DBP Reduction in a Small Filtered Surface Water System

City of Raymond, Washington
Disinfection Byproducts Study

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City of Raymond, Washington

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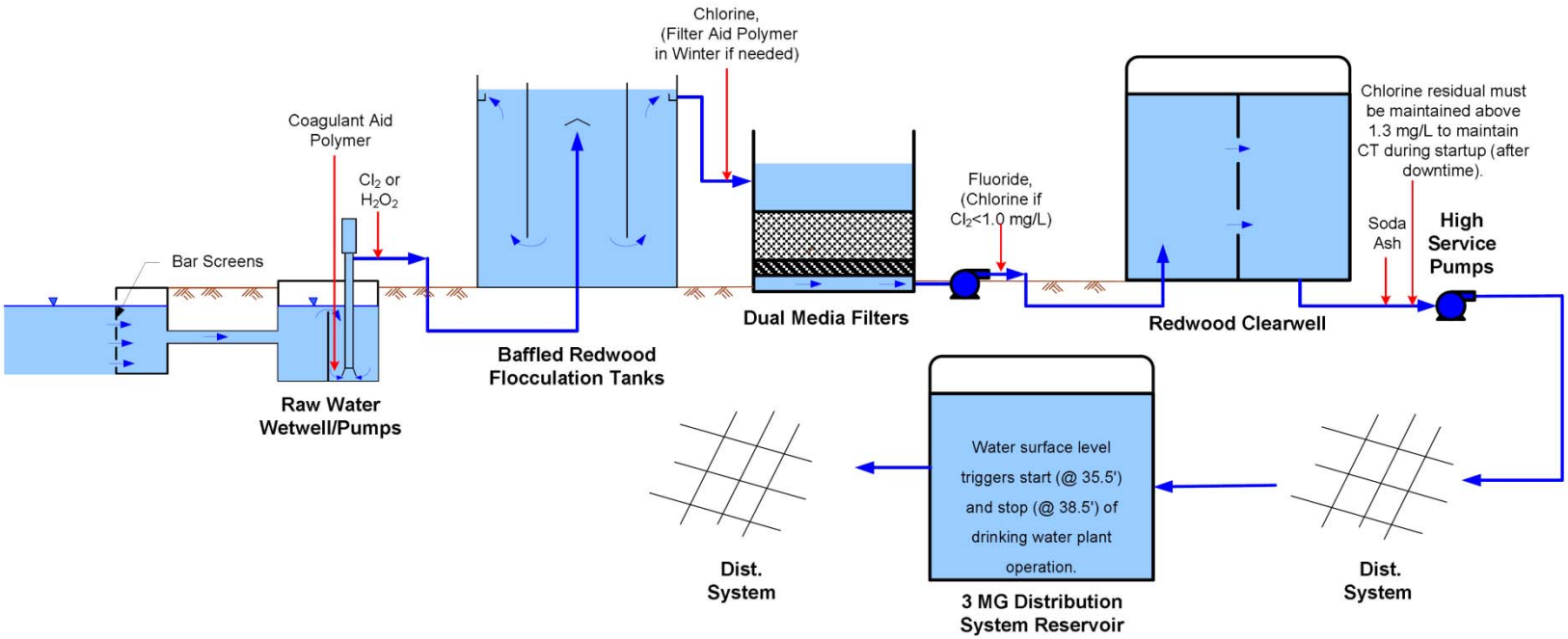
Raymond Water System

- City of Raymond Population: ~3,000
- Source is South Fork Willapa River – drains coastal mountain range
- Average Flow: 0.56 mgd (388 gpm)
- Treatment Capacity: 2.1 mgd (1,400 gpm)
- One 3 MG reservoir in distribution system

Raymond Water System



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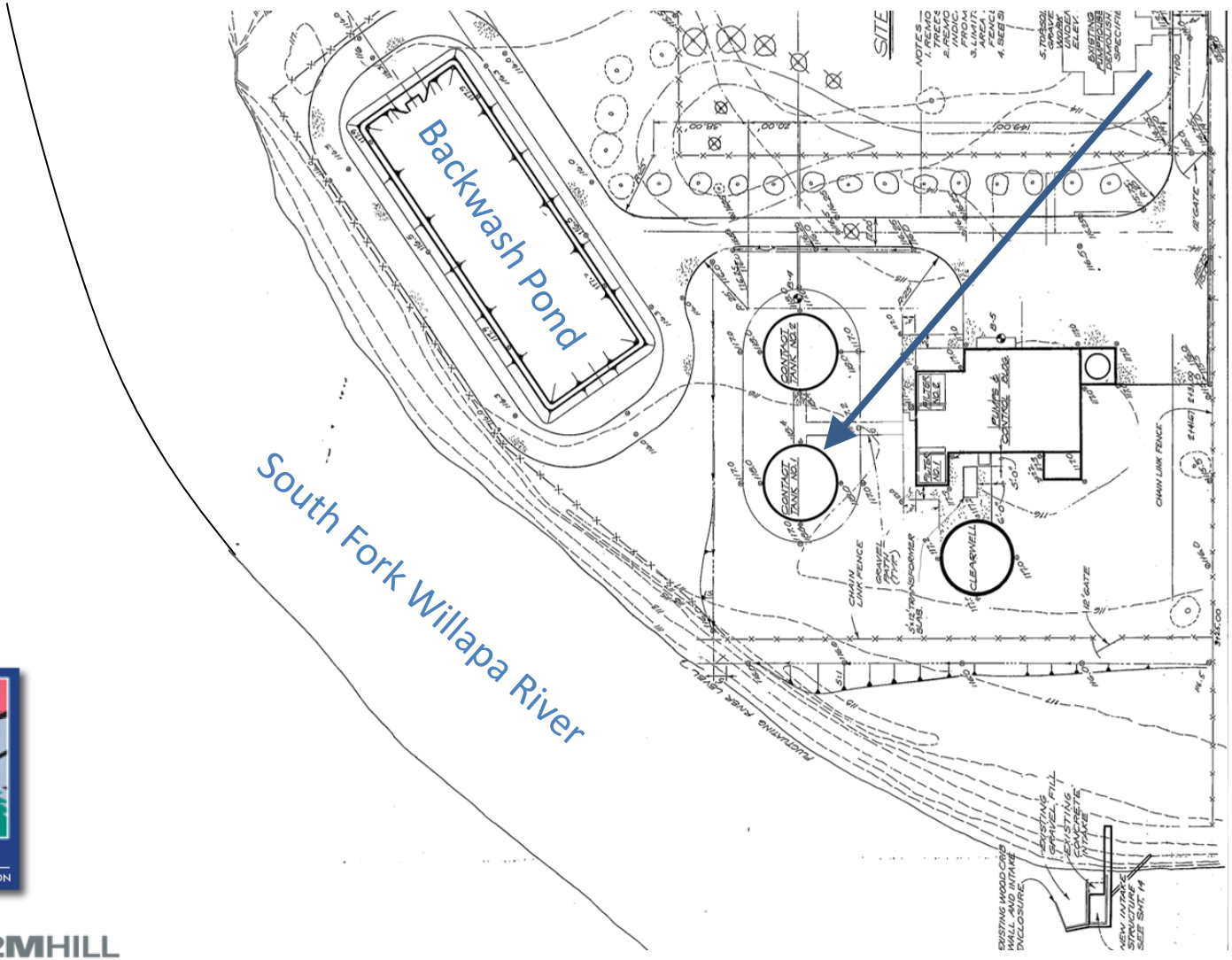
Raymond Water Treatment Plant

Raymond Water Treatment Plant



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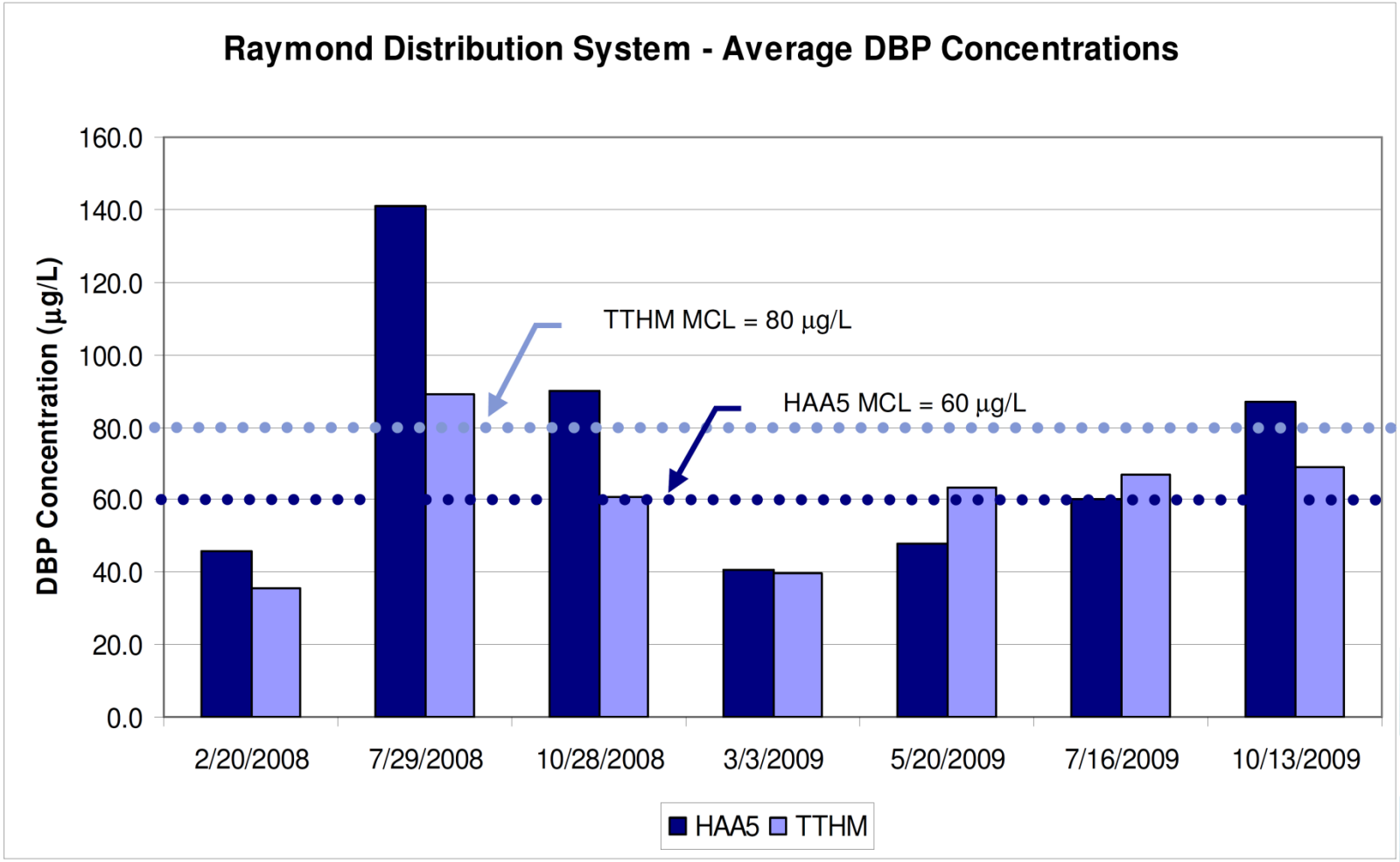
Raymond Water Treatment Plant

Disinfection Byproduct History

- City began sampling for DBPs in accordance with the Stage 1 Disinfectants and Disinfection Byproducts Rule
- Bilateral compliance agreement required submission of a project report addressing DBPs to be submitted to DOH by Feb 2010
- Started sampling for Stage 2 IDSE in 2009

Historical DBP Levels



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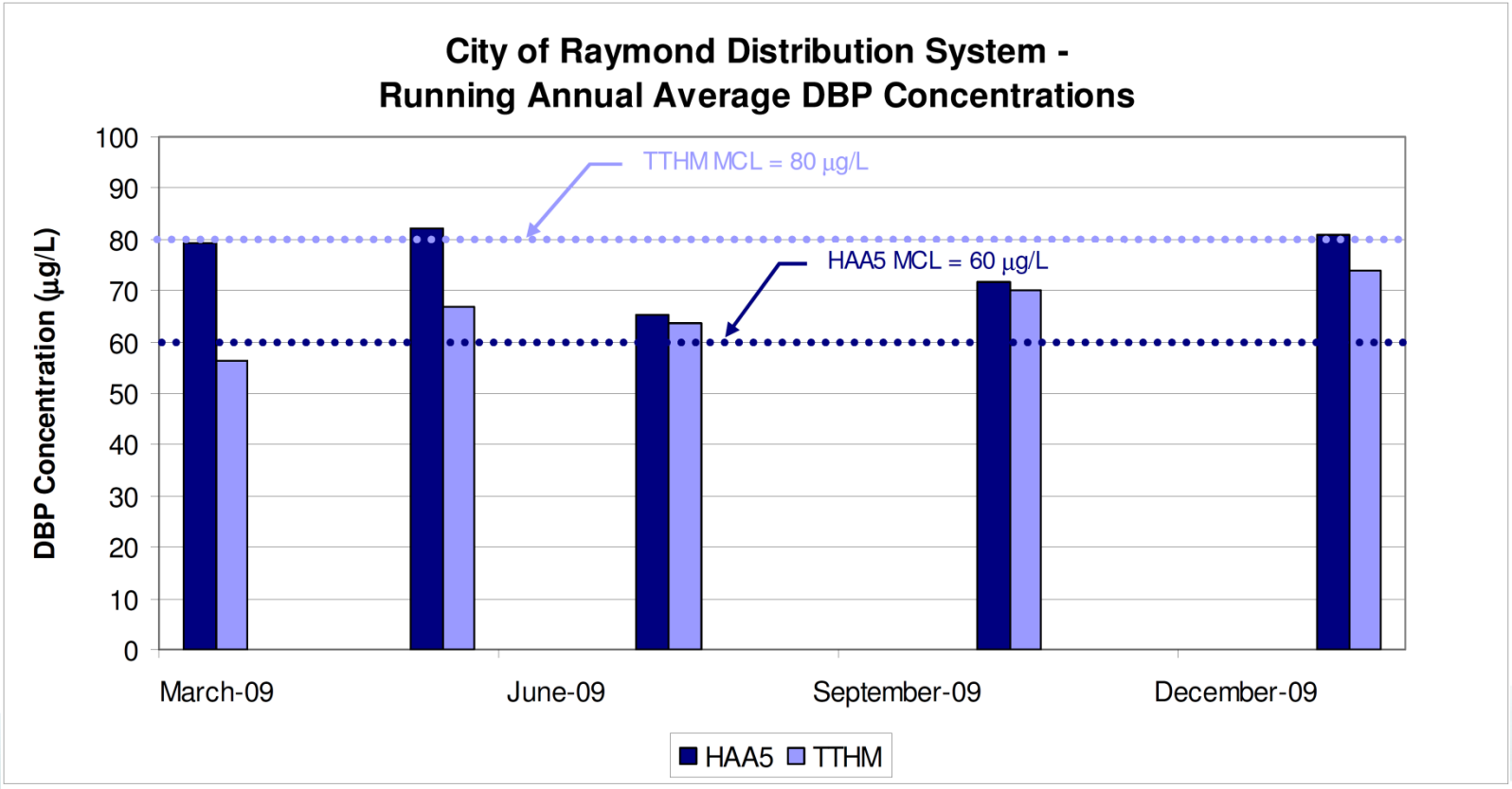
Disinfection Byproduct Compliance



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Surprising DBP Results?

Water Quality Parameter	Raymond, Washington	Ketchikan, Alaska
Average HAA5 (µg/L) MCL = 60	67.6	68.1
Average TTHM (µg/L) MCL = 80	60.9	48.1
Typical Total Organic Carbon (mg/L)	0.93	1.52
Typical Dissolved Organic Carbon (mg/L)	0.74	~1.0
Typical UV 254 (per cm)	0.046	0.040-0.070
Typical SUVA (L/mg-m)	6.2	4.0 – 7.0

Alternatives Evaluated

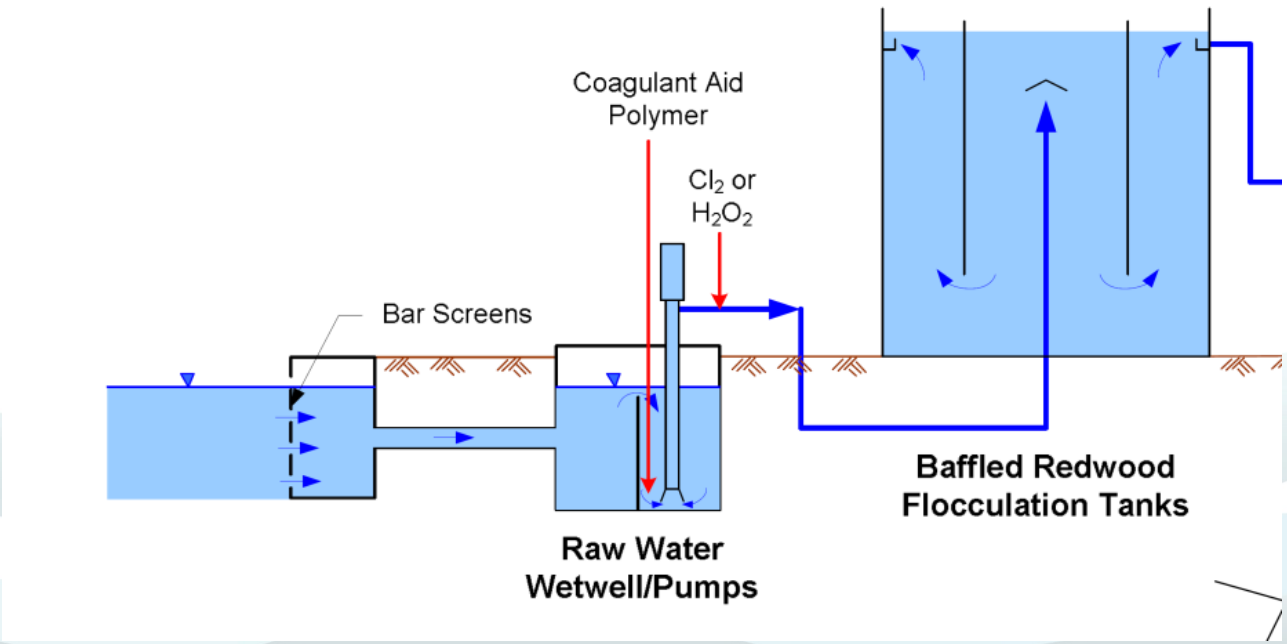
- Operational improvements
- Minor capital improvement
- Major capital improvements

Operational Improvements

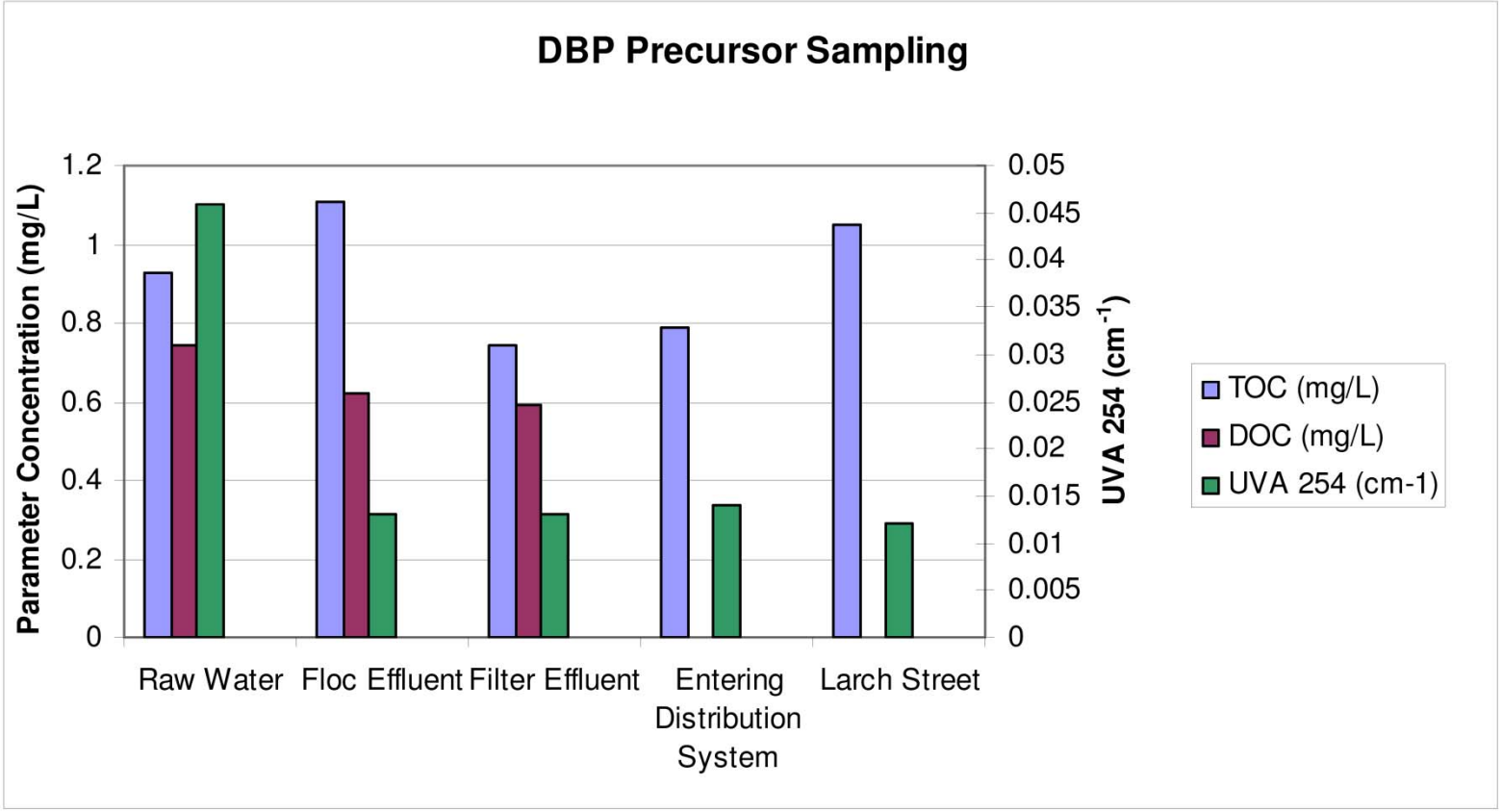
- Modified coagulation (bench-scale testing)
- Changing the point of chlorination (bench-scale testing)
- Decreased water age (bench-scale testing)

Modified Coagulation

- Original Coagulant – Alum
- Mid 1990's Coagulant change – Nalco 8150



Changing the Point of Chlorination



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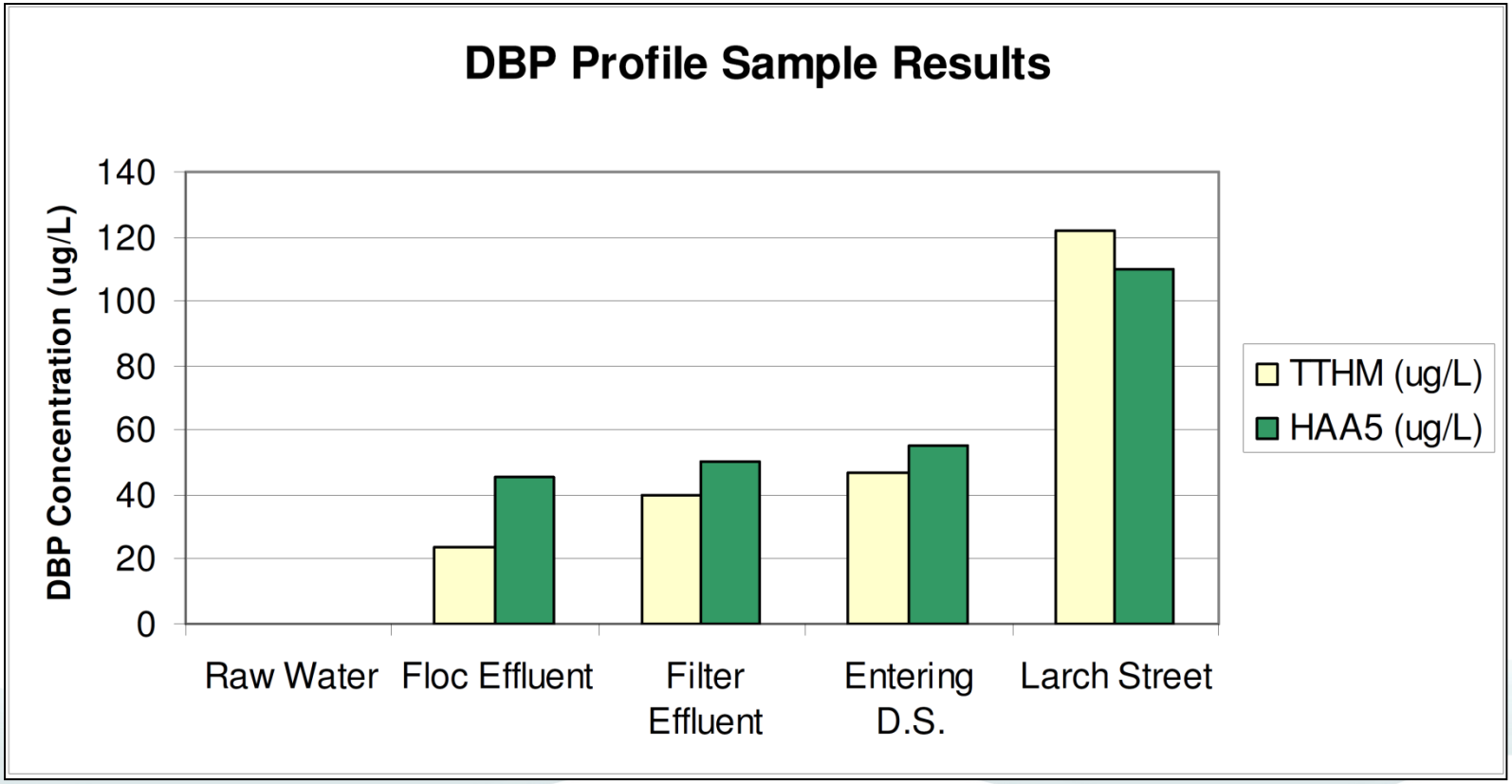
Decreased Water Age Not a Solution



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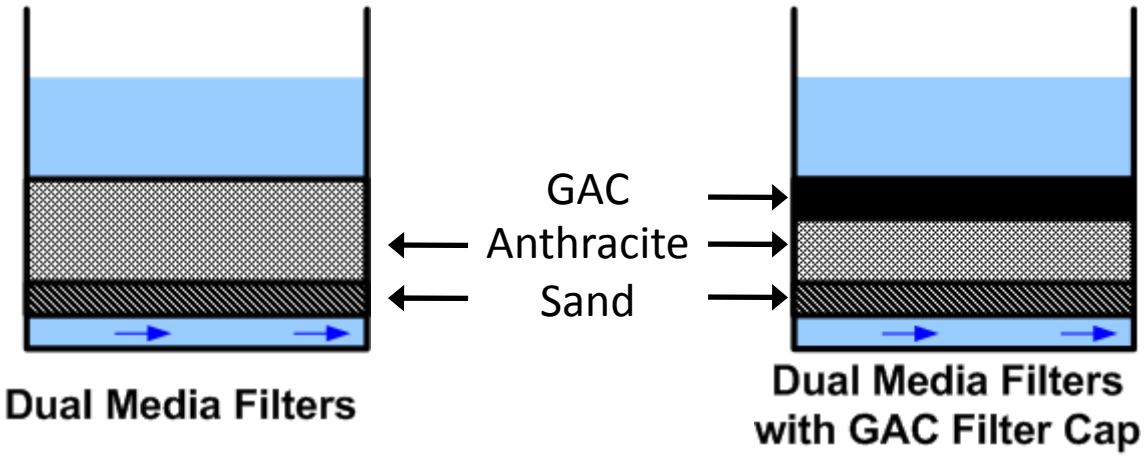
Minor Capital Improvements

- Ammonia injection to form chloramines (bench-scale testing)
- GAC filter caps (desktop study)
- Control system upgrades (desktop study)

Chloramines

- Ammonia is added to water after free chlorine CT is accomplished to provide a residual
- Chlorine:Ammonia ratio is typically 4:1 - 5:1
- Conversion to chloramines limits formation of DBPs
- Free chlorine is still required in plant for CT
- Conversion requires public education and increased system maintenance

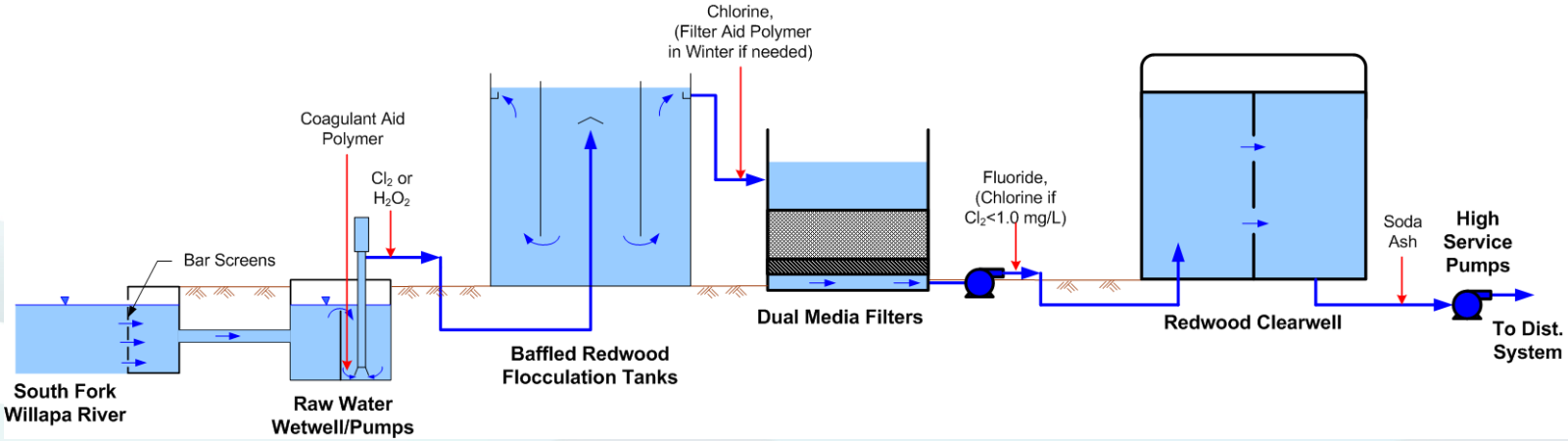
Granular Activated Carbon Filter Caps



- 12 inch GAC layer would be exhausted and require regeneration every 6 months.

Control System Upgrades

- Control System built in 1970s
- Only two treatment plant operators
- No AFDs on pumps



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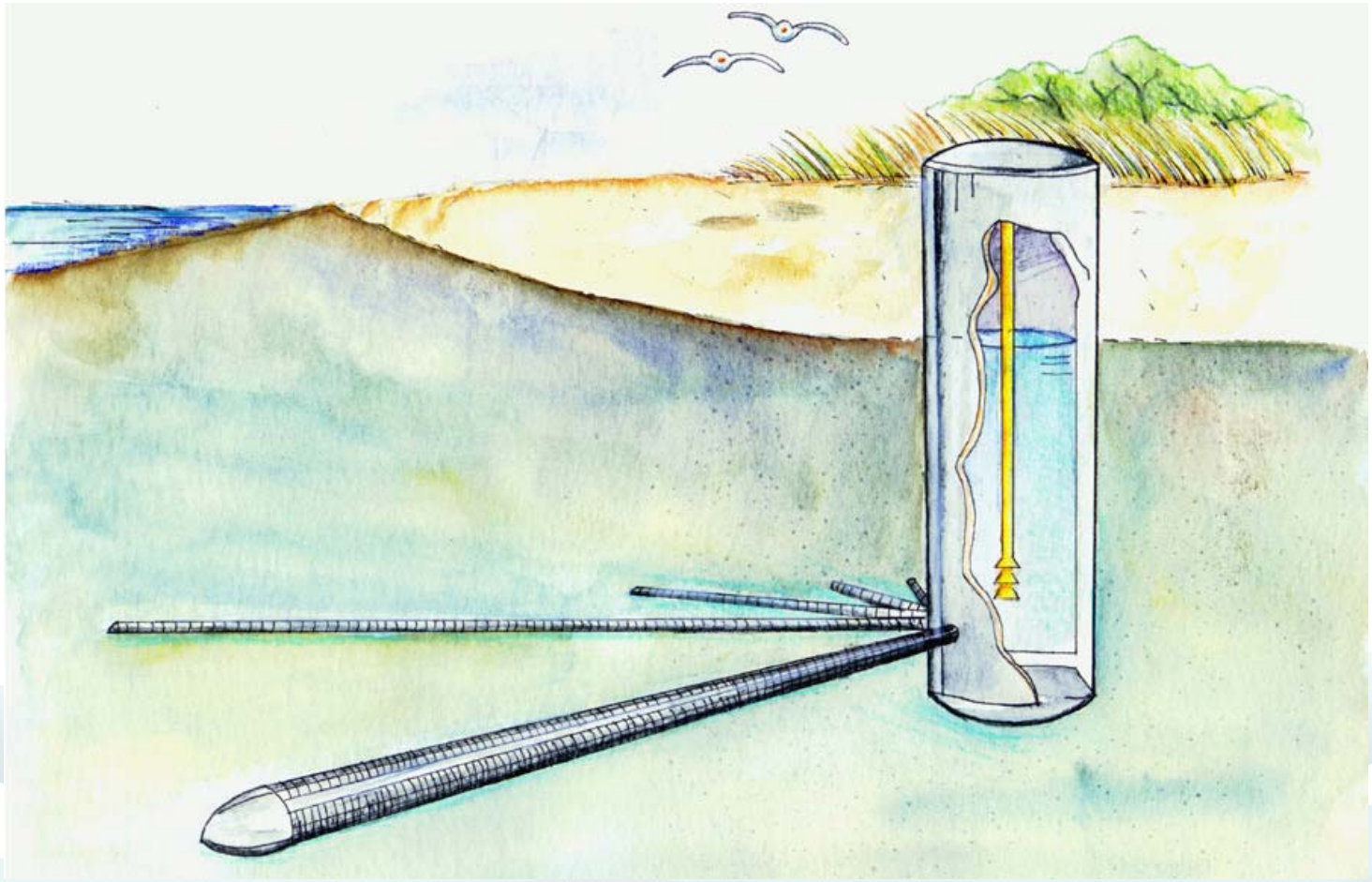
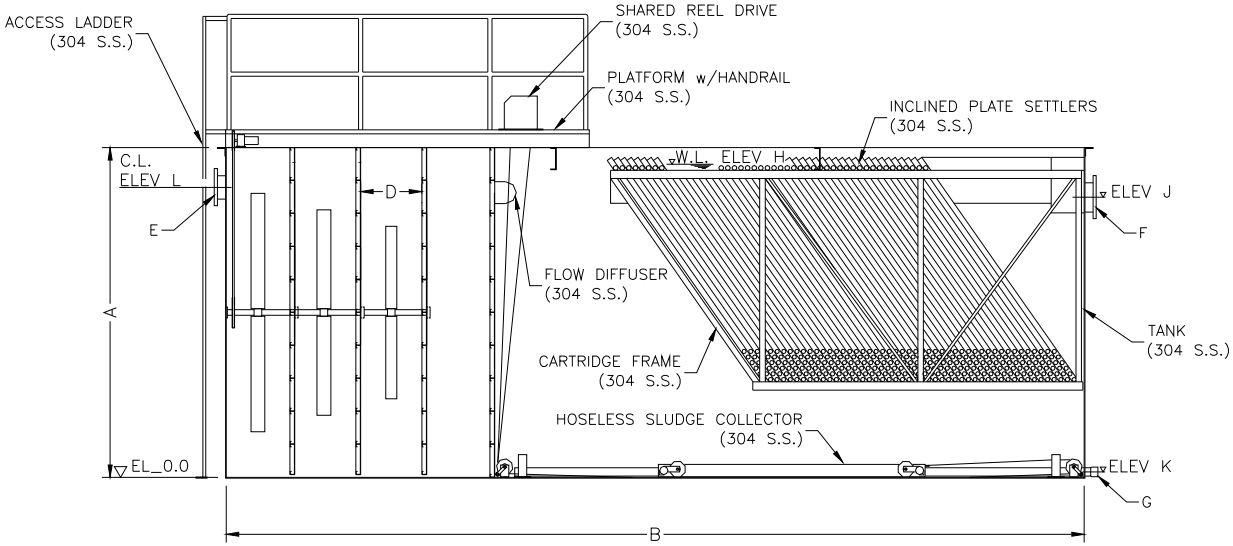
Major Capital Improvements

- Riverbank filtration (desktop study)
- Flocculation/sedimentation improvements (desktop study)
- GAC contactors (desktop study)
- UV Disinfection (desktop study)

Riverbank Filtration



Flocculation/Sedimentation Improvements

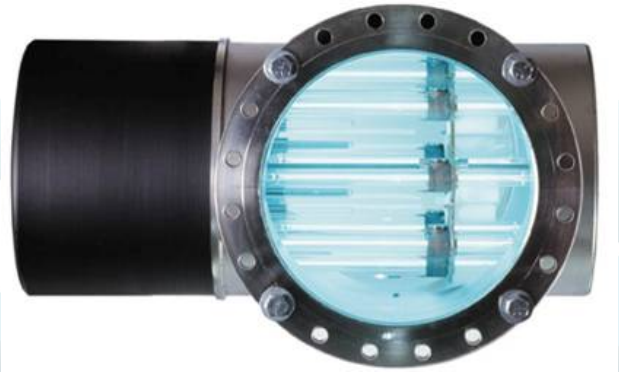


GAC Contactors

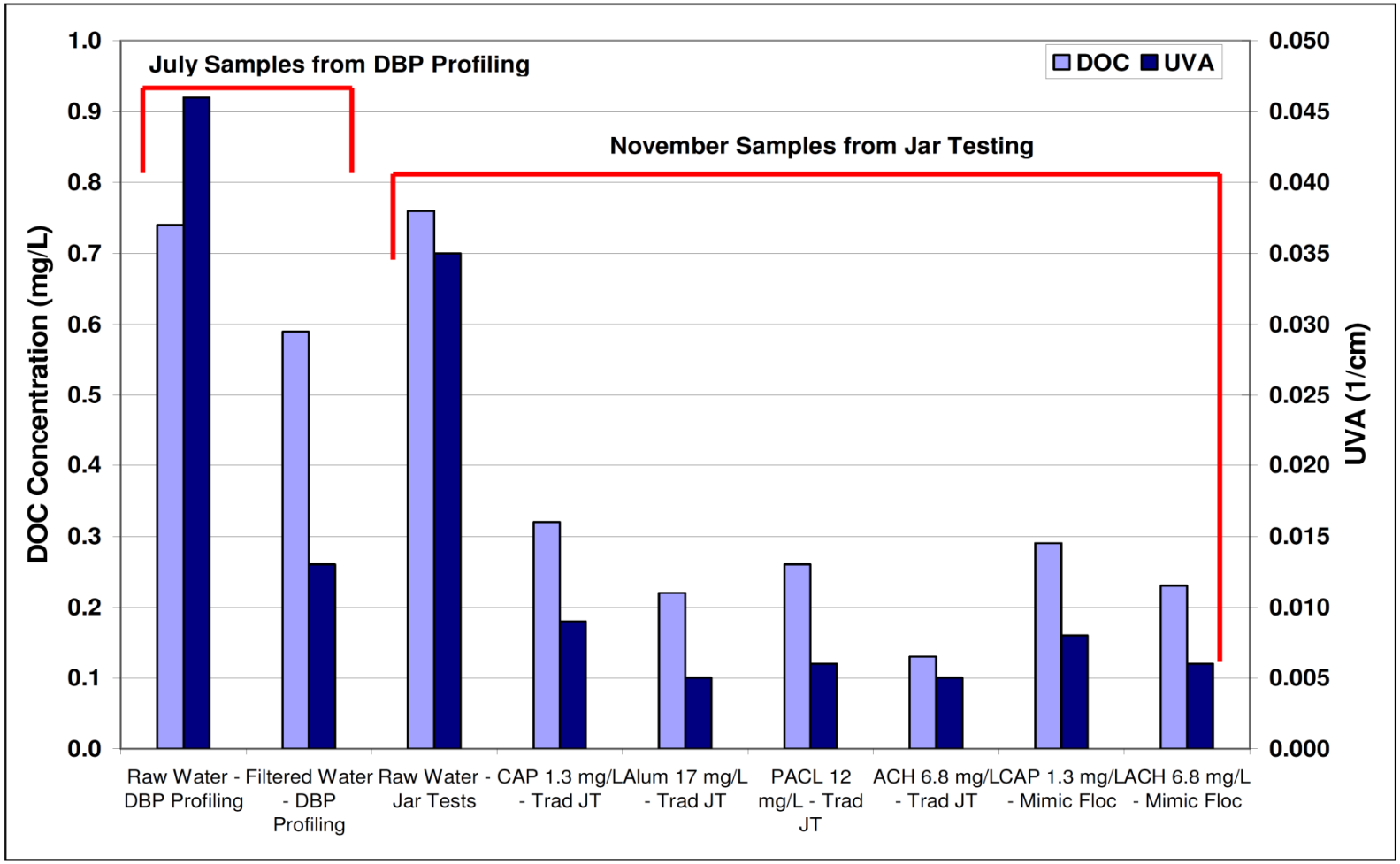
- Provides substantial reduction in DBP precursors
- Requires GAC replacement/regeneration every 2 years

UV Disinfection

Target Organism	Direct Filtration Removal Credit	UV Inactivation	Free Chlorine Inactivation Required
Cryptosporidium	2.0-log	~1.0-log (not required)	None
Giardia	2.0-log	1.0-log	None
Viruses	1.0-log	None	3.0-log



Jar Test and DBP Formation Potential



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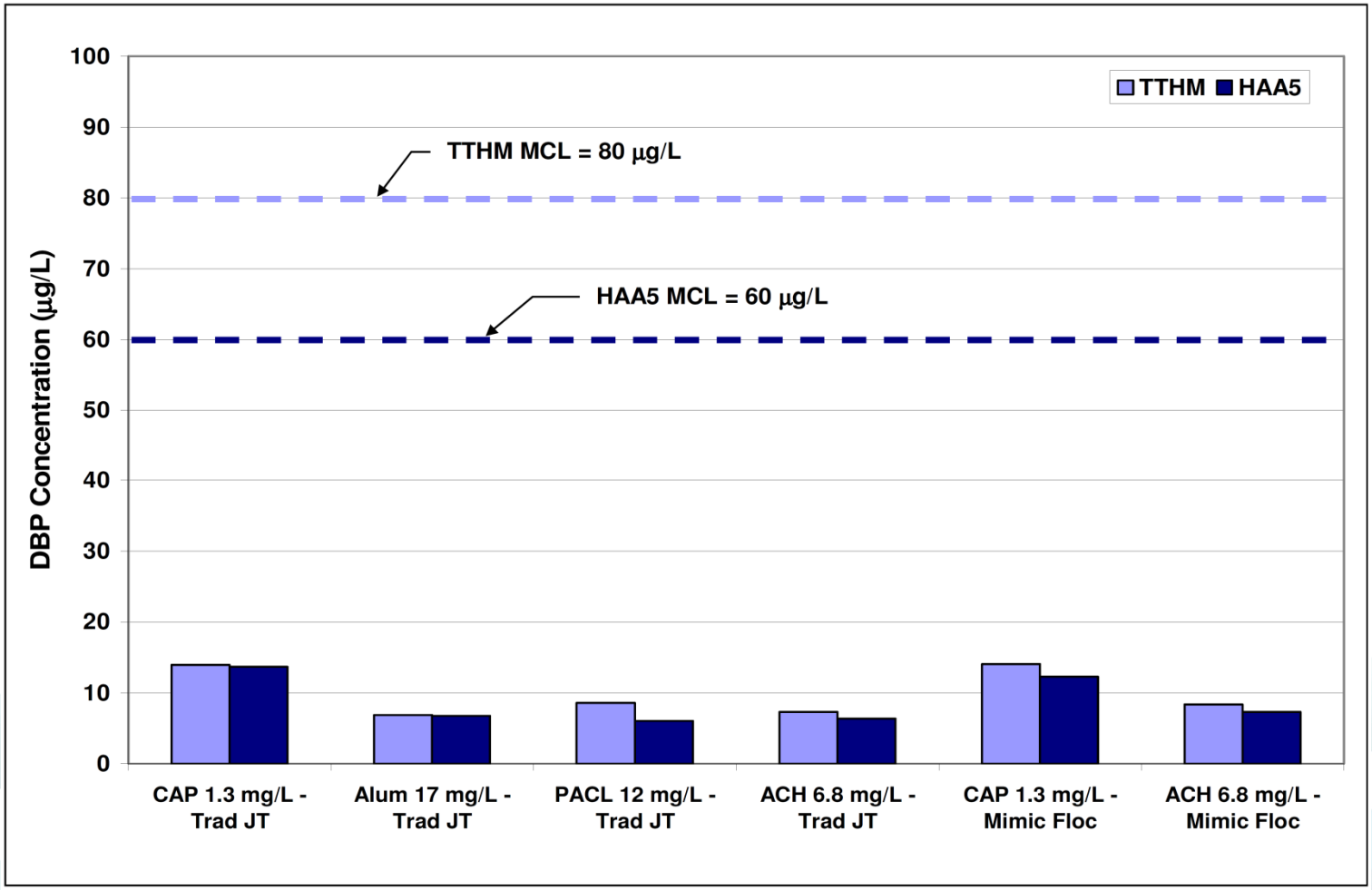

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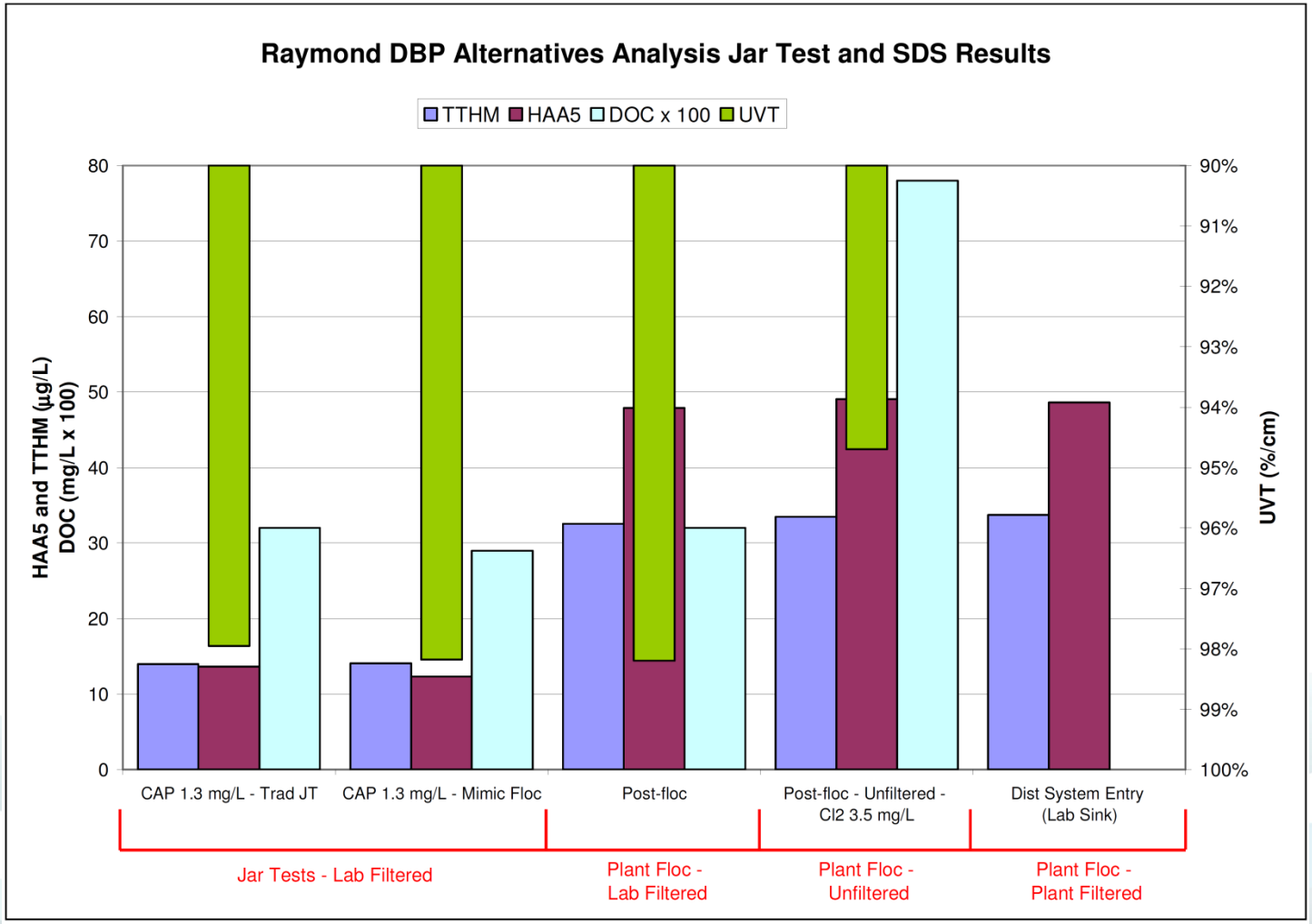

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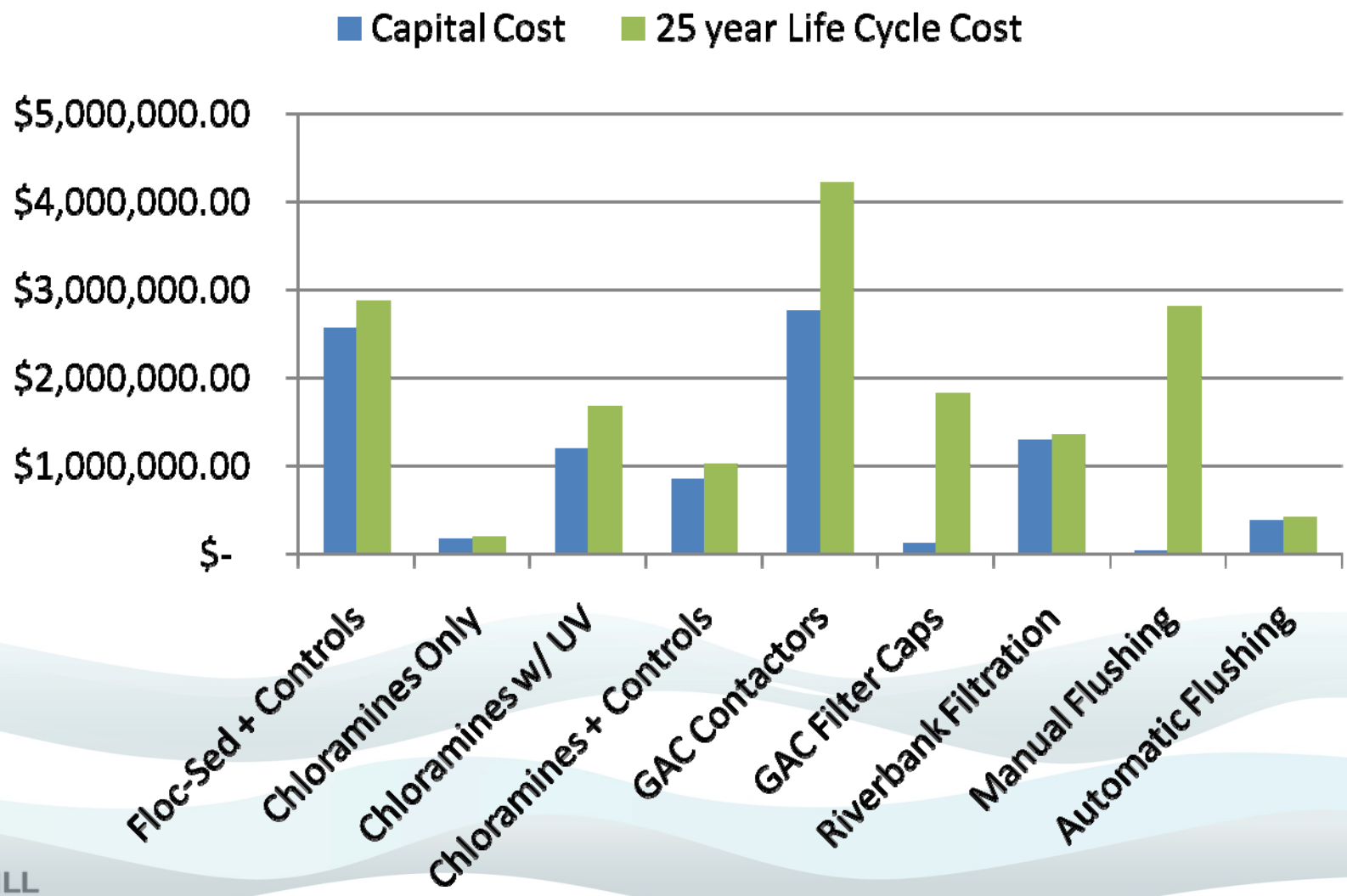
Comparison of Packaged Alternatives

- Flocculation-Sedimentation with Control System Upgrade
- Chloramines Only
- Chloramines with UV Disinfection
- Chloramines with Control System Upgrades
- GAC Contactors
- GAC Filter Caps
- Riverbank Filtration
- Manual Flushing (2 Person Crew)
- Automatic Flushing (6 Stations)

Capital and 25 Year Life Cycle Costs



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Current Status and Path Forward

- Project Report and Loan Application Submitted to Washington State Department of Health in February
- Awaiting loan application results
- Preparing to proceed with design Summer 2010.

Questions?

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