

A FILTER LESS GRAVELED

**City Of Bellingham
Filter Plant Upgrade**

**AWWA PNW Section Conference
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**Bill Evans
Chief Operator Water Treatment
City of Bellingham**

Bellingham's Water Treatment Plant

- *Built In 1968*
- *In-line Filtration Plant*
- *Six Dual Media Filters,
3360 Total Sq/Ft*
- *Avg. Daily Flow, 11 mgd*



Plant Media Configuration 1968

Depth	Media
16.5 inches	Anthracite
9.0 inches	Silica Sand
4.5 inches	Garnet
9.0 inches	Gravel

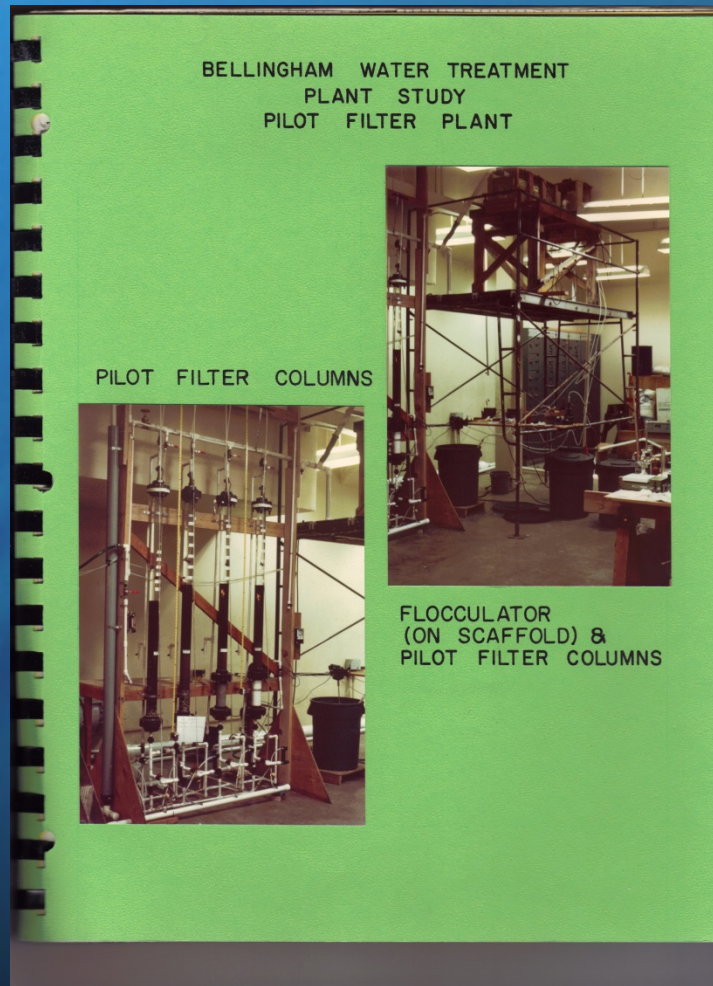
1979

Plant Evaluation & Pilot Study

PLANT UFRV's	
Winter	Summer
4700 gal/sq.ft.	3400 gal/sq.ft.

- Plant been in operation for about 10 years.
- Hired Consultant to evaluate plant:
 - Chemical dosing, mixing, pilot different polymers.
 - Look at Plant & Filter operations
 - Plant improvements

1979 Evaluation Recommendations



- ◆ Increase BW flow rate to improve bed expansion from 15% to 30%
- ◆ Increase B/W trough height & Disposal system
- ◆ Move chemical injection points further upstream of plant filters and provide static mixing.
- ◆ Change out filter media with media configuration that was tested on pilot filters rather than add new filters.

1981 MEDIA REPLACEMENT PROJECT



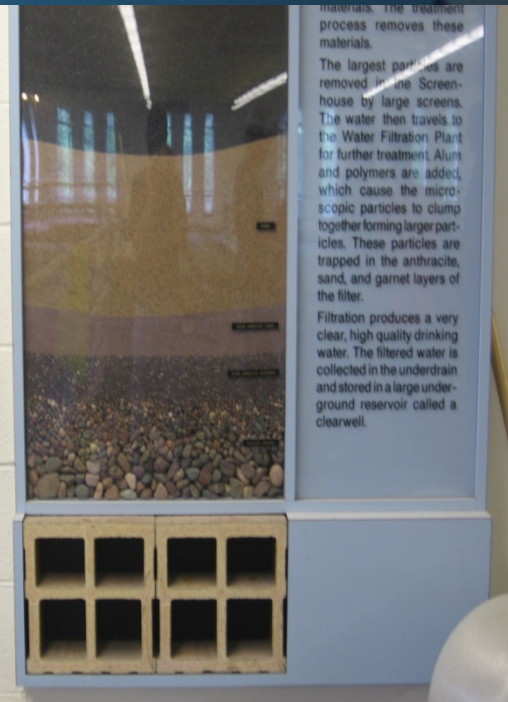
New Media Configuration

**Table 3.7-1
Filter Media (Top to Bottom)**

Pilot Filter Media	Filter No.		
	1,2,3,4	5	6
Media			
Anthracite Coal (1.5 SG) 22"	1.10 ⁽¹⁾	1.15 ⁽¹⁾	1.25 ⁽¹⁾
Sand (2.6 SG) 11"	0.525	0.525	0.525
Garnet (4.0 SG) 3"	0.35	0.35	0.35
Support Gravel			
High Density (4.0 SG) 3"	0.0555-0.1875 ⁽²⁾	0.0555-0.1875 ⁽²⁾	0.0555-0.1875 ⁽²⁾
Fine Gravel (2.6 SG) 3"	0.1875-0.375	0.1875-0.375	0.1875-0.375
Medium Gravel (2.6 SG) 3"	0.375-0.75	0.375-0.75	0.375-0.75
Coarse Gravel (2.6 SG) 3"	0.75-1.5	0.75-1.5	0.75-1.5

⁽¹⁾ Approximate effective size in mm

⁽²⁾ Approximate range in inches

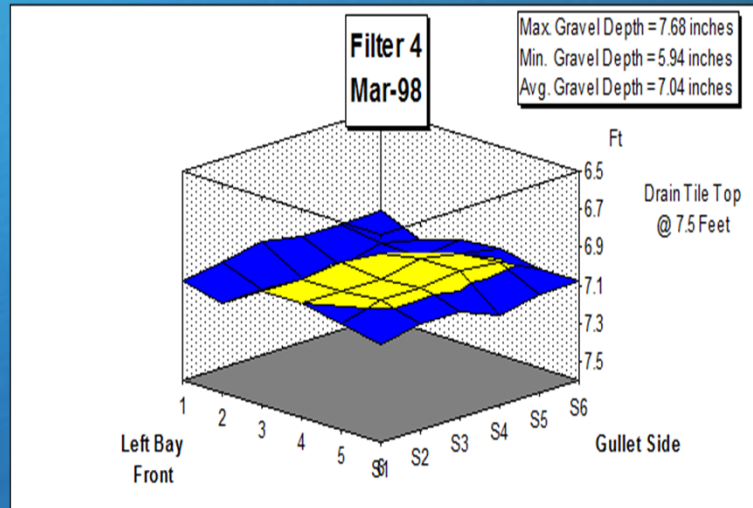


1998 Plant Operational Issues & Procedures

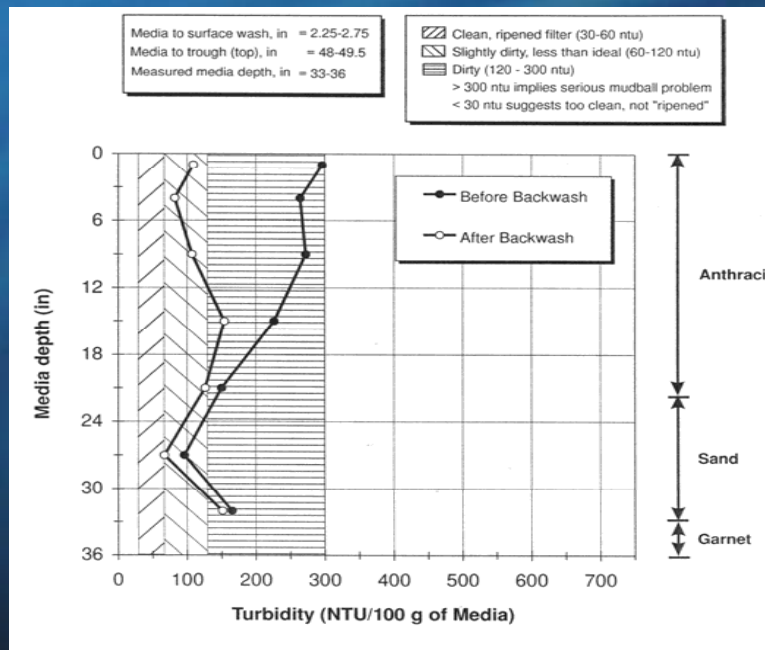
PLANT UFRV's		
	Winter	Summer
1979	4700 gal/sq.ft.	3400 gal/sq.ft.
1998	4379 gal/sq.ft.	3478 gal/sq.ft.

- ◆ Another 10 years of operation
- ◆ Hired Consultant to review plant operational issues & procedures:
 - Filtration Evaluation
 - Pretreatment Investigations
 - DBP & Taste and Odor Investigations

1998 Review Conclusions



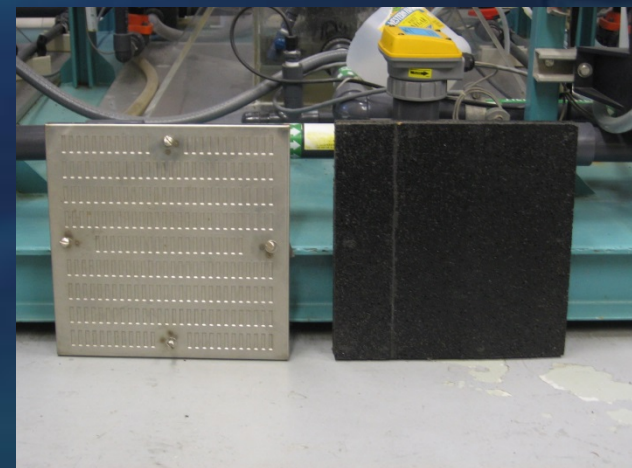
- Install flash mixer to improve coagulation process.
- Modifications to existing filter to waste piping for bumpless filter startup.
- Filters 5 & 6 not hydraulically matched to sand.
- Backwash water storage capacity limited.
- Filter Turbidity & Particle counts show outstanding performance. Recommend city test various media configurations on city pilot filter system.



2001- 2002 In-House Pilot Study

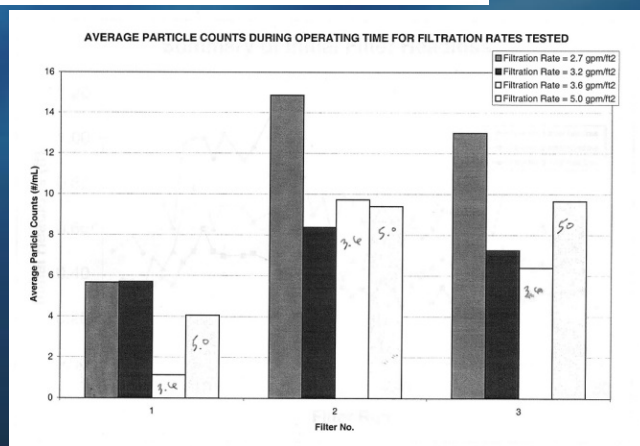
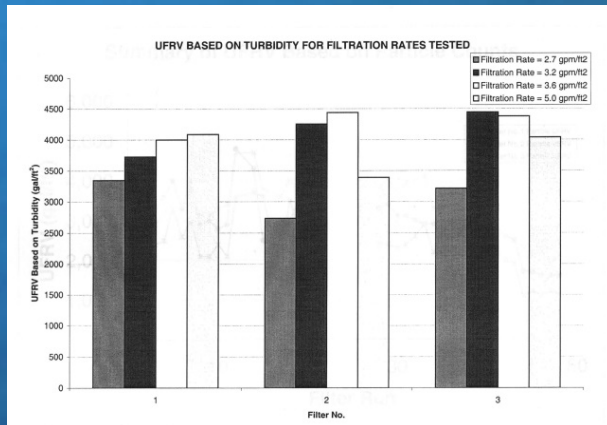
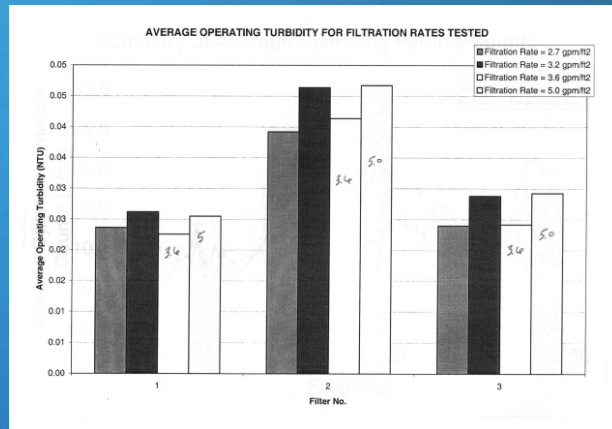
- ♦ Goal of study was to standardize media & under drain design
 - Tested graveless under drains
 - Tested 3 different media configurations

Pilot Filter	Media Configuration
1	32" Anthracite, 12" Sand
2	44" Anthracite Only
3	39" Anthracite, 5" Sand



Pilot Study Conclusions

- The plant coagulated water was supplied to the pilot filters.
- There were a total of 50 pilot filter runs completed at various flow rates.
- Based on pilot testing results the filter media in pilot column #1 proved to be the best.
- Both the IMS cap (plastic) and the AWI (stainless) under drains compared well.
- Traveled to different plants that are currently using the 2 under drain systems.



PLANT UFRV's		Gal/sq.ft.
	Winter	Summer
1979	4700	3400
1998	4379	3478
2006	3260	3377

2007 Plant Upgrade “A Filter Less Graveled”

- ◆ To improve filter performance, standardize media configuration in all the filters and replace 39 year old under drains with a graveless type
- ◆ The project was divided up into two phases
 - Phase 1 – Under drains - 2007
 - Phase 2 – Air Scour System - 2010
- ◆ One filter was removed from service and the project was under way in March.

Work Sequence

🔹 Filter offline

- Remove filter Media – City crews
- Remove under drains
- Build under drain support base
- Install under drains
- Structural integrity test – Backwashing no media
- Add sand, B/W, check level
- Add anthracite, B/W, Skim, B/W, check lvl
- Filter Disinfection, Bacteria test, next filter

Media Removal



Under Drain Removal and Discovery



Discovery #2



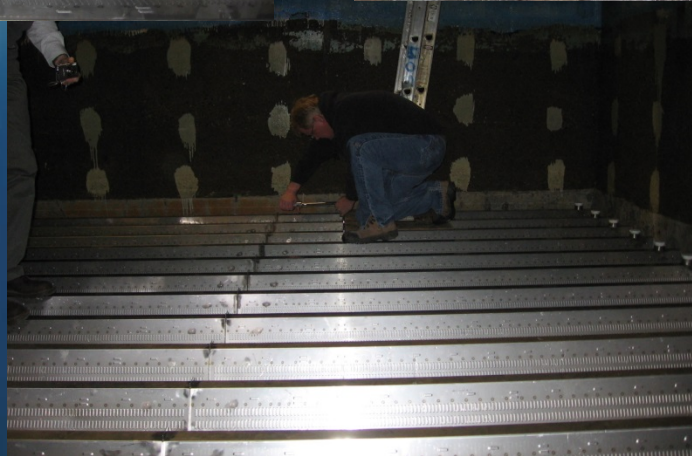
Under Drain Transport



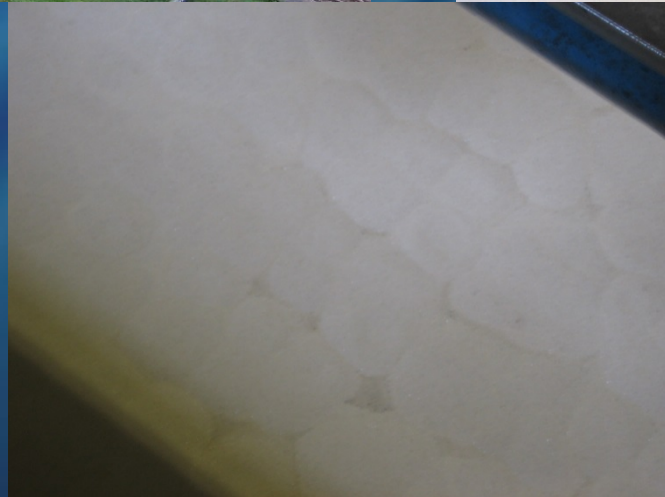
Under Drain Support Base



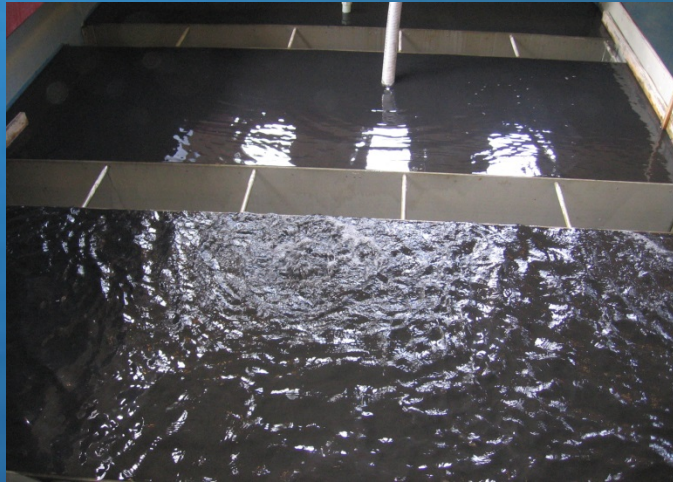
Under Drain Installation



Sand Addition



Anthracite Addition



Project Summary

- ◆ First filter work sequence took one month to complete. By the time the contractor got to the 6th filter it only took a week to complete.
- ◆ Issues with media removal, equipment problems, contractor had to wait on city crews.
- ◆ Discovered asbestos, delayed project, extra cost.
- ◆ Two filters off line at one time, impacted plant production.
- ◆ Project delays caused project completion date into high demand period.

Conclusions

PLANT UFRV's		
	Winter	Summer
1979	4700 gal/sq.ft.	3400 gal/sq.ft.
1998	4379 gal/sq.ft.	3478 gal/sq.ft.
2006	3260 gal/sq.ft.	3377 gal/sq.ft.
2013	5351 gal/sq.ft.	3774 gal/sq.ft.

2015
Future
Project



DAF

Questions?

