

Filter Asset Management

EXTENDING THE LIFE CYCLE
OF YOUR FILTER PLANT

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Agenda

- **Introduction**
- **US Markets**
- **Why Asset Management**
- **Components of a filter Asset Management program**
- **Benefits**
- **Questions**

US Water Market

- **US Domestic Water supply is 73% surface water**
- **11,976 systems surface water, serving 210.7 million**



Regulations 101

- **The list is numerous and growing...**
 - Primary and Secondary Drinking Water Standards
 - Turbidity
 - Inorganics (Arsenic, Iron, Nitrate, etc.)
 - Organics (Coliform, Cryptosporidium, Dioxin, etc.)
 - Exotic and emerging contaminants
 - IE<2SWTR
 - Lower turbidity standards
 - Remove microbial contamination
 - Stricter monitoring and reporting
 - Stage 2 DBPR
 - And more

Fouling & System Problems

FOULING DEPOSITS

Organic or Inorganic

Bed Expansion, Channeling, Low Run Time, Poor WQ, etc.

SYSTEM PROBLEMS

Temporary or Permanent

Turbidity $< .3$, Craters, Mounds, Blowouts, Headloss, MCL Exceedances, etc.

Industry

- **Filter Maintenance Industry**
 - Can be fragmented (engineers, contractors, suppliers, etc.)
 - Look for a partner experienced in bridging those gaps
 - Linked to increasing regulatory requirements
 - Long-term service & cost management solutions are needed

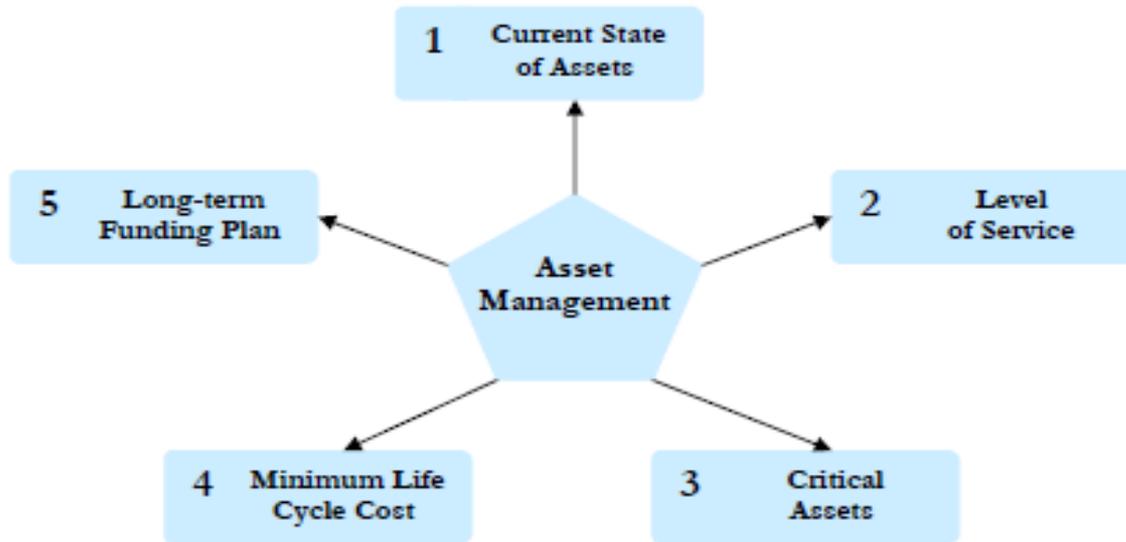
Filter Asset Management

Why Filter Asset Management

- **Most Filters are run to failure**
- **Filters are last barrier for particulate and microbial contamination**
- **Few plants have a filter asset management plan**
 - ~ less than 5%
- **A fraction of those plans are followed**

5 Pillars of Asset Management

Flow Chart: The Five Core Questions of Asset Management Framework



This flow chart shows the relationships and dependencies between each core framework question.

Filter Maintenance Program (MP)

- **Initial Condition Assessment of your granular filtration system**
- **Initial filter rehabilitation**
- **Maintenance work over the chosen MP period**
 - Engineering as needed for predicted work (e.g. clean or replace)
- **Annual Condition Assessments throughout MP**
- **Asset Management tool spreads and predicts cost**



Components for developing a Filter Asset Management Plan

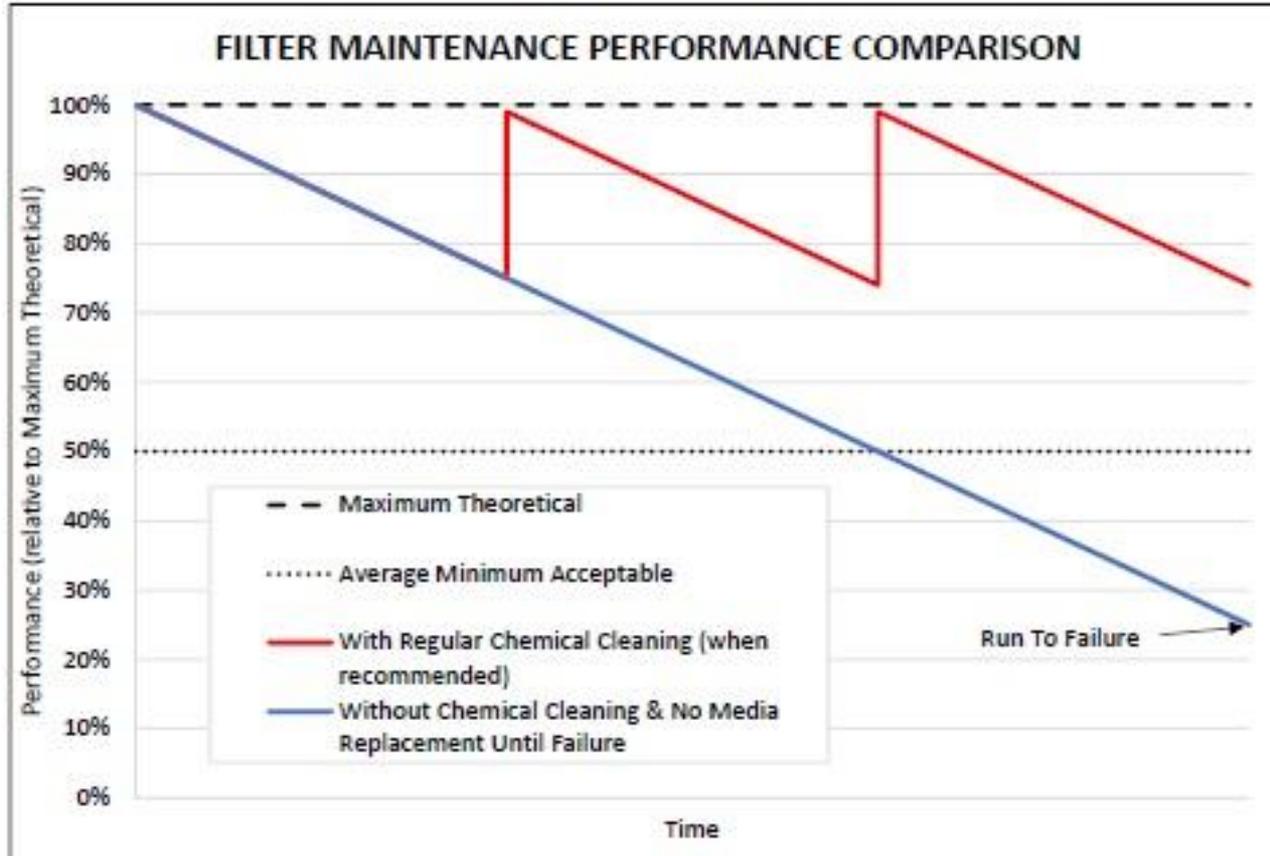
- Condition assessment
- Media sampling and analysis
- Estimating the cost of renovations
- Estimating the life expectancy
- Developing a financial plan

Example Filter MP

Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Initial CA & CIP	Annual CA & CIP	Annual CA & CIP	Annual CA & CIP	Annual CA & CIP	Annual CA & CIP	Annual CA & CIP	Annual CA & CIP	Annual CA & CIP	Annual CA & CIP
Develop & Sign MP Proposal	Evaluate, Confirm Planned Work								
Chemical Cleaning			Chemical Cleaning			Chemical Cleaning			Media Replacement
									UD Repair, Vessel Rehab

- **CA = Condition Assessment**
- **CIP = Capital Improvement Planning**
- **UD = Underdrain**

Avoid “Run to Failure”



Condition Assessment

Basics of Plant Condition Assessment

FILTER PERFORMANCE INDICATORS SUMMARY		
Parameter	Characteristics	Metrics
Filter Run Times	Monomedia	24 hrs. to 72 hrs.
	Dual Media or Multimedia	72 hrs. to 140 hrs.
Filtration Rate	Optimized	1.4 gpm/sf to 4 gpm/sf
	Surface filtration	<1.4 gpm/sf
Filter Effluent Turbidity	Regulation	<0.3 NTU 95% samples
	Best practice	≤0.1 NTU
	Optimized operations	0.03 NTU to 0.05 NTU

Plant Condition Assessment

- **Physical Observations about filters**
 - Media surface (mounds, cracks, craters, low and high spots)
 - Mud ball diameter and appearance
 - Mud present on top of filters



Plant Condition Assessment

- **Observe backwash for even flow and boils**
 - Check if the troughs are level with even flow
 - Check surface sweep for smooth rotation
 - Check backwash flow rates



Plant Condition Assessment

- **Observe the overall conditions of structures**
 - Paint, electrical, lighting, HVAC, flooring, I&C, concrete, windows, doors
 - Clean filters do not help if the ceiling is falling in



Filter Ceilings in “Bad” Shape



Example of Concrete Wall Corrosion in Need of Repair



Filter Maintenance

Media Analysis

- Strategic media sampling
- Detailed scientific lab analysis & evaluation
 - Detect mudballs, odors, colors
 - Multiple advanced organic & inorganic tests
 - Biomass via ATP & HPC, particulates, metals & mineral deposits
 - Confirm & quantify issues such as Calcium Carbonate (CaCO₃), Sulfur Reducing Bacteria (SRBs), Giardia, etc.
 - Bench-scale chemical cleaning with variety of products
 - Microscopic high-resolution pictures to document physical condition
 - Sieve analysis to measure size & conformity of each unique media for comparison to your design specifications
 - Lab Report with Customized Recommendations
 - No “over cleaning” or premature replacement
 - Presented and discussed with your staff

Filter Media Sampling Kit

- **Materials needed:**
 - 5 foot long 1 or 1-1/2 inch PVC pipe
 - 2 - 2x2 sheets of ½ inch plywood
 - Box of 1 gallon zip lock bags
 - Sharpe marker
 - Ladder
 - Rope to tie off ladder (safety)



How and where to sample

- **Backwash the filters and drain water but not completely**
- **Enter filter with a ladder (confined space protocol)**
- **Take representative samples**
 - Layout a grid and take samples 10 x10 area
 - Composite samples of anthracite, mix and bag
 - Composite samples of sand, mix and bag
- **Measure depth of media at each sample location**
- **Write date, name, filter info. on bags**

Example Lab Analysis Results



Chemical Analysis of Material Removed:

ANALYSIS	PERCENT BY WEIGHT	
	Sand	Anthracite
Carbonate compounds	35.1	42.1
Iron oxide	0.2	0.3
Phosphate compounds	< 0.1	< 0.1
Silica	< 0.1	< 0.1
Manganese dioxide	< 0.1	< 0.1
Sulfate	< 0.1	< 0.1
Aluminum hydroxide	< 0.1	< 0.1
Insoluble particulate matter	1.6	1.1
Moisture content	34.1	34.5
Organic biomass	29.0	22.0
Total	100%	100%

Biological Analysis:

	Sand	Anthracite
Plate Count (colonies/ml)	3	1
Fe / Mn Oxidizing Bacteria	Negative	Negative
Sulfate Reducing Bacteria	Negative	Negative
Anaerobic Growth	<10%	<10%
Pre Cleaning ATP (cells per ml)	185,000	148,000

Media Cleaning and Replacement

Filter Maintenance

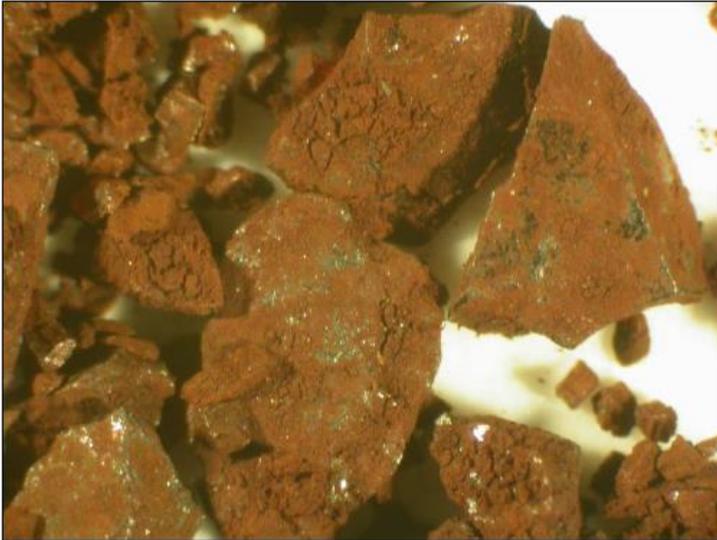
Chemical Cleaning

- Custom-blend for each filter sampled
- Only NSF-approved products
- Specialized Safety Training
 - Confined Space Entry qualified
 - OSHA 30-Hour Training minimum
- Chemical injection & agitation followed by backwashing (multiple applications if needed)
- BW monitoring (pH & turbidity)
- BW neutralization before disposal if required
- Disinfect media, and entire filter system and piping
- Follow up with your staff after they put filters put back into service

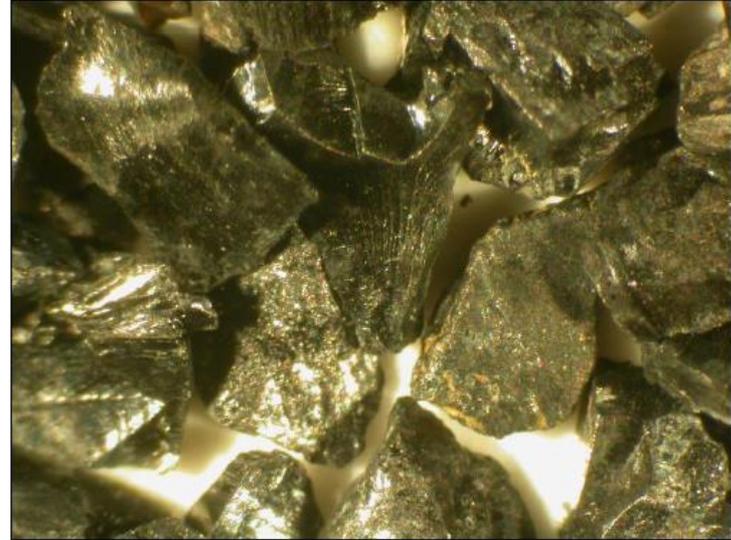


Example Cleaning Results

Before



After

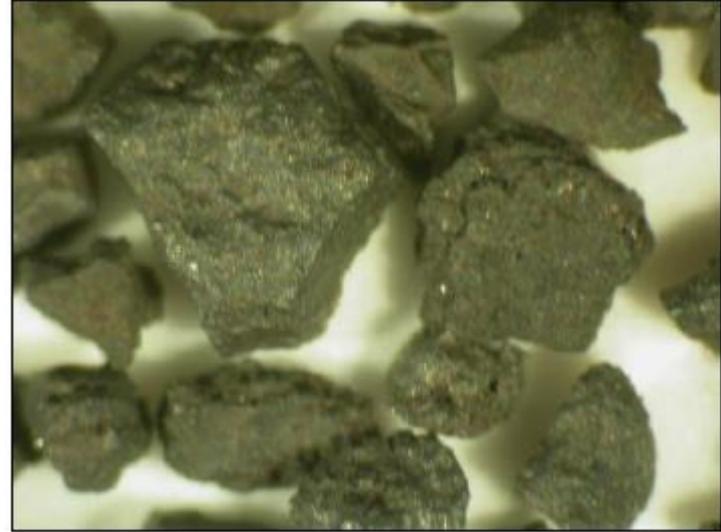


Example Cleaning Results

Before



After



Example Cleaning Results

Before



After



Example Cleaning Results

Before



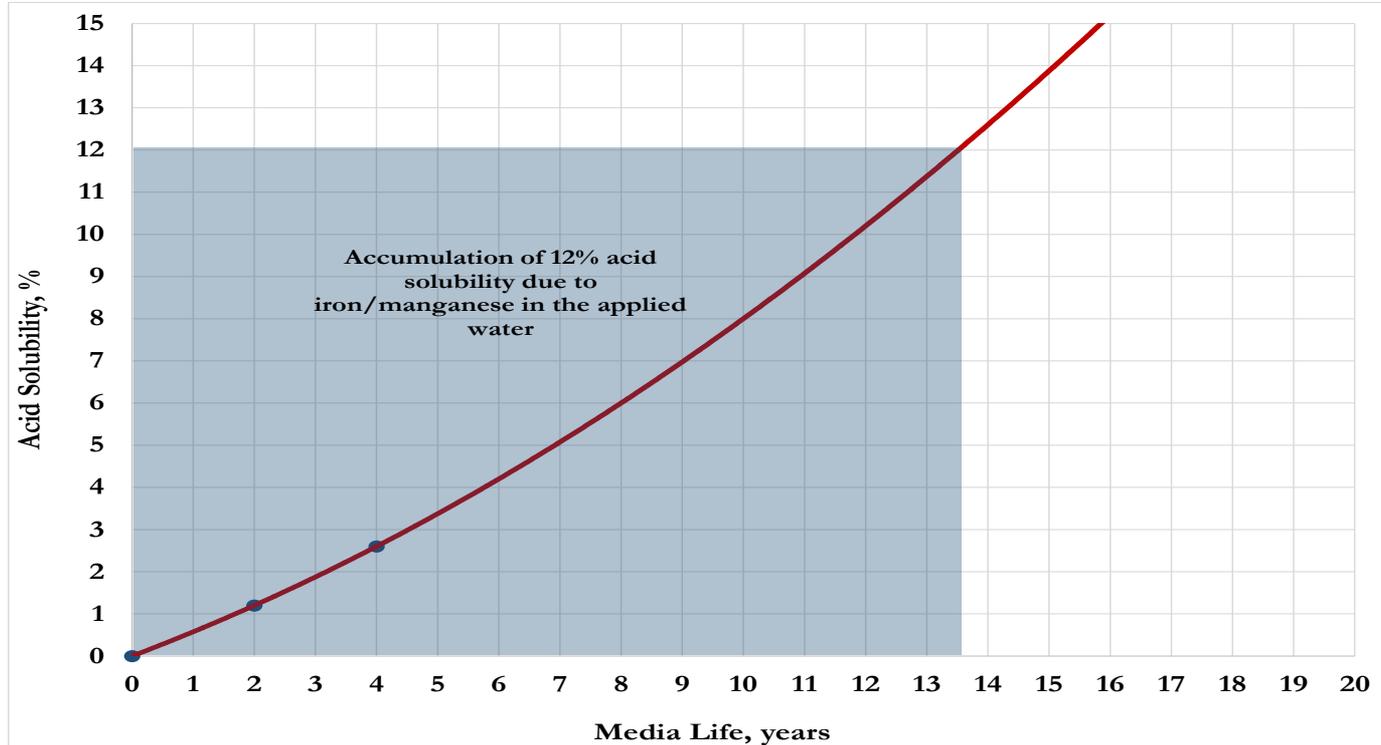
After



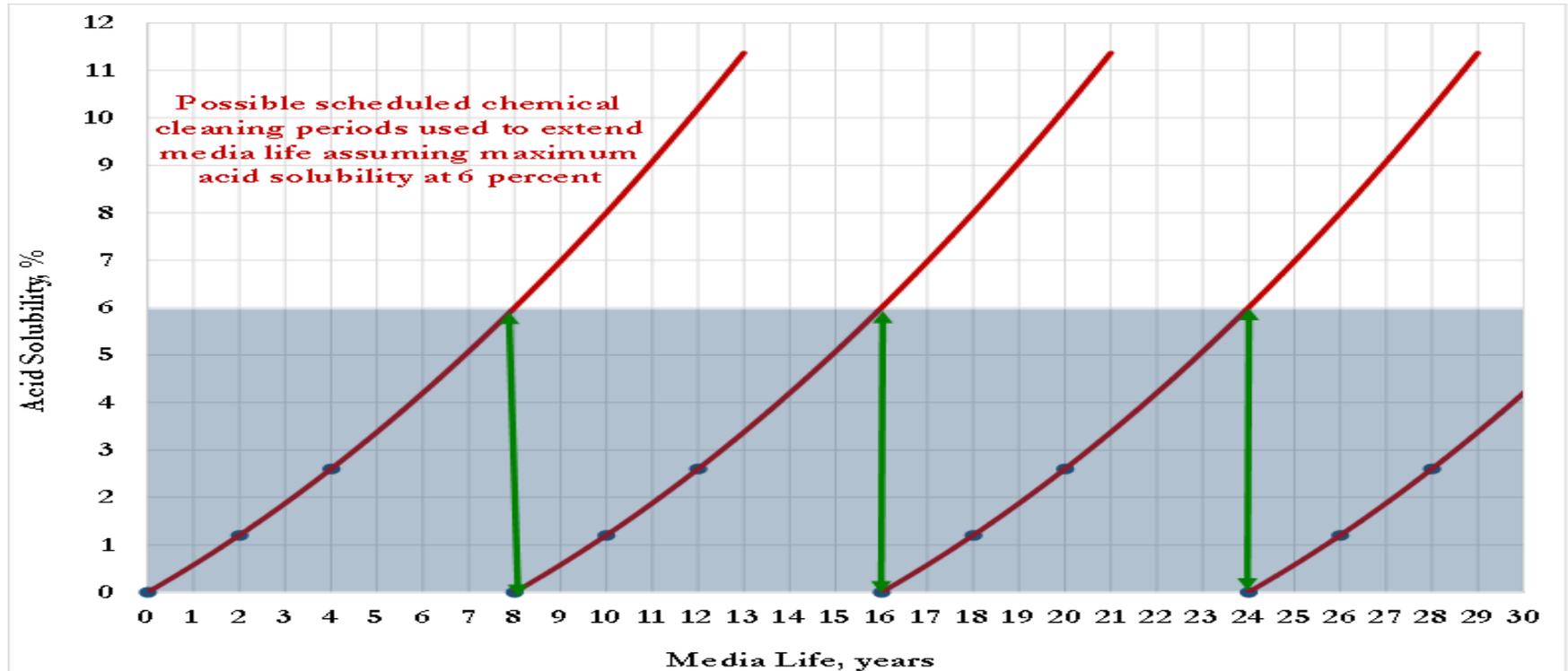
Filter Media Replacement

- **New media and materials match plant specifications**
- **Only NSF-approved products by AWWA guidelines**
- **OSHA Training**
- **Service must include**
 - Remove and dispose old media & gravel
 - Full underdrain cleaning and inspection
 - Wall inspection and repair and/or repaint surfaces
 - Underdrain repairs and replacement
 - Filter System upgrades (e.g. media, equip.)
 - Engineering & permitting as needed
 - Order & install new media & gravel
 - Bring online & assist with disinfection and Bac-T samples

Predicting Cleaning and Replacement



Extending the life of the media



Developing a Financial Plan

Hypothetical Plant Asset Management Plan																					
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Sample Media	\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000		\$ 2,000
Clean Media						\$ 30,000						\$ 30,000					\$ 30,000				
Replace Media	\$ 250,000																				\$ 250,000
Replace Surface Wash	\$ 100,000																				\$ 10,000
Rehab surface wash							\$ 10,000							\$ 10,000							
Epoxy Coat Filters Box	\$ 300,000																				\$ 300,000
Rehab Underdrains	\$ 60,000																				
Replace Underdrains																					\$ 400,000
	\$ 712,000	\$ -	\$ 2,000	\$ -	\$ 2,000	\$ 30,000	\$ 12,000	\$ -	\$ 2,000	\$ -	\$ 2,000	\$ 30,000	\$ 2,000	\$ 10,000	\$ 2,000	\$ -	\$ 32,000	\$ -	\$ 2,000	\$ -	\$ 962,000

Example

Media Removal



AFTER...



Power Wash Pre-Blast/Coat



Epoxy/Paint Finish



Pipe Gallery Actuator Upgrades



Steam Heater Replacement



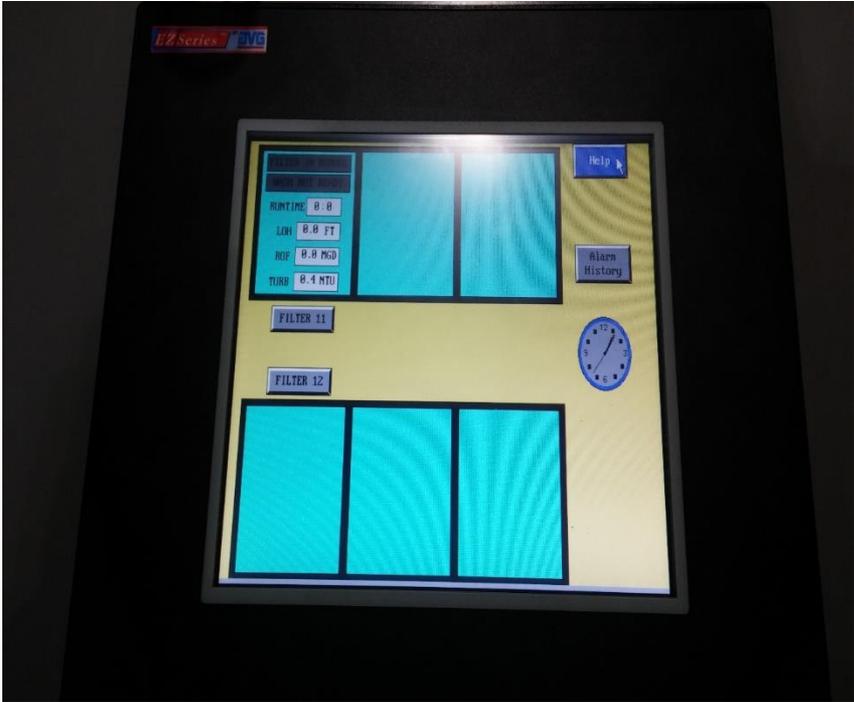
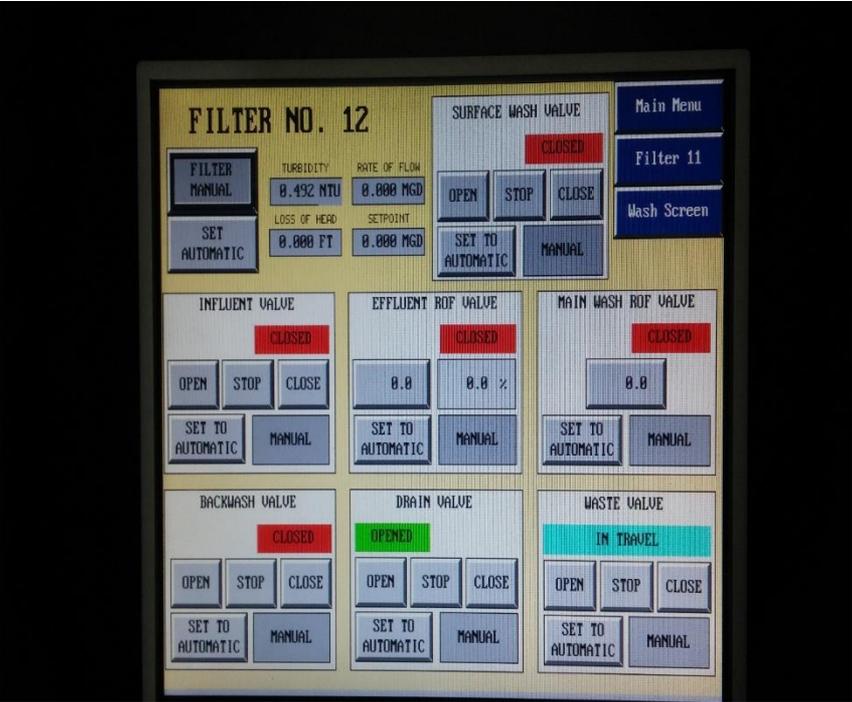
Painting and Lighting Upgrades



Old Controls Replaced



Automation Even...



Filter Maintenance Program – Benefits

- **Restores and Improve Filter Performance**
- **Extend Filter Asset Life**
- **Responsible Asset Management through Condition Assessments**
- **Build future cost model for financial needs**
- **Control O&M Costs**
- **Provides predictable fiscal budgeting**

Chilling Questions?

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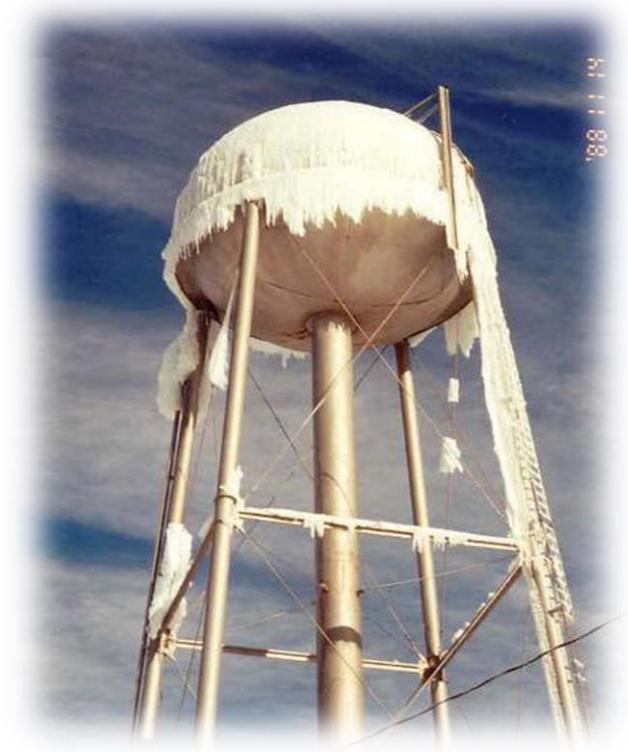
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Filter Maintenance

Products & services involve filtered water for either potable, industrial, or wastewater sectors

- Goal of restoring your granular filter system to either at or near original design specifications
- Specific services:
 - Filter Media Sampling & Detailed Laboratory Analysis
 - Filter System Condition Assessment
 - Filter Rehabilitation through Chemical Cleaning, Media Replacement, Underdrain Repair, System Upgrades, Repainting, and/or Concrete Repair
 - Maintenance Program