

Design Alternatives for the Upgrade of the Moffat Drinking Water Plant to 300 MGD

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Design Team

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Project Scope

- Design a water treatment plant for Denver Water that provides 300 MGD to the Denver area to meet future demands.
- Moffat treatment plant meeting end of design life
 - Can be upgraded or replaced with new plant

Moffat Water Treatment Plant

- Located in Lakewood, CO
- Plant design capacity is 210 MGD
- Originally constructed in 1938
- Some treatment processes are 50-70 years old
- At the end of its design life

Design Options

Two Options:

1. Upgrade the current Moffat Treatment Plant to handle 300 MGD
 - Reuse rapid mix basins, contact basins, clear wells
2. Build new plant at Ralston Reservoir Site

Moffat Water Treatment Plant



Ralston Reservoir Site

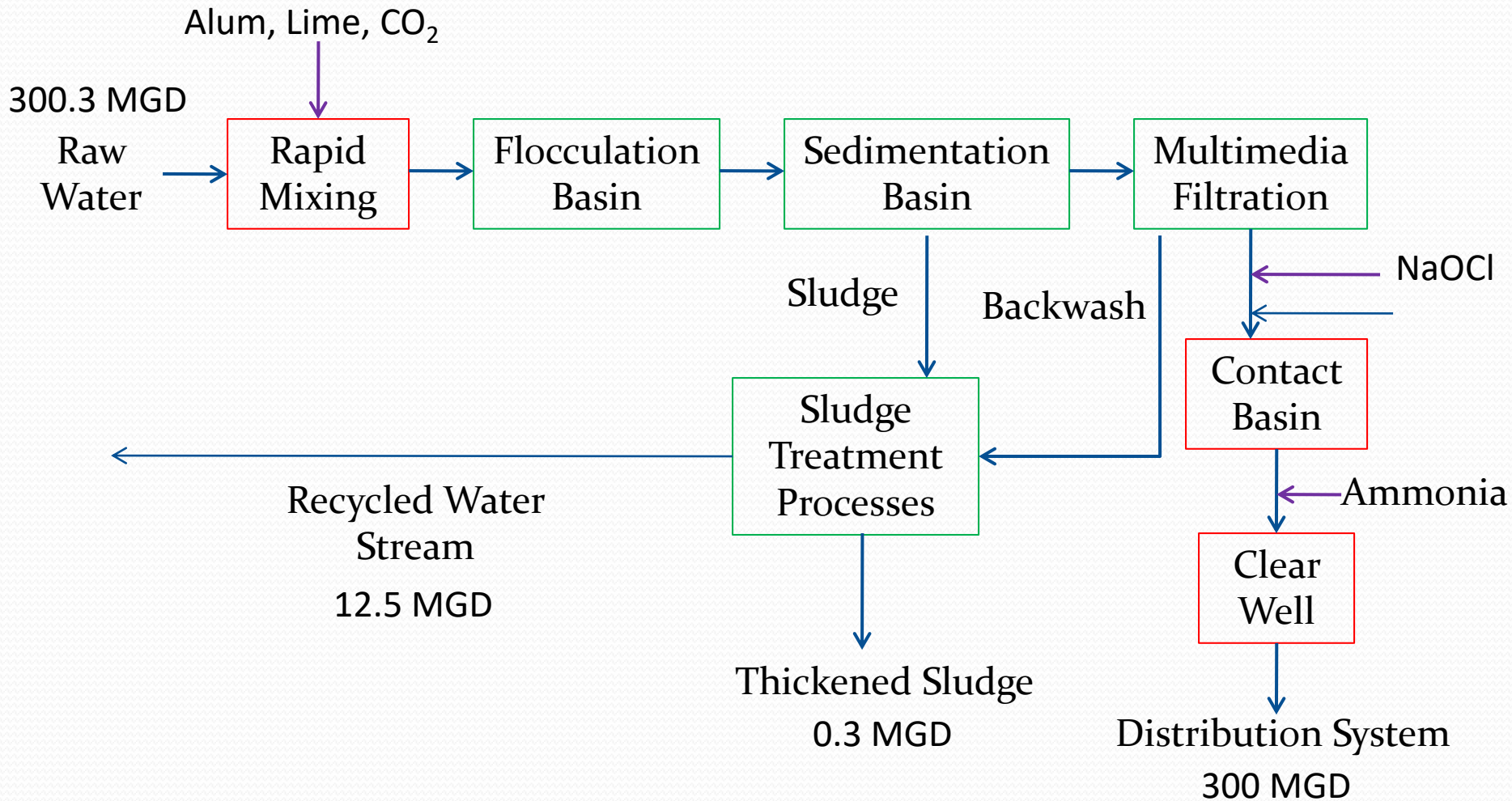


Water Quality Parameters

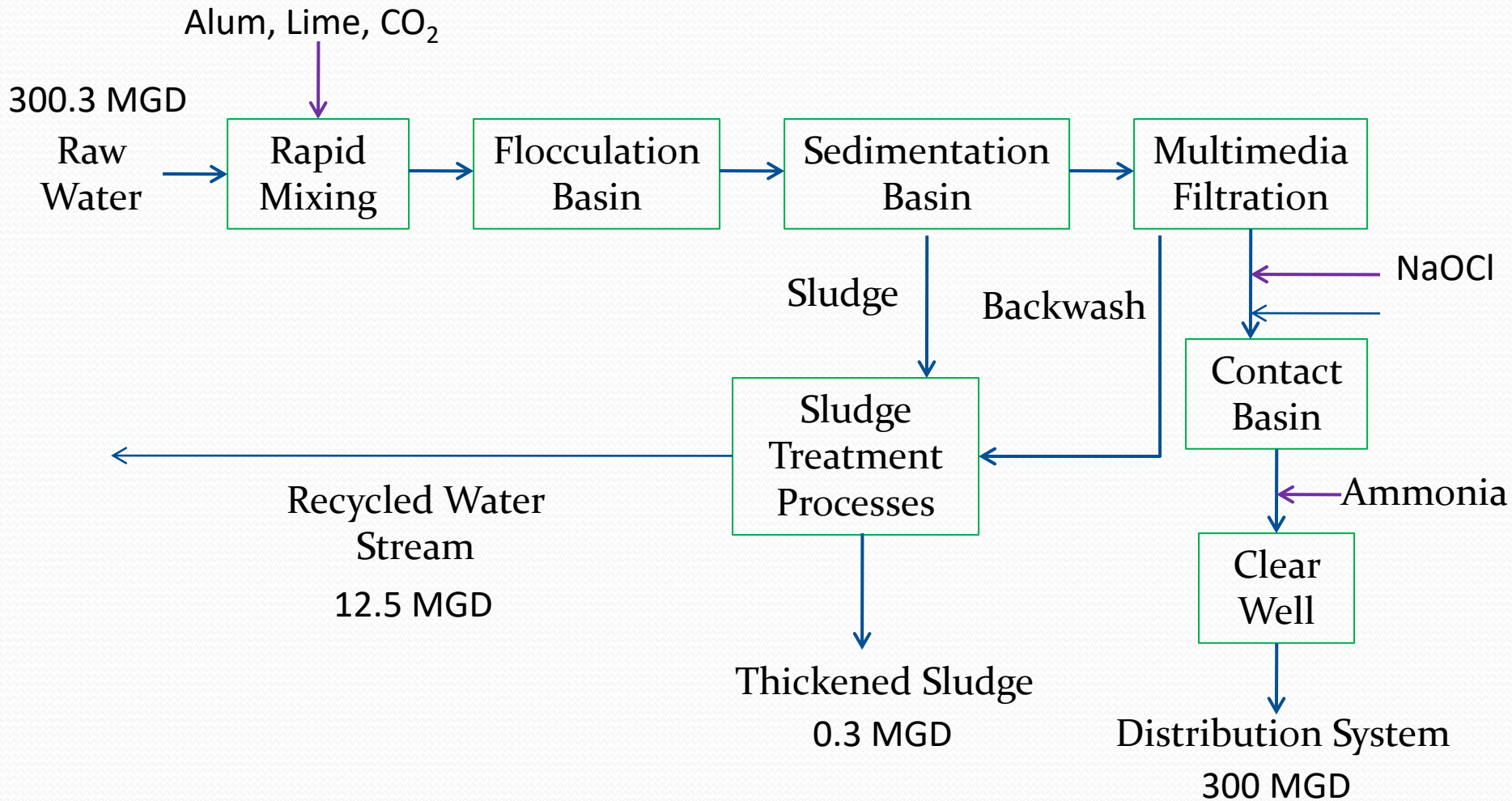
<u>Raw Water Data</u>	<u>High</u>	<u>Low</u>	<u>Average</u>	<u>MCL</u>
Turbidity, NTU	5.91	1.83	3.15	1.0
pH	7.79	6.86	7.34	6.5-8.5
Fluoride, mg/L	0.17	0.07	0.12	4.0
Temperature, °C	17	5	11	*
Alkalinity, mg/L as CaCO ₃	29	17	22	*
Hardness, mg/L	38	17	24	*

*These parameters do not have required MCL's but are important to consider when designing treatment processes.

Moffat Treatment Schematic



Ralston Treatment Schematic



Rapid Mix Tanks

<u>Rapid Mix Design</u>	<u>Ralston Site</u>	<u>Moffat Site</u>
Total Number of new Tanks	2	1
Detention time in tank*	5 s	5 s
Volume of each tank	2340 ft ³	714 ft ³
Dimensions of each tank (LxWxH)*	13ft x 10ft x 18ft	8.5ft x 7ft x 12ft
Flow Capacity of each tank	303 MGD	92 MGD
Power Requirements of motor for 1 tank (includes inefficiencies of motor)*	76 hp	23 hp

*calculations were performed based off of assumptions that are consistent with features of current Moffat site Rapid Mix tanks.

Flocculation Basins

Flocculation		
Flow Rate	27,850	ft ³ /min
Detention Time*	20	min
Total Basin Volume	557,000	ft ³
Number of Basins	16	basins
Individual Basin Volume	35,000	ft ³
Compartments per basin*	3	compartments
Total Basin Length	54	ft
Length of each compartment	18	ft
Basin Depth	18	ft
Basin Width	36	ft

- 18 basins needed in case 2 are offline

* are assumptions taken from CDPHE “design criteria for potable water systems”

Sedimentation Tanks

Resulting Design:

Total Number of Tanks	16
Detention Time	5 hr
Dimensions of Tanks (LxWxH)*	380ftx95ftx32ft
Flow Capacity of Tanks	18.75 MGD
Critical Settling Velocity for Smallest Floc	6.56 ft/hr
Design Overflow Rate	6.48 ft/hr

*Assumptions based on 10 State Standards and State of Colorado Recommendations

Multimedia Filtration

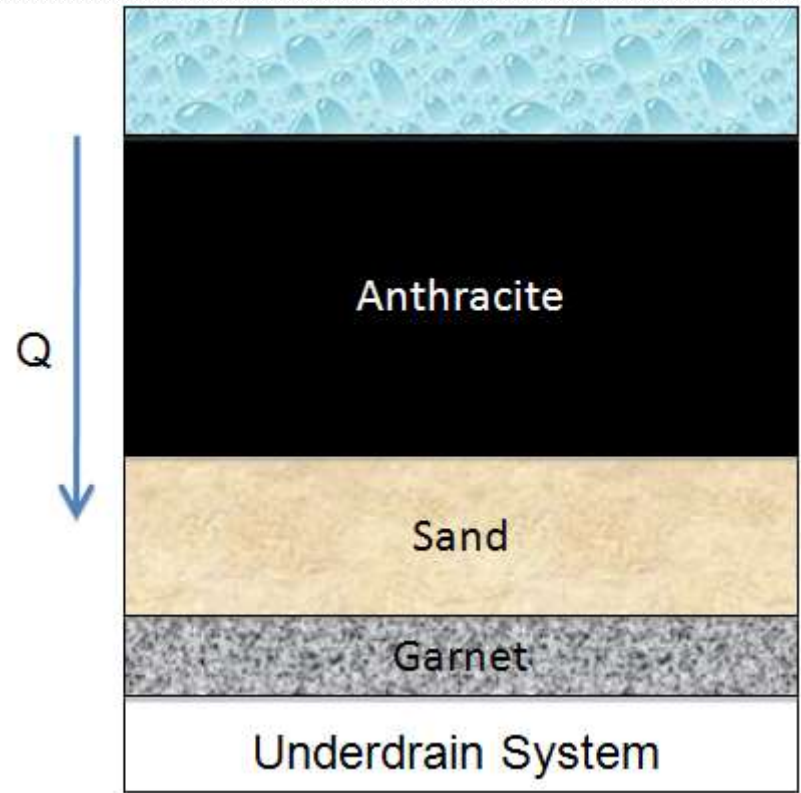
Multimedia Filters		
Flow Rate	1,671,000	ft ³ /hr
Filtering velocity*	30	ft/hr
Filtration Loading Rate*	3.74	gpm/ft ²
Total Filter Surface Area	55,700	ft ²
# of 37' by 37' filter beds*	41	beds
Total height of filter bed	20	ft
Depth of water above media*	10	ft

- 44 beds are needed leaving 3 offline due to backwash or maintenance

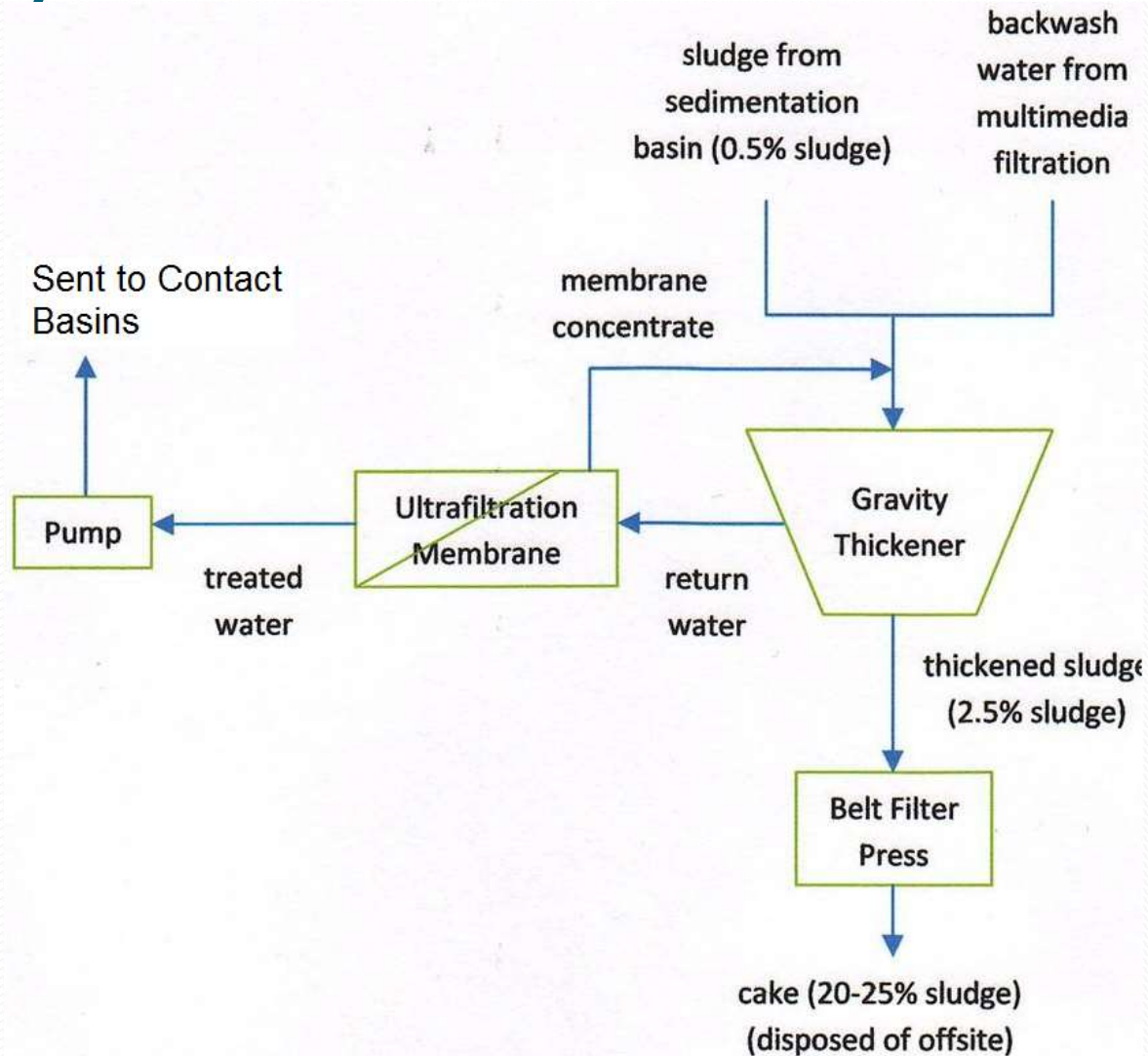
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Multimedia Filtration

Multimedia		
Total Media depth	3.5	ft
Anthracite depth	24	in
Sand depth	12	in
Garnet depth	6	in



Sludge/Backwash Water Treatment

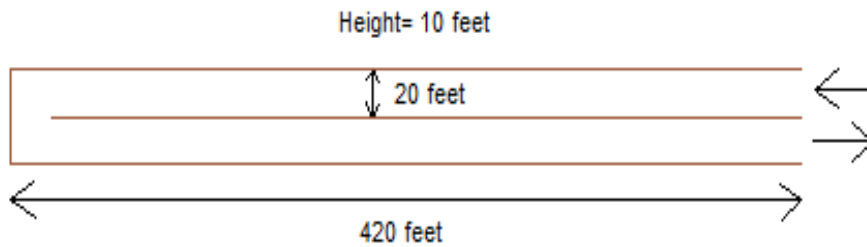


Disinfection/ Contact Basin

- 12.5% Sodium hypochlorite (NaOCl) solution as the primary disinfectant
- Contact basins designed for 30 mins of contact time
- [NaOCl]= 3 mg/L
- Meets disinfection requirements

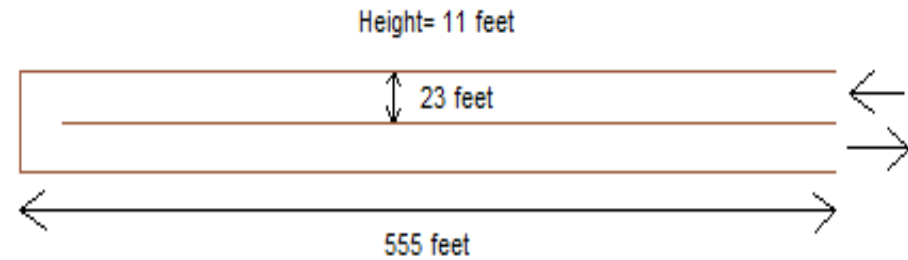
Contact Basin

Moffat Plant Upgrade



- One more contact basin needed

Ralston Plant



- Construction of 3 new contact basins

Clear Well

Moffat Plant Upgrade


- Add one more clear well with:
 - Depth= 25 ft
 - Width= 300 ft
 - Length=385 ft

Ralston Plant

- 2 clear wells:
 - Depth=25 ft
 - Length=300 ft
 - Width=300 ft
- 1 clear well:
 - Depth=25 ft
 - Length= 600 ft
 - Width= 150 ft

Alternative Comparison Matrix

<u>Criteria</u>	Weight of Criteria (K)	Moffat Rating (VM)	Moffat Total Score (VM)*K	Ralston Rating (VR)	Ralston Total Score (VRm)*K
(a.) Anticipated/Current Complaints from Neighbors	0.143	2	0.29	7	1.00
(b.) Extent of Environmental Analysis Required	0.214	8	1.71	8	1.71
(c.) Sustainability Options	0.143	5	0.71	7	1.00
(d.) Construction Feasibility	0.500	5	2.50	8	4.00
Total (S)=$\Sigma V*K$			5.21		7.71



Any Questions?