



Startup and 1st Year of Operation at the Ventura Avenue UF WTP



PNW AWWA Conference 2009



Todd Reynolds, PE, BCEE

Acknowledgements

Aileen Kondo, Kennedy/Jenks Consultants

**Jim Passanisi and Mike Oakley,
City of Ventura, California**





Presentation Outline

- **Overview of the Avenue WTP**
- **Startup and 1st Year Performance**
- **Lessons Learned**
- **Questions**

Overview of the Avenue WTP

- **Filtration plant to treat groundwater under the influence of surface water**
- **10 MGD expandable to 15 MGD**



Avenue WTP typically has high quality source water

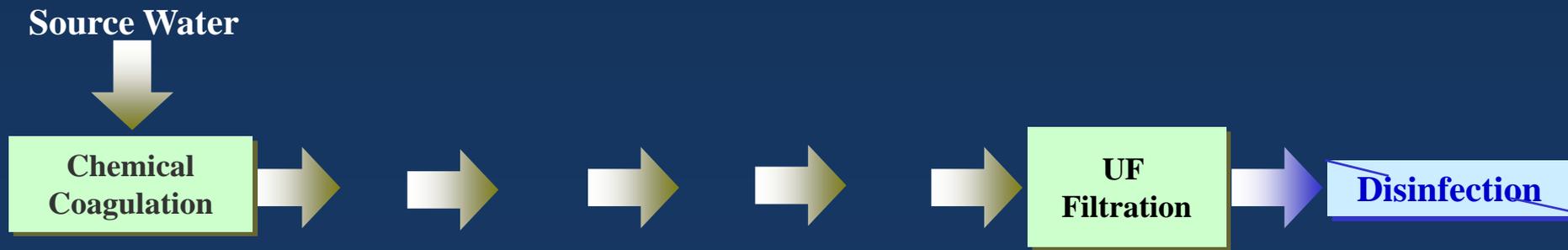
Parameter	Units	Foster Park Source Water	
		Average	Maximum
Turbidity	NTU	0.15	5
Total Dissolved Solids	mg/l	660	750
Total Hardness	mg/L CaCO ₃	400	480
Alkalinity	mg/L CaCO ₃	225	250
Temperature	° C	17	15
pH	units	7.3	7.9
TOC	mg/L	1.5	4
Color	CU	3	5
Iron	mg/L	0.05	0.1
Manganese	mg/L	0.01	0.03
Silica	mg/L	15	20

New Avenue WTP provides treatment with fewer processes

Previous Avenue WTP Conventional Water Treatment



New Avenue WTP In-line UF Membrane Water Treatment

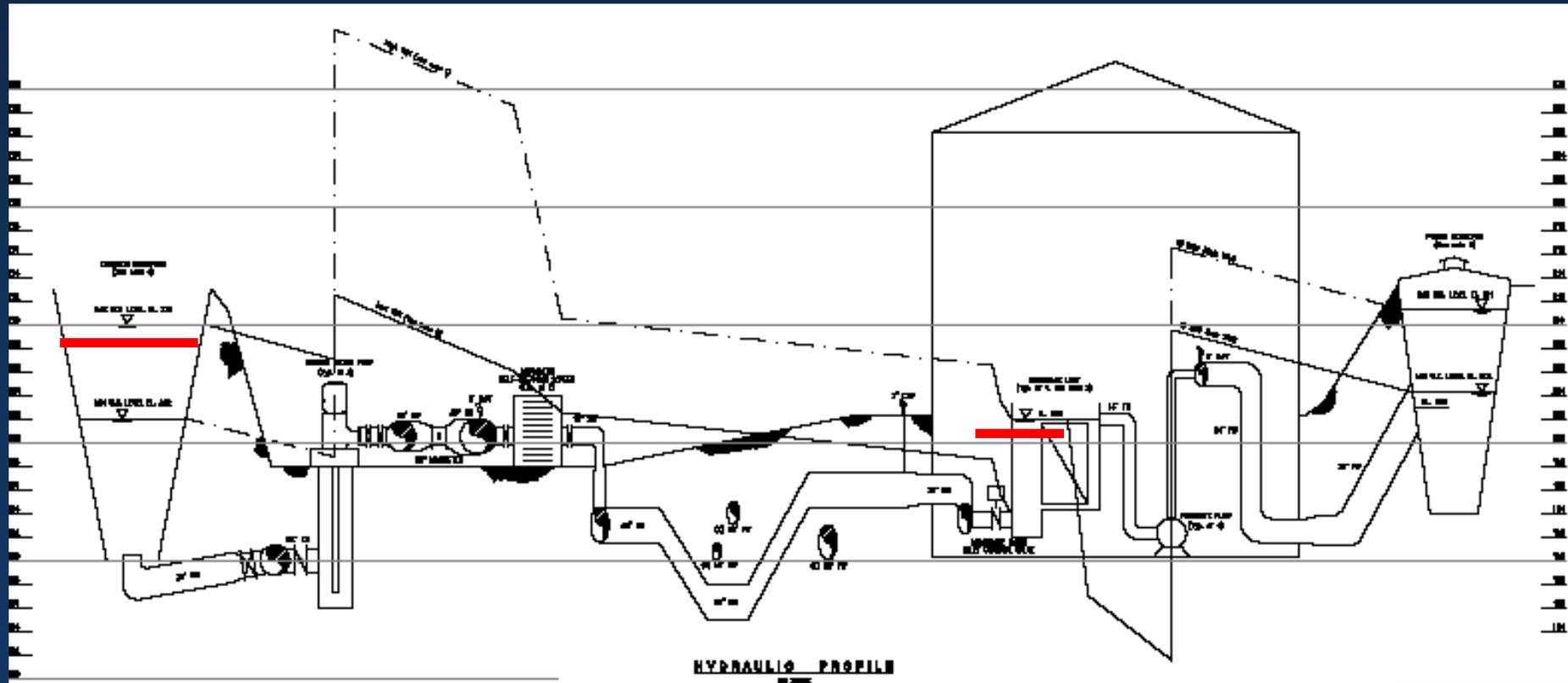


Kingston Source Water Reservoir

- **10 MG open, raw water equalization basin**
- **Pre-oxidation with chlorine**
- **Water from:**
 - Foster Park
 - Filtered return water
 - CMWD (treated surface water)



At low flows and high levels in KR, water can flow by gravity and save energy



SW Screens and Coagulation Contactor



- Two auto backwashing screens
- 500 micron removal
- Coagulant and chlorine addition
- Hydraulic coagulation contact pipeline with 3 minute HRT

Membrane Filtration Building Overview

- **Zenon 1000 UF Membrane Filters**
- **Control Room, Server Room, Lab, Restroom**
- **Blower and Electrical Rooms**
- **Work and membrane lay-down areas**
- **4-ton crane**



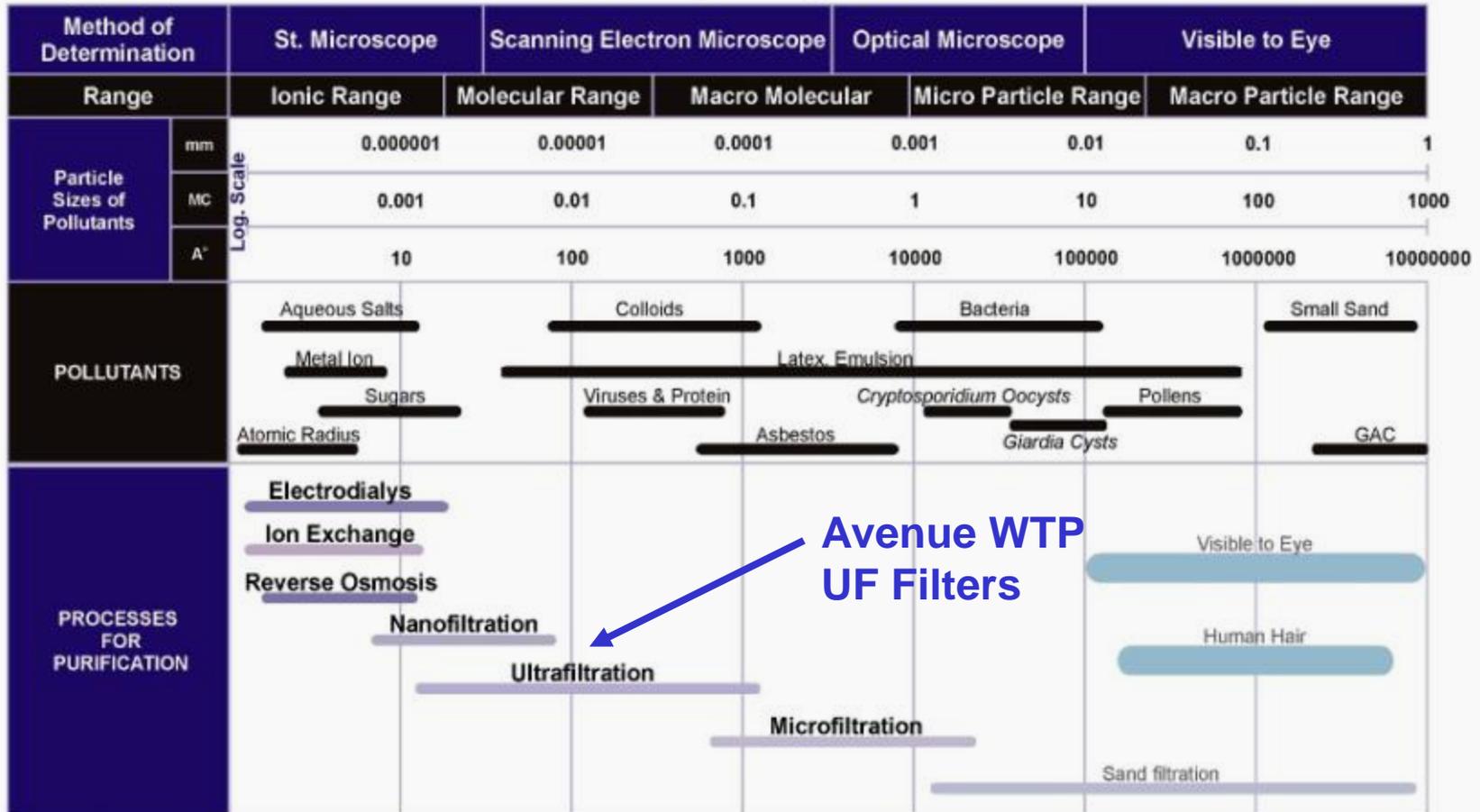


Zenon 1000 UF Membrane Filters Overview

- **4 Membrane Basins – plus 2 for future expansion**
- **Basin design capacity is 2.5 MGD**
- **6 cassettes per basin**
- **V3 UF membrane elements – 0.02 micron pore size**

Membrane filters are a physical separation process

Water Treatment Processes Depending on Water Characteristics

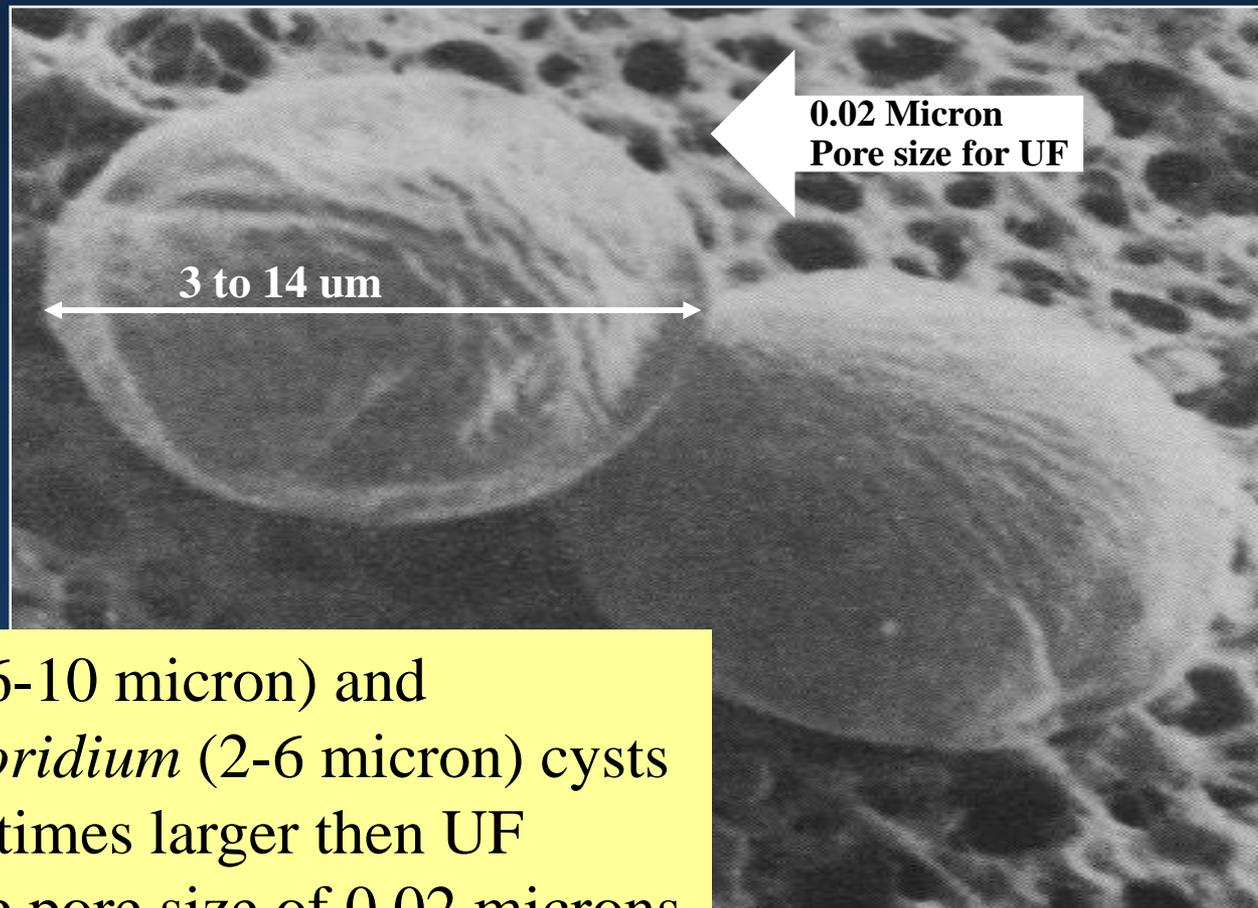


Avenue WTP
UF Filters

1 Angstrom(A⁺) = 10⁻¹⁰Meter(m) = 10⁻⁴Microns(MC) = 10⁻⁷Millimeter(mm)

G: PW-Group\SFPW-Graphics\Graphics-Images\Illustrate\WTPProcess

UF membranes remove particles that are larger than the membrane pore size

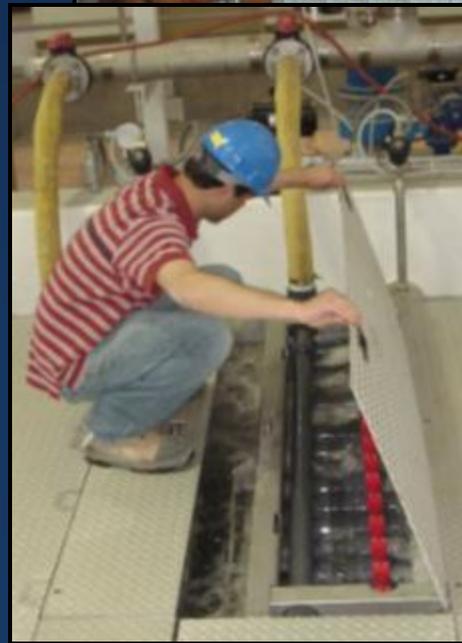


0.02 Micron
Pore size for UF

3 to 14 um

Giardia (6-10 micron) and
Cryptosporidium (2-6 micron) cysts
are many times larger than UF
membrane pore size of 0.02 microns

Overhead crane and membrane lay-down areas simplify maintenance



Membrane Cleaning



CIP water heating tank,
pumps and softener (behind)

- **CEB** – 10 ppm chlorine in softened backwash water.
- **EFMC** – 100 ppm chlorine – soak for ~30 minutes.
- **Recovery Clean** – acid or hypochlorite **CIP** – 5 hr soak
- **EFMC** and **RC** waste is neutralized and sent to sewer.

Filtered water is disinfected, conditioned and pumped to distribution



- **Free chlorine disinfection and contact time in clearwell**

- **Ammonia for chloramination in distribution system**

- **Caustic and orthophosphate addition for corrosion control**





Avenue WTP Reliability Features

- **Critical treatment process redundancy**
- **Continuous SCADA system monitoring and alarm**
- **Automatic startup of standby equipment**
- **Standby engine generator for critical loads**
- **Well trained and motivated Operators and Maintenance Staff**

Startup and Initial Lessons Learned



- **Startup was phased to accommodate existing plant operations**
- **Close coordination between the Contractor, Owner and Engineer**
- **Plan for where you will put the water**

Laying the foundation for a successful facility operations

- Involved operations staff in the design process
- Training on the overall plant process and operations
- Tours of the facility for operators during construction
- Operators worked with Contractor during startup process and plant testing



Startup systems slowly and pay attention to control loop and valve response times



Water Hammer
Damage



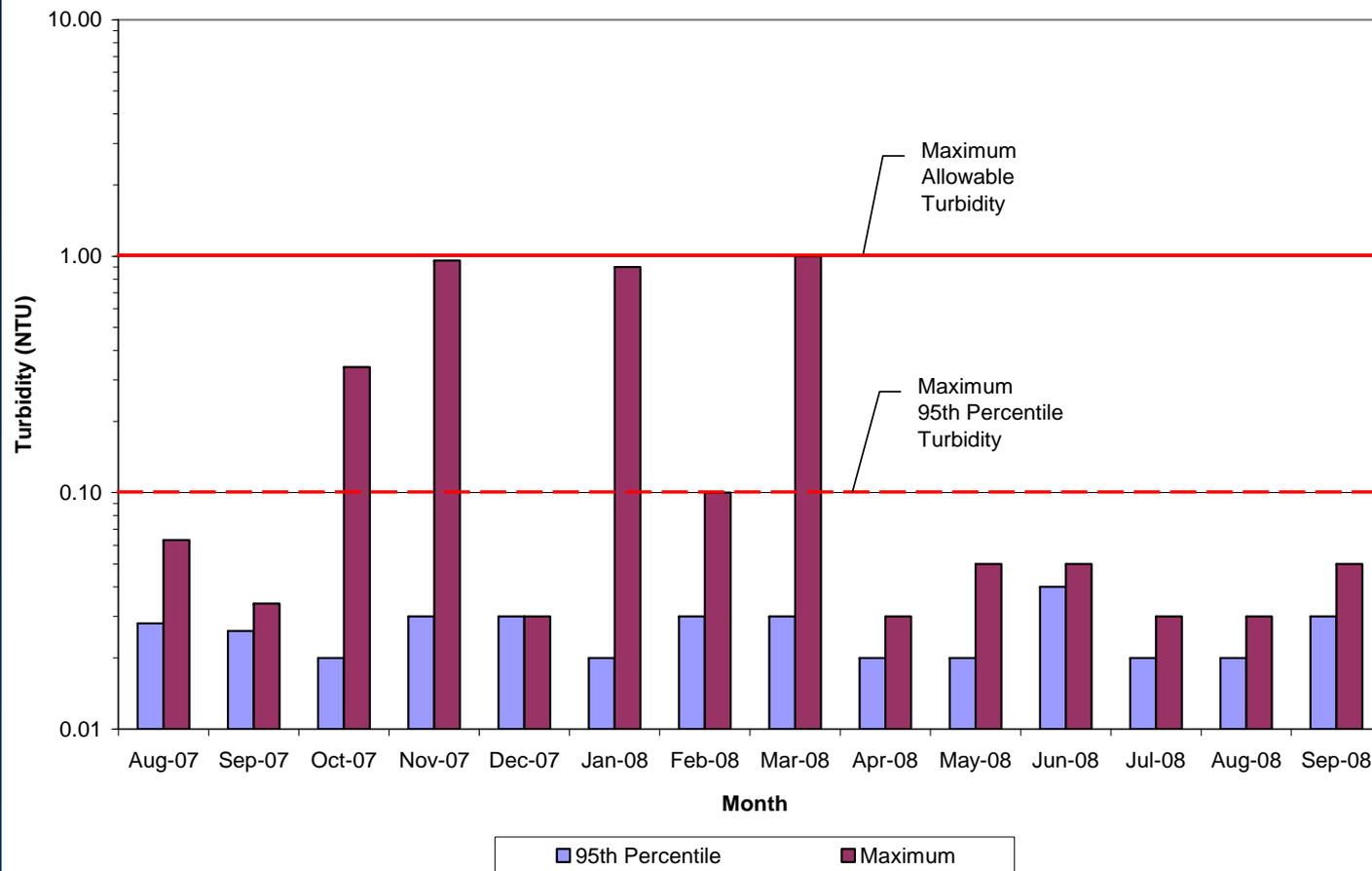


Avenue WTP has performed well in the first year of operation

- **Met State and Federal drinking water requirements**
- **< 0.03 NTU turbidity 95% of the time**
- **Stable UF system operations with low to moderate cleaning frequency**
- **Washwater system met the objectives of the California *Cryptosporidium* Action Plan**

Filtered water turbidity is consistently below the required levels

Avenue WTP Alternative Technology Engineering Report
Figure 1A - Combined Filter Water Turbidity



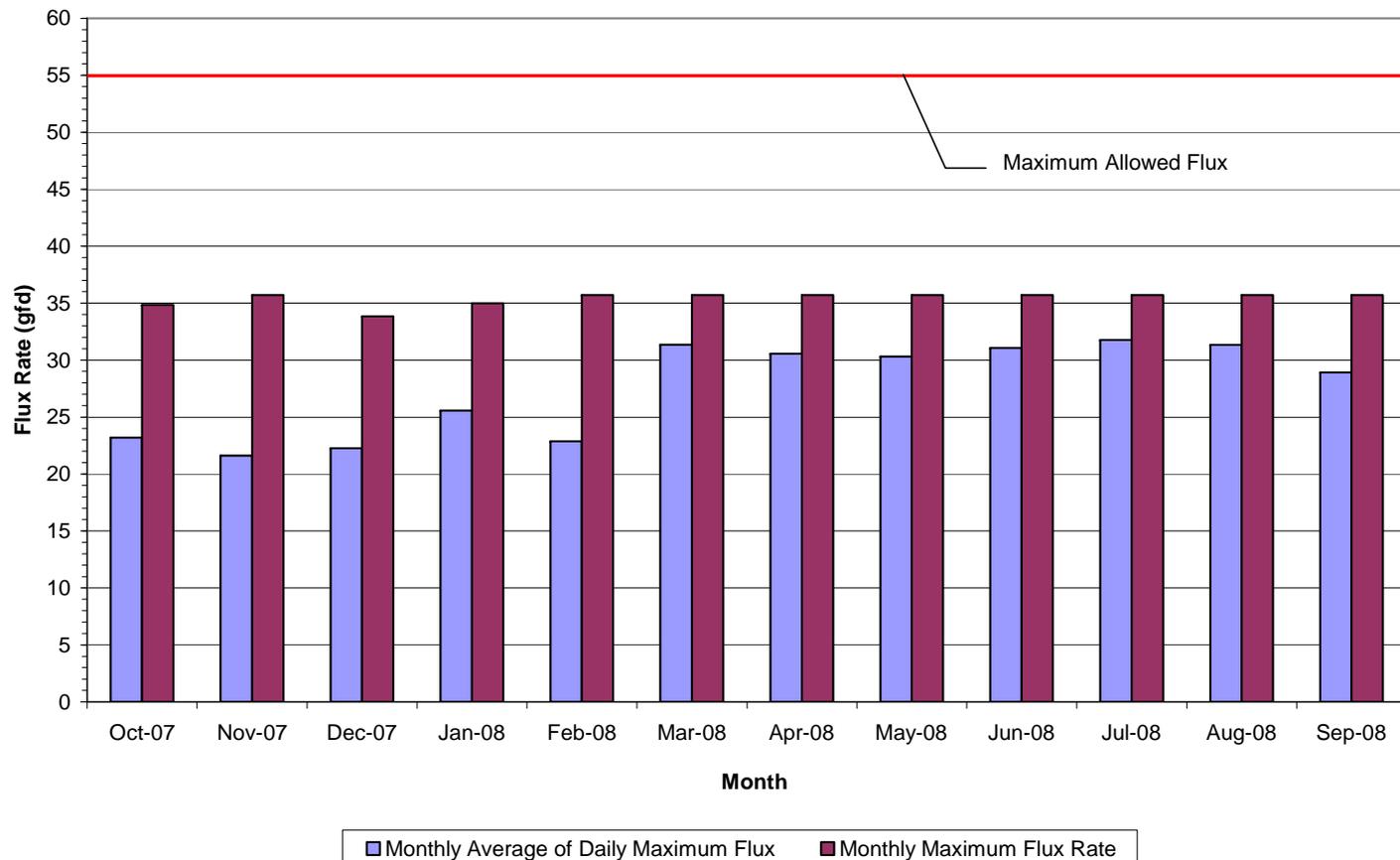


UF Membrane Filter Operational Parameters

- **Design flux rate - 29 gfd (40 gfd max. permitted)**
- **Max TMP - 12 psi**
- **Recovery - 95%**
- **Air and water backpulse - every 45 min**
- **Chemical Enhanced Backwash (CEB) - daily**
- **Enhanced Flux Maintenance Clean (EFCM) - weekly**
- **Recovery Clean (RC) - quarterly**

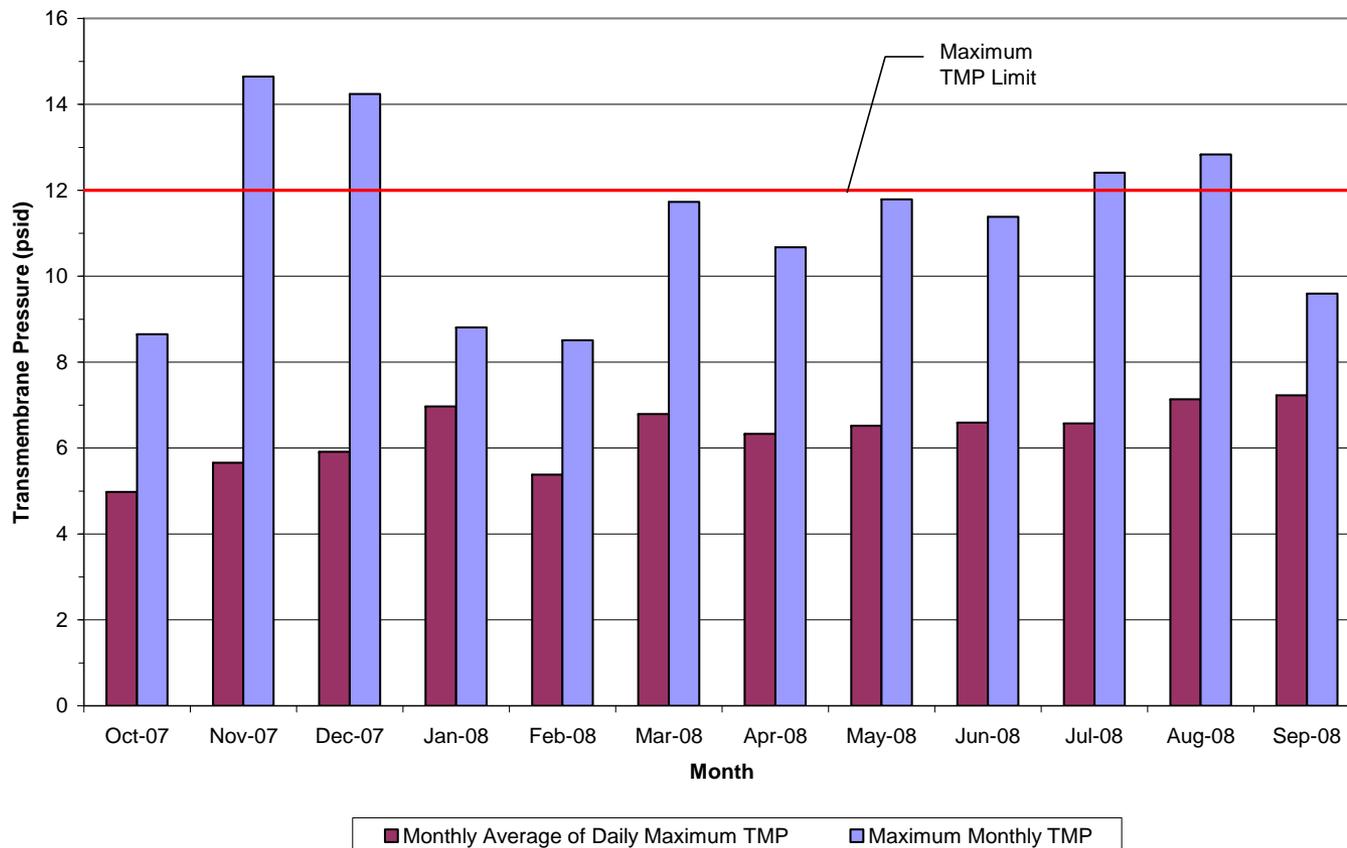
Average UF Flux rate of 25 to 30 gfd

Avenue WTP Alternative Technology Engineering Report
Figure 2 - Membrane Flux Rate



Average TMP range from 5 to 7 psi

Avenue WTP Alternative Technology Engineering Report
Figure 3 - Transmembrane Pressure Data



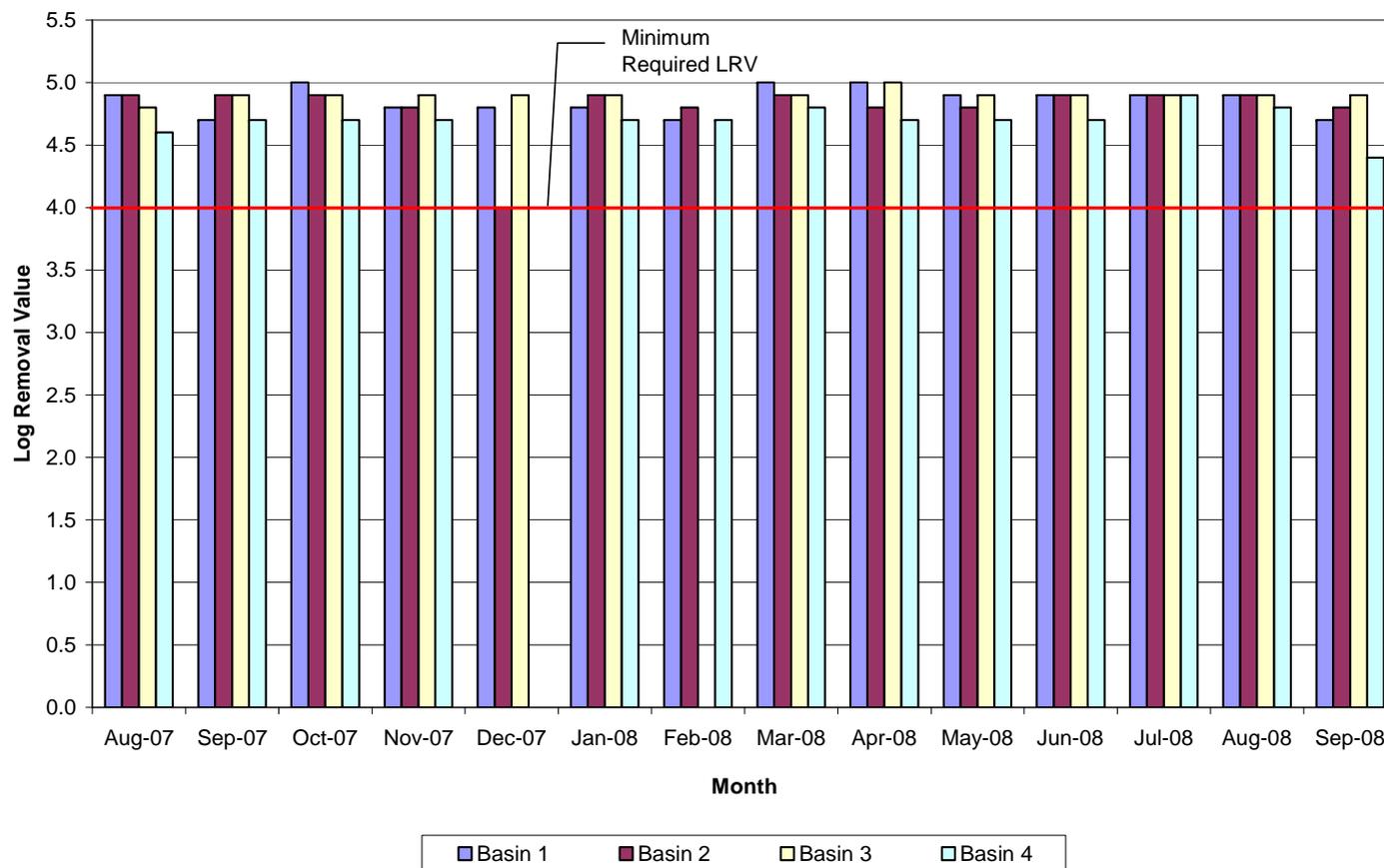
Avenue WTP provides double the required pathogen removal/inactivation

Pathogen	SWTR/DPH Required Removal/Inactivation	Zenon UF Removal Credits	Power Reservoir Free Chlorine Inact. ⁽¹⁾	Total WTP Removal/Inactivation
Giardia	3-log	4-log	2-log	6-log
Crypto.	2-log	4-log	N/A	4-log
Virus	4-log	3.5-log	>6-log	>9-log

(1) Based on 0.5 mg/l chlorine residual, 15°C, pH 8 and 1.7 hrs of contact time at low level (206ft) and max flow (15 MGD). Power Reservoir is assumed to have a T10 to hydraulic detention time ratio of 0.1 to 1.

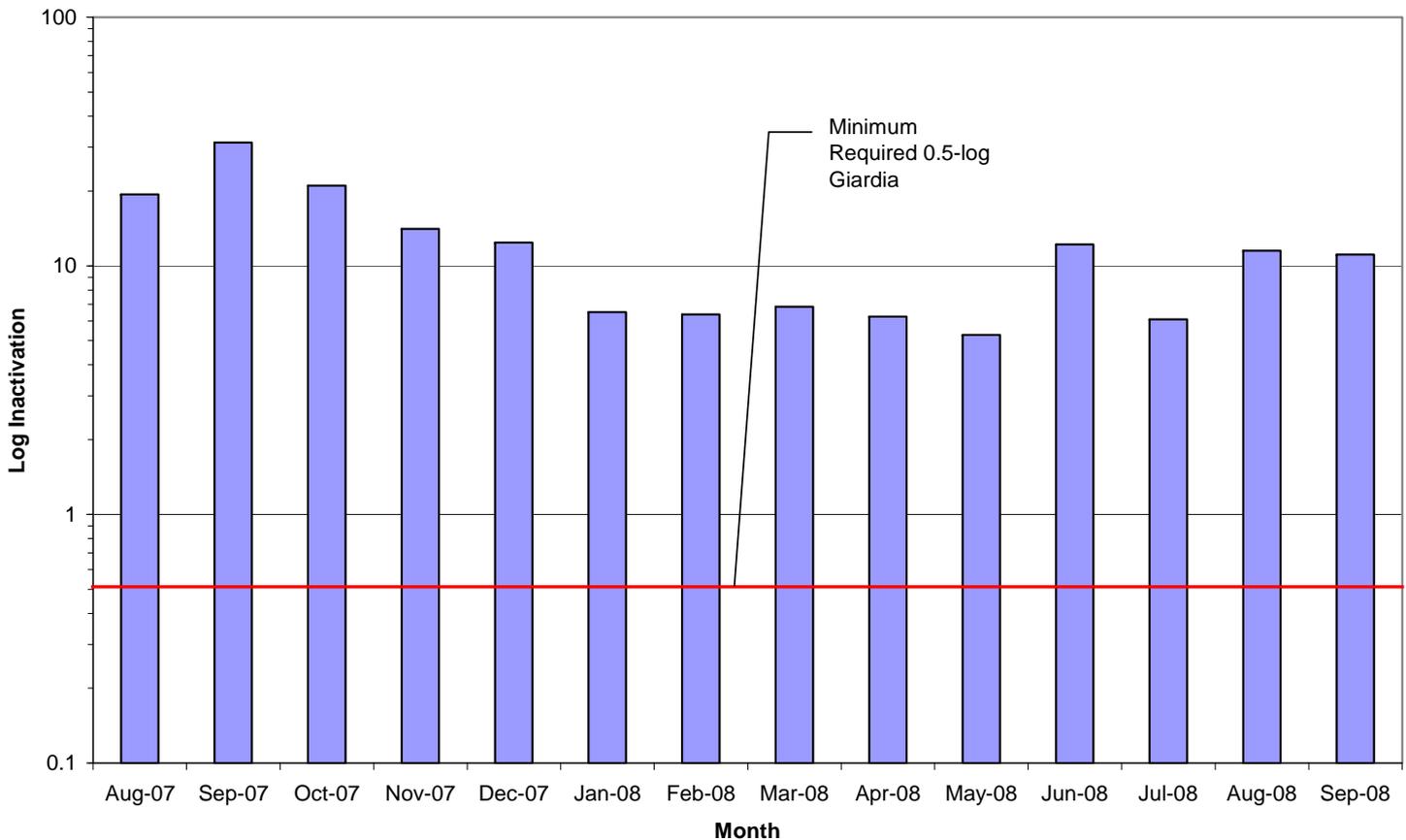
UF minimum log removal values (LRV) calculated from membrane integrity test

Avenue WTP Alternative Technology Engineering Report
Figure 4 - Monthly Minimum Log Removal Value



Required inactivation is achieved through free chlorine contact time

Avenue WTP Alternative Technology Engineering Report
Figure 5 - Monthly Minimum Log *Giardia* Inactivation



Backwashwater is captured, treated and returned to raw water reservoir

- **Coagulant addition condition particles**
- **3 Settling basins**
- **Return flow limited to 10% of plant flow**
- **Chlorine injection**



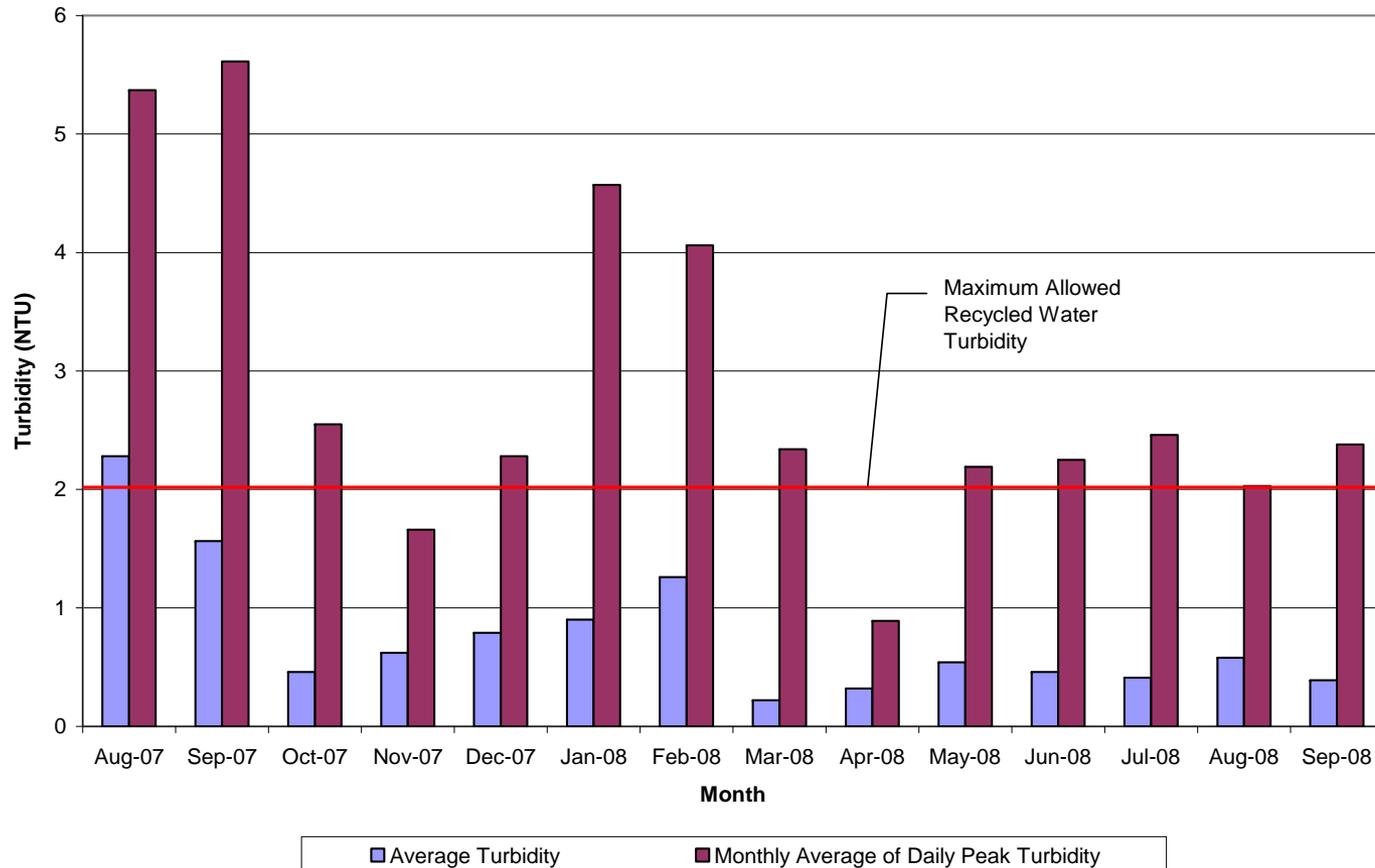
Return water pressure filters provide treatment to reduce turbidity to < 2 NTU



- **2 pressure filters operate in parallel to meet CAP**
- **Automatic backwash sequentially**
- **Filtered return water is send to the head of Kingston Reservoir**

Operators are optimizing the WWR System to meet return water turbidity goals

Avenue WTP Alternative Technology Engineering Report
Figure 6 - Recycled Water Turbidity





Lessons learned from startup and operations at the Avenue WTP

- **Training, training, training!**
- **Use softened water for UF cleanings**
- **Provide additional CIP makeup water storage capacity**
- **Security and computer equipment can change from specification to construction. Specify fixed \$ amount for Contractor to bid.**



Lessons learned from startup and operations at the Avenue WTP

- **All changes to SCADA must go through the Agency's programmer. Copy of program is then sent to UF supplier. No dial-in changes!**
- **Plant optimization takes time. Keep making adjustments and training operators.**
- **Communicate and celebrate your successes with the whole team!**

Questions?

