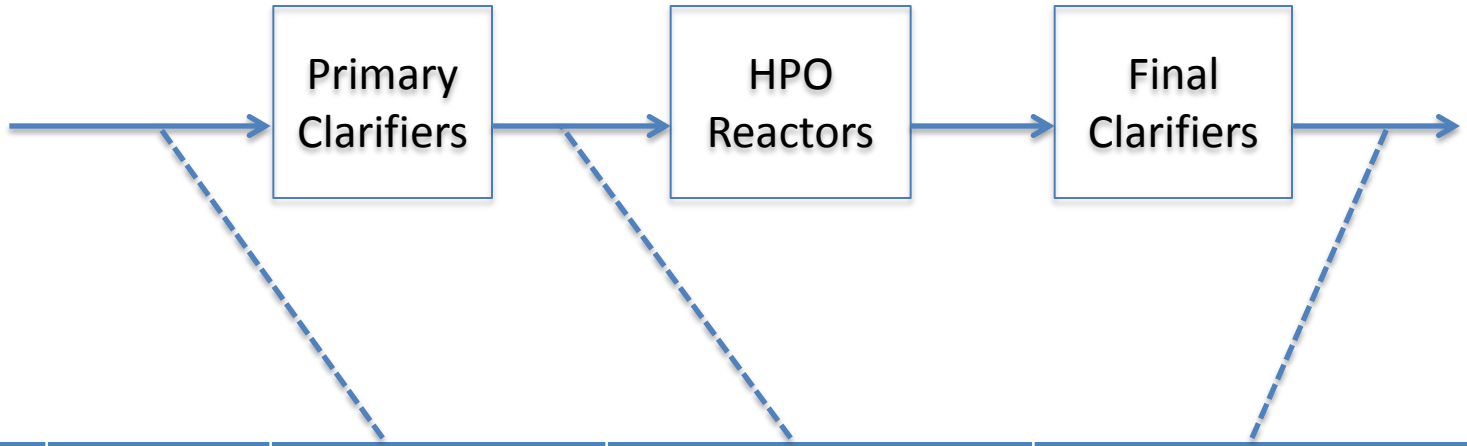
Appendix D – JWPCP Background and NDN

SANITATION DISTRICTS OF LOS ANGELES COUNTY

JWPCP Background

JWPCP Water Quality



	Unit	Influent	Primary Effluent	Secondary Effluent
BOD	mg/L	460	240	<5
COD	mg/L	740	370	55
TSS	mg/L	530	150	15
NH_4-N	mg N/L	41	45	42
TKN	mg N/L	64	58	44
TP	mg P/L	8.8	7.0	0.59

HPOAS Process

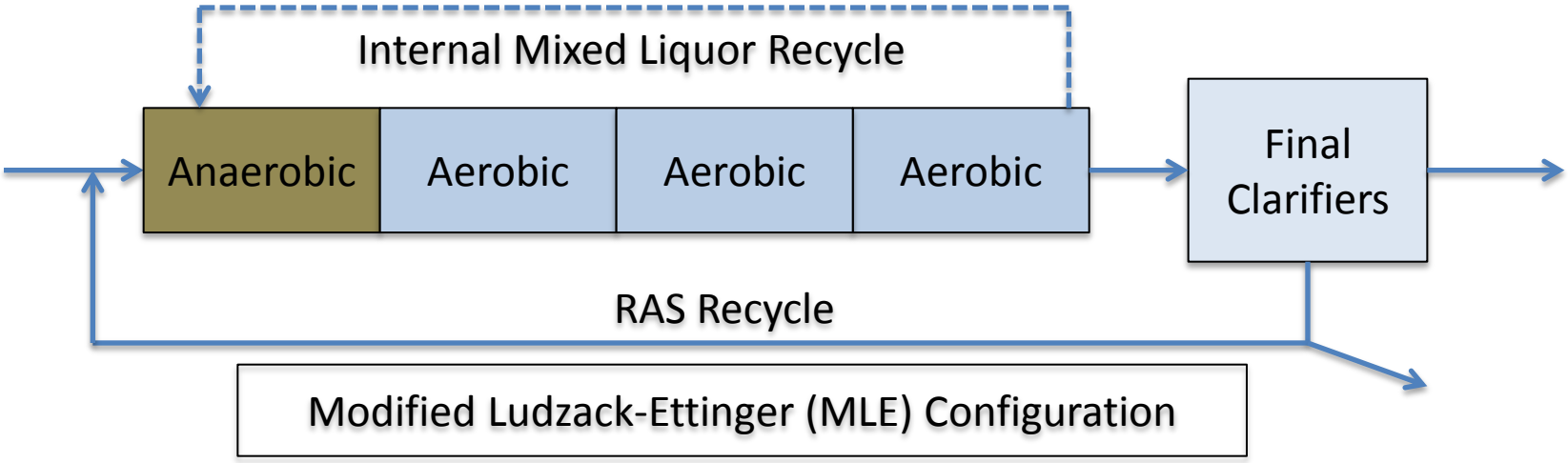
8 Treatment Units (Each Unit: Reactor + 26 Final Clarifiers)
Currently Operating 6 Treatment Units

Parameter	Unit	Design	Current Operation
Average Flow	MGD	50	54
Reactor			
Hydraulic Retention Time (HRT)	Hours	2.5	2.3
RAS Recycle Ratio	%	30	30
MLSS	mg/L	4,000	3,300
Final Clarifiers			
Overflow Rate	gpd/ft^2	550	590
Solids Loading Rate	$lb/ft^2\text{-}d$	24	22
Mean Cell Residence Time (MCRT)	Days	3.5	3.4
MCRT (Reactor Only)	Days	--	2.3
Aerobic MCRT (Reactor Only)	Days	--	1.8

Operate HPOAS to Nitrify Only

- Minimum aerobic MCRT: 1.5 days @ 25°C, 0.9 days @ 30°C → Operating aerobic MCRT: 5 – 8 days for reliable nitrification
- Need to increase MLSS by decreasing sludge wasting → high MLSS could cause solids loading to exceed design criteria for clarifiers
- Operate one more treatment unit
  → One unit operated at <50 MGD (35 MGD?)
- More oxygen required
  - 270 tons/d O_2 used for COD stabilization
  - Additional 250 tons/d O_2 required to fully nitrify
- Existing HPOAS plants rarely operated in single-sludge nitrification mode

Nitrification and Denitrification (NDN)

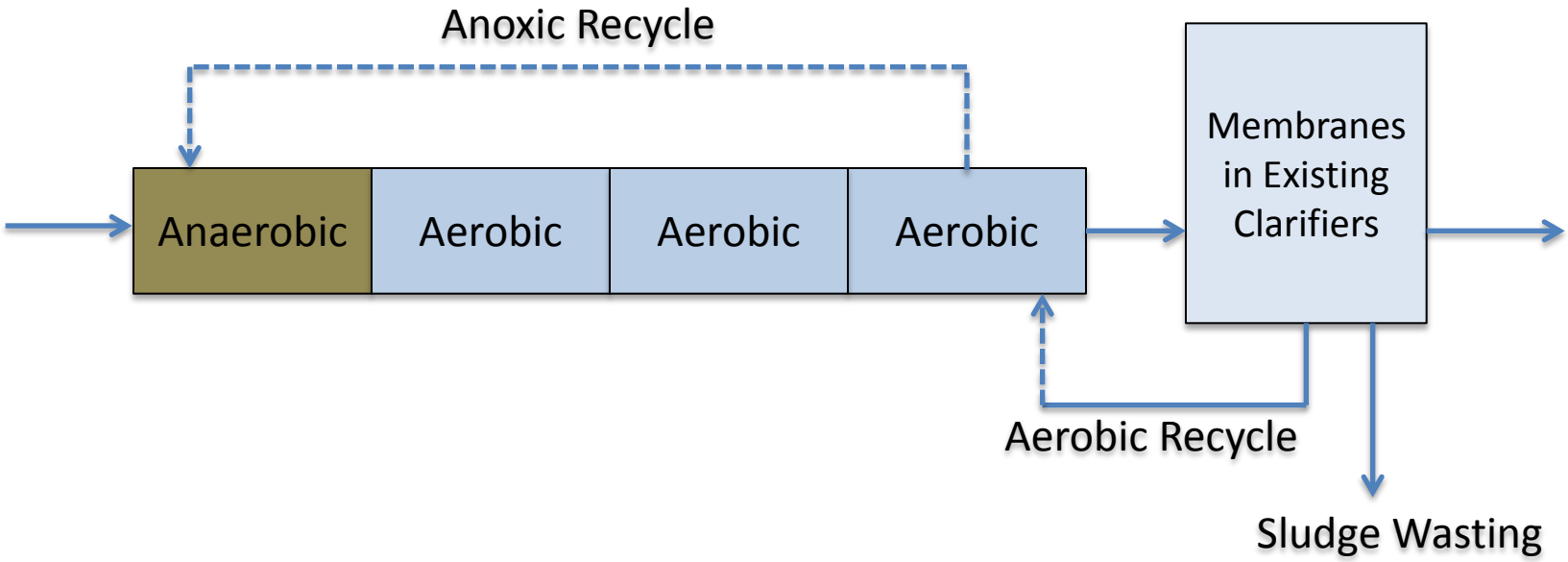


Modified Ludzack-Ettinger (MLE) Configuration

Parameter	Unit	Water Reclamation Plants	JWPCP
HRT	Hours	6 – 8	2.5
MLSS	mg/L	4,000 – 6,000	3,300
MCRT	Days	15	3.4
RAS Recycle	%	100	30
Internal ML Recycle	%	250 – 300	None

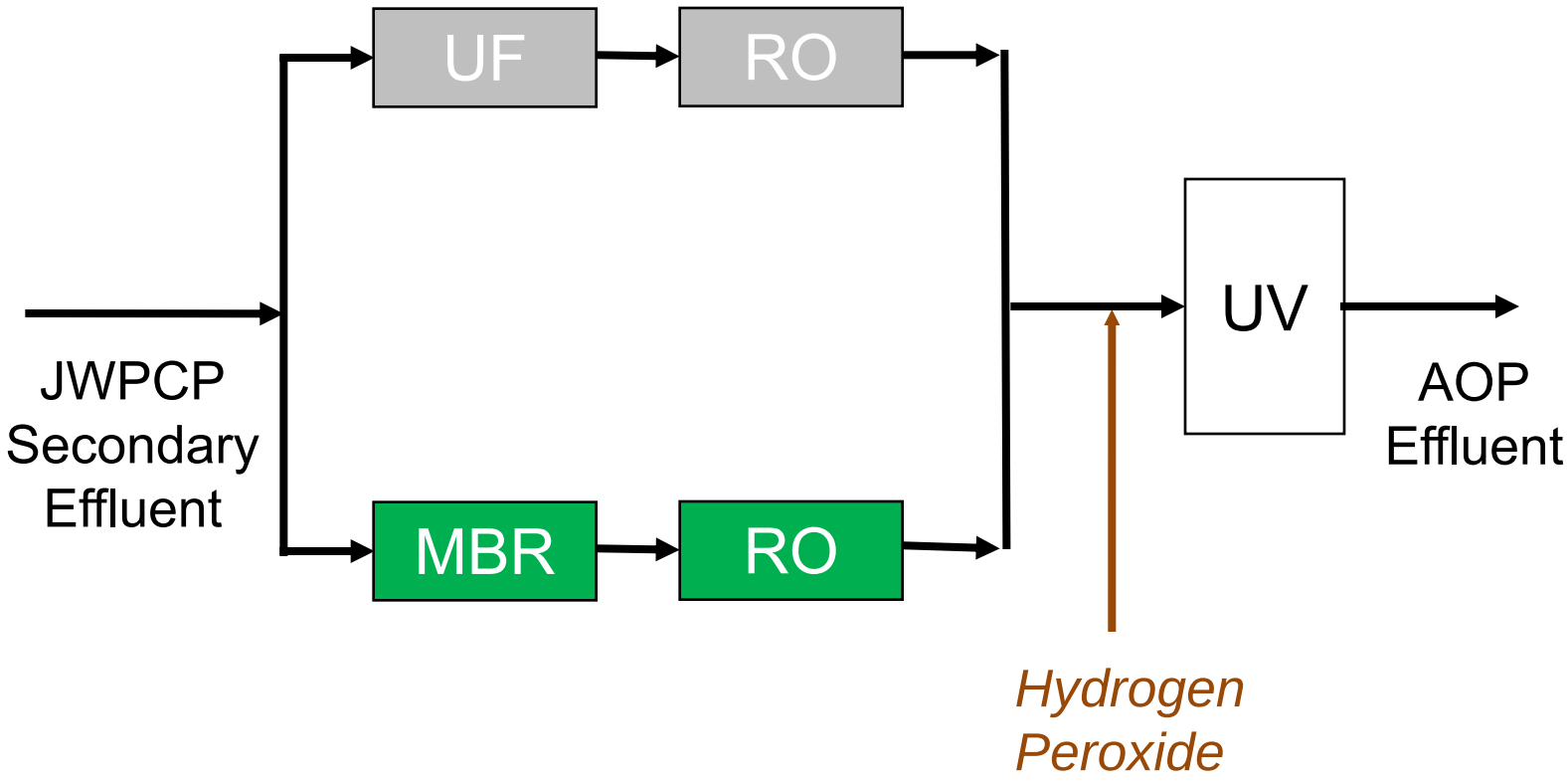
Significant “derating” expected (50 MGD → 25 MGD?)

NDN without Derating (MBR Treating Primary Effluent)



- MLSS: 8,000 – 10,000 mg/L
- MCRT: 15 days
- Significant modifications of existing systems (pumping, membranes)
- Expensive

MBR Fully Nitrifies JWPCP Effluent



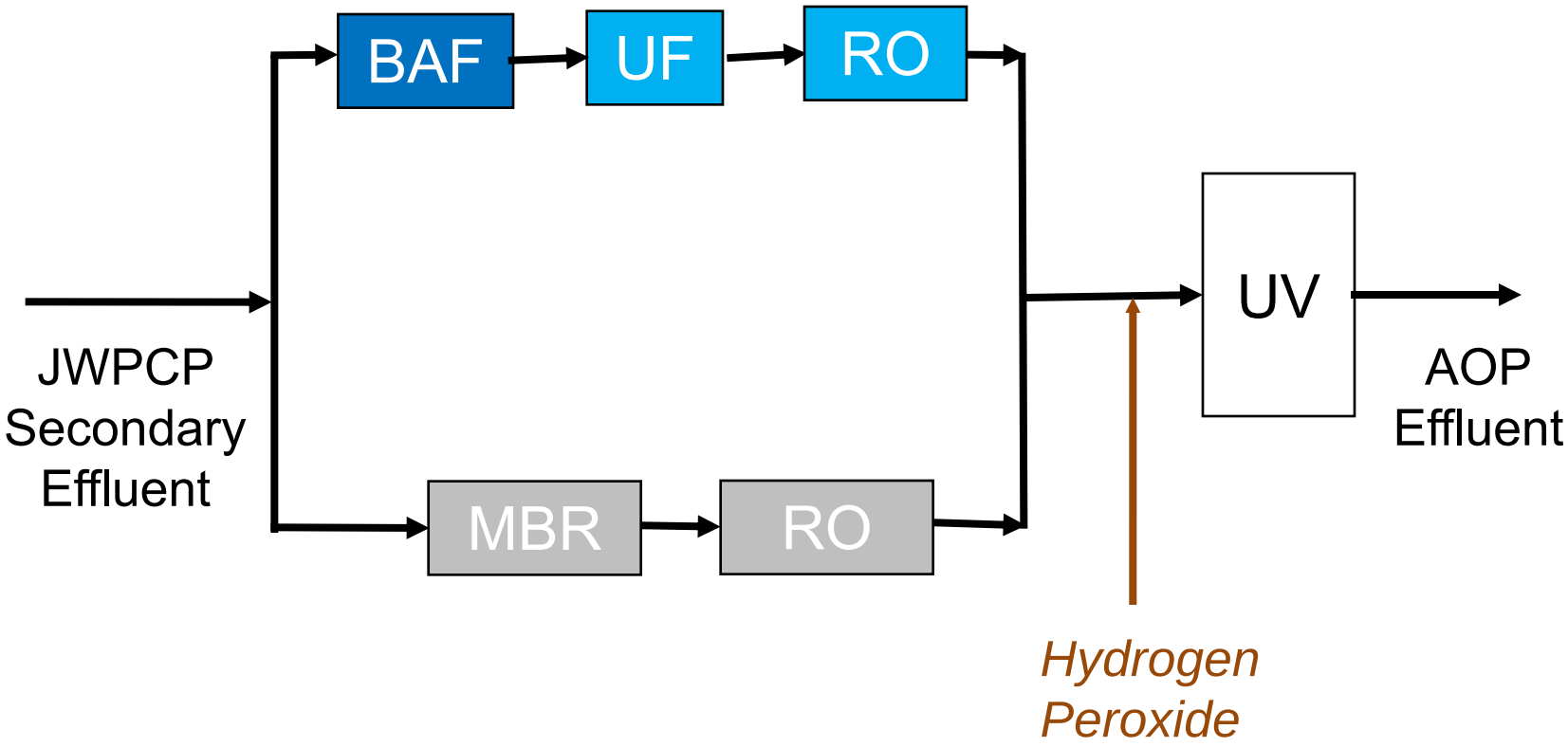
Water Quality - MBR vs. UF

Parameter	Units	JWPCP Effluent	MBR Permeate	UF Permeate
pH (Field)	-	7.1	7.0	7.3
Ammonia	mg N/L	37	<1.0	36
TKN	mg N/L	40	<1.0	38
Nitrate	mg N/L	<0.10	39	<0.10
Nitrite	mg N/L	0.03	0.02	0.04
Phosphate	mg P/L	0.50	0.29	0.25
COD	mg/L	55	32	--
TOC	mg/L	16	9.2	13
Alkalinity, Total	mg $CaCO_3$/L	373	100	372

Summary of MBR Advantages

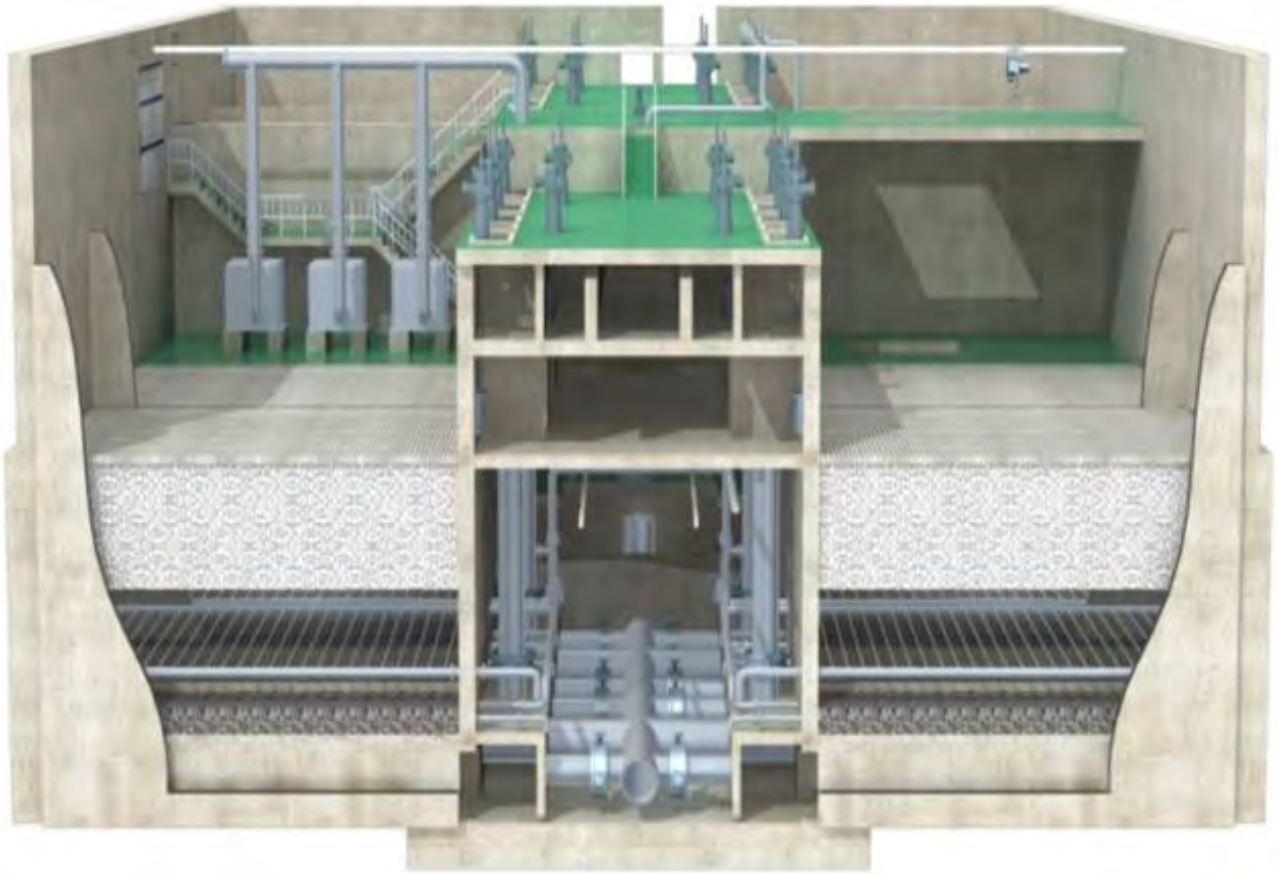
- Removes biodegradable organic matter and degrades some trace organics
  - Better water quality feed to RO
  - RO permeate TOC always < 0.5 mg/L
- Fully nitrifies secondary effluent → less acid needed for pH adjustment upstream of RO
- Less fouling, less cleaning time vs. UF
- Membranes can be operated at 23 gfd (similar to UF membranes treating non-NDN secondary effluent)

Nitrify JWPCP Effluent Upstream of UF-RO with Biological Aerated Filter (BAF)



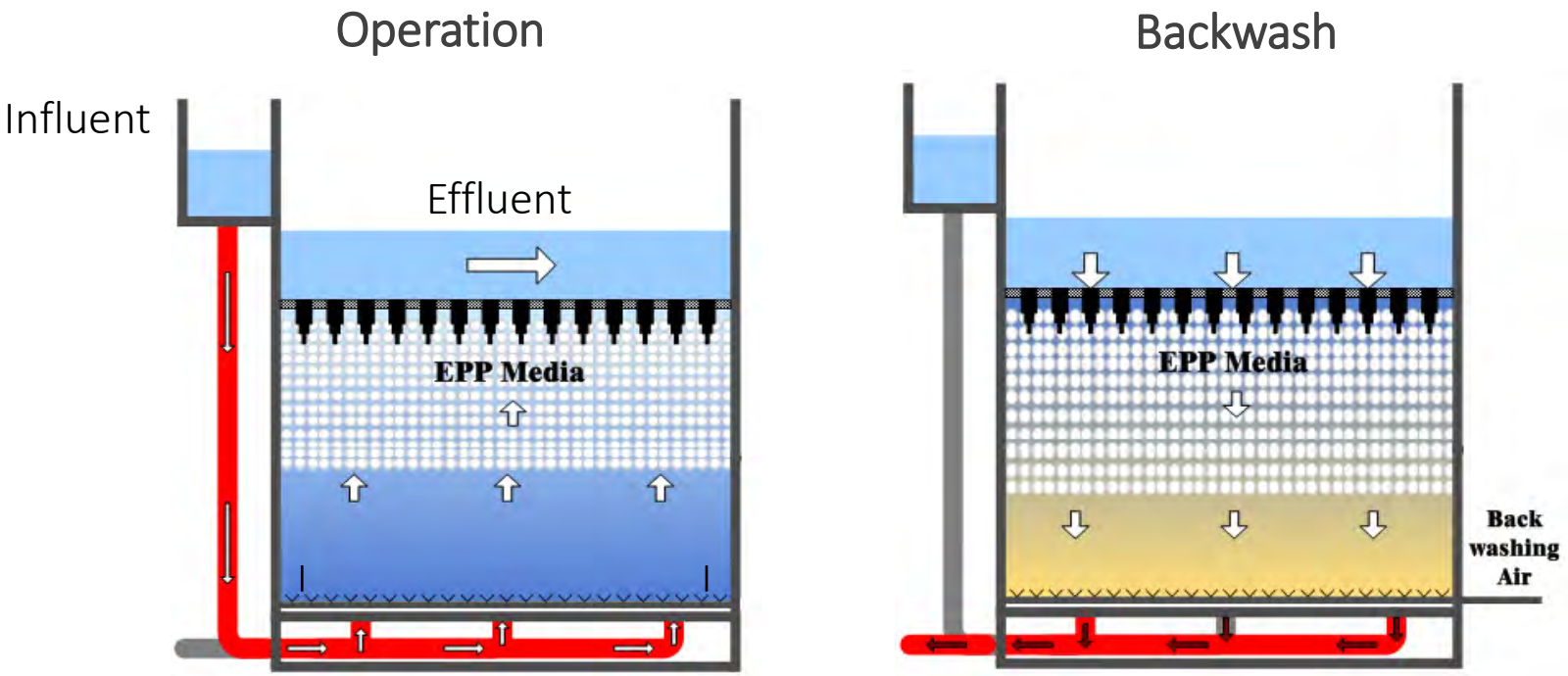
Biological Aerated Filter

- Up-flow reactor with proprietary media for biofilm attachment
- Applications: nitrogen removal with simultaneous particle removal
- Several manufacturers (Kruger, IDI, BKT)



BAF Operations

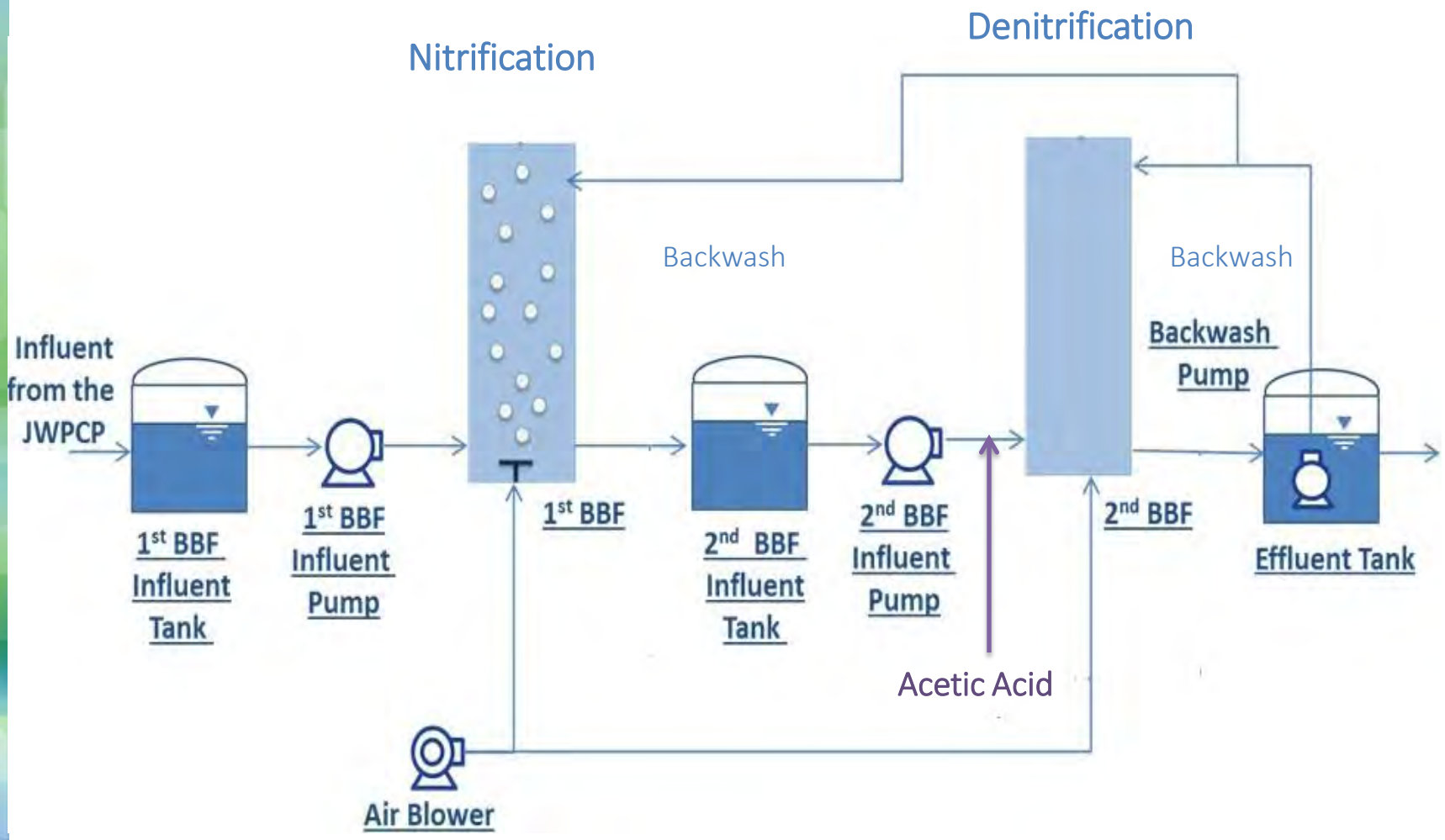
- Up-flow filtration (operation)
- Gravity based down-flow backwash
- Particles are filtered by the floating media



BKT's BAF Pilot System

- One column for nitrification and one for denitrification (need external electron donor)
- Expanded polypropylene media
- Title 22 approved for tertiary filtration

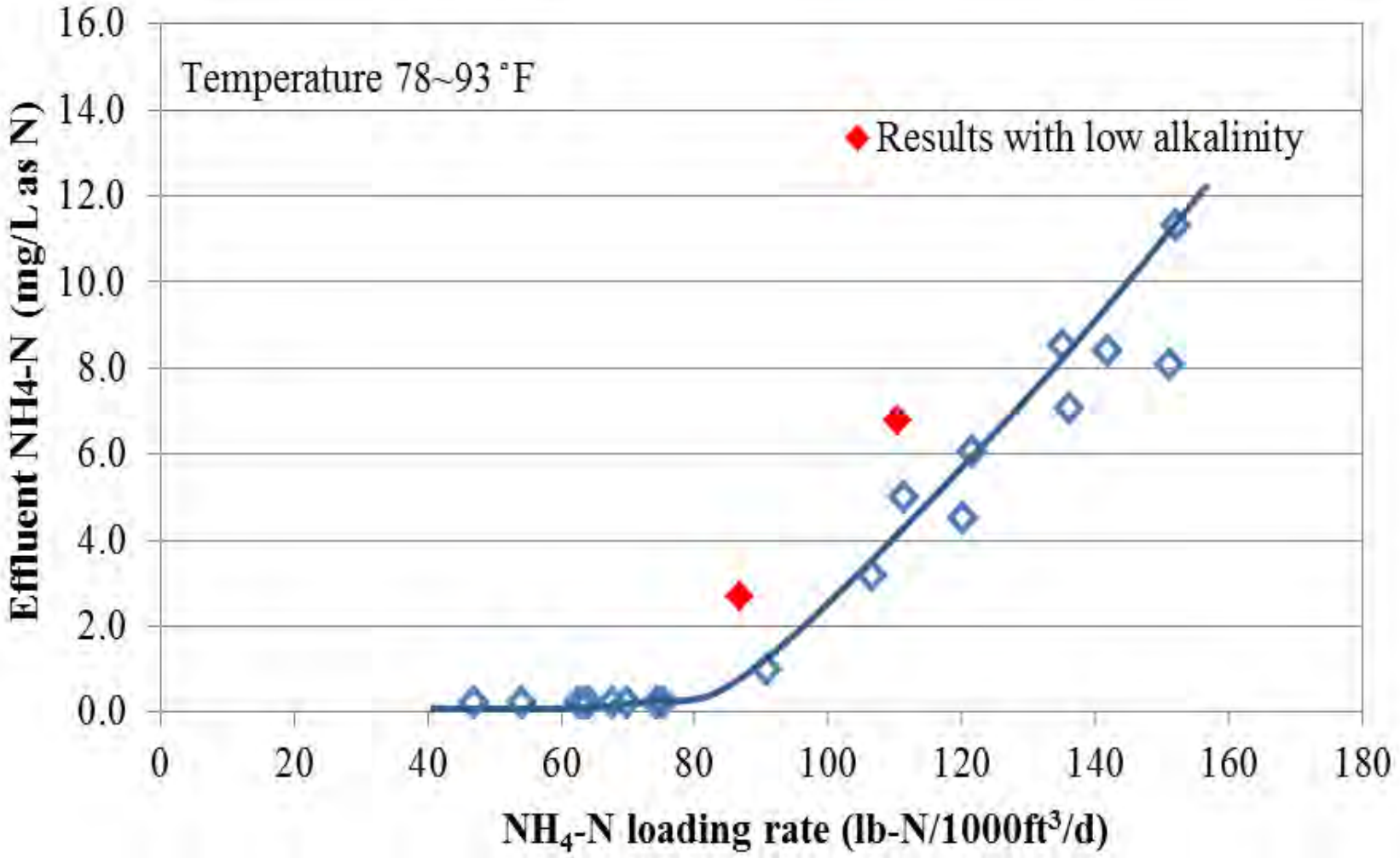
Schematic Diagram



Operating Conditions of Nitrifying BAF

Parameters	Units	Flow (gpm)			
		1.7	2.6	3.3	4.0
Empty Bed Contact Time	min	52	34	27	22
Hydraulic Loading Rate	gpm/ft^2	0.9	1.3	1.7	2.0
NH_4-N Loading Rate	lb N/1000 ft^3-d	65	95	124	146
	Kg/m^3-d	1.0	1.5	2.0	2.4
DO	mg/L	5.0~6.5			
Temperature	℉	78~93			

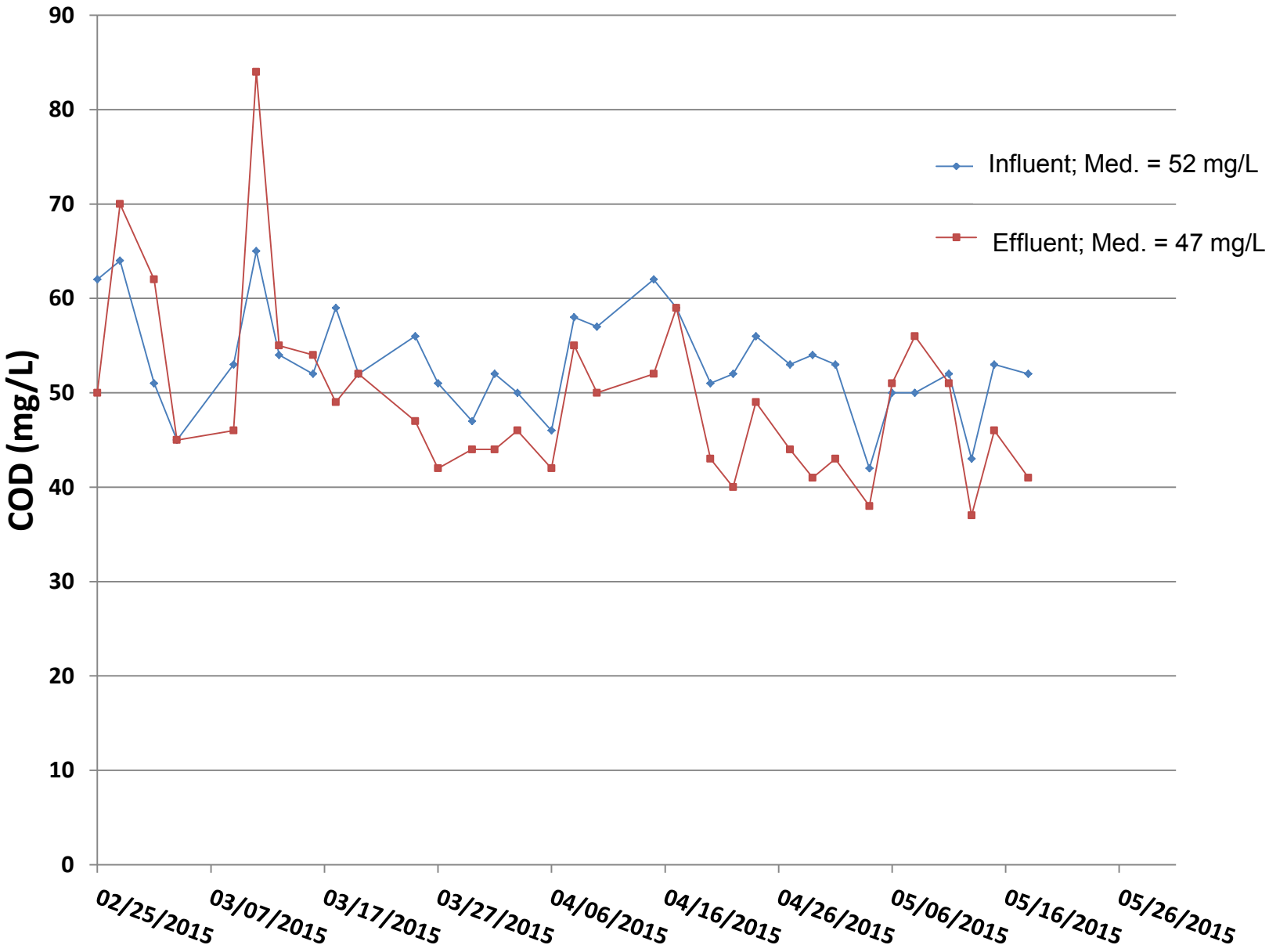
Nitrification Capacity of Nitrifying BAF



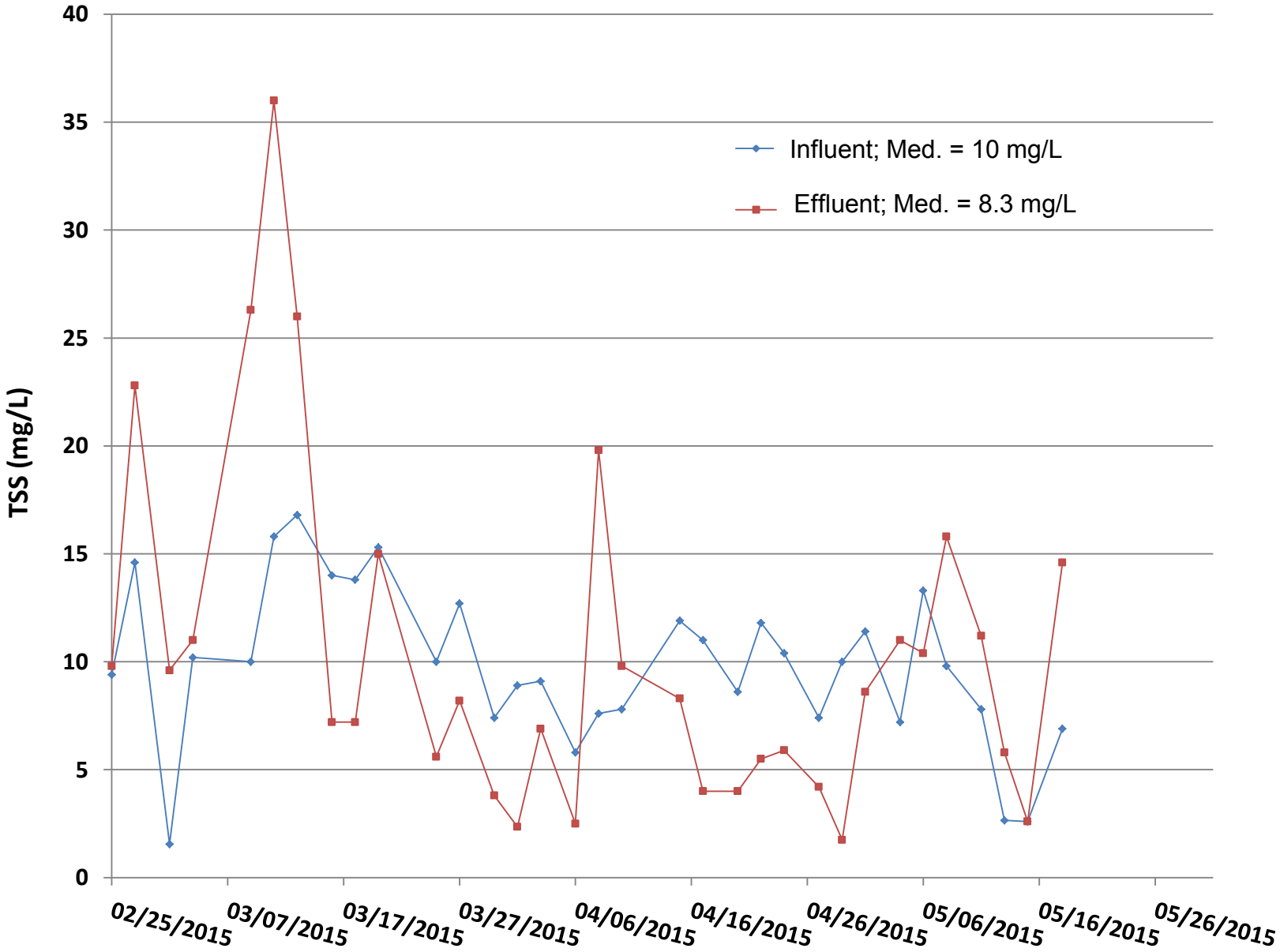
Nitrifying BAF Performance

Parameters	Units	Influent			Effluent		
		Average	Min	Max	Average	Min	Max
NH_4-N	mg N/L	38.1	34.9	40.5	4.2	<1	12.4
NO_3-N	mg N/L	ND	-	-	31.2	20.8	37
NO_2-N	mg N/L	ND	-	-	2.7	0.1	8.54
Alkalinity	mg $CaCO_3$/L	333	218	380	118	92	130
COD	mg/L	58	43	75	48	41	61
BOD	mg/L	3.5	3	4	-	-	-
TSS	mg/L	10.5	9	12	5.0	3.1	7.9
Turbidity	NTU	4.4	2.3	16	1.5	0.8	2.5

Nitrifying BAF COD Removal



Nitrifying BAF TSS Removal



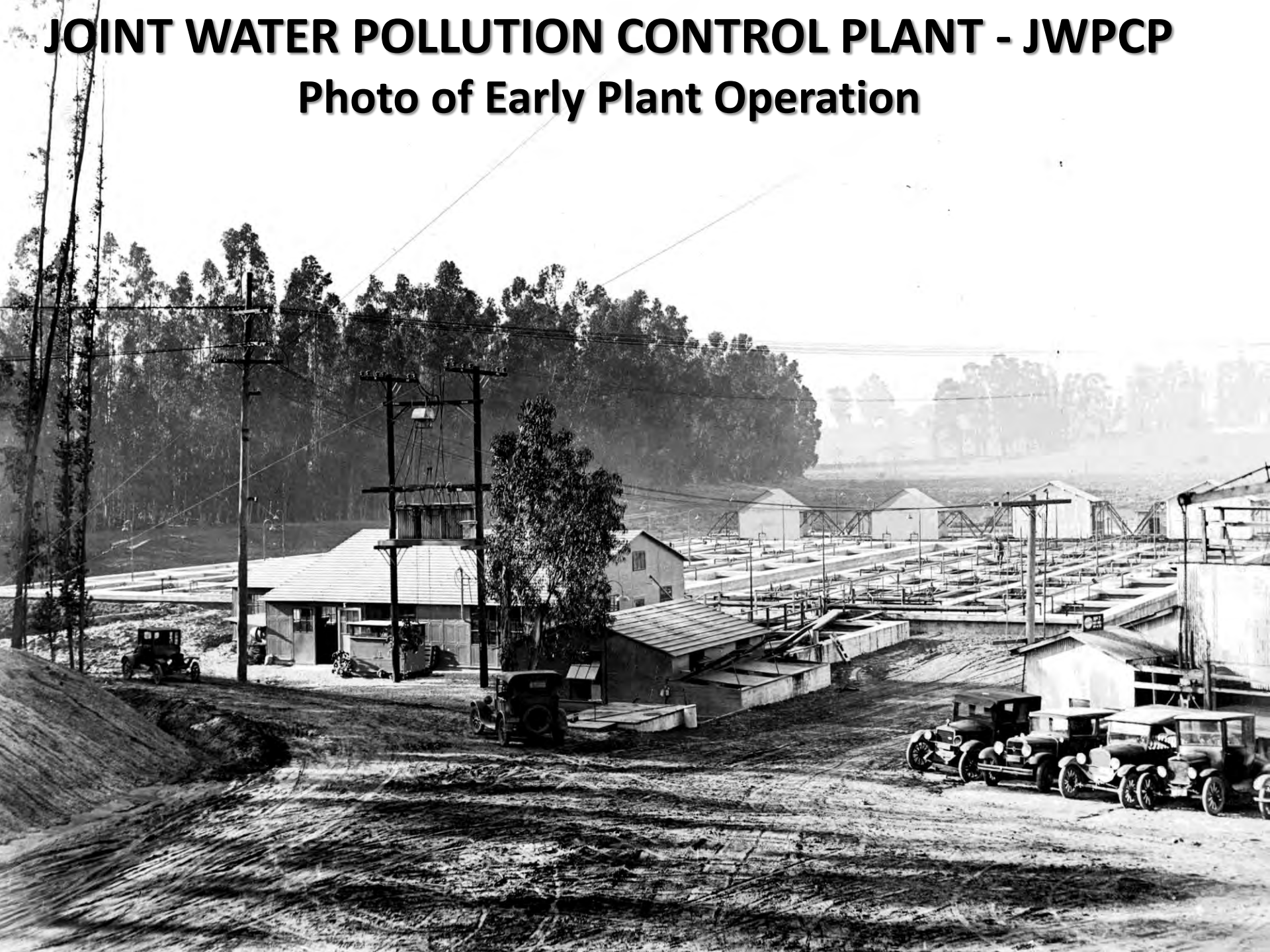
Summary

- JWPCP's HPOAS system is not designed for nitrification or biological nitrogen removal; upgrade would result in substantial derating or significant costs.
- JWPCP effluent can be nitrified separately; options include MBR or nitrifying BAF followed by UF.
- MBR-RO-AOP has been extensively tested and has a number of advantages.

Wastewater Treatment Facilities Map

JOINT WATER POLLUTION CONTROL PLANT - JWPCP

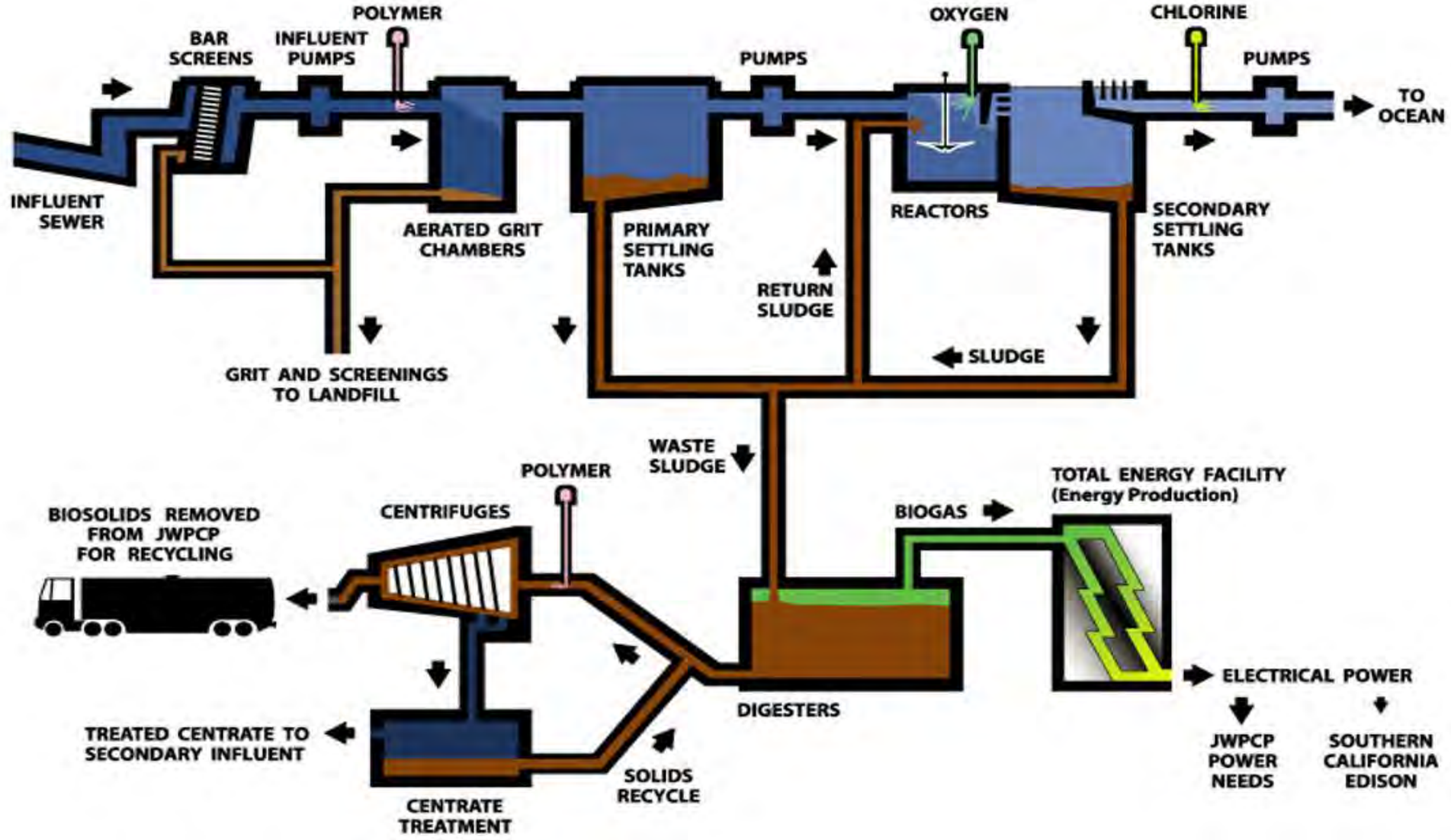
Photo of Early Plant Operation



Aerial View of the JWPCP
285 MGD

JWPCP Treatment Areas

JWPCP PROCESS FLOW




J.O.-B SEWER

Primary Treatment Area

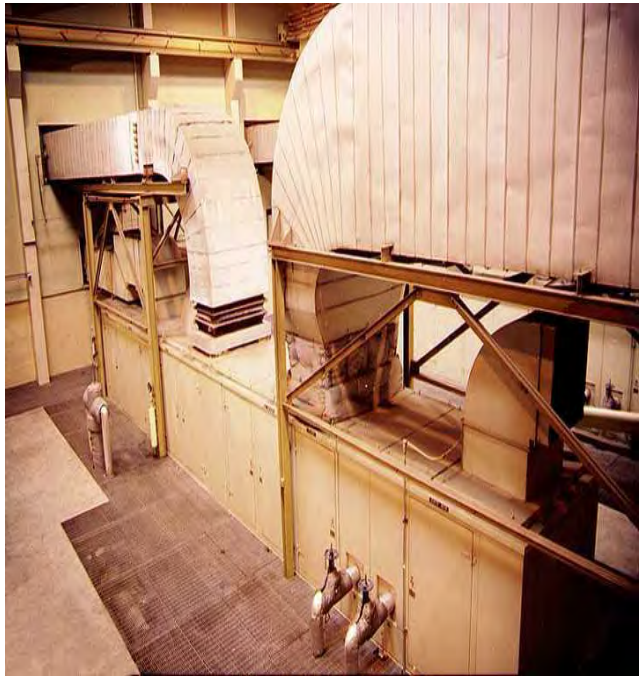
Inlet Works


Aerated Grit
Chambers &
Inlet Pumps


PRIMARY SEDIMENTATION TANKS &
SECONDARY INFLUENT PUMP STATION

Anaerobic Digesters

Power Generation



Two Stage Treatment of Air in Primary Treatment

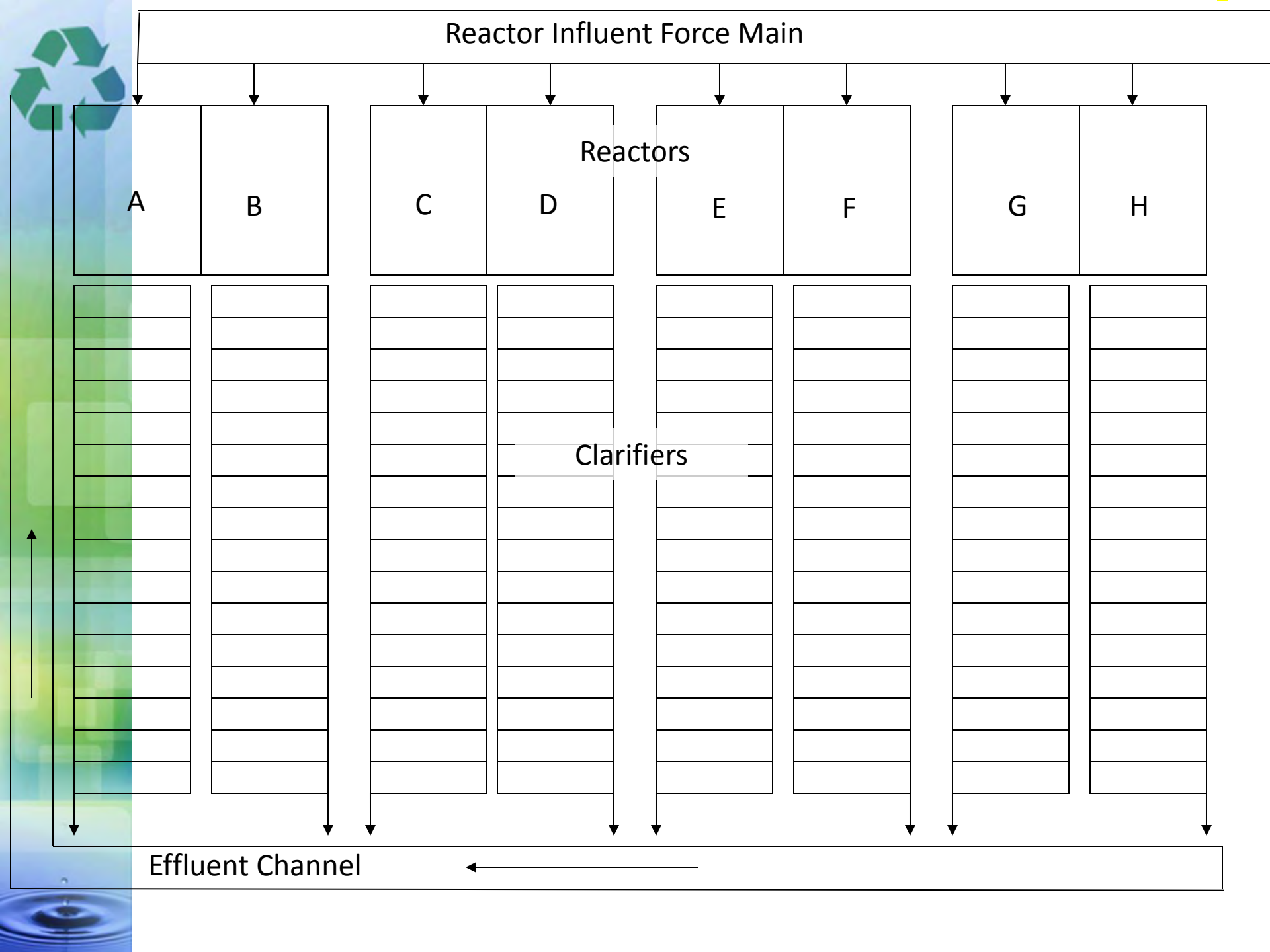
Biotrickling Filters + Activated Carbon

Secondary Treatment

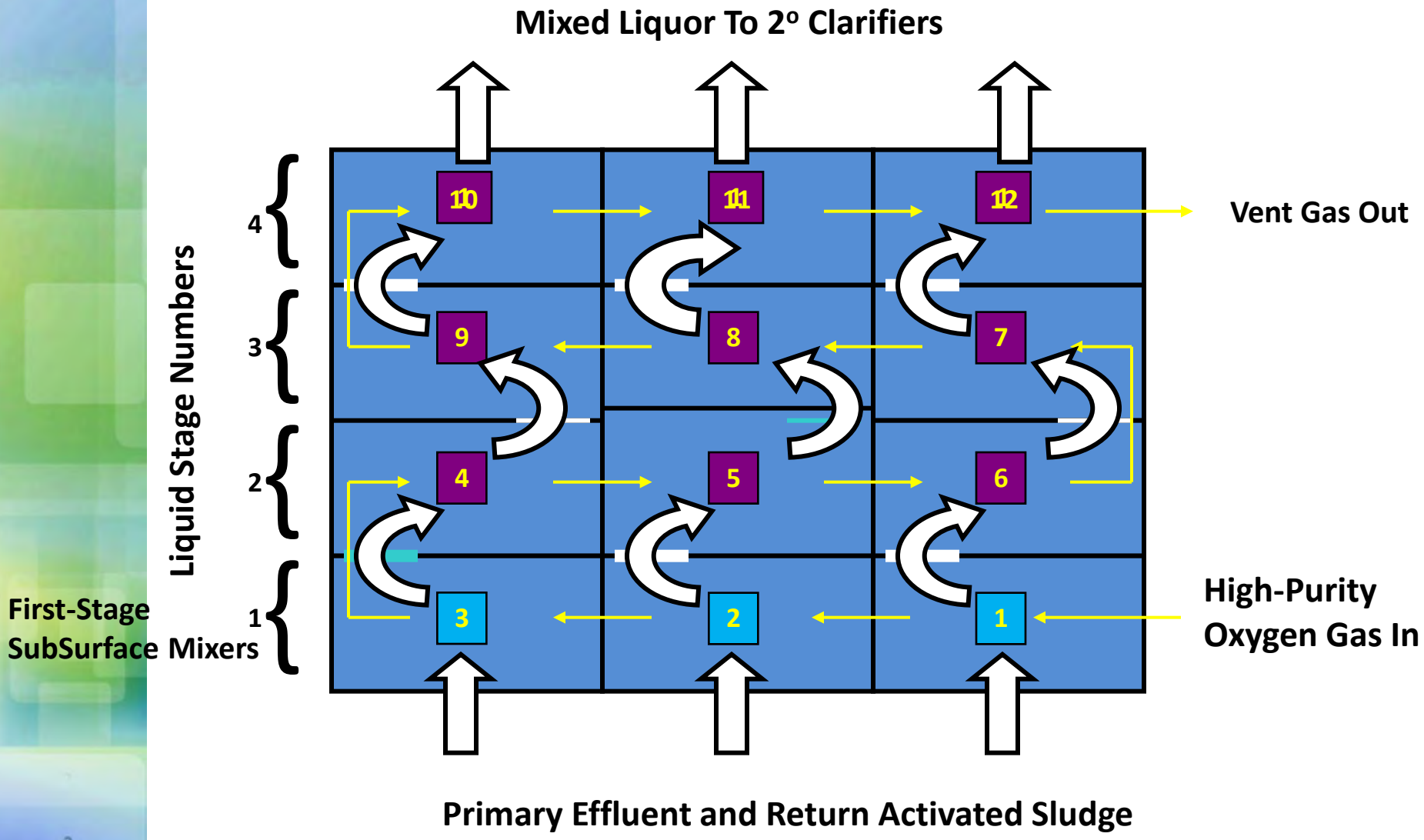
Reactors

Clarifiers

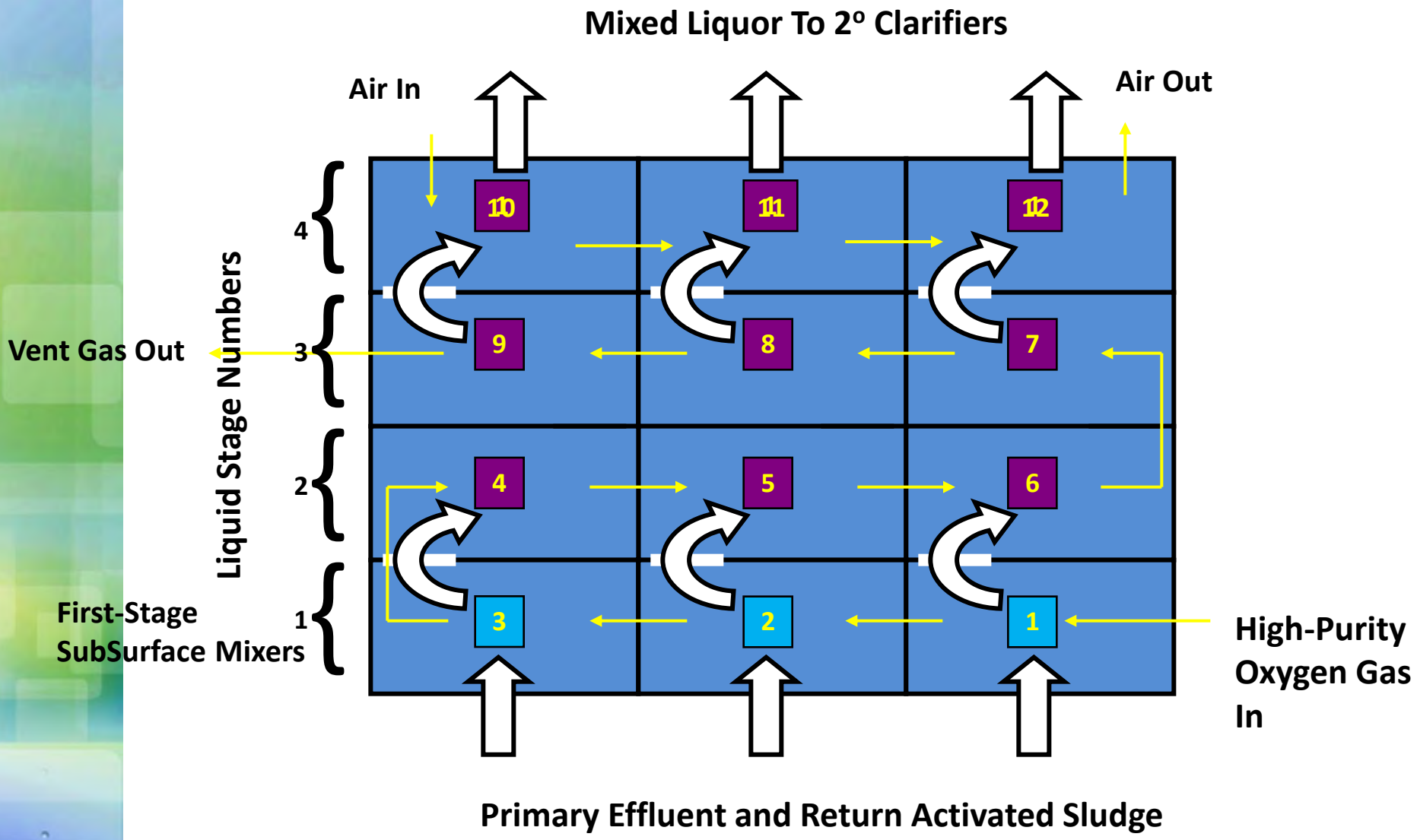
Secondary Treatment Reactors & Clarifiers


Reactor Influent Force Main
Reactors
A
B
C
D
E
F
G
H
Clarifiers
Effluent Channel

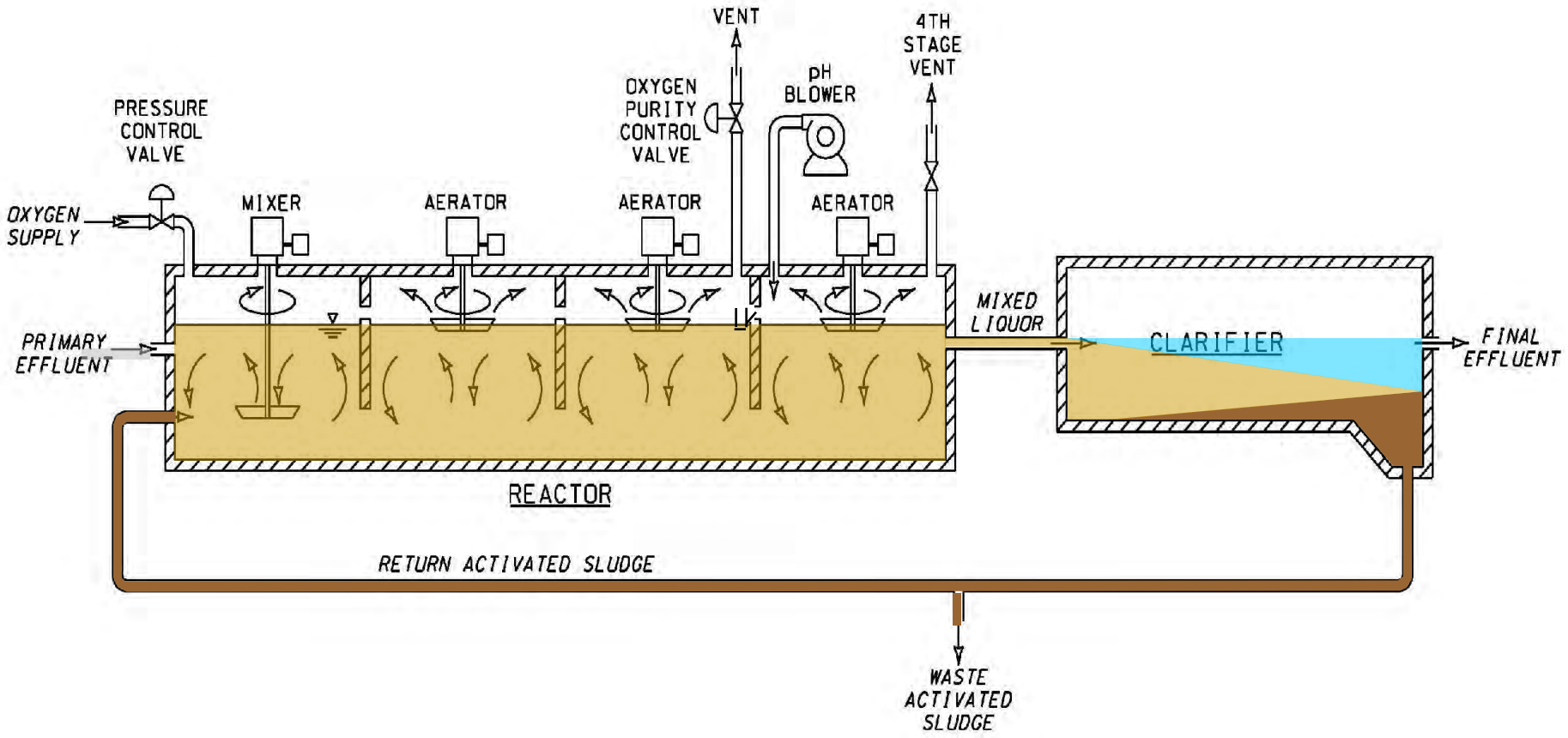
JWPCP Secondary Oxygen and Liquid Process Flows
Arrangement No. 1



JWPCP Secondary Oxygen and Liquid Process Flows Arrangement No. 2



Activated Sludge Process



Cryogenic Oxygen Separation Plants

JWPCP Tunnel/Outfall

- 2 Tunnels
- 4 Outfalls
  - 2 miles out
  - Over 160 feet below surface

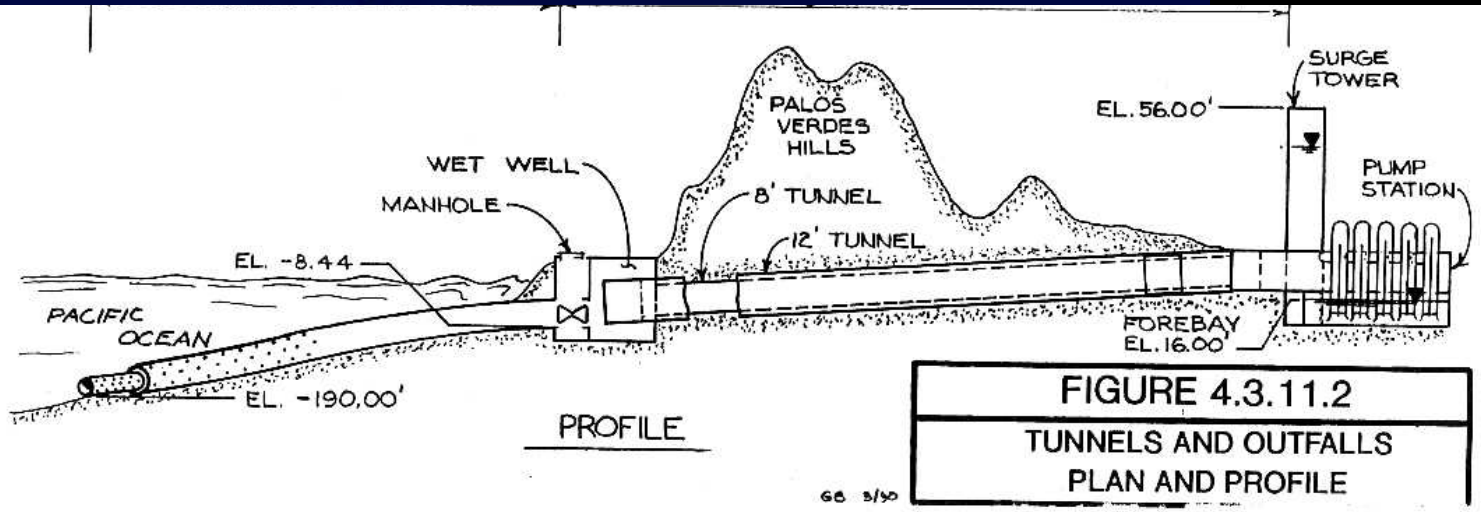


FIGURE 4.3.11.2
TUNNELS AND OUTFALLS
PLAN AND PROFILE

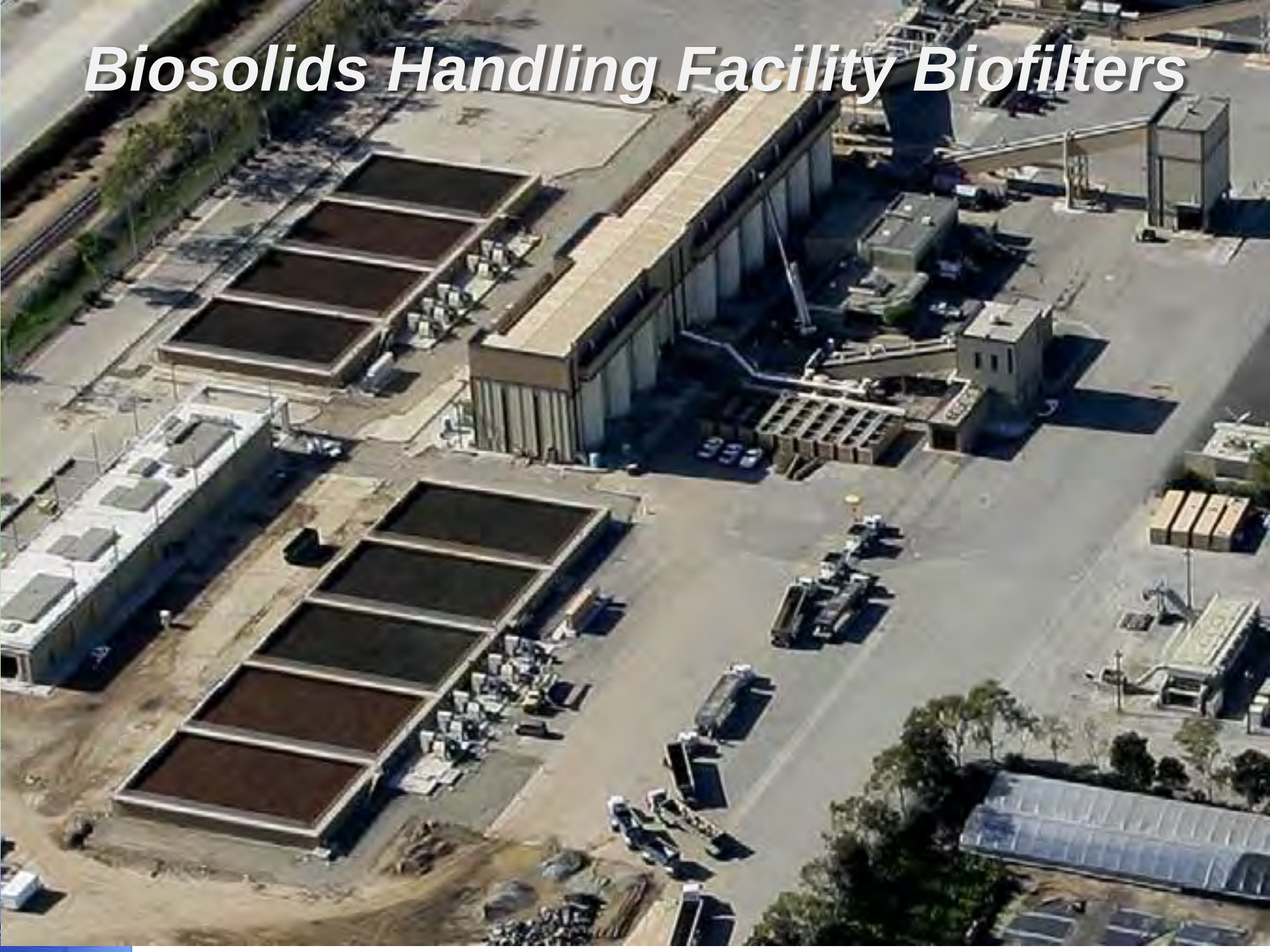
GB 3/90

Solids Handling Facility


Dewatering Building

Truck Loading Stations

Biosolids Handling Facility Biofilters



Questions?