Design, Startup and Operation of Utah's First Deammonification System

August 8, 2024

WATER TECHNOLOGIES

VEOLIA

Meet The Presenters

Phillip Heck PhD, P.E.
General Manager
Central Valley WRF

Dustin Gloor
Process Coordinator
Central Valley WRF

Rodrigo Lara
Regional Sales Manager
Veolia Water Technologies

WATER TECHNOLOGIES

VEOLIA

Agenda

1 Deammonification System

2 CVWRF Timeline

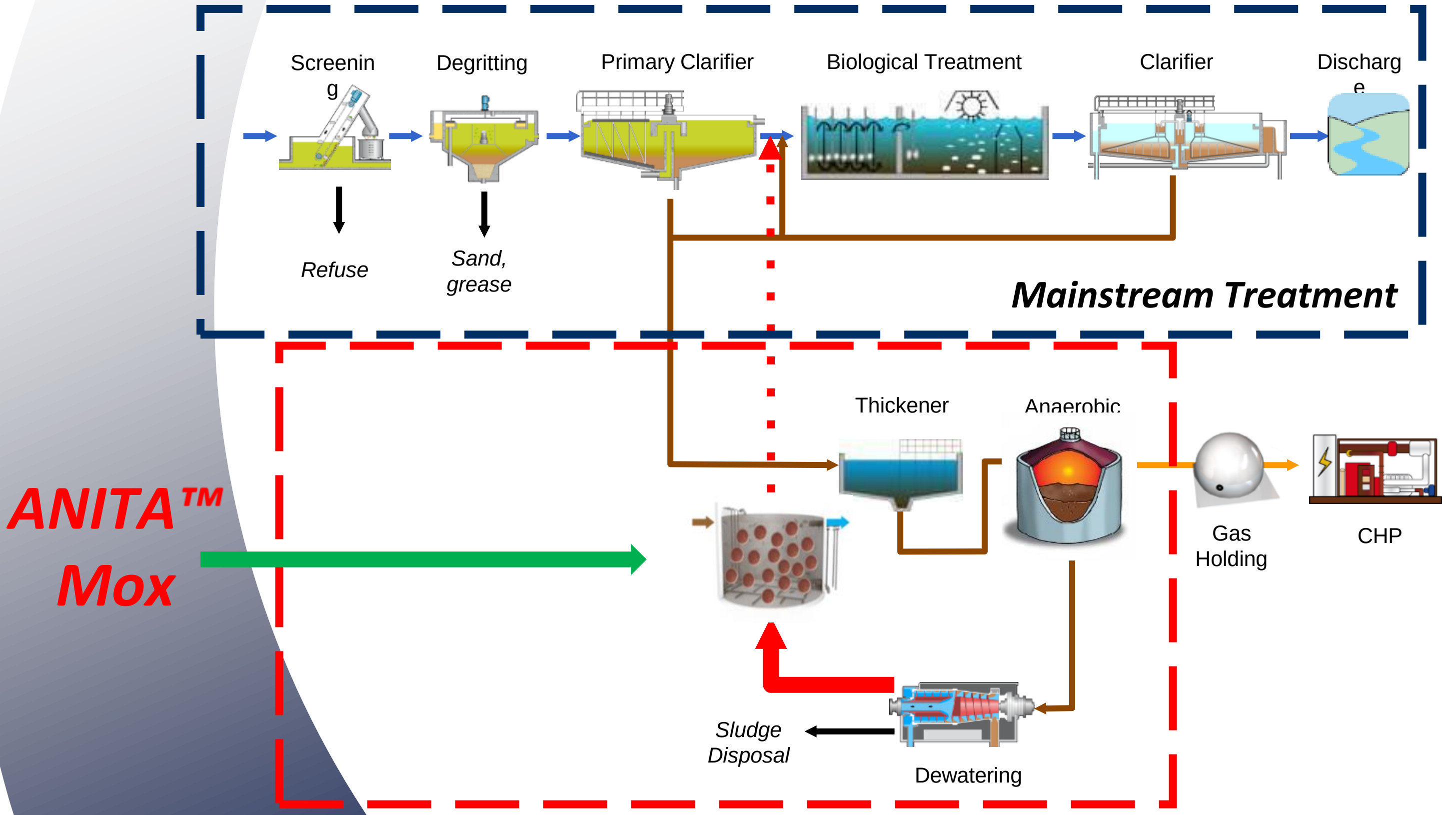
3 Nutrient Removal Process at CVWRF

4 Process & Financial Benefits

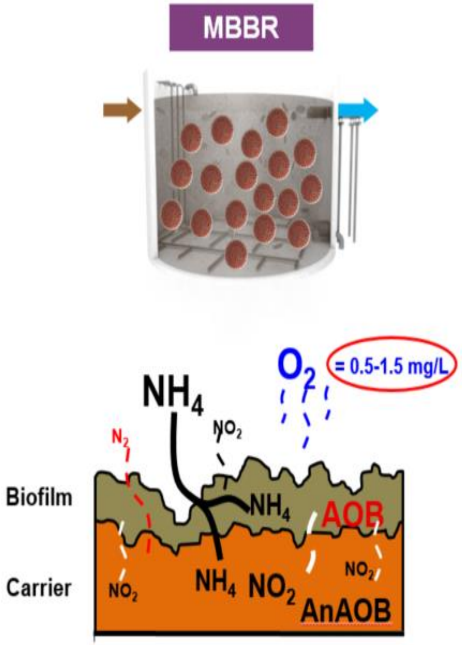
5 Solution Selection

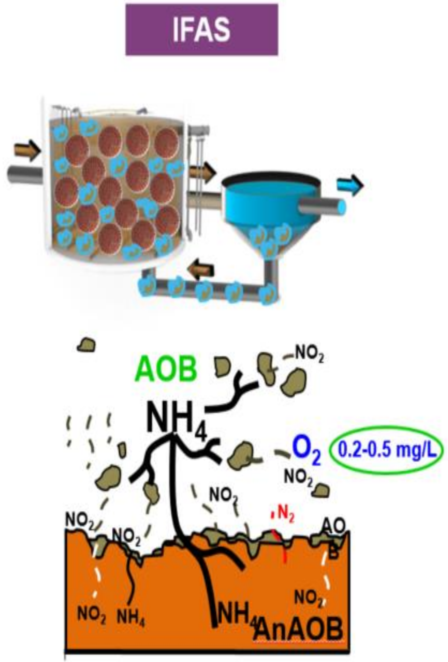
6 Q&A

ANITA™ MOX For Centrate / Filtrate Treatment



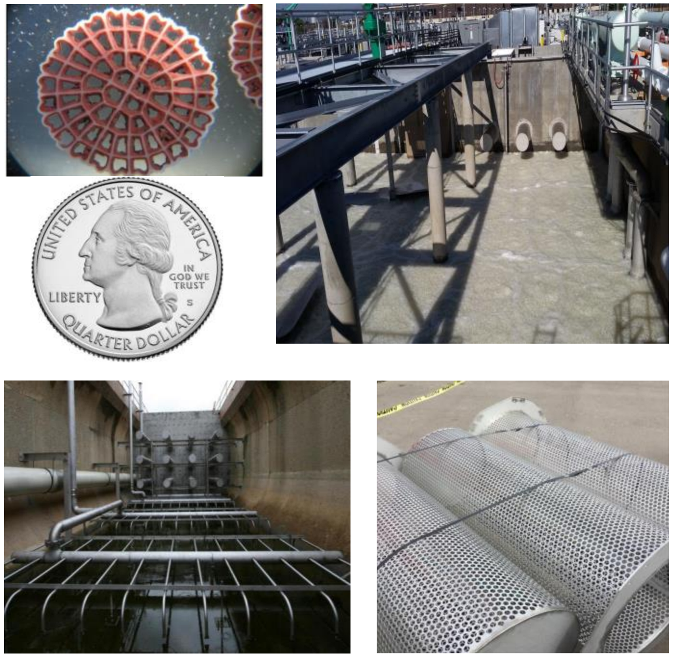
Two Process Options For Flexibility & Expansion





AOB in biofilm = NO_2^- limitation

AOB in flocs = less NO_2^- limitation

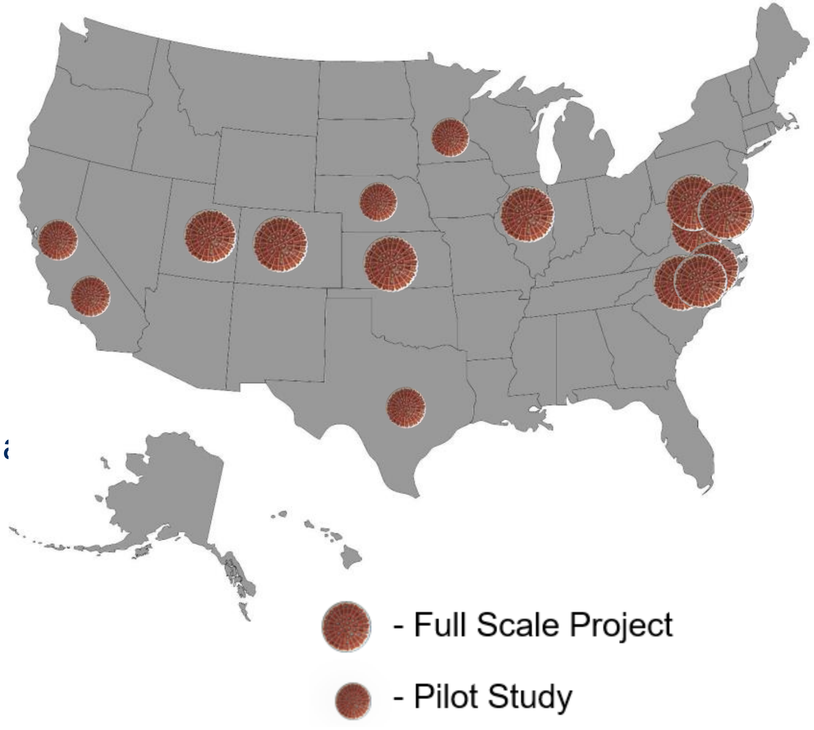


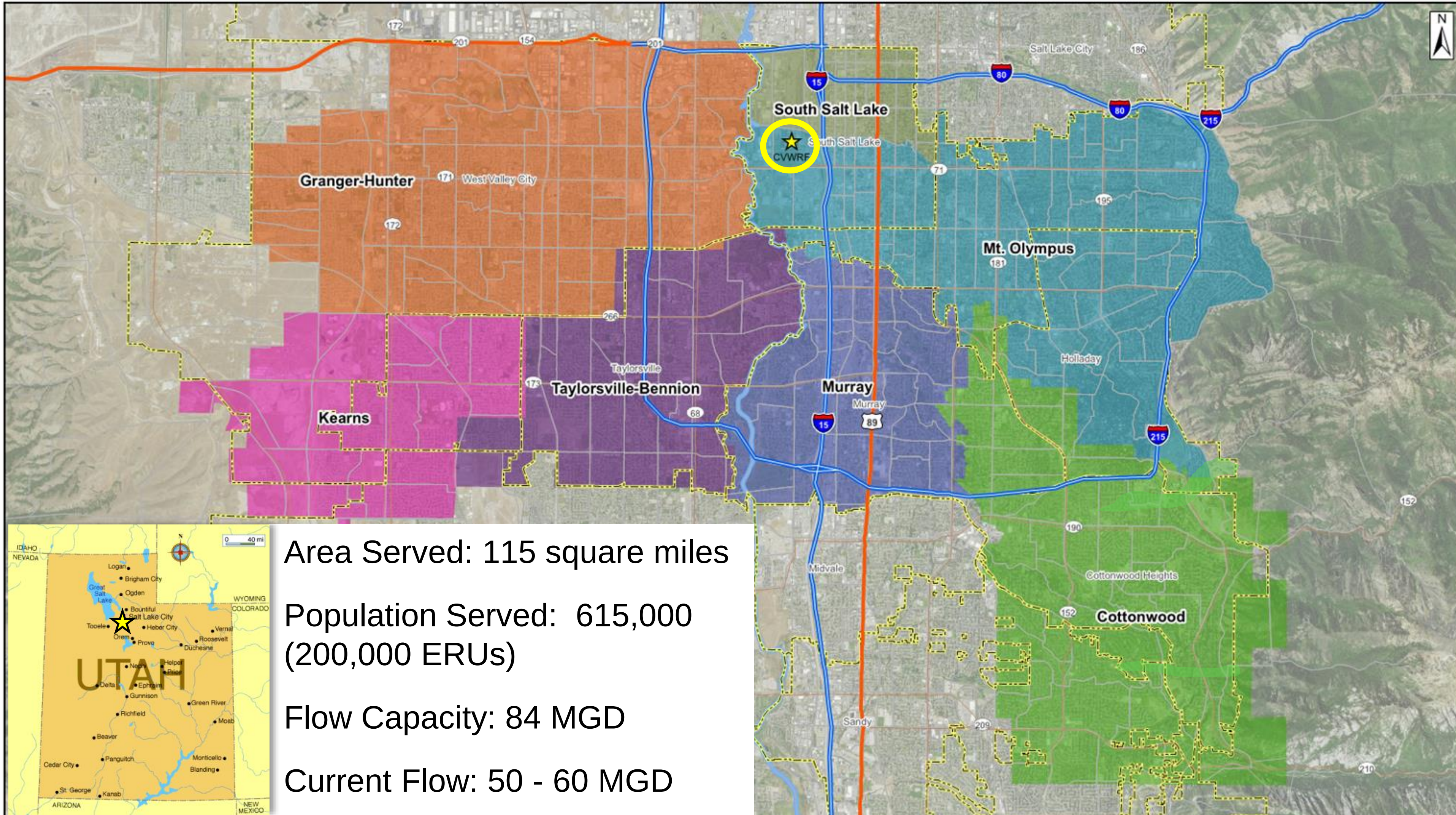
Biofilm Technology Proven To Be Simple, Stable & Robust

- Operator friendly technology
- Resilient, works with flexible dewatering schedules
- Minimal operation and maintenance requirements
- Biofilm technology, significant lower risk of anammox washout
- Tolerate high range of TSS, polymer, DO, pH, NO2 residual etc.
- Greater protection from shocks / toxicity
- Reuse existing tanks, wide water depth (10-30ft) and geometry
- Capacity increase by adding more media, phased approach for expansion

A Decade Of Experience With 40 Projects Worldwide

- James River TP, VA (HRSD) (2014) – 550 lbs/day
- South Durham WRF, NC (2015) – 700 lbs/day
- Denver Metro, CO (2017) – 9,000 lbs/day
- Howard County MD (2018) – 2,000 lbs/day
- Tomahawk Creek, KS (2021) – 950 lbs/day
- WSSC, MD (THP, 2022) – 5,700 lbs/day
- Central Valley, UT (2022) – 2,000 lbs/day
- North Durham NC (bid) – 700 lbs/day
- Raleigh Neuse NC (THP, bidding soon) – 3,400 lbs/da
- Fresno-Clovis RWRF (pre-selected 2023)
- Other Preselected Projects





Area Served: 115 square miles

Population Served: 615,000 (200,000 ERUs)

Flow Capacity: 84 MGD

Current Flow: 50 - 60 MGD

CVWRF Nutrient Program Timeline

2015-2026

2015

Utah Adopts Technically Based Phosphorus Effluent Limits Rule

2016-17

Investigation and selection of P removal alternative

Pilot Testing of Selected Process - Biological Phosphorus Removal (BNR)

2018-19

Preliminary and Final Design of BNR

Regulatory Approvals

2020

Construction started on BNR Basins and Blower Building Projects

Design of Airprex side-stream phosphorus (SSP)

Design of Anitamox side-stream Nitrogen (SSN)

2021-22

Construction Started on SSP and SSN Projects

Construction started on Primary Sludge Fermentation and Thickening Project

2023-24

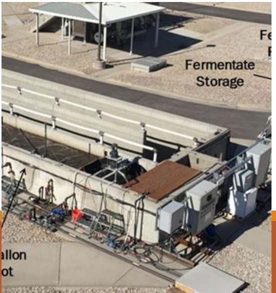
Construction Started Dewatering Bldg. Upgrades

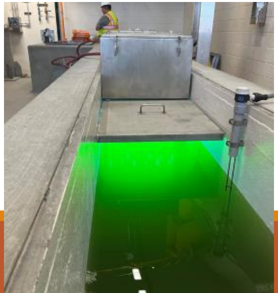
SSN and SSP Start-up Q4 2023

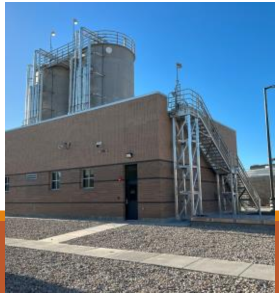
2024-26

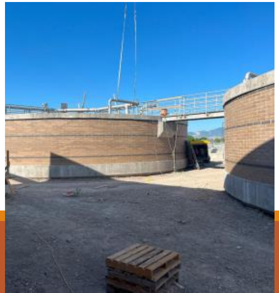
Blower Building Start-up planned for Q3 2024

BNR Start-up planned for Q3 2025

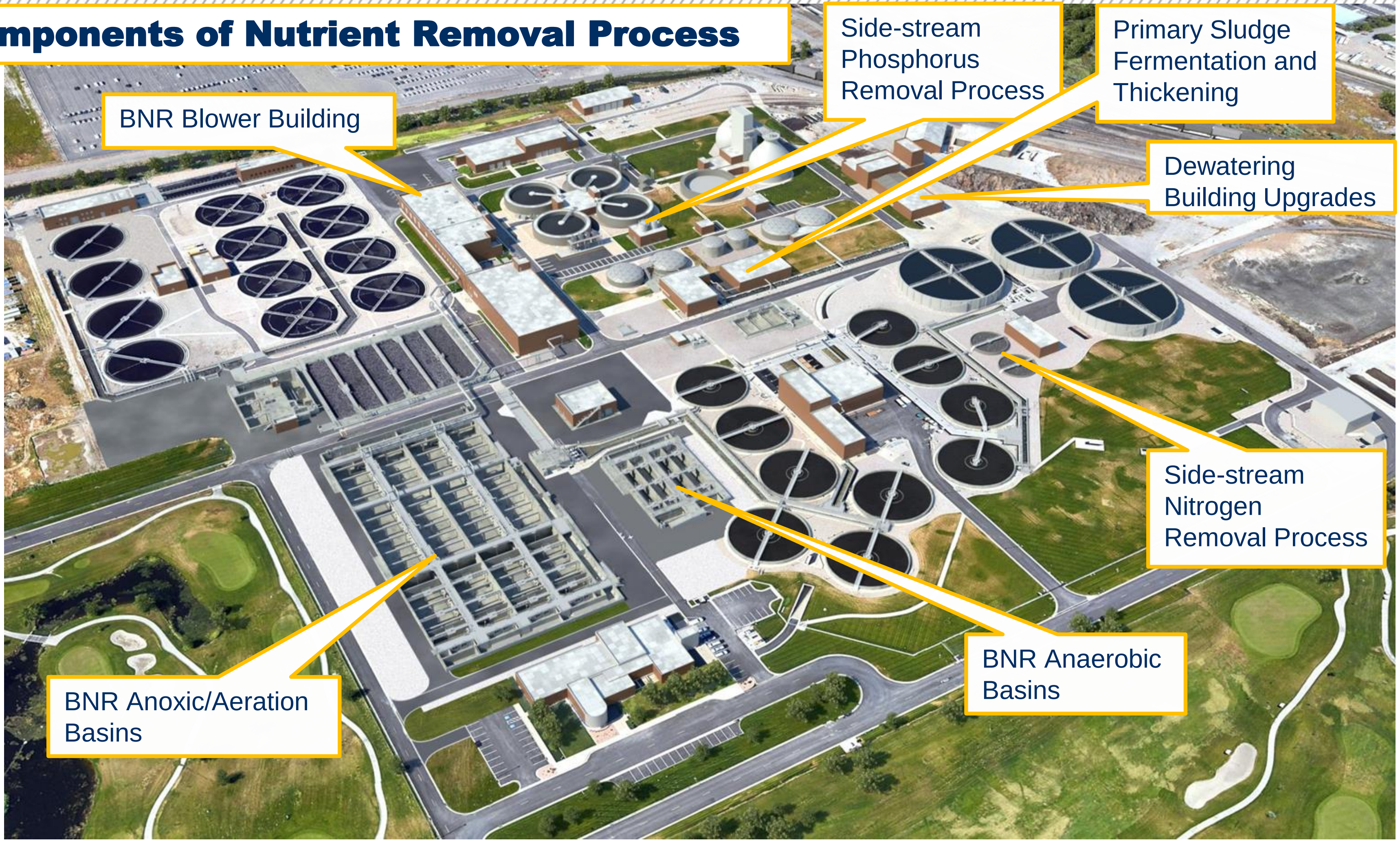




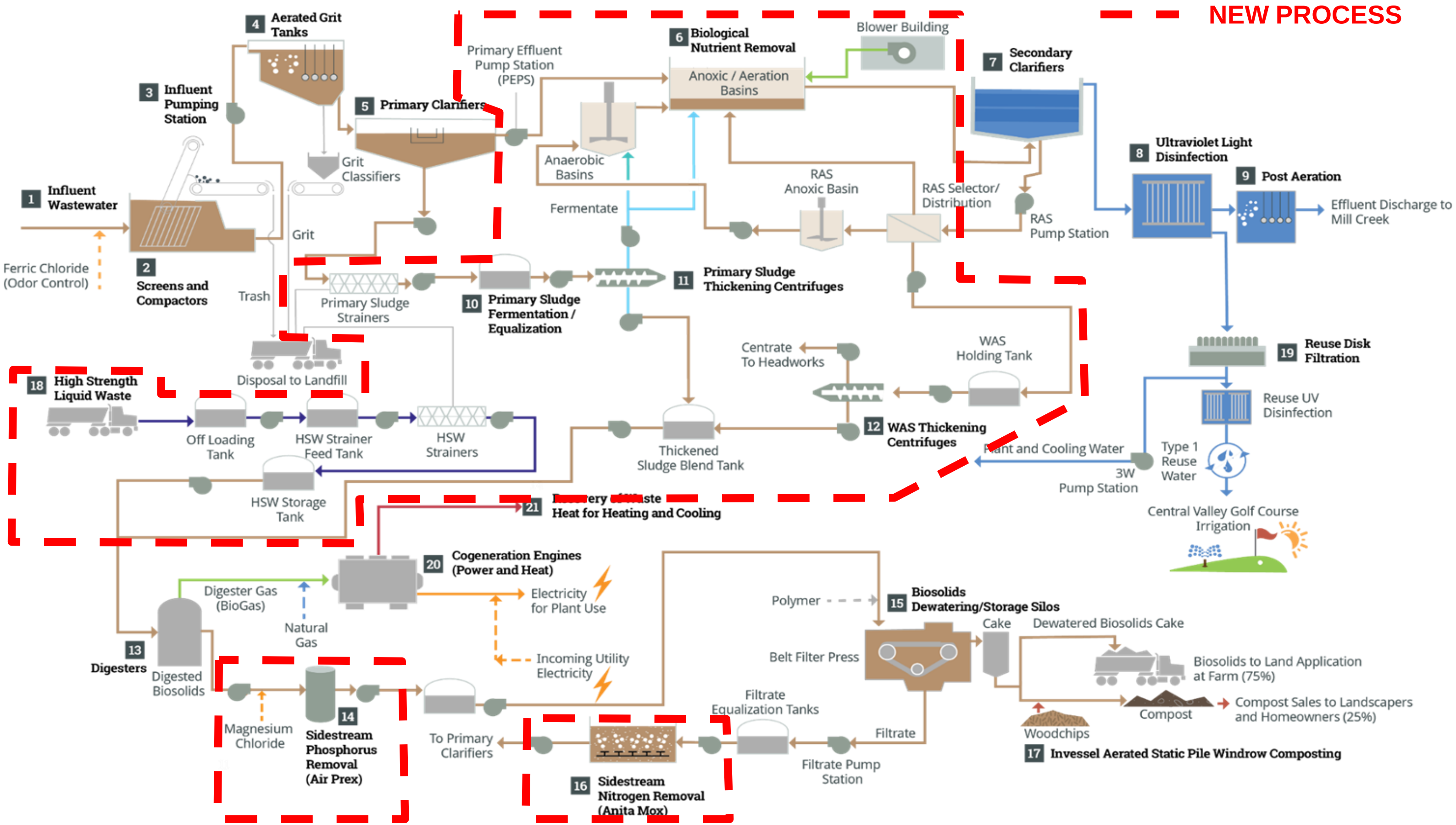




Components of Nutrient Removal Process



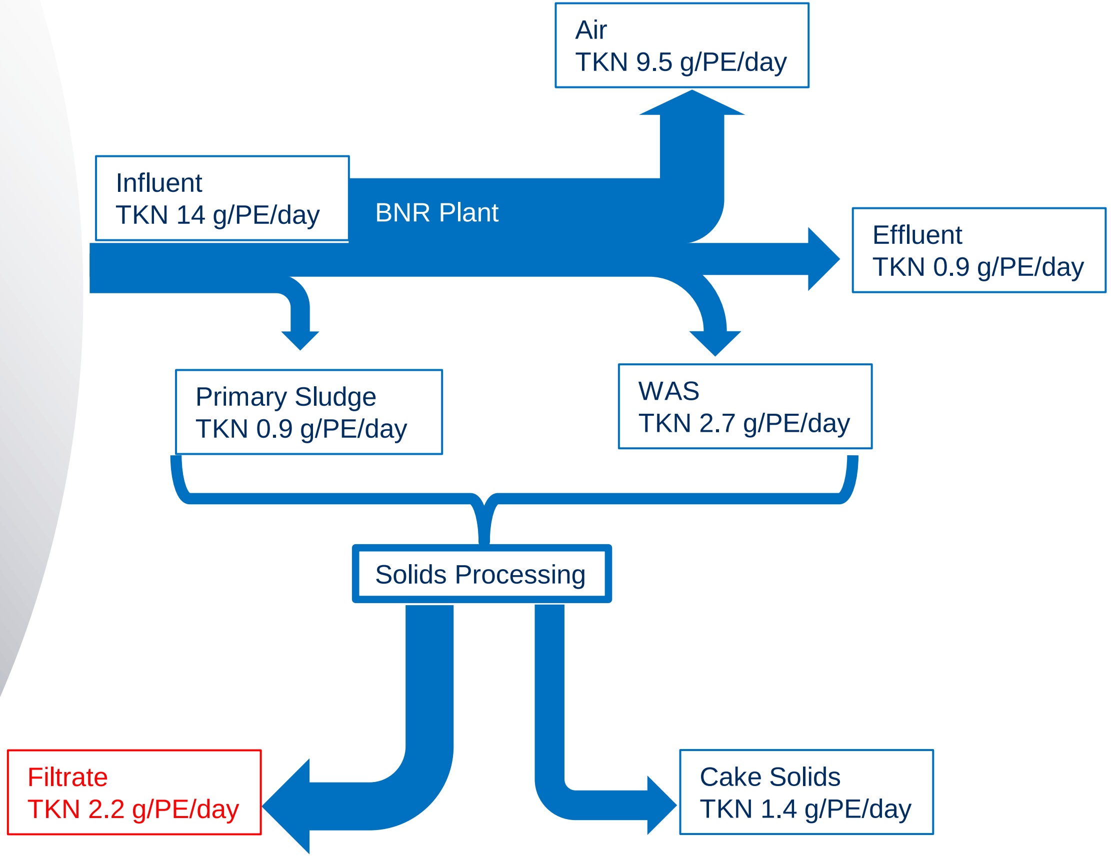
New BNR – Westside Process with PS Fermentation, SSP and SSN



Nitrogen Mass Balance in a BNR Process

Why do SSN Removal?

- Typically, 15 to 20% of Total TKN Load returned to influent in filtrate as Ammonia
- This Ammonia must be nitrified and then denitrified for successful BNR
- Nitrification and denitrification consumes oxygen and carbon



Process Benefits of SSN and SSP to the Design of CVWRF BNR Process

Operational Parameter	Baseline BNR (w/o SST)	BNR with SST	Difference	% Reduction
BNR Basin Volume (Mgal)	25.6	21.6	4.00	16%
Fermentate, mgd	0.50	0.17	0.33	66%
IMLR Pumping, mgd	236	108	128	54%
Aeration Demand, scfm	57,000	40,000	17,000	30%
WAS Production, lb/d	60,400	45,900	14,500	24%
Total Power, Kwh/yr	24,898,000	17,858,000	7,040,000	28%

Financial Benefits of SSN to BNR Process

Annual Cost	Baseline BNR (w/o SST)	BNR with SST	Savings
WAS Treatment and Disposal	$ 3,528,950	$ 2,680,578	$ 848,372
Aeration and Pumping Power	$ 2,420,000	$ 1,791,000	$ 629,000
Total Annual Cost	**$ 5,948,950**	**$ 4,763,578**	**$ 1,185,327**
Capital Cost			
BNR Basins and Aeration	$ 121,500,000	$ 98,300,000	$ 23,200,000
WAS Thickening	$ 2,500,000		$ 2,500,000
Anammox		$ 21,000,000	$ (21,000,000)
Total Capital Cost	**$ 124,000,000**	**$ 119,300,000**	**$ 4,700,000**
25 Year NPV			
Years	25		
Discount Rate	3.5%		
Present Value Capital Savings	$ 4.7M		
Present Value of Operational Savings	$ 19.5M		
Total NPV Savings	**$ 24.2M**		

SSN Vendor Pre-Selection Process

Criteria	Weight	Evaluation	Weighted Scores
Experience	15	Higher scores will be given to manufacturer's with: longer installation history, more installations at capacities similar to this project, and positive references from existing installations.	**75 points possible**
Design and Performance	35	Higher scores will be given to manufacturer's whose units are deemed to perform more favorably at CVWRF. Systems that demonstrate a well developed and robust/resilient design with site specific considerations will be considered more favorable.	**175 points possible**
Maintenance	20	Higher scores will be given to manufacturer's whose units are deemed to require less maintenance or where the maintenance is easier to perform.	**100 points possible**
Life Cycle Cost	30	Owner and Engineer will determine the total capital and O&M cost from information found in the Bid Form. Higher scores will be given to bids with lower life cycle costs.	**150 points possible**

Anammox Technologies Comparison

	ConDEA^{TM}/Demon	ANITA^{TM}Mox	AnammoPAQ^{TM}
Flow	Continuous	Continuous	Continuous
Aeration	Intermittent	Continuous	Continuous
Anammox bacteria form	Granules	Biofilm on media	Granules
Method of retaining Anammox bacteria	Batch settling + microscreen retention of granules	Media retention screens (coarse screens)	Lamella plate settler inside reactor
Worldwide installations	>65 installations - Mostly municipal	>25 installations - Mostly municipal	>45 installations - Mostly industrial - Mostly in China

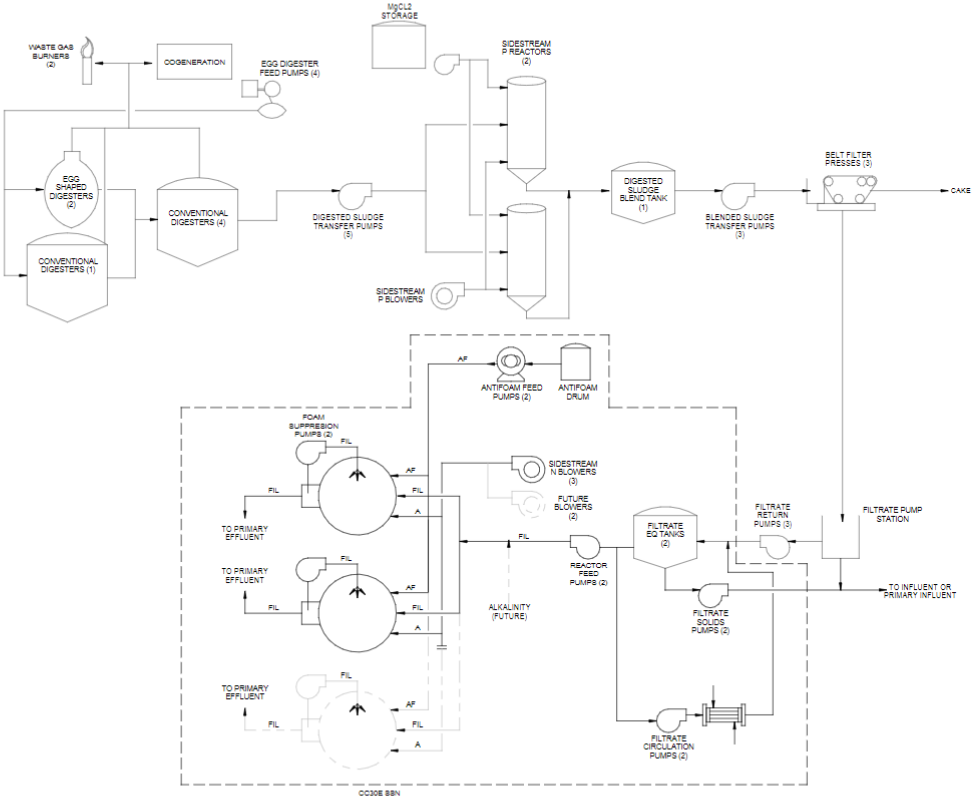
ANITA Mox Process Design

Design Parameters

Parameter	Units	Values			
		Startup	Interim Conditions	2035 Average Day	2045 Maximum Month
Flow, Design	MGD	0.3 - 0.5	0.5	0.57	0.62
sCOD	mg/L	90-125	125	125	150
TSS	mg/L	< 50			
NH_4-N	mg/L (ppd)	300-450 (1,200)	300-450 (2,100)	1,500 (7,135)	1,550 (8,020)
Alkalinity	mg/L	>5000			
Temp, Min	°C	> 20			

Performance Requirements:
>75% NH3 removal >70% TIN removal

ANITA Mox Process Design



Parameter	Units	Value
No. Reactors		2 plus 1 future
Reactor Dia.	Ft.	55
Liquid depth	Ft.	21
Reactor Volume, each	Gal.	380,000
Media Fill Vol.	Cu. Ft.	15,000
No. Blowers		3 plus 2 future
Blower size	Hp./SCFM	60/1,000

Process Startup

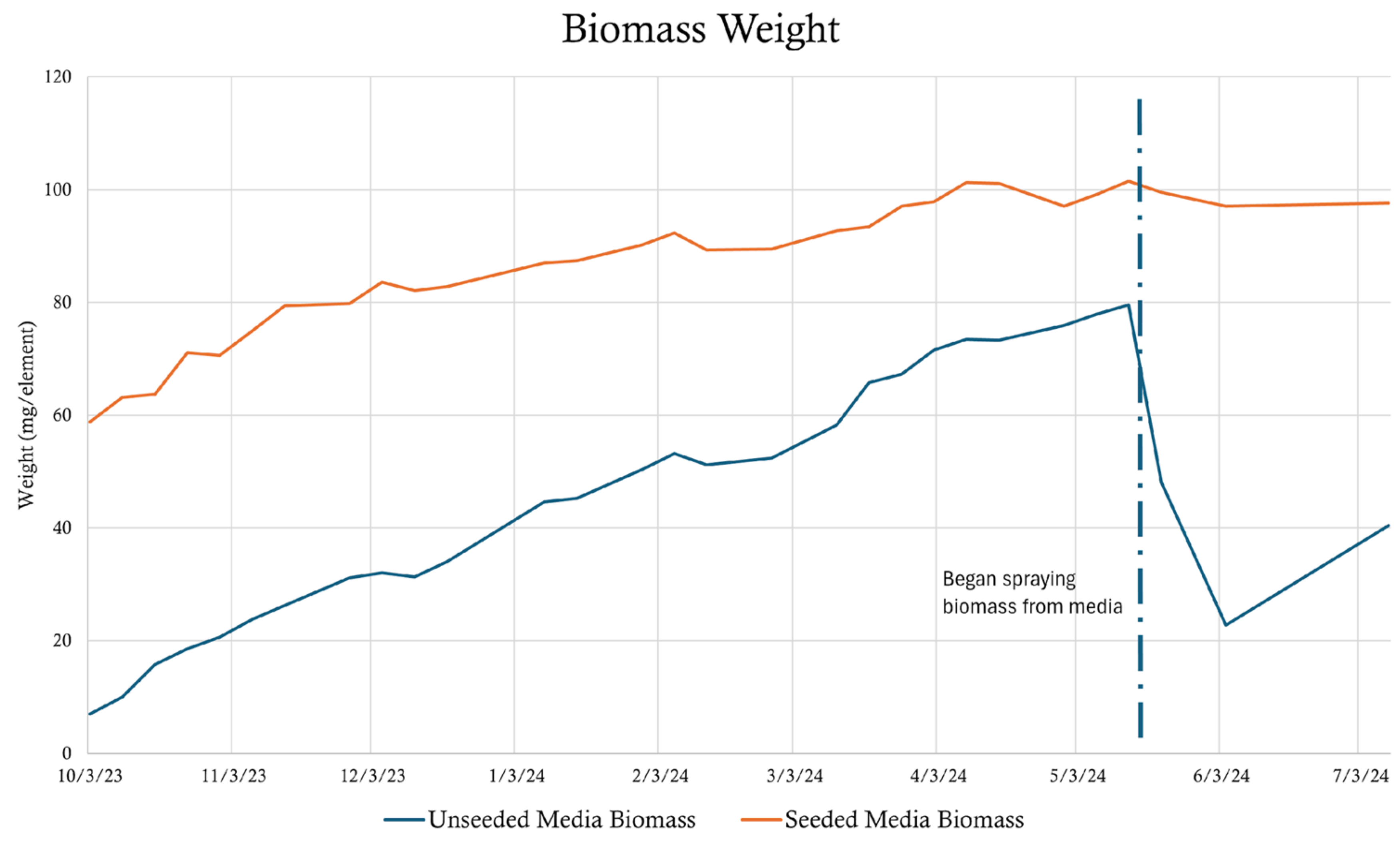
Biomass Growth

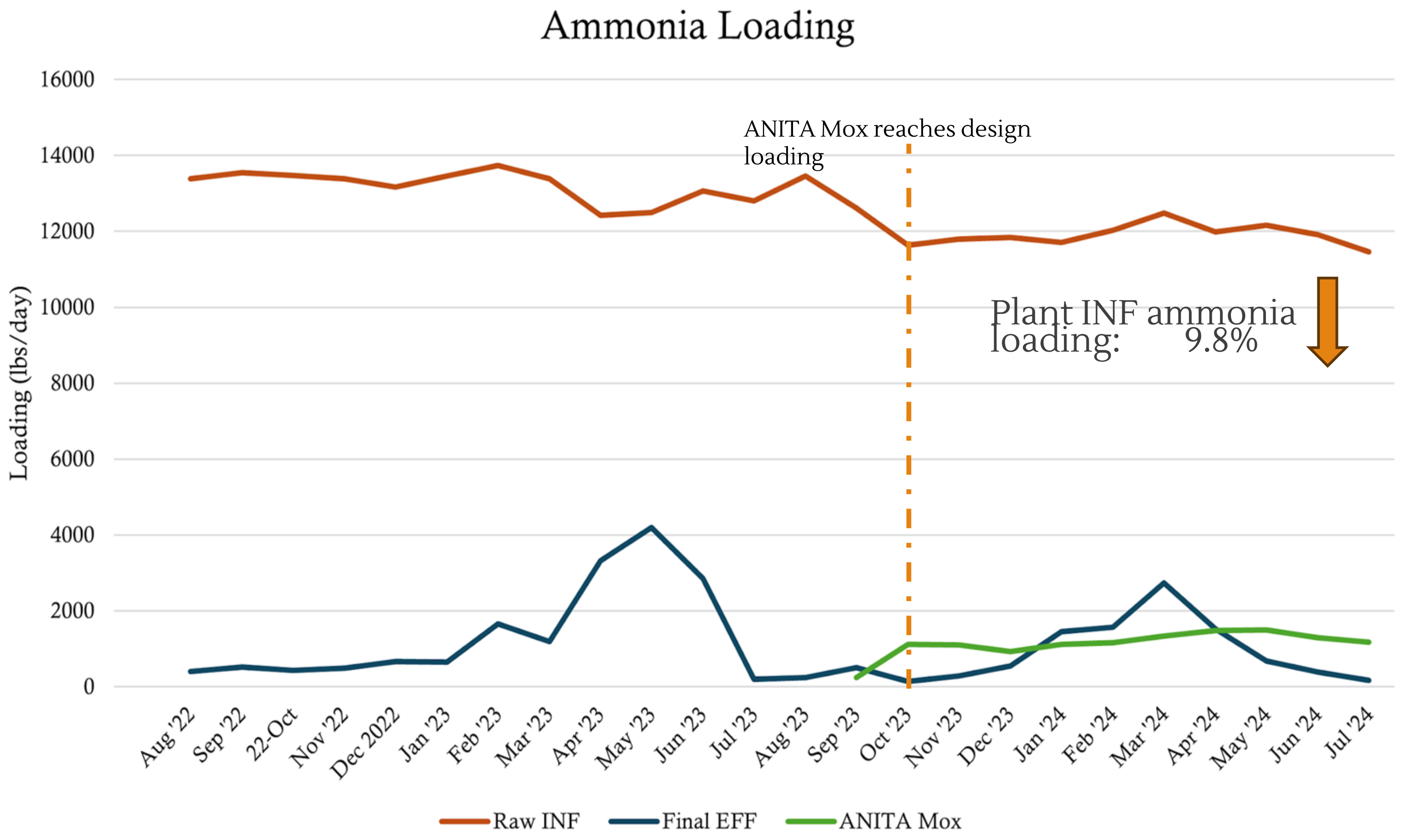
- 5% seed media delivered from Biofarm
- 14,250 ft^3 virgin media
- 750 ft^3 seed media

2 Months | 6 Months

Seeded Media

Unseeded Media


Biomass Weight
120
100
80
60
40
20
0
Weight (mg/element)
10/3/23
11/3/23
12/3/23
1/3/24
2/3/24
3/3/24
4/3/24
5/3/24
6/3/24
7/3/24
Began spraying
biomass from media
Unseeded Media Biomass
Seeded Media Biomass


Ammonia Loading
16000
14000
12000
10000
8000
6000
4000
2000
0
Loading (lbs/day)
ANITA Mox reaches design loading
Plant INF ammonia loading: 9.8%
Aug '22
Sep '22
22-Oct
Nov '22
Dec 2022
Jan '23
Feb '23
Mar '23
Apr '23
May '23
Jun '23
Jul '23
Aug '23
Sep '23
Oct '23
Nov '23
Dec '23
Jan '24
Feb '24
Mar '24
Apr '24
May '24
Jun '24
Jul '24
Raw INF
Final EFF
ANITA Mox

Operational Challenges

High TSS loads:	>20,000 mg/L
Temperature:	< 26℃
Foaming:	Water-based defoamer
Media Rafting	Altered aeration

Q&A

For More Information:

Rodrigo Lara
rodrigo.lara@veolia.com

WATER TECHNOLOGIES

VEOLIA