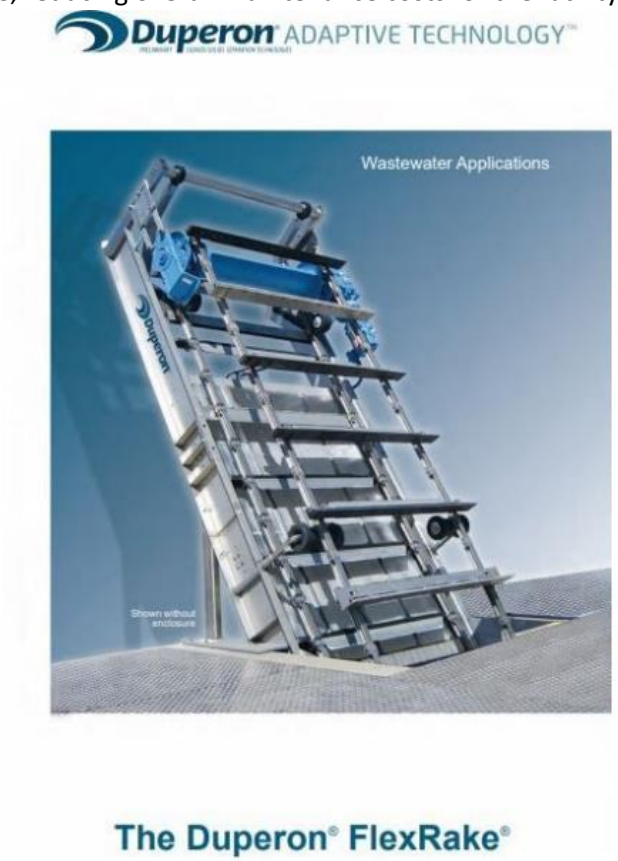
Design process

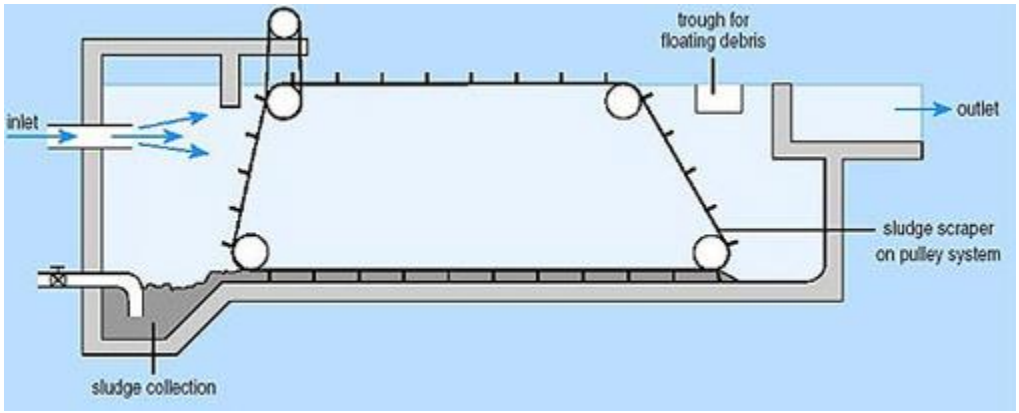
1- Preliminary Process

The preliminary screening was considered simply enough not to merit a formal decision-making process, and a bar screen was chosen due to its ubiquitous usage in existing WTPs. This means that the structure will be the most cost efficient, as commercial versions will be cheaply available and WTP workers will be familiar with its Maintenance and Operation (O&M), and there is little doubt about the effectiveness of its function. The bar screen will catch large objects, isolating them from the plant and preventing them from causing damage to more expensive treatment processes. The bar screen will reduce maintenance costs for processes further down the line, reducing overall maintenance costs for the facility.



2- Primary treatment (Clarifiers)

The primary clarifier design is a rectangular clarifier. Phase zero will implement one clarifier with a width, depth, and length of 11.2m, 4.2m, and 37.2m respectively. This gives a total surface area of 416m^2. Phase one will implement another clarifier of the same dimensions for a total of two clarifiers. This gives a total surface area of 832m^2. Phase two will not add any more clarifiers as the phase one clarifier total is sufficient to satisfy phase two demand.

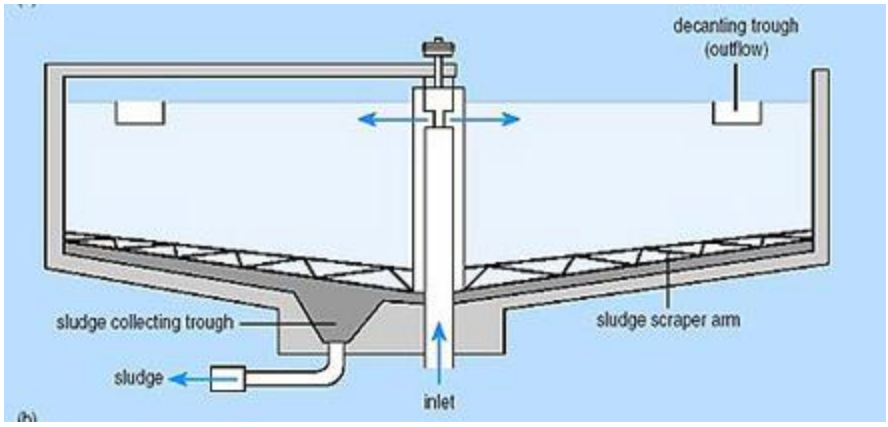


Rectangular clarifier	
Dimensions of Clarifier	13.3m wide, 4.3m depth, 37.3m long
Phase 0 (2021) 45 MGD	1 Rectangular Tank Surface area : 496m^2
Phase 1 (2030) 60 MGD	Adding 1 Tank (Total 2 rectangular clarifiers) Total Surface area: 992m^2

Flowrate	2.4 m^3/s
Dynamic visocisty	0.00157 pa*s
Density of water	1000 kg
Partivle siz	0.1 mm
Desity of particle	2650 kg/m^3
gravity	9.81 m/s^2
Settling velocity	0.0057 m/s
surface area	421
surface overflow rate	0.0057
depth	4.3 m

3-Secondary

Phase zero will implement four $14m$ diameter clarifiers that will have a total surface area of $615m^2$. Phase one will implement two more $14m$ circular clarifiers to increase the surface area by $307m^2$. At this point there will be six circular clarifiers with a total combined area of $923m^2$. Phase two will not see any more secondary clarifiers added, as the phase one surface area provides enough surface overflow rate to accommodate the phase two demand. Each clarifier will have a depth of $4m$, this includes freeboard, and a detention time of approximately 12 minutes.



Description	Name	Variable	Value	Unit	Value	Unit	Source	Page Number(s)	Equation/Table Number
Flowrate of "Fresh" water into the Clarifier	In Flowrate	Q_in	1.97	m^3/s		mgd			
Flowrate of the Recycled Water	Underflow Flow Rate	Q_Under	0.99	m^3/s		mgd			
Flow of Water Leaving the Clarifier	Overflow Flow Rate	Q_Over	1.97	m^3/s	45	mgd			
Flowrate of Underflow and Flowrate together Entering the Clairfier	Flowrate	Q	2.96	m^3/s		mgd			
The Flowrate per Unit of Surface Area of the Clarifier	Surface Overflow Rate	SOR	0.01	m^3/s/m^2					
Radius of the Clarifier	Radius	r	12.82	m					
Diamter of the Clarifier	Diamter	d	25.64	m					
Depth of the Clarifier	Depth	h	4	m					
Area of the water surface	Area	A	516	m^2					
The Volume of the Clarifier	Tank Volume	V	2065	m^3					
Time the Water spends in the Clarifier before leaving	Detention Time	t_o	698	s					
The acceleration caused by Earths Gravtiy	Gravitational Acceleration	g	9.81	m/s^2			Assumed Knowledge		
The Dynamic Viscosity of Water at Standard Conditions	Dynamic Viscosity of Water	mue_water	0.00157	Pa*s			Fundamentals of Hydraulic Engineering Systems	Front Cover	
Density of Water at Standard Conditions	Density of Water	roe_water	1000	kg/m^3			Fundamentals of Hydraulic Engineering Systems	Front Cover	
Kinemativ viscosity of water at standard conditions	Kinematic viscosity of water	nue_water	0.00000157	m^2/s			Fundamentals of Hydraulic Engineering Systems	Front Cover	
Density of the Particle being considered	Density of Settling Particles	roe_Particle	2650	kg/m^3			Assumed from Water and Wastewater Sedimentation Section		
Diamter of the particle being considered	Diameter of Particles	d_Particle	0.0001	m	0.1	mm	Assumed from Water and Wastewater Sedimentation Section		
Settling Velocity of the particle being considered	Settling Velocity	v_s	0.0057	m/s			Assumed from Water and Wastewater Sedimentation Section	10-4	10-12
reynolds number for the particle	Reynolds Number	Re	0.3648	Unitless			Assumed from Water and Wastewater Sedimentation Section	10-4	10-9

	Total Surface Area(m^2)	Diameter (m)	Total Surface Area (ft^2)	Diameter (ft)	Tank Count	Surface Area per Tank (m^2)	Tank Diamter (m)	Design Diamter (m)
Phase 0	520	25.73	5597.23	84.42	4	130.00	12.87	13
Phase 1	700	29.85	7534.74	97.95	6	116.67	12.19	13
Phase 2	810	32.11	8718.77	105.36	6	135.00	13.11	14

	Final Design	Added Deisgı
Design Diamter(m)	14	
Phase 0 Surface area(m^2)	616	
Phase 1 Surface area(m^2)	924	308
Phase 2 Surface area(m^2)	924	
Phase 0 Overdesign Percentage	18%	
Phase 1 Overdesign Percentage	32%	
Phase 2 Overdesign Percentage	14%	

4- Filtration phasing design

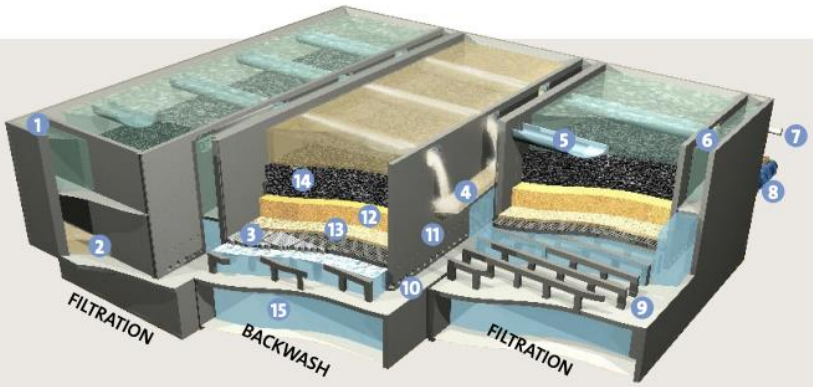
Rapid Sand Filtration-Veolia Filtraflo TGV			
	Phase 0 (2025)	Phase 1 (2030)	Phase 2 (2050)
Q (MGD)	45	60	70
Q (CMD)	7098	9464	11829
Desired Velocity (m/hr)	16	16	16
Total Required Filter Area, AT (m^2)	443.6	591.5	739.3
Minimum Filters Needed (with filter size of 50m^2)	9	12	15
Number of Filters Total	10 filters-9 for treatment, 1 for redundancy	14 filters-12 for treatment, 2 for redundancy	16 filters-15 for treatment, 1 for redundancy
Area Needed per Individual Filter, AI (m^2)	44.4	42.2	46.2
Dimensions of Each Individual Filter	8m X 6m	8m X 6m	8m X 6m
Area of Each Individual Filter (m^2)	48m	48m	48m
Area of All Filters (m^2)	480	672	768
Actual Velocity (m/hr)	14.8	14.1	15.4
Depth of Anthracite (m)	0.9	0.9	0.9
Depth of Manganese Dioxide (m)	0.3	0.3	0.3
Depth of Sand (m)	0.3	0.3	0.3
Total Depth of Media (m)	1.5	1.5	1.5
Water Level	up to 1.4m above media	up to 1.4m above media	up to 1.4m above media
Height of Filtration Unit (including 1m for underdrain system, media, water level, 0.6m freeboard)	4.5m	4.5m	4.5m
Width of Unit (m)	18	18	18
Length of Unit (m)	38	50	56

Filtraflo TGV

High speed filtration

After the clarification phase, filtration is the key treatment step in water treatment plants for the removal of suspended solids. Veolia Water Technologies has especially developed the high rate filtration system Filtraflo TGV for this treatment step.

Filtraflo TGV filters employ the familiar basic principle of rapid gravitational filtration of settled water through a granular media. The filtering bed is composed of single, dual or triple media layers. Filtraflo TGV is actually the most advanced and the most compact gravity filtration system within the VWT' filtration technology portfolio.



1. *Filters's Raw water inlet*
2. *Backwash water outlet*
3. *Slabs and nozzles*
4. *Dirty backwash water exit*
5. *Distribution (feed) & evacuation backwash) trough*
6. *Raw water inlet*
7. *Scour air feed*
8. *Backwash water feed*
9. *Nozzled slabs supports*
10. *Holes for backwash/filtered water pathway*
11. *Holes for scour air pathway*
12. *Sand layer*
13. *Gravel layer*
14. *Anthracite layer*
15. *Filtered water*

Operating process

The high rate Filtraflo TGV filters combine a deep sand bed (2.0 m) with a coarse filter sand (effective size 1.35 mm). The principle of Filtraflo TGV is to increase the depth and the grain size of the media, this allows the suspended solids to penetrate deeper into the filter bed, thus allowing a "volume filtration" rather than a "surface filtration".

As a consequence, high rate Filtraflo™ TGV filters can retain a larger amounts of suspended solids than conventional filters.

Optimized backwashing

Unlike conventional filters with mainly superficial clogging, the backwashing of high rate filters must be engineered to remove deeply imbedded particles distributed throughout the sand bed. To achieve such action, backwashing velocity needs to be much higher than the filtration rate.

The backwashing of the Filtraflo TGV filters includes isolation of filters, air scour, combined air and water backwash and final rinse. The first two stages are to expand and stir the filter bed to remove the bulk of the accumulated solids.

The final rinsing step by water alone allows to flush the remaining particles out of the filter.

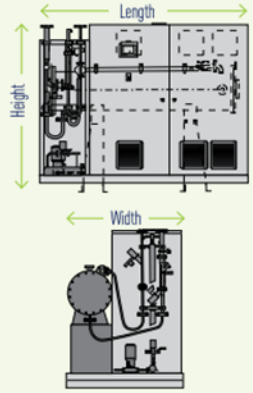
5- Disinfection

5.1 Ozone calculations

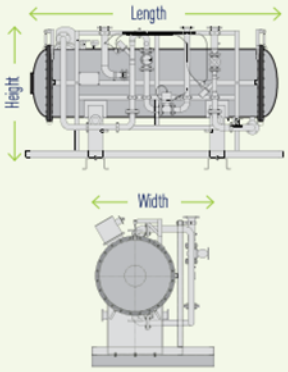
model	feedgas oxygen			feedgas air		
	max production O_3		concentration O_3	max production O_3		concentration O_3
	lb/d	kg/h	(%-wt)	lb/d	kg/h	(%-wt)
ozonia® CFV-02	100.5	1.9	6 to 14	48,1	0,9	1 to 5
ozonia® CFV-03	148.2	2.8	6 to 14	72,5	1,4	1 to 5
ozonia® CFV-04	195.8	3.7	6 to 14	94,2	1,8	1 to 5
ozonia® CFV-05	301.6	5.7	6 to 14	139,2	2,6	1 to 5
ozonia® CFV-10	597.9	11.3	6 to 14	278,8	5,3	1 to 5
ozonia® CFV-15	904.8	17.1	6 to 14	421,7	8,0	1 to 5
ozonia® CFV-20	1,153.5	21.8	6 to 14	537,6	10,2	1 to 5
ozonia® CFV-30	1,899.5	35.9	6 to 14	-	-	-

* at standard conditions

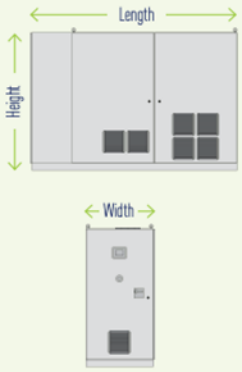
ozonia® CFV-02 to CFV-20



ozonia® CFV-30 Vessel



ozonia® CFV-30 PSU-Cubicle



technical features

- **ambient temperature:** +5 to 40°C
- **design altitude:** < 1,000m.a.s.l.
- **humidity:** RH < 65% (yearly average)
- **voltage:** 3 x 360 to 495 VAC
- **frequency:** 50 / 60 Hz

options

- **profinet (Siemens PLC)**
- **modbus TCP (Allen Bradley PLC**
- **modbus TCP (Schneider PLC)**
- **power-cut and lightning protection**
- **power analyser**

remote control and alarms

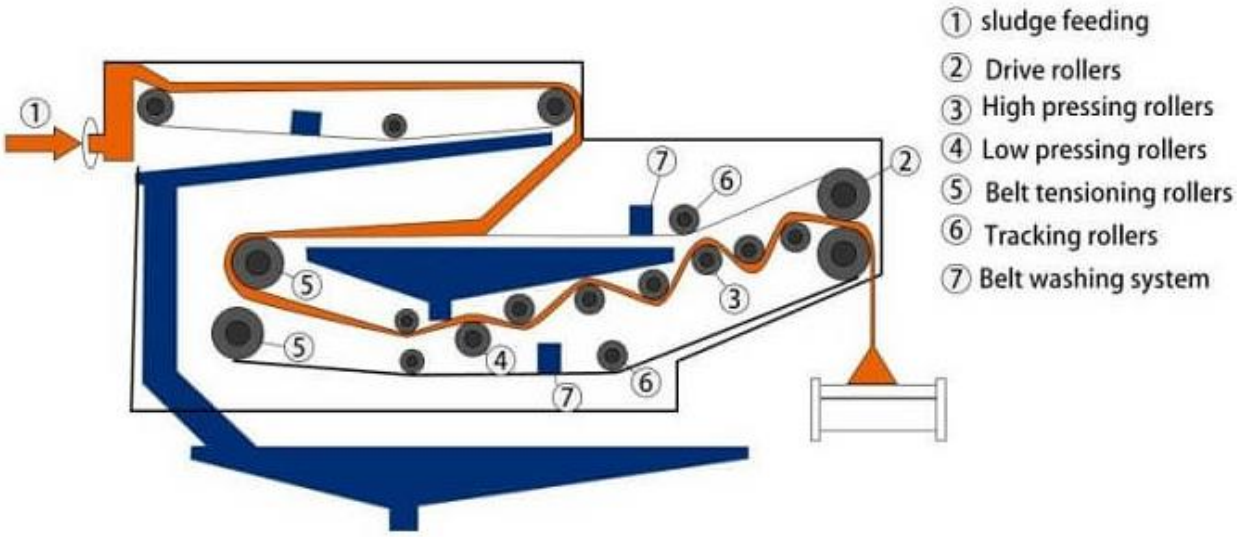
- **supply ON/OFF**
- **enable REMOTE**
- **alarm RESET**
- **emergency STOP**
- **gasflow ON**
- **collective ALARM**
- **setpoint current (4-20 mA)**

model	L x H x W		weight	
	inch	mm	lb	kg
ozonia® CFV-02	78.74 x 78.74 x 45.27	2,000 x 2,000 x 1,150	~ 1653	~750
ozonia® CFV-03	78.74 x 78.74 x 45.27	2,000 x 2,000 x 1,150	~1874	~ 850
ozonia® CFV-04	78.74 x 78.74 x 45.27	2,000 x 2,000 x 1,150	~ 2,094	~ 950
ozonia® CFV-05	98.42 x 78.74 x 45.27	2,500 x 2,000 x 1,500	~ 4,409	~ 2,000
ozonia® CFV-10	114.17 x 78.74 x 74.80	2,900 x 2,000 x 1,900	~ 4,519	~ 2,050
ozonia® CFV-15	114.17 x 78.74 x 74.80	2,900 x 2,000 x 1,900	~ 5,511	~ 2,500
ozonia® CFV-20	114.17 x 78.74 x 74.80	2,900 x 2,000 x 1,900	~ 6,614	~ 3,000
ozonia® CFV-30 Vessel	135.82 x 74.80 x 61.02	3,450 x 1,900 x 1,550	~ 8,377	~ 3,800
ozonia® CFV-30 PSU-Cubicle	118.11 x 78.74 x 39.37	3,000 x 2,000 x 1,000	~ 4,960	~ 2,250

5.2 UV Calculation

UV	
TrojanUV Signa lamps will be used	Each TrojanUV solo lamp is 1000 Watts
Watts per TrojanUV solo lamp	1000
Dimensions of UV Channel	2m wide X 1.2m deep X 18m long
Phase 0 (2025) 45MGD	144 lamps
	Approx. 87 lamps replaced per year
	6 Banks-5 for flow, 1 for redundancy
	144,000 W in Channel
Phase 1 (2030) 60MGD	Add 48 lamps (192 total)
	Approx. 116 lamps replaced per year
	8 Banks-7 for flow, 1 for redundancy
	144,000 W in Channel
Phase 2 (2050) 70MGD	Add 24 lamps (216 total)
	Approx.130 lamps replaced per year
	9 Banks-8 for flow, 1 for redundancy
	144,000 W in Channel

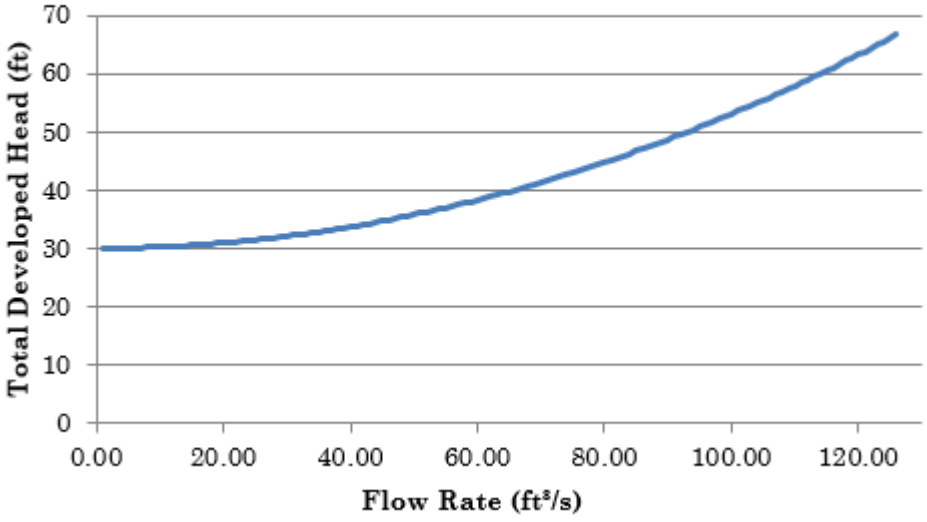
6- Solid Treatment



7- Hydraulics

Maximum Flow Capacity (MGD)	70
Pipe Material	Ductile Iron
Pipe Diameter (ft)	3
Number of Pumps	3 (1 for redundancy)
Type of Pumps	Goulds 3420 centrifugal pump
Capacity(GPM)	65,000

PUMP 1


Total Developed Head (ft)
70
60
50
40
30
20
10
0
0.00
20.00
40.00
60.00
80.00
100.00
120.00
Flow Rate (ft³/s)