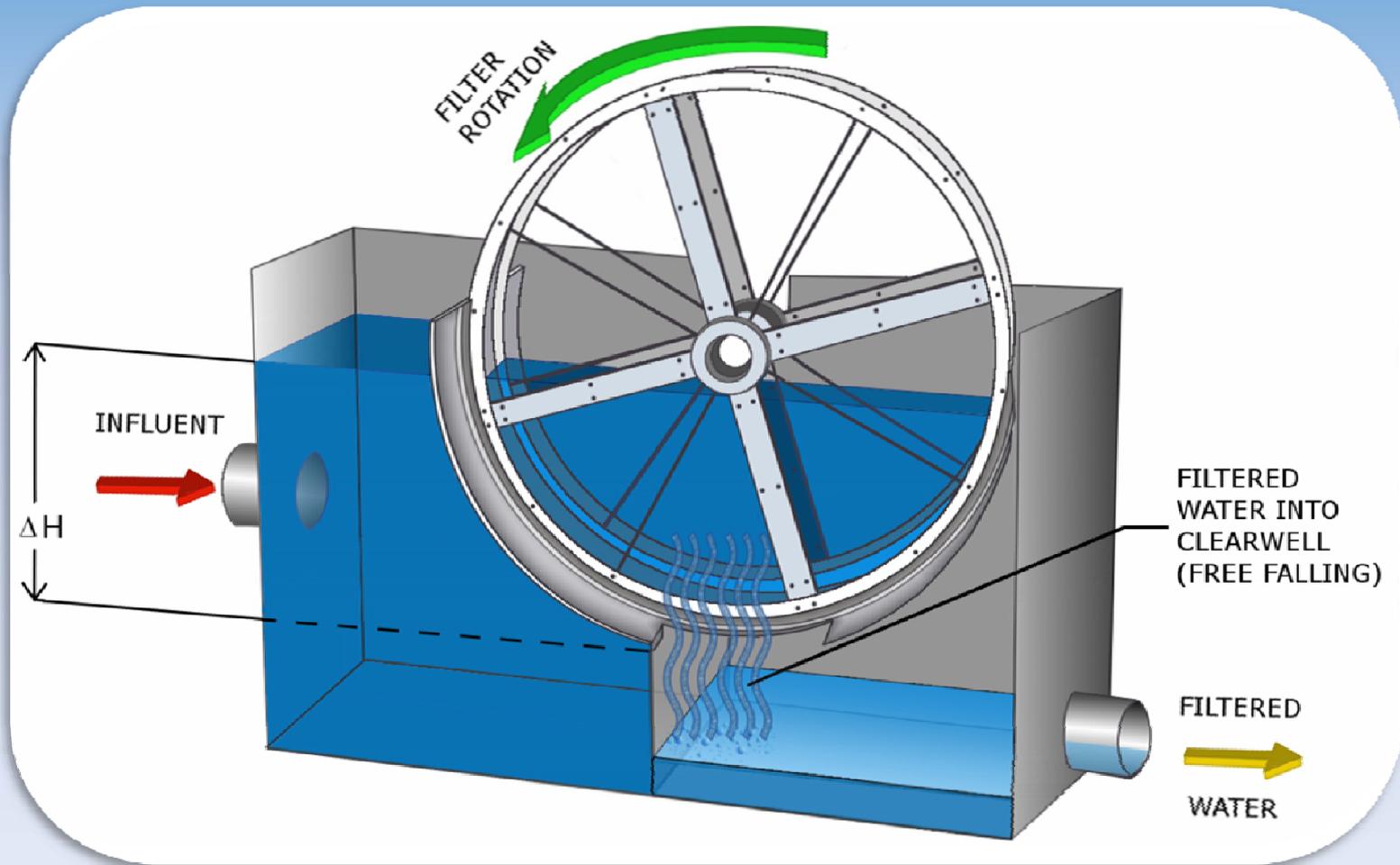


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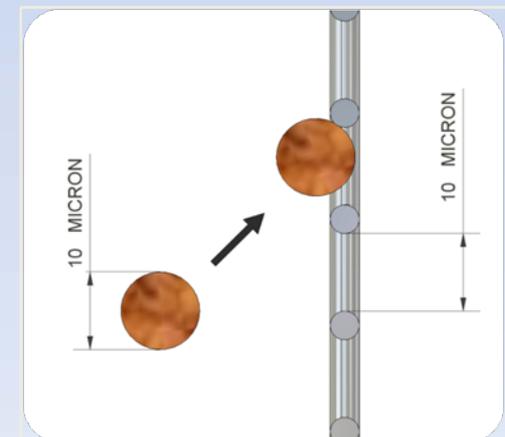
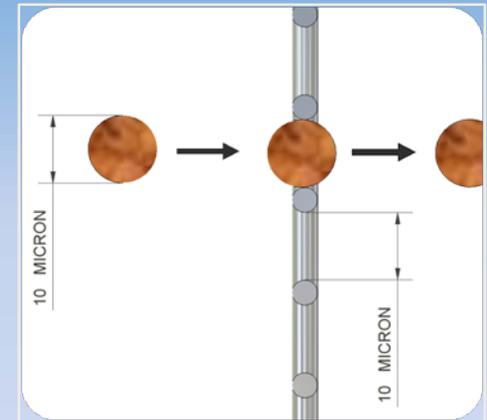
Nova Ultrascreen Operation





Dynamic Tangential Filtration

- Particle Approach Angle 90°
- Solids Exclusion & Pre-coating
- Allows For Minimal Driving Head Force
- Smaller Openings Mean Higher Wash Water Reject Rates & Lower Throughputs
- With Rotating Disks, Openings Appear to be Smaller Than They Are
- Removes Smaller Solids than the Weave Openings
- Easier to Clean
- Require Less Wash Water
- Allows Higher Throughputs





Nova Ultrascreen Filter

- CA Title-22 water reuse certification (less than 2 NTU) performed by Carollo Engineers at two sites using full scale equipment
- The Ultrascreen was tested side by side with two previously approved Title-22 filtration technologies
- Both sand media and cloth disk media were compared
- The Ultrascreen operated at loading rates up to 8 times higher with equivalent effluent quality and significantly lower reject rates

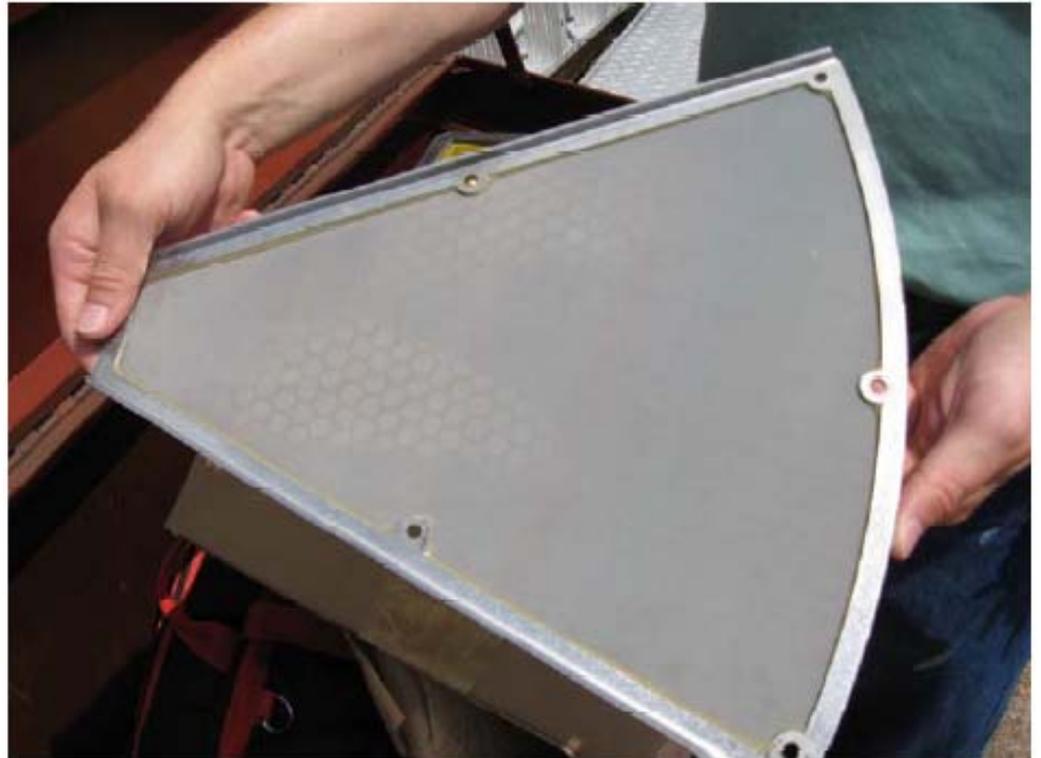
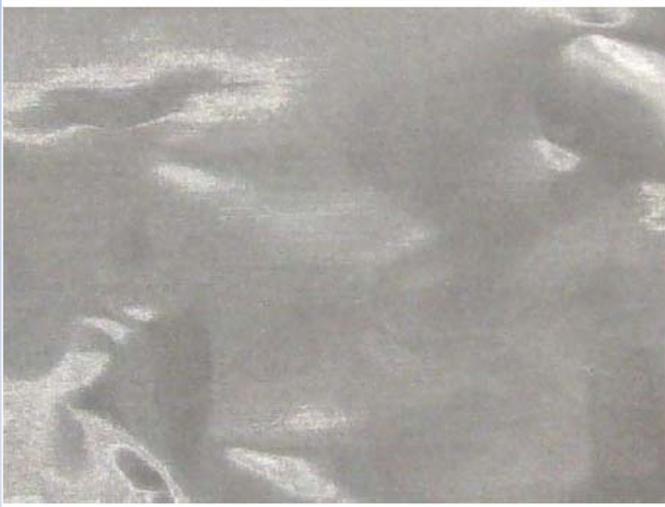


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Stainless Steel Mesh



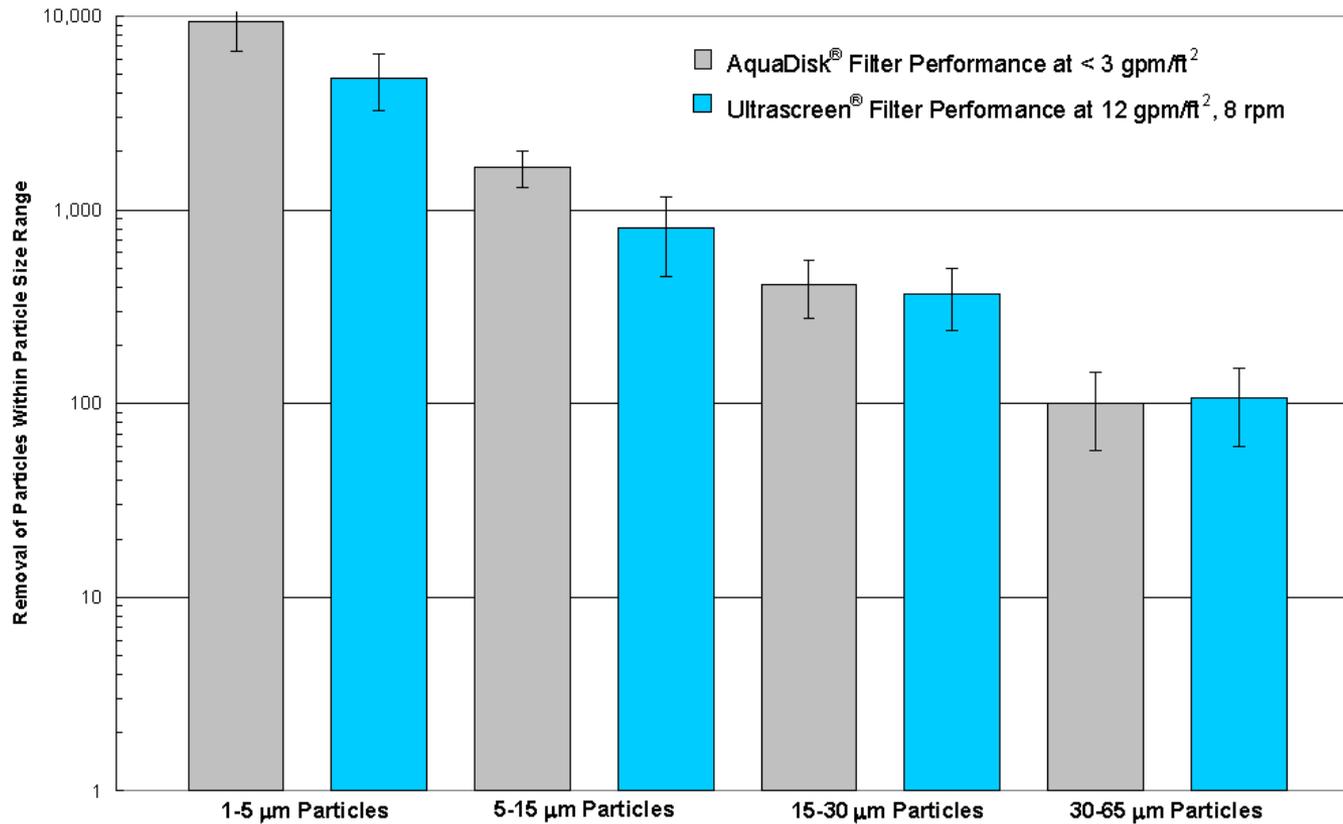


Filter validation testing

- California Title 22 requires validation testing
- Performed by independent entity
- Testing criteria:
 - Hydraulic loading rates
 - Turbidity reduction
 - Particle counts
 - Particle size distribution (PSD)
 - Backwash rejection



Particle Removal

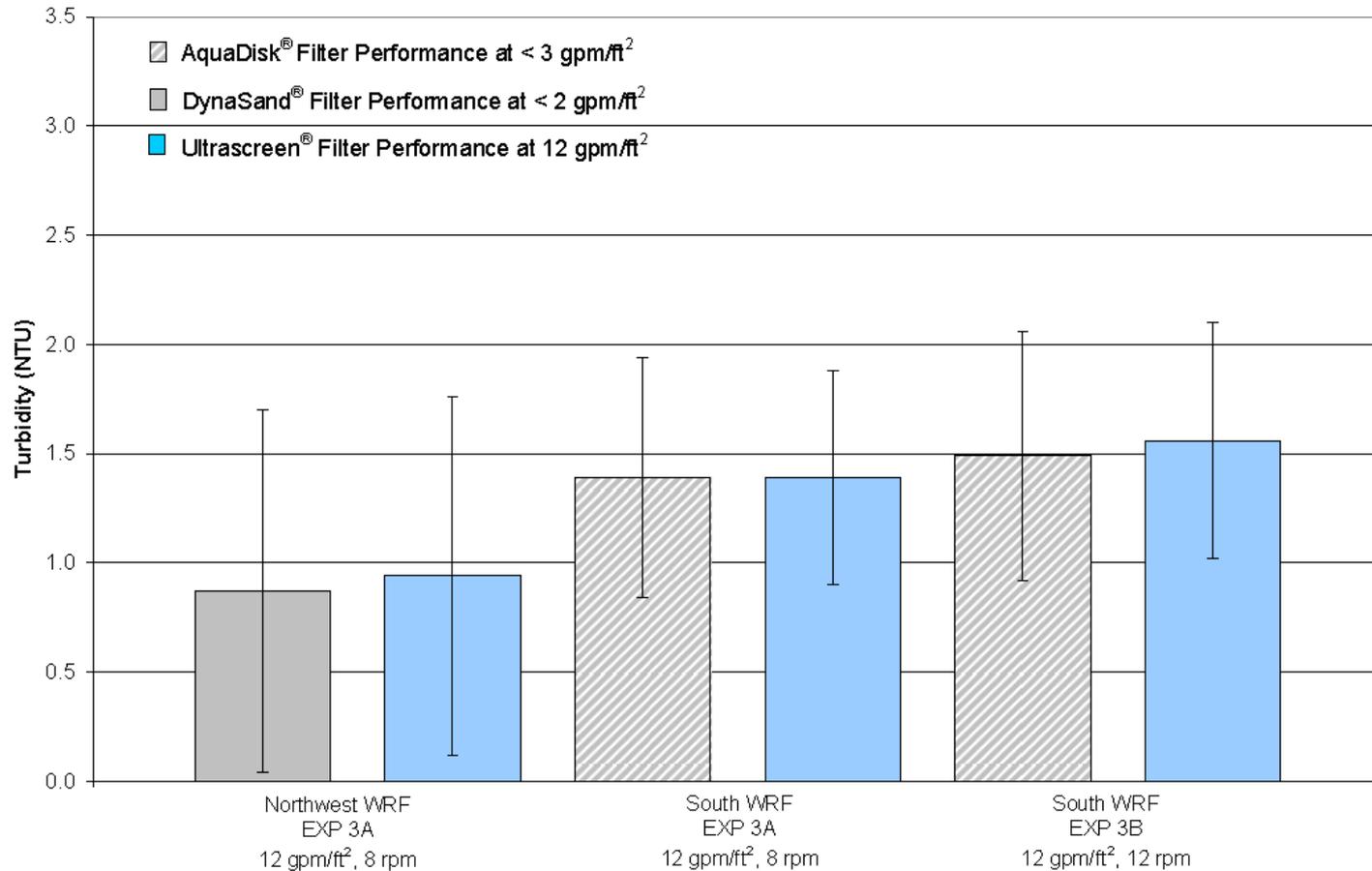


PARTICLE REMOVAL AT THE SOUTH WRF
EXPERIMENT 3A (12 gpm/ft², 8 rpm)

FIGURE 43

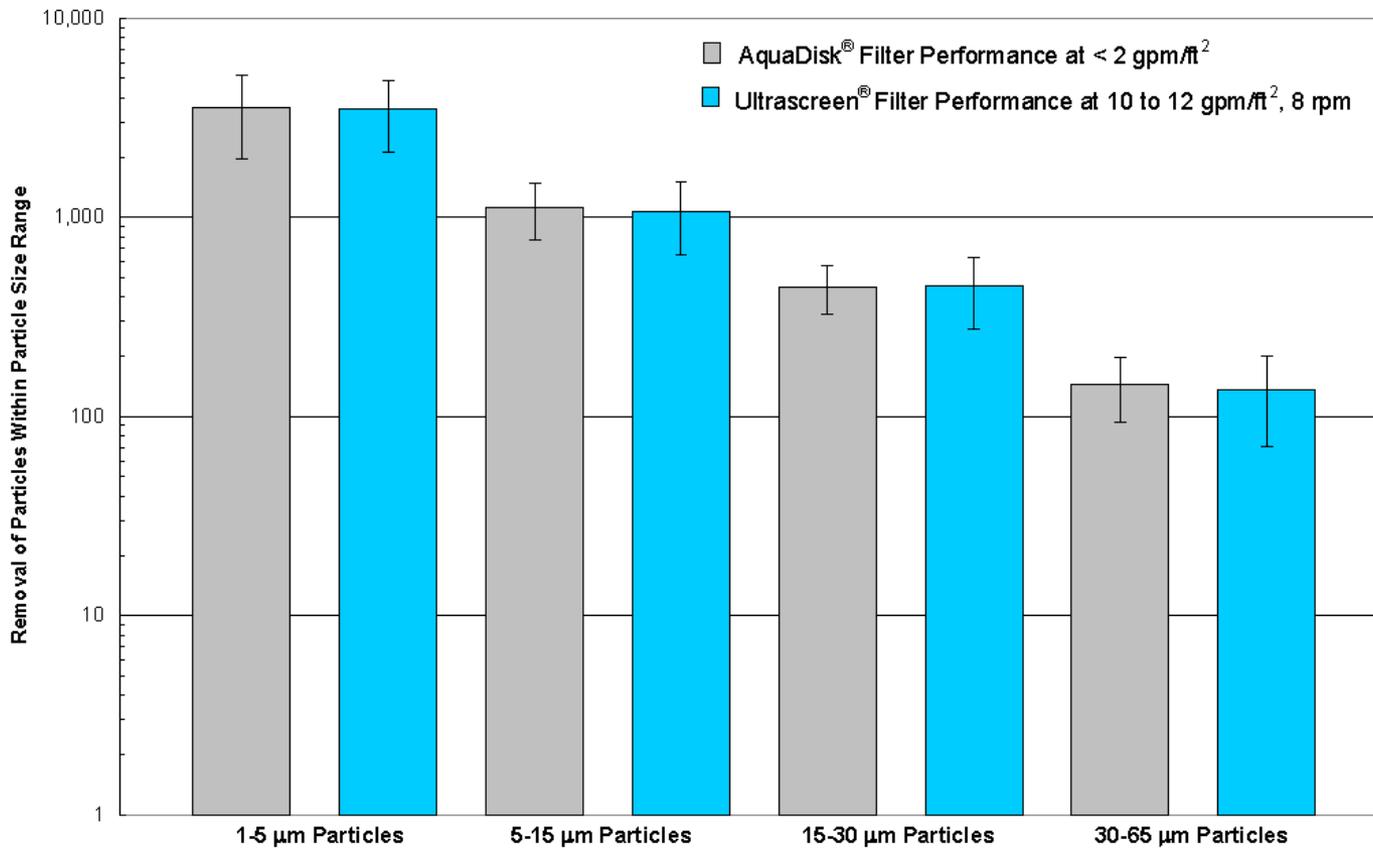


Filter Effluent Turbidity at 12 gpm/sf





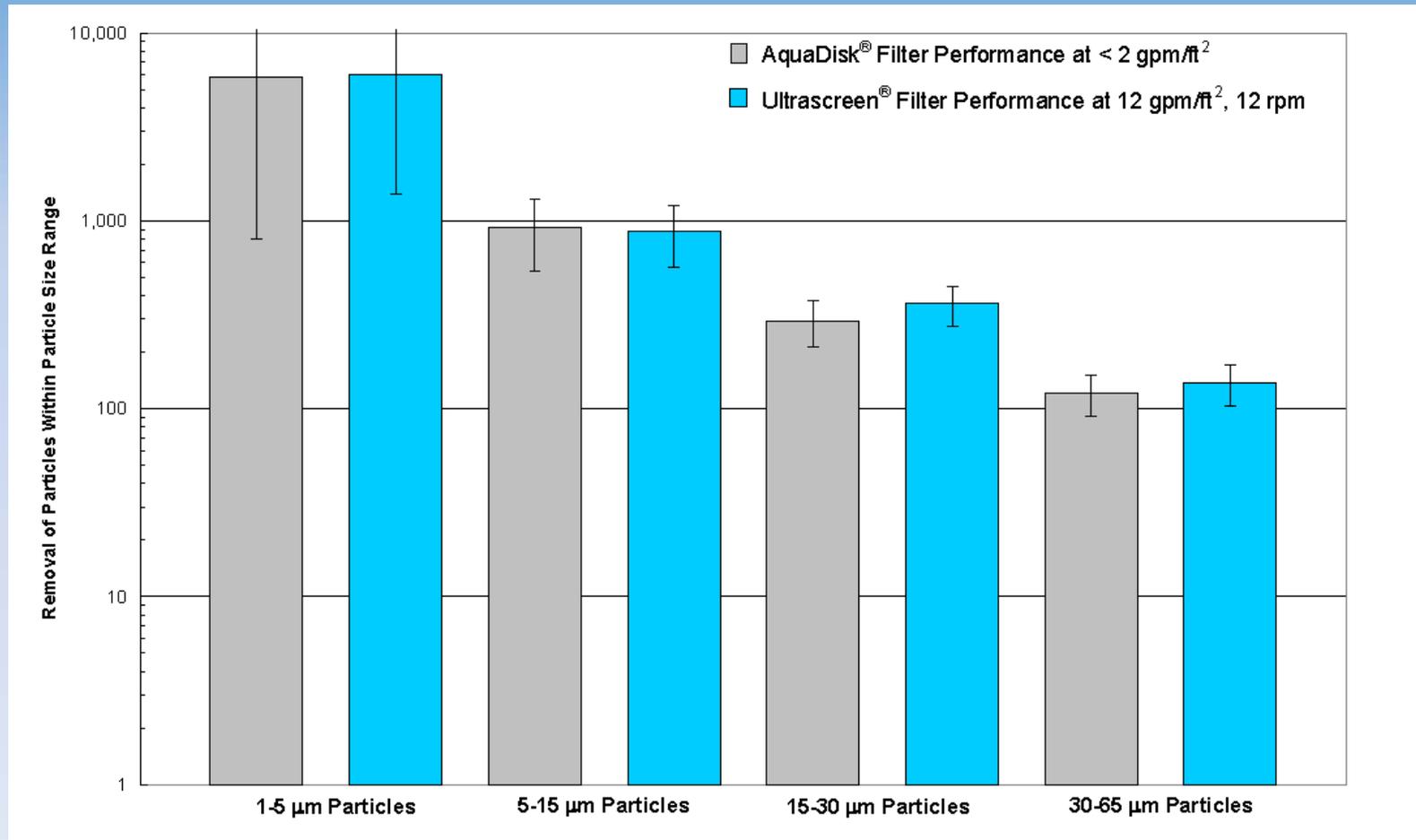
Particle removal at 12 gpm/sf



**PARTICLE REMOVAL AT THE SOUTH WRF
EXPERIMENT 2B (10-12 gpm/ft², 8 rpm)**

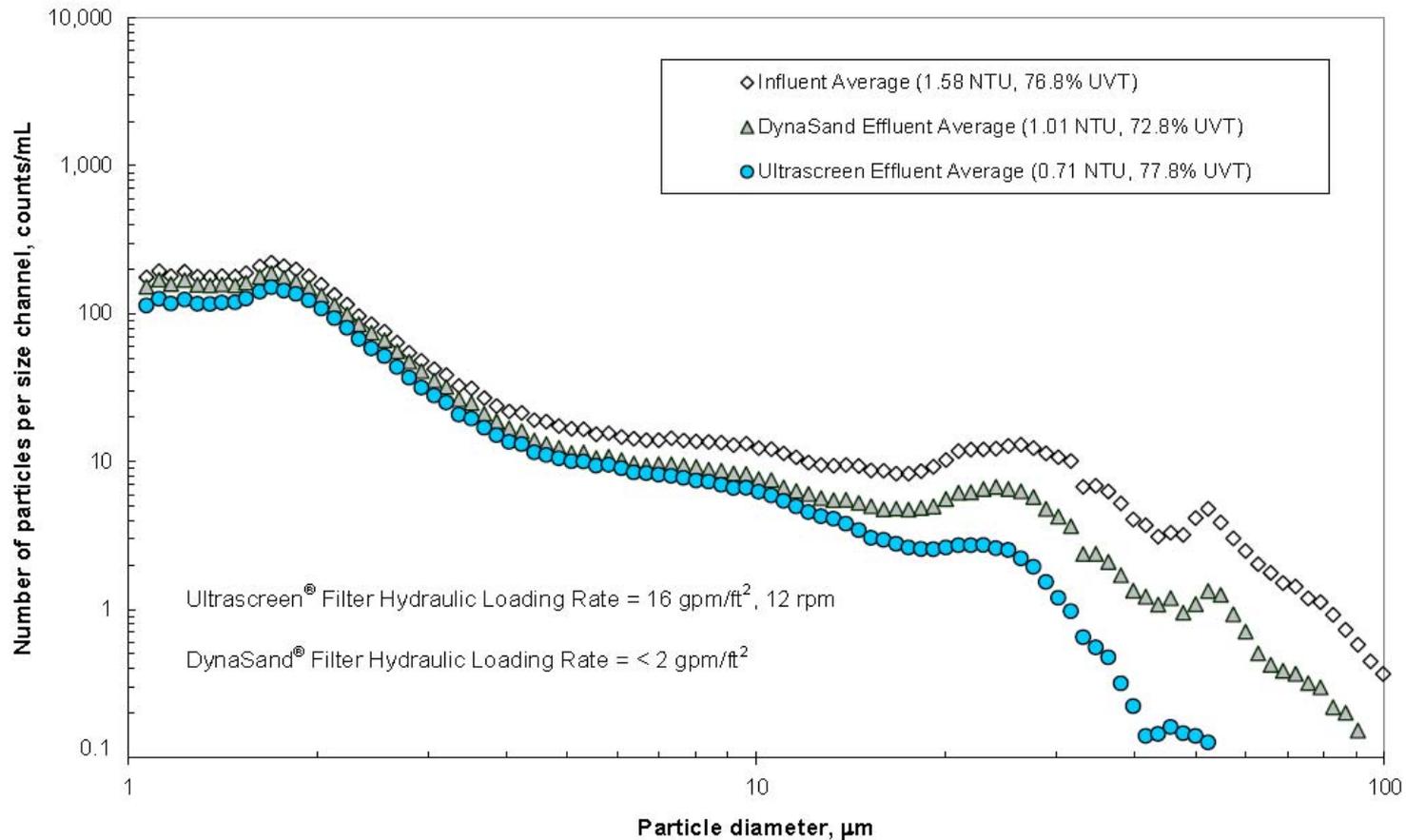


Particle removal at 12 gpm/sf



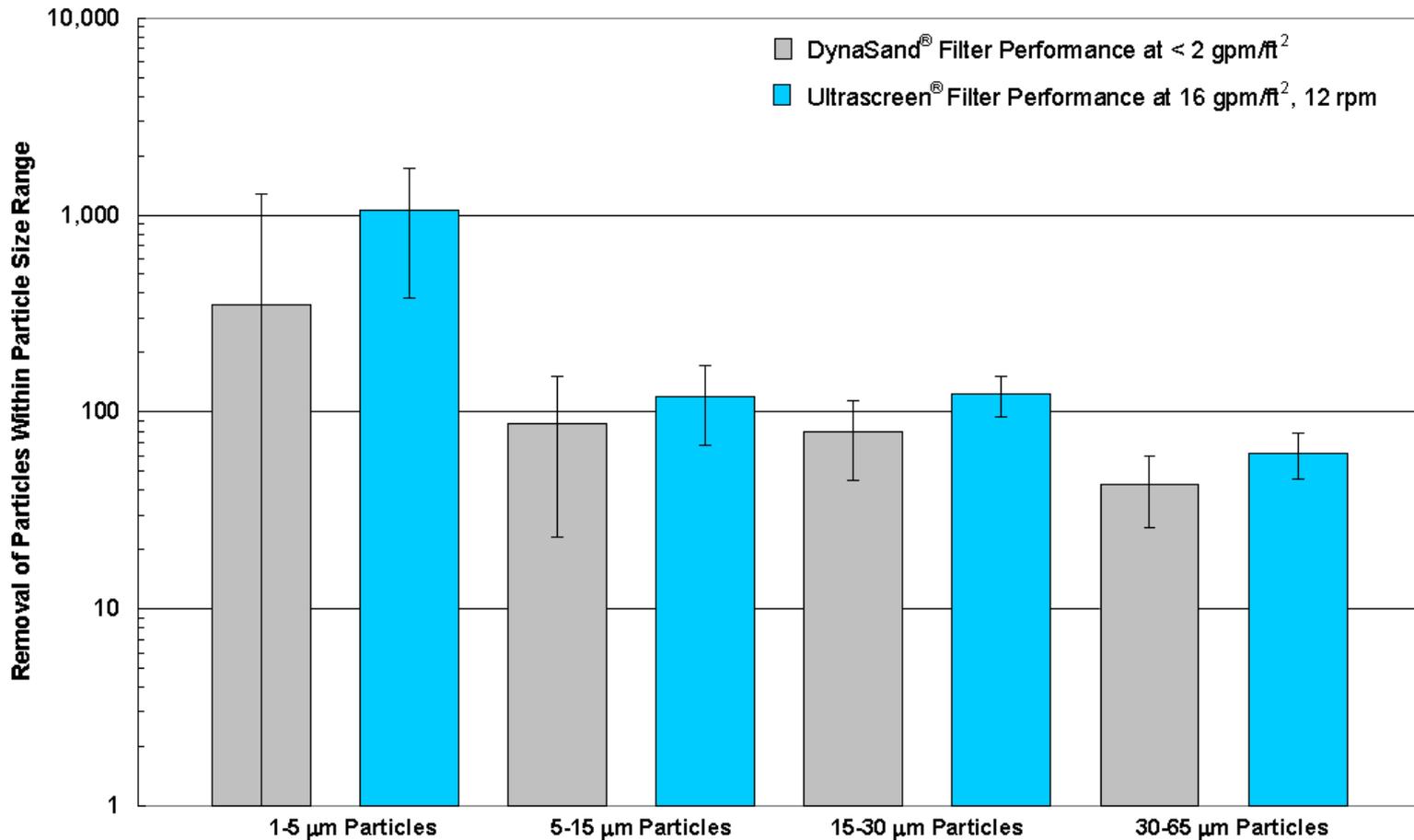


Particle Size Distribution at 16 gpm/sf



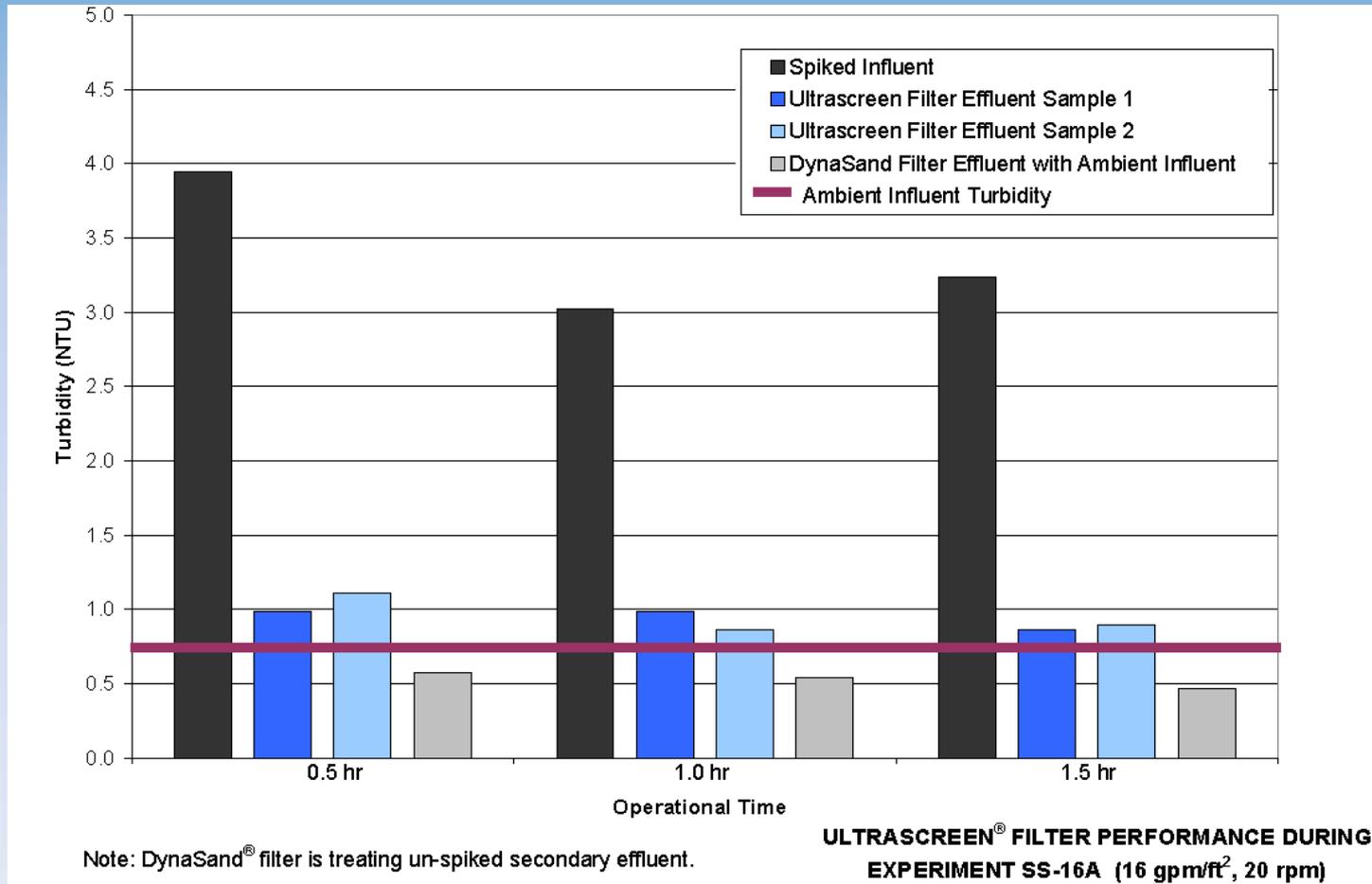


Particle Removal at 16 gpm/sf



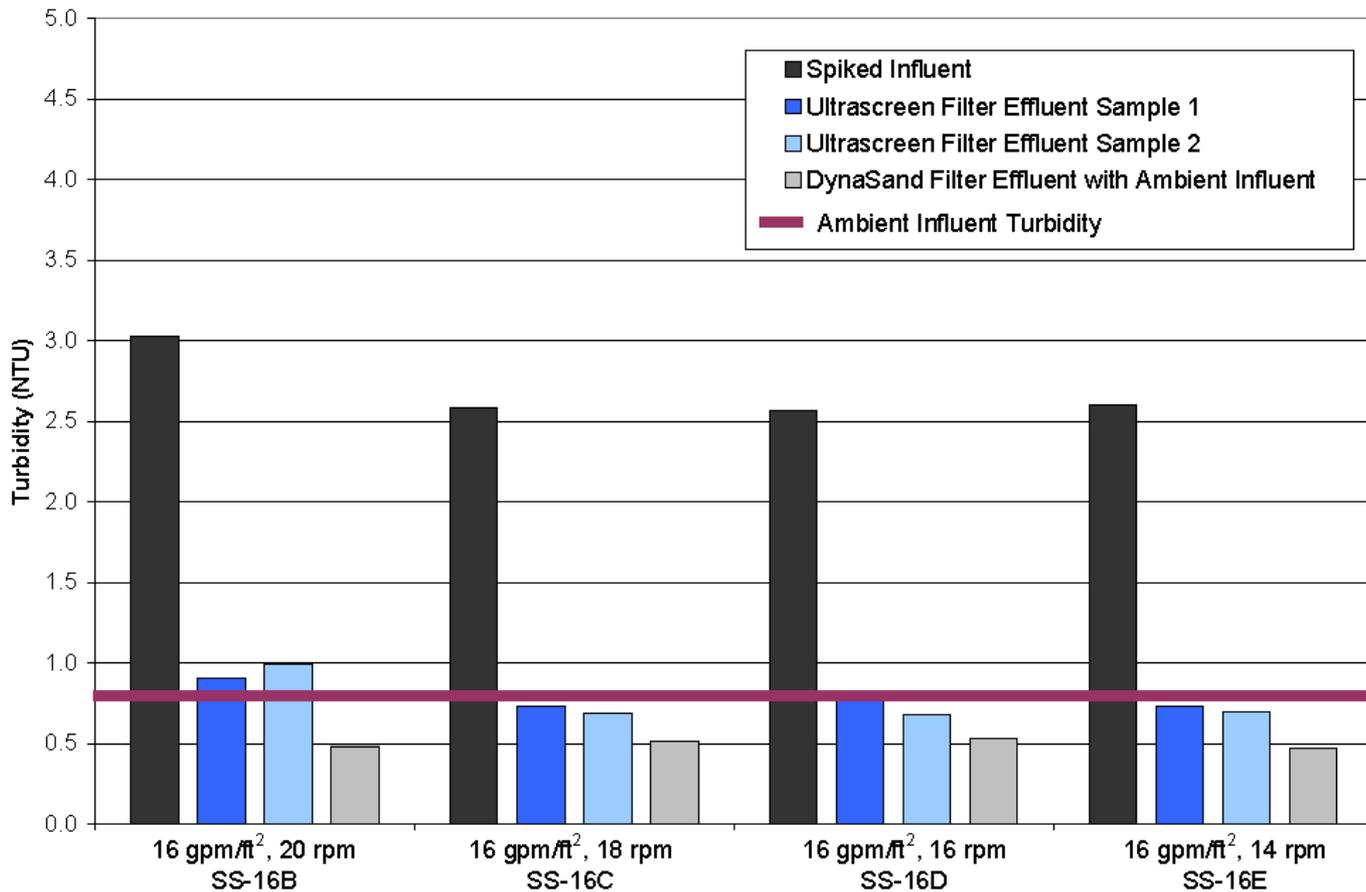


Solids Removal Spiking Experiment



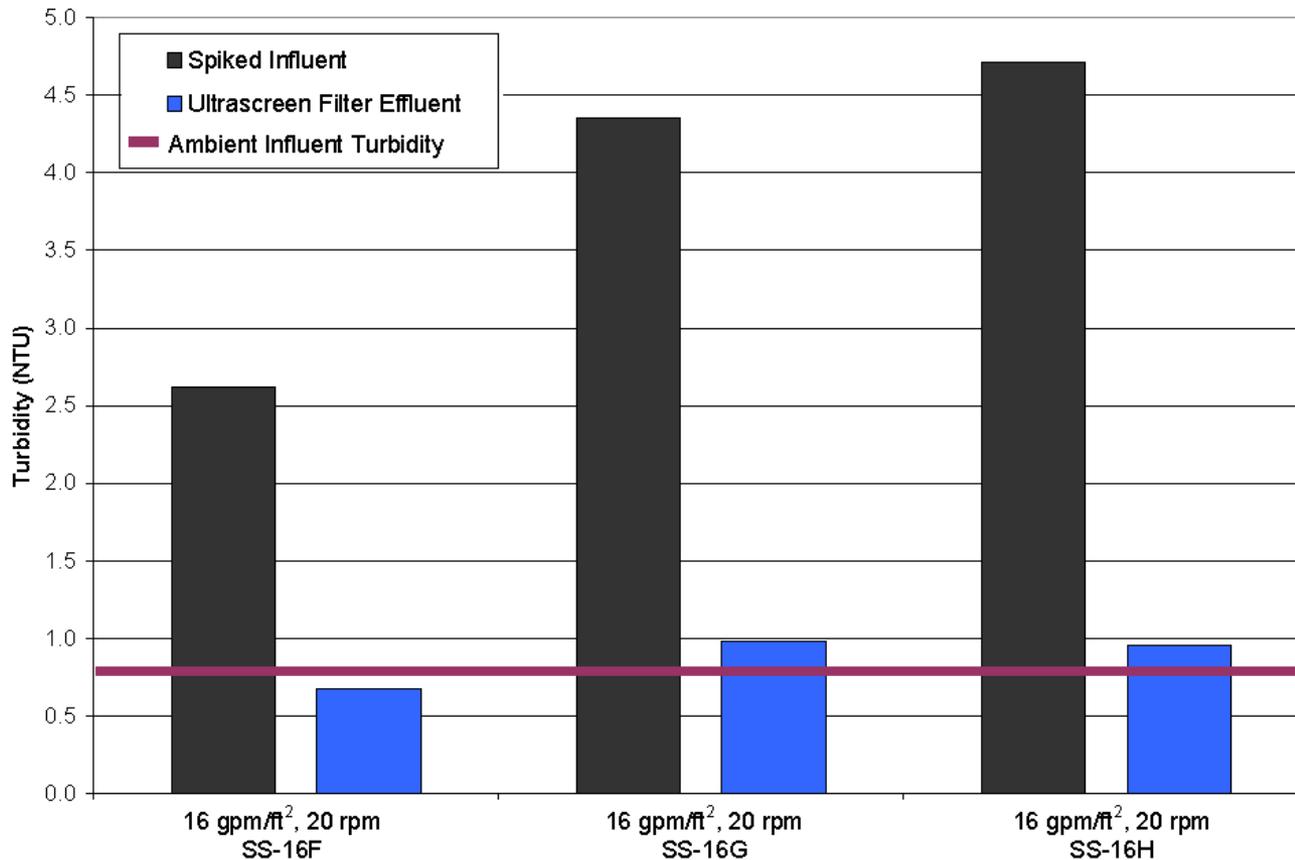


Turbidity spiking at 16 gpm/sf





Spiked influent at 16 gpm/sf





Backwash Water Reject

Table 9 Backwash Reject Water Results
Title 22 Performance Testing of the Ultrascreen® Filter
Nova Water Technologies

WRF	Method of Measurement	Ultrascreen®		AquaDisk® or DynaSand® (1)	
		Average Filter Loading Rate, gpm/ft ²	Reject Rate, %	Average Filter Loading Rate, gpm/ft ²	Reject Rate, %
South-1B	Manually	5.98	<0.10	<5	<6.0 (2)
South-3A	Manually	11.97	0.59	<3	<6.0 (2)
Northwest-1A	Data logger	6.55	0.49	<2	20.6
Northwest-1B	Data logger	6.72	1.06	<2	21.4
Northwest-2A	Data logger	8.26	1.65	<2	19.6
Northwest-2B	Data logger	8.12	0.79	<2	22.0
Northwest-3A	Data logger	12.37	1.40	<2	20.7
Northwest-4A	Data logger	16.21	1.09	<2	20.6
Northwest-4B	Data logger	16.17	0.97	<2	12.6

Notes:

- (1) The South WRF had an AquaDisk® filter system and Northwest WRF had a DynaSand® filter system.
- (2) The AquaDisk® reject rate was not measured during these experiments. However, historically at this WRF under similar operating conditions the reject rate has been observed to be less than 6 percent.



Conclusions

- Reuse is becoming increasingly important due to:
 - Increasing cost of treating and transmitting raw water
 - Stringent environmental regulations
 - Stressed water supplies
 - Improving treatment technology
 - Economic conditions





Conclusions (cont)

- Disk filtration is in the “sweet spot” between granular media and membranes for reuse:
 - Turbidity removal to Title 22 standards
 - High Loading rates
 - Lower capital cost
 - Low headloss
 - Low backwash
 - Simple operation





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Acknowledgements

- Dan Loy, NOVA Water Technologies
- Keith Borgeous, Carollo Engineers
- John Corkery, PSI Process

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Questions?

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