Dual Media Filter Design

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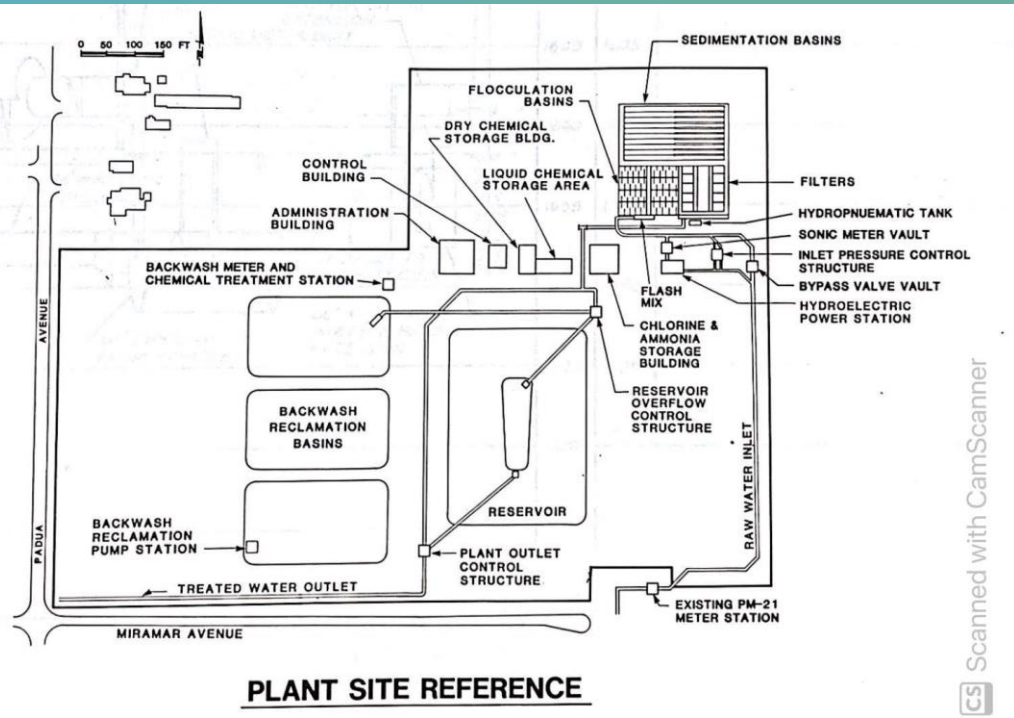
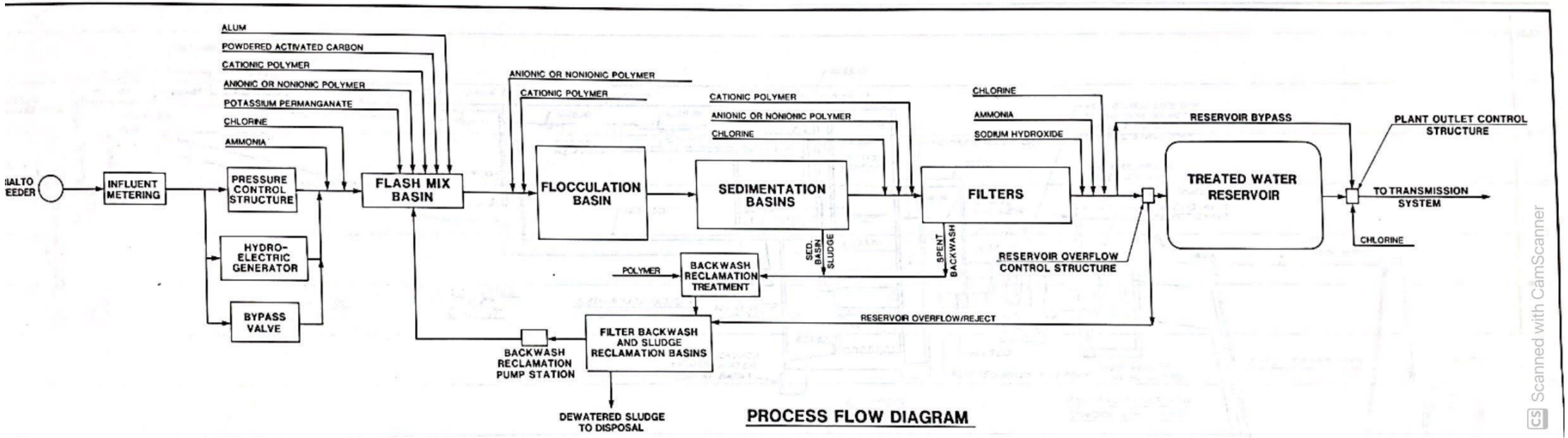
Facility Schematic



PLANT SITE REFERENCE



PROCESS FLOW DIAGRAM

Summary Table

Capacity	**20 mgd = 76,000 m^3 / day**
Filtration Rate (Velocity)	230 m^3 / (day * m^2)
Filter Media Depth	Anthracite = 0.5 m; Sand = 0.25 m; Gravel = 0.1 m
Number of Filters	8
Filter Dimensions	Width = 2.45 m, Length = 9.63 m; Area = 47.1 m^2
Filter Head Loss	0.6 m
Depth of the Filter Boxes	4.65 m
Expanded Filter Bed Depth	1.075 m

Filter Media Depth Part 1

- Ratio of Anthracite Depth : Sand Depth = 2:1 (Asano, 2007)
- Anthracite Depth: 0.5 m
- Sand Depth: 0.25 m
- Gravel Depth: 0.1 m
- Total Media Depth: 0.5 + 0.25 + 0.1 = 0.85 m

Ranges:				
	Effective Size Min (mm)	Effective Size Max (mm)	Depth Min (m)	Depth Max (m)
Sand	0.3	0.6	0.18	0.36
Anthrocite	0.8	1.2	0.36	0.9

Filter Media Depth Part 2

- Anthracite Effective Size (from Miramar Design Criteria): 1.05 mm
- Sand Effective Size (calculated): 0.48 mm
- Gravel Effective Size (from Miramar Design Criteria): 12.7 mm

Calculation:
Total Depth / Total Effective Size = 1000
Depth Sand / Sand Size + Depth Anthrocite / Anthrocite Size = 1000
250 / Sand Effective Size + 500 / 1.05 = 1000
Sand Effective Size = .48

Number of Filters

Equation	N=.0195(Q)^0.5	
		Conversion:
Q (MGD)	20	
Q (ft^3/day)	2680000	*.134*1000000
Q (m^3/day)	75889.14887	*(.3048)^3
N	5.371857114	

N = 5.372

Add 1 for Breaks and Backwashes = 6.372

Round Up to Even Number = 8 Filters

Filter Dimensions

Width: 2.45 meters

Length: 9.63 meters

Area: 47.1 meters^2

What we did:		
Filter Dimension		
q:	230	m3/d-m2
N	7	
Max design flow, Q:	75889	m3/d
Area:	47.13602484	m2
Width	2.447074904	m
Length	9.631095632	m
L:W	3.935758409	
Constraints:		
W</= 6 m		
L:W >/= 2		
L:W </= 4		

Filter Head Loss

+ Head loss for clean filter of less than 0.6m
+ Based on Rose equation
+ Porosity and diameter of sand grains inversely proportional to head loss

Expanded Bed Depth

	Depth (m):	Percent Expansion:	Expanded Depth (m):
			Depth * ((100 + Percent Expansion) / 100)
Sand:	0.25	40%	0.35
Anthracite:	0.5	25%	0.625
Gravel:	0.1	0%	0.1
			Total: 0.35 + 0.625 + 0.1 = 1.075

Depth of the Filter Boxes

- Depth of filter must accommodate:
- Media depth
- Underdrain
- Water above media
- Backwashing(freeboard)
- Safety factor

	A	B
1	Depth of Filter Boxes	
2	Depth of water above filter bed:	2.4
3	Anthracite Depth:	0.5
4	Sand Depth:	0.25
5	Underdrain Depth:	0.3
6	Saftey Factor:	0.6
7	Freeboard:	0.6
8		
9	Total Depth of Filter Box (m)	4.65