"Beefing Up" Treatment Capacity and Energy Savings with IFAS and Advanced Aeration Control

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Outline

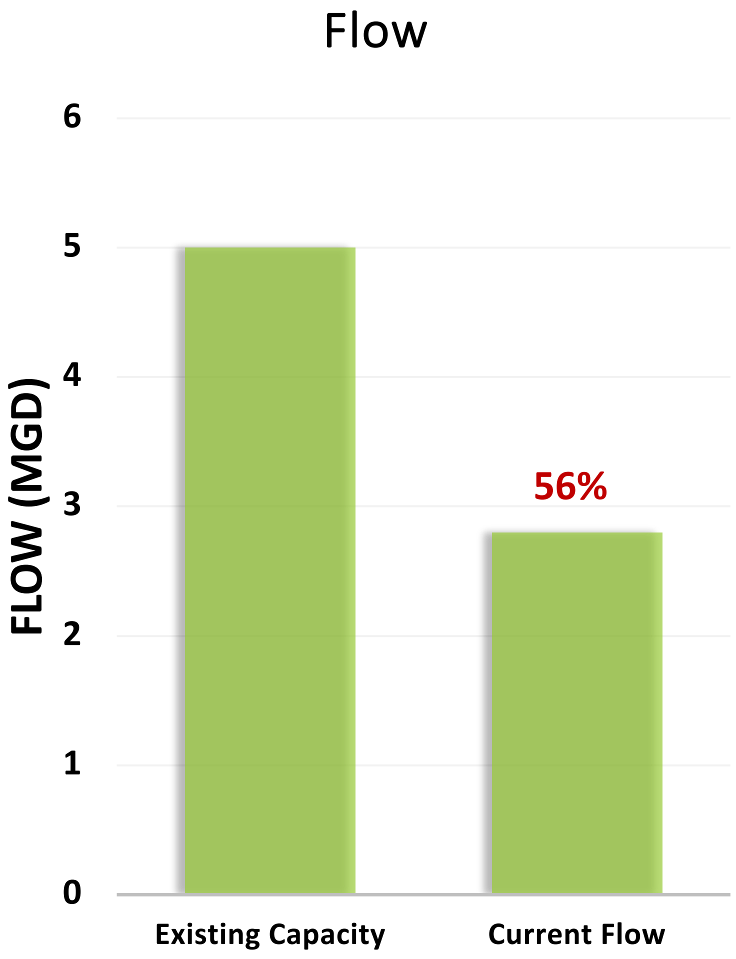
- Allison WRRF Background
- Project Goals
- Integrated Fixed-Film Activated Sludge (IFAS) System Overview and Implementation at Allison WRRF
- Advanced Aeration Control System
- Conclusion

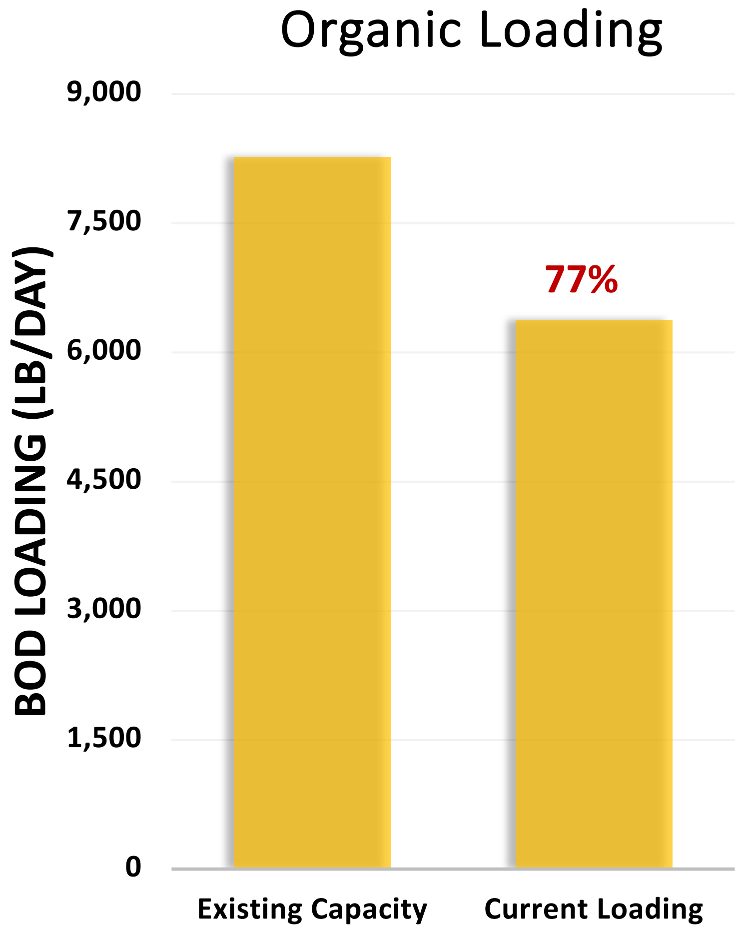
Allison WRRF Background

Permit Discharge Limits:

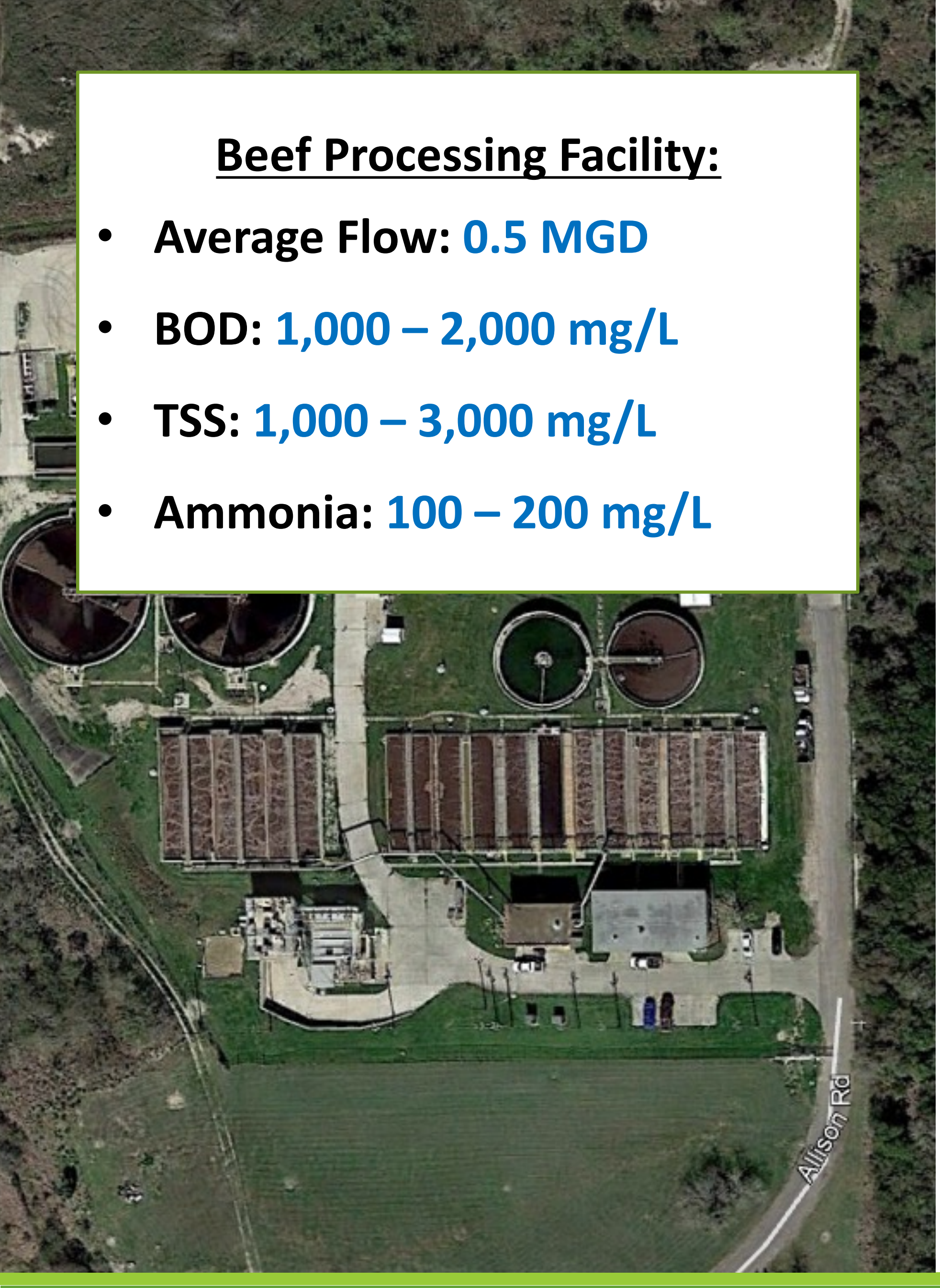
- **Average Daily Flow (ADF): 5.0 MGD**
- **2-Hr Peak Flow: 15.0 MGD**
- **cBOD5: 20 mg/L**
- **TSS: 20 mg/L**
- **Ammonia-Nitrogen: 12 mg/L**

Allison WRRF Background





Allison WRRF Background

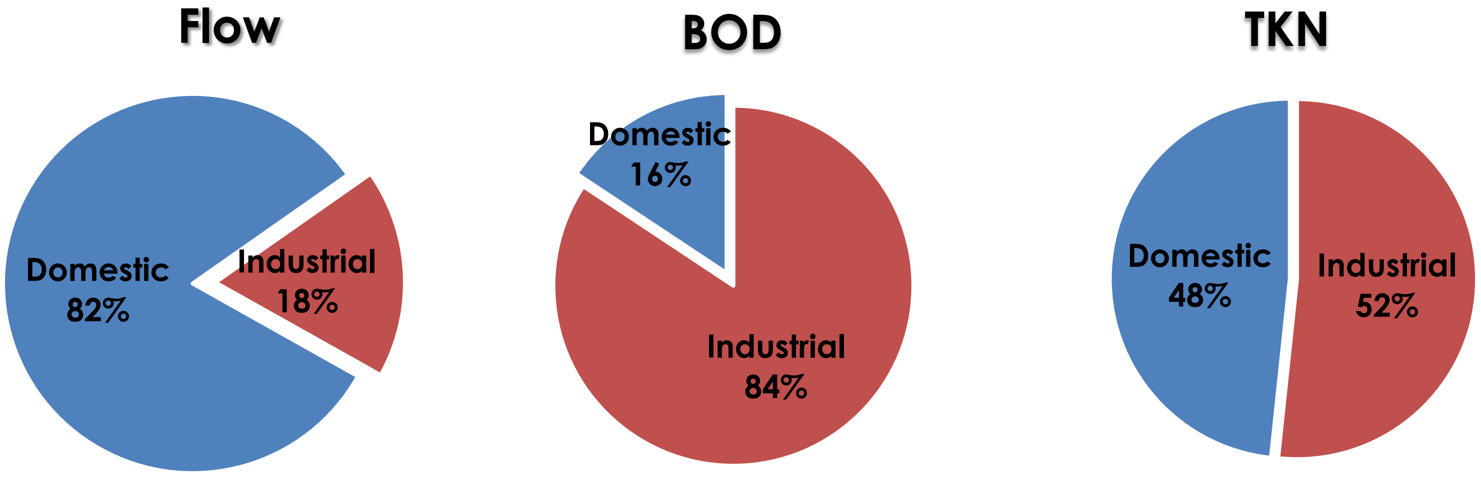


Beef Processing Facility:

- Average Flow: 0.5 MGD
- BOD: 1,000 – 2,000 mg/L
- TSS: 1,000 – 3,000 mg/L
- Ammonia: 100 – 200 mg/L

- Industrial Contributor – Beef Processing Facility
- High Strength Industrial Discharge
- Frequent Slug Loads of BOD, TSS and Ammonia

Domestic vs. Industrial Contribution



- Update to the Surcharge Rate in Pretreatment Program

Project Goals

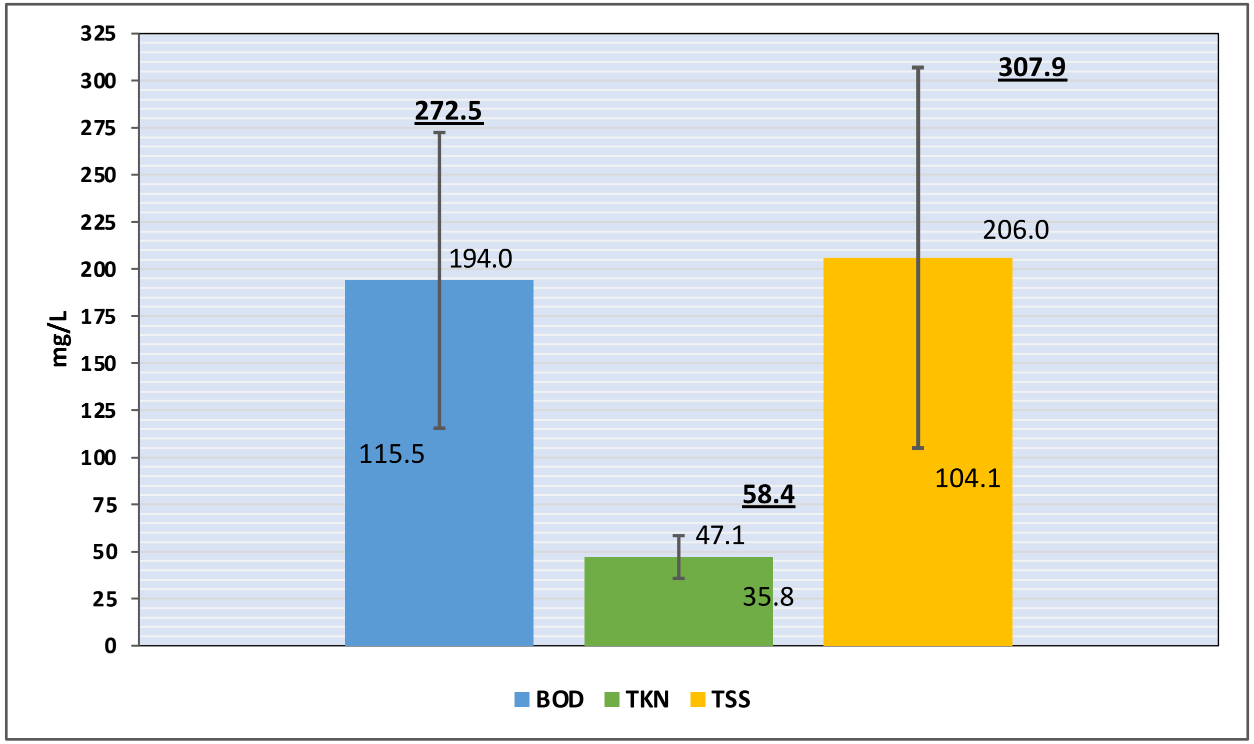
- Increase Secondary Treatment (Organic) Capacity
- Enhance Resiliency of the Biological Treatment Process to Slug and Varying Loads
- Improve Process Control
- Maintain Compliance
- Energy Savings

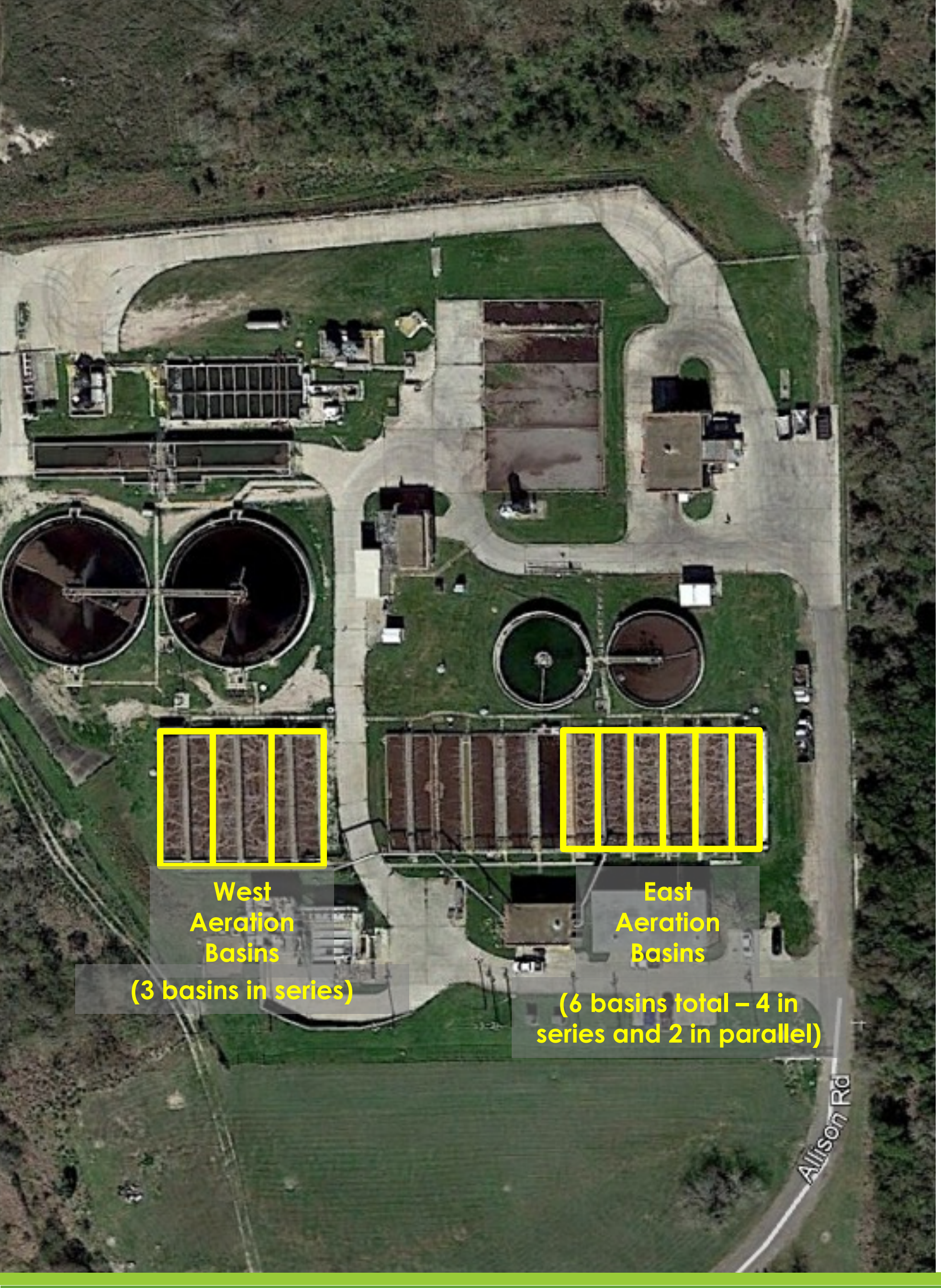
Allison WRRF Background

Influent Characteristics/Design Criteria

- Three-year data
- Design Conc.: **Avg + 1 Std. Dev.**

Parameter	Influent Design Concentration
BOD	**273 mg/L**
TKN	**58 mg/L**
TSS	**308 mg/L**





Allison WRRF – Existing Secondary Treatment Capacity

Design Basis:

- **Average Daily Flow – 5 MGD**
- **Influent TKN – 58 mg/L**
- **Influent BOD5 Conc. – 273 mg/L**
- **Influent Organic Loading – 11,362 lb/day**
- **Effluent Limits (BOD/TSS/NH3-N) – 20/20/12**

Available Aeration Basin Capacity	Additional Aeration Basin Capacity Required
8,264 lb/day	3,098 lb/day

38% Increase in Secondary Treatment Capacity Needed

Allison WRRF: Improvement Alternatives Evaluated

Recommended

- **Alternative 2:** Retrofit Existing Aeration Basins with IFAS

✓ No additional basins needed

✓ Lowest capital cost alternative

✓ Utilize existing infrastructure

✓ Provides resiliency to toxic and slug loads

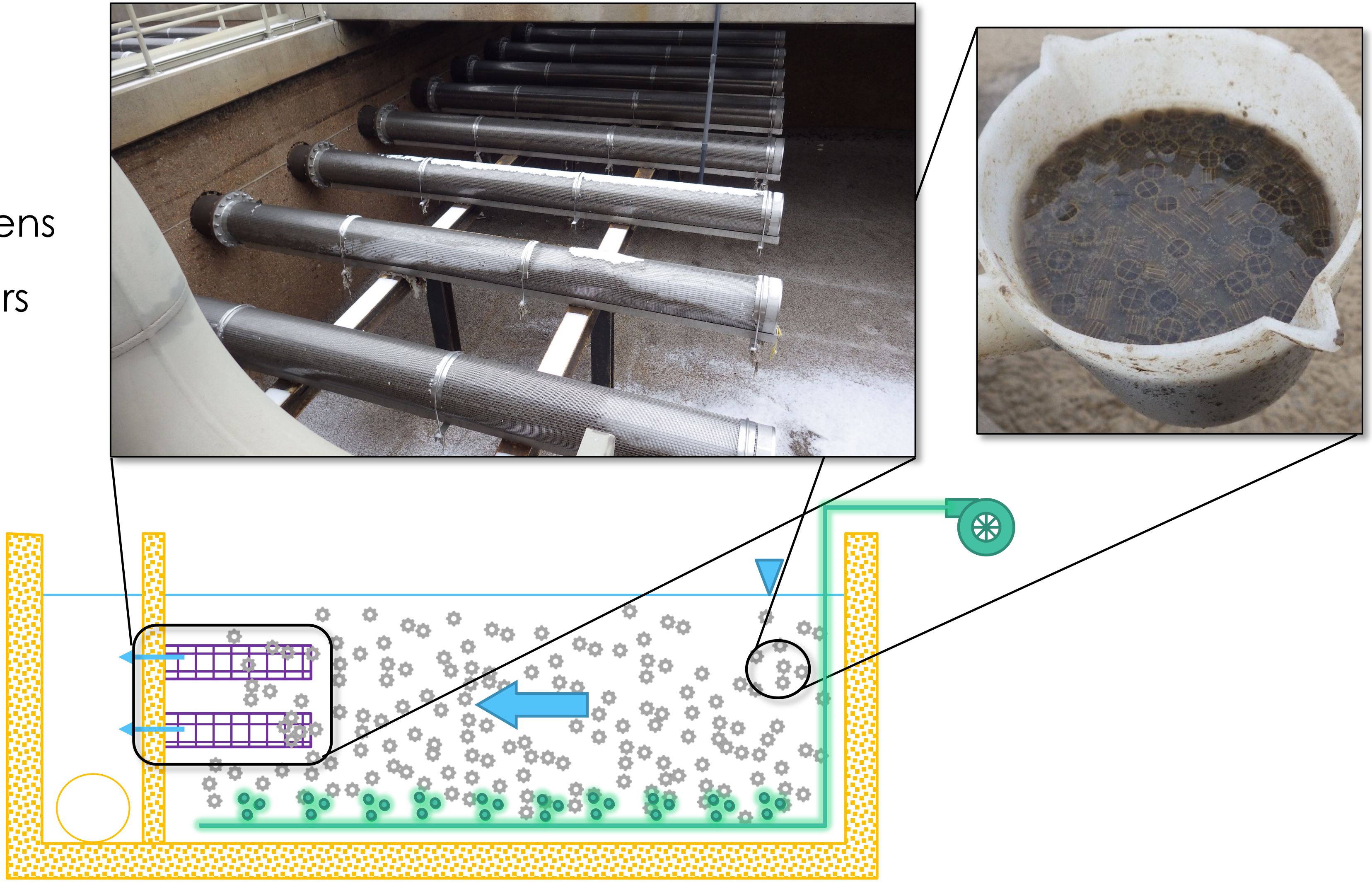
✓ Allows phased implementation

Integrated Fixed-Film Activated Sludge (IFAS)

- Addition of fixed film or attached growth media to activated sludge process
- Media provides extra surface area for biomass growth
- Increase organic loading capacity of aeration basins
- Easily retrofitted in existing basins
- ***Stable under varying organic and ammonia loadings***

IFAS System Basic Operation

- Media
- Media Retaining Screens
- Coarse Bubble Diffusers

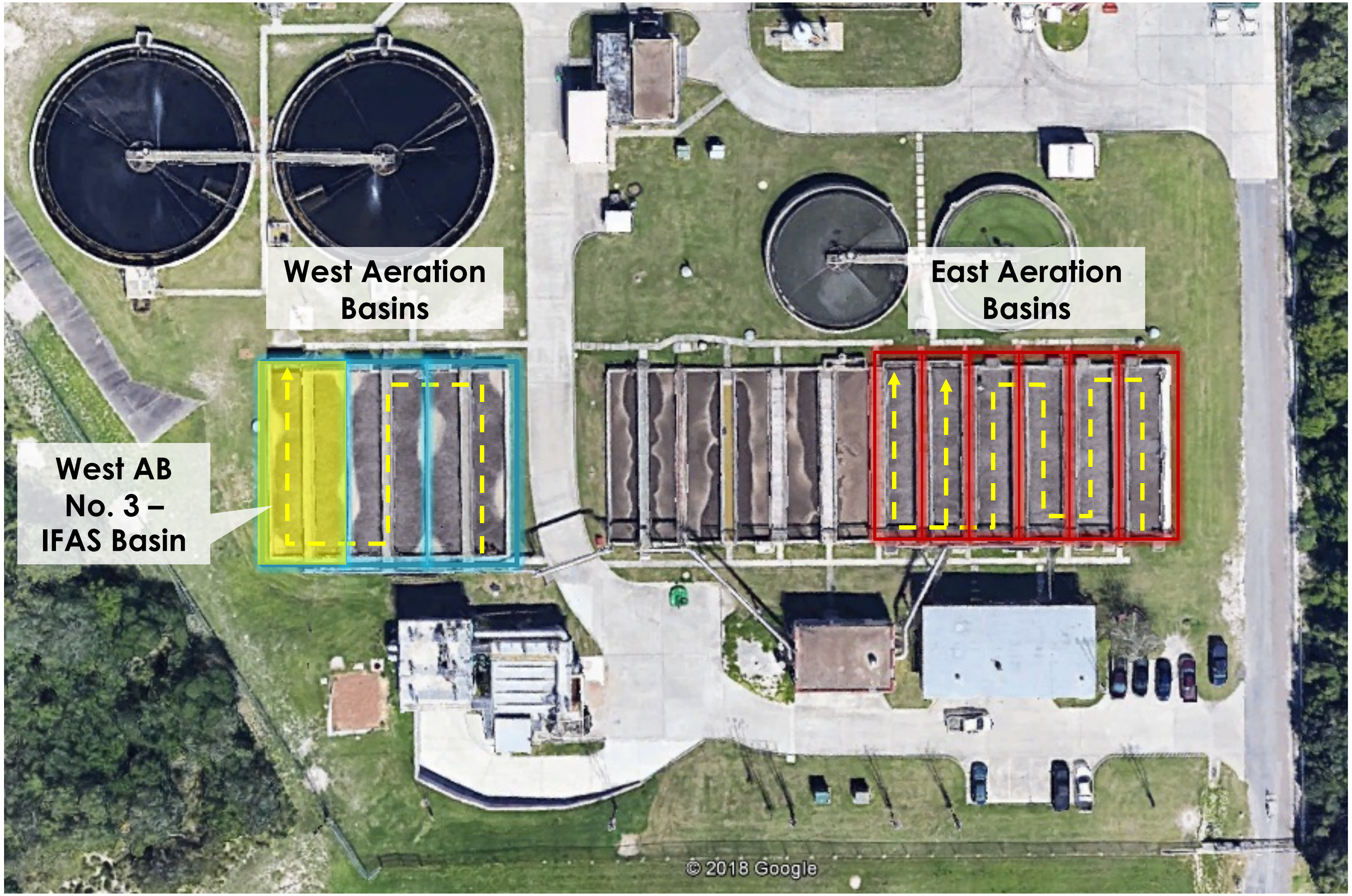


Allison WRRF – IFAS Implementation

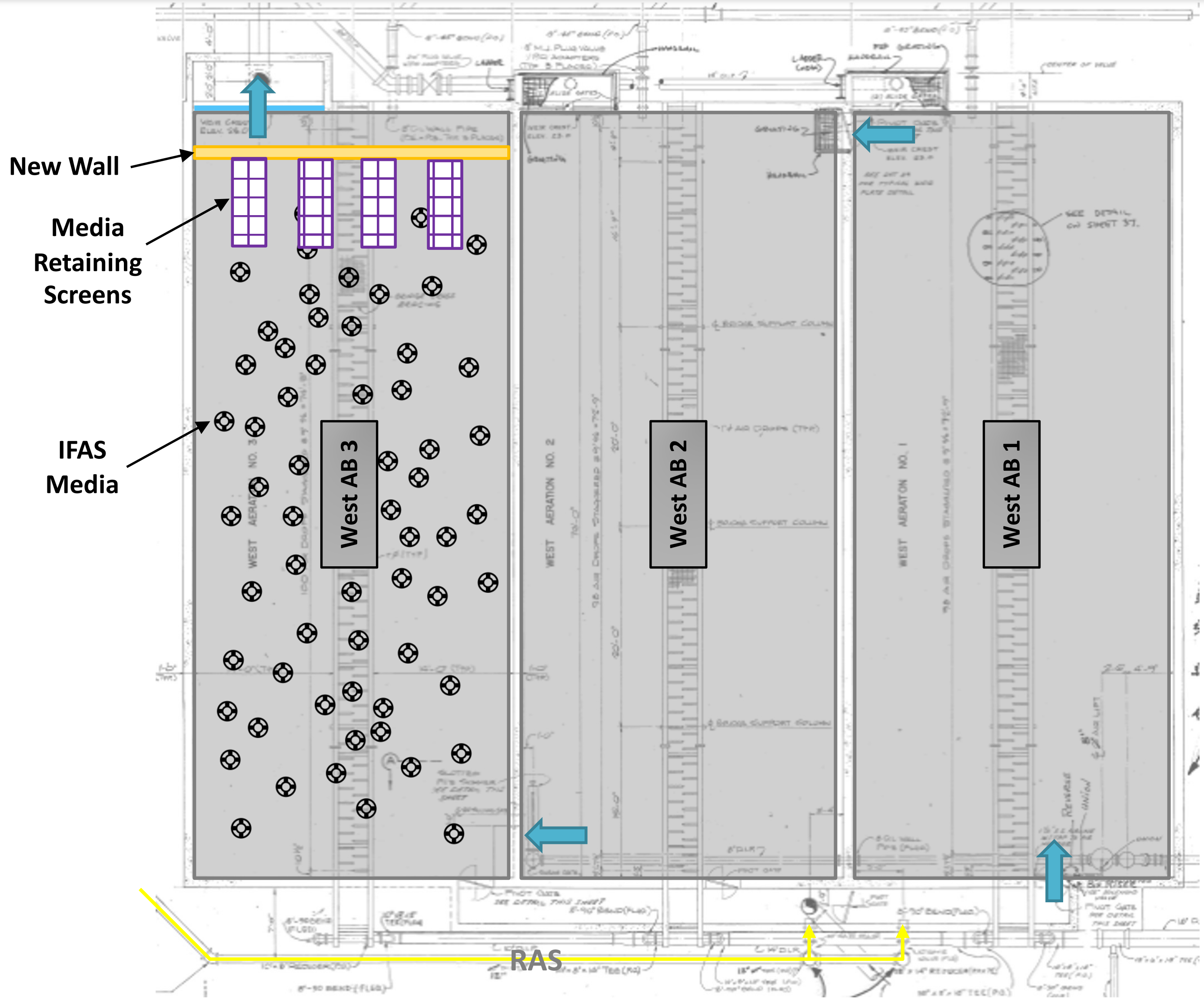
Design Basis

- Average Daily Flow – 5 MGD
- Influent BOD – 273 mg/L
- Influent TKN – 58 mg/L

3,098 lb/day Additional Capacity Required

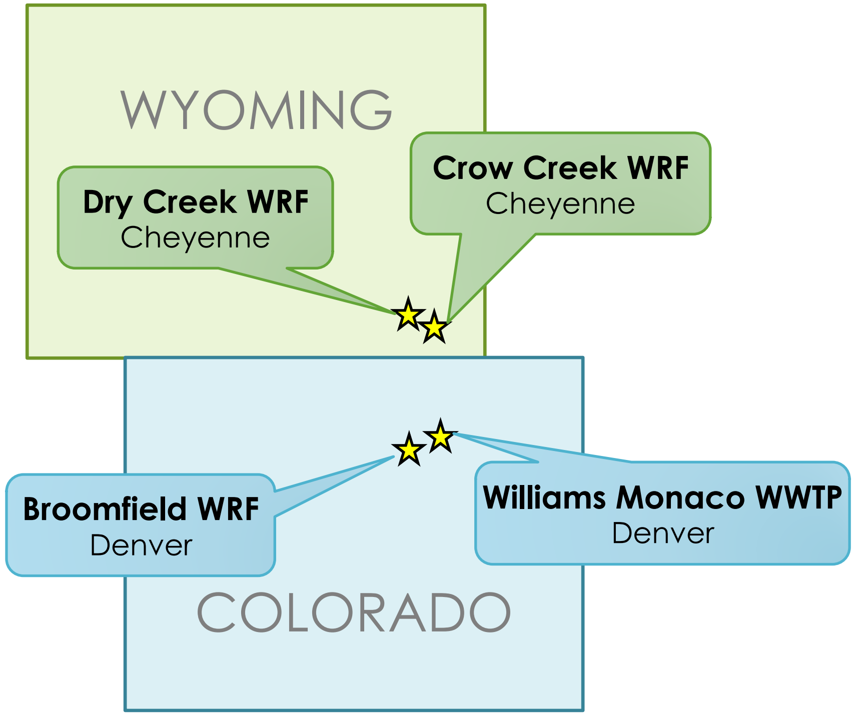


Allison WRRF – IFAS Implementation



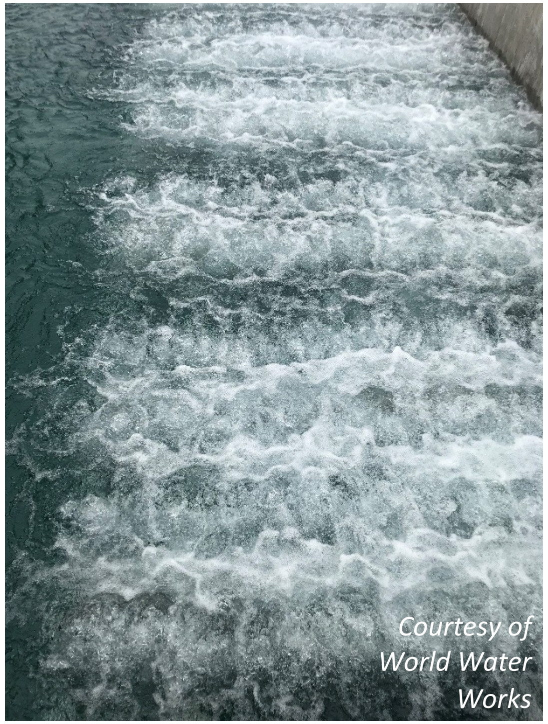
IFAS Installation Site Visits

- Consistent treatment performance reported with IFAS
- Meeting stringent permit limits with IFAS
- Operational management strategies
  - Foam control
  - Media retaining screens
  - Advanced aeration control



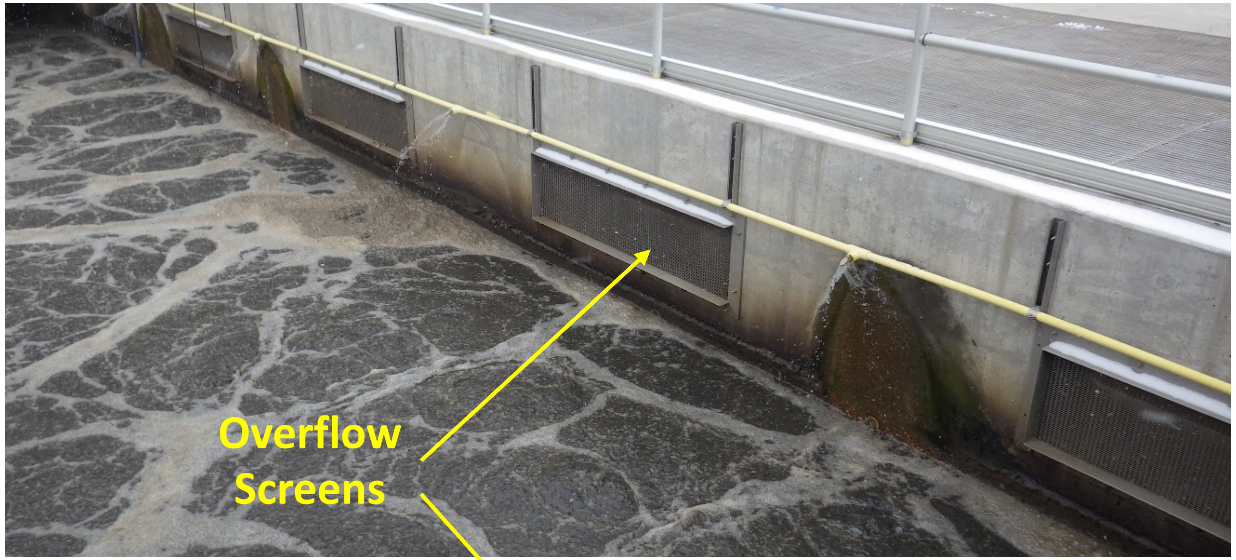
IFAS Design Considerations

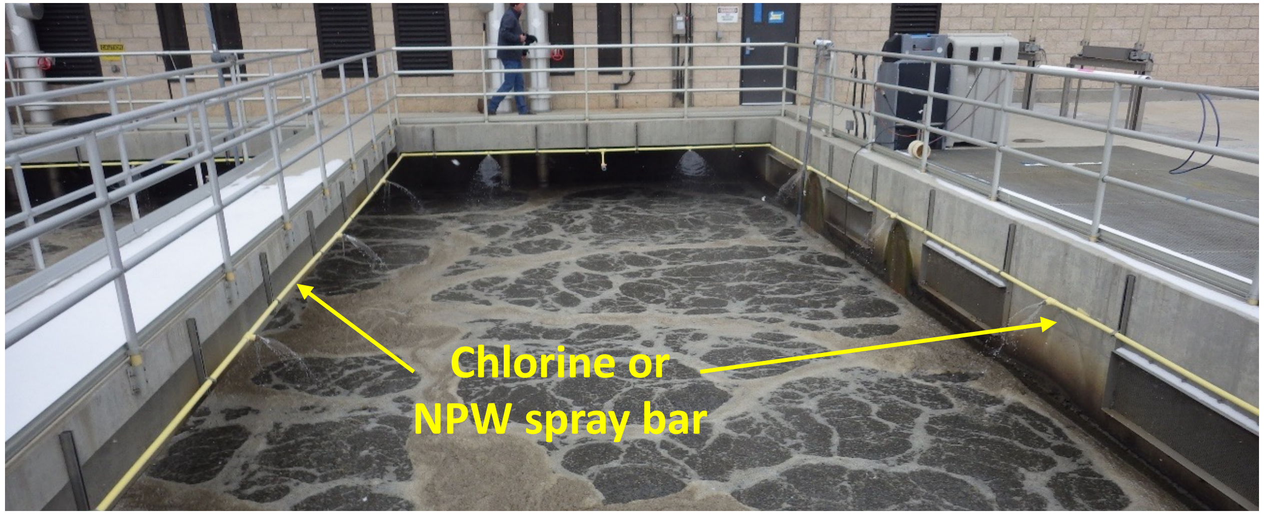
- Cylindrical "self-cleaning" wedge-wire screens
- Air sparge system below screens to prevent media accumulation ("stacking")
- 0.32 to 0.39-inch openings



IFAS Design Considerations

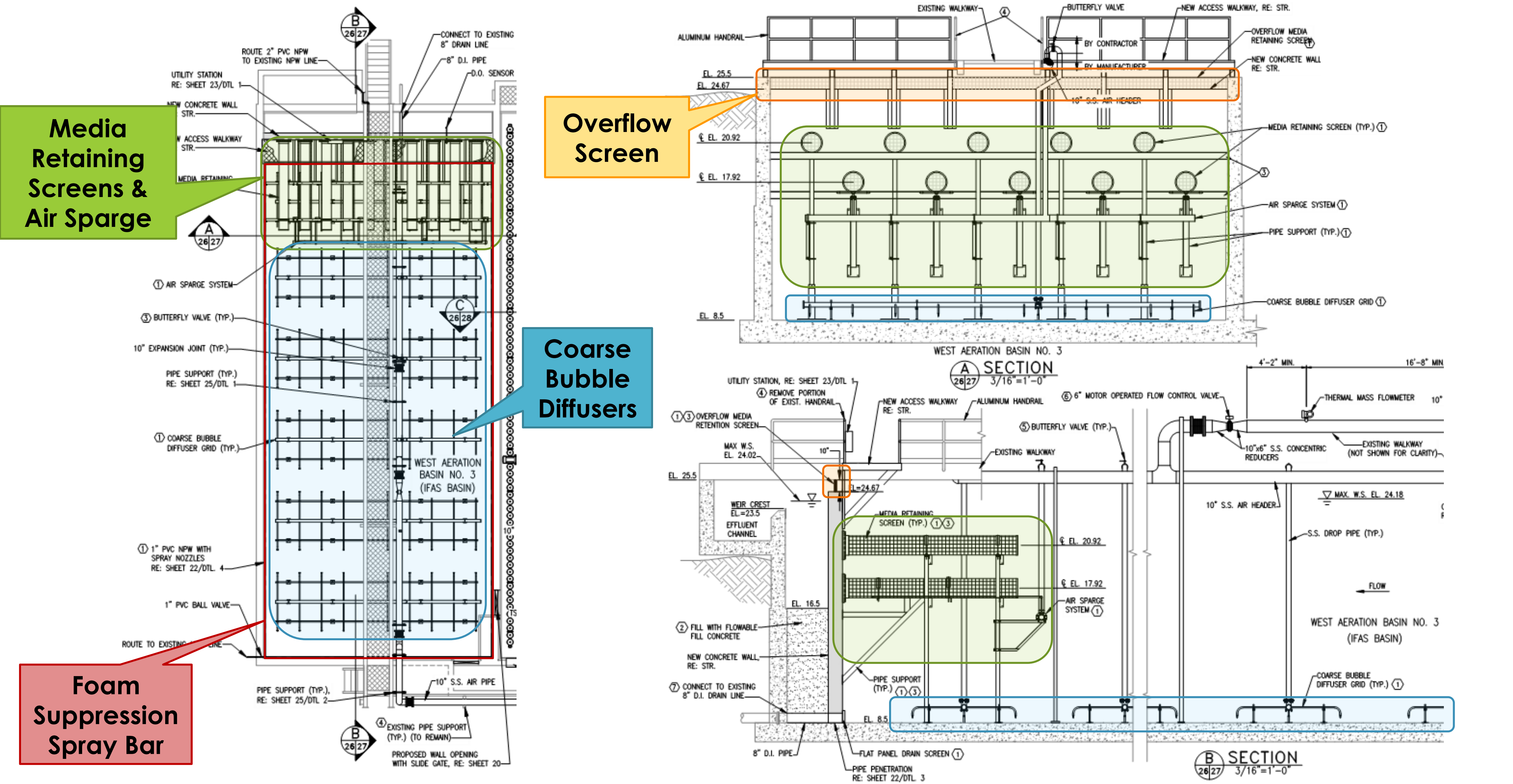
- Foam can accumulate in basins due to no overflow
- Control methods:
  - Higher freeboard
  - Overflow screens
  - Spray system
  - Surface skimmer





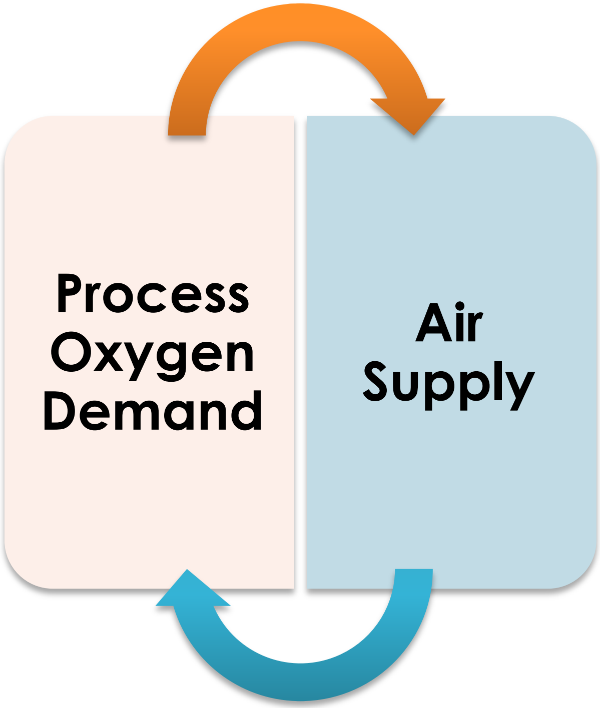
IFAS Design Considerations

Industry Standard	Allison WRRF Design
• Approach velocity – Typical max. **30-35 m/hr** – ↑ approach velocity = ↑ stacking potential	**~36 m/hr @ peak flow** **+ Air Sparge** **↑ Screen SA (↓ Screen HLR)**
• Screen hydraulic loading rate (HLR) – Typical up to **24 gpm/sf**	**20 gpm/sf**
• Freeboard – **2-3 feet** preferred – Foaming	**1.4 ft @ peak flow** **+ foam suppression spray bar** **+ overflow screens** **+ surface skimmer + high level alarm**
• Fill fraction – Typical **25-55%**	**20%-38%**
• Upstream screening requirement – **1/4-inch** or finer	**¼-inch**



Media Retaining Screens & Air Sparge
Overflow Screen
Coarse Bubble Diffusers
Foam Suppression Spray Bar
WEST AERATION BASIN NO. 3 (IFAS BASIN)
AIR SPARGE SYSTEM
BUTTERFLY VALVE (TYP.)
10" EXPANSION JOINT (TYP.)
PIPE SUPPORT (TYP.) RE: SHEET 25/DTL 1
COARSE BUBBLE DIFFUSER GRID (TYP.)
1" PVC NPW WITH SPRAY NOZZLES RE: SHEET 22/DTL. 4
1" PVC BALL VALVE
UTILITY STATION RE: SHEET 23/DTL 1
ROUTE 2" PVC NPW TO EXISTING NPW LINE
CONNECT TO EXISTING 8" DRAIN LINE
8" D.I. PIPE
D.O. SENSOR
10" S.S. AIR PIPE
PIPE SUPPORT (TYP.), RE: SHEET 25/DTL 2
EXISTING PIPE SUPPORT (TYP.) (TO REMAIN)
PROPOSED WALL OPENING WITH SLIDE GATE, RE: SHEET 20
EXISTING WALKWAY
BUTTERFLY VALVE
NEW ACCESS WALKWAY, RE: STR.
ALUMINUM HANDRAIL
BY CONTRACTOR
OVERFLOW MEDIA RETAINING SCREEN
NEW CONCRETE WALL RE: STR.
10" S.S. AIR HEADER
EL. 25.5
EL. 24.67
EL. 20.92
EL. 17.92
EL. 8.5
MEDIA RETAINING SCREEN (TYP.)
AIR SPARGE SYSTEM
PIPE SUPPORT (TYP.)
COARSE BUBBLE DIFFUSER GRID
WEST AERATION BASIN NO. 3
SECTION A 26 27 3/16"=1'-0"
REMOVE PORTION OF EXIST. HANDRAIL
OVERFLOW MEDIA RETENTION SCREEN
MAX W.S. EL. 24.02
WEIR CREST EL.=23.5
EFFLUENT CHANNEL
EL. 16.5
FILL WITH FLOWABLE FILL CONCRETE
CONNECT TO EXISTING 8" D.I. DRAIN LINE
8" D.I. PIPE
FLAT PANEL DRAIN SCREEN
PIPE PENETRATION RE: SHEET 22/DTL. 3
6" MOTOR OPERATED FLOW CONTROL VALVE
THERMAL MASS FLOWMETER
10"x6" S.S. CONCENTRIC REDUCERS
EXISTING WALKWAY (NOT SHOWN FOR CLARITY)
MAX. W.S. EL. 24.18
S.S. DROP PIPE (TYP.)
FLOW
COARSE BUBBLE DIFFUSER GRID (TYP.)
SECTION B 26 27 3/16"=1'-0"

Aeration Control System



Benefits of Aeration Control

- Energy savings
- Process control
- Slug load management
- Compliance

Considerations

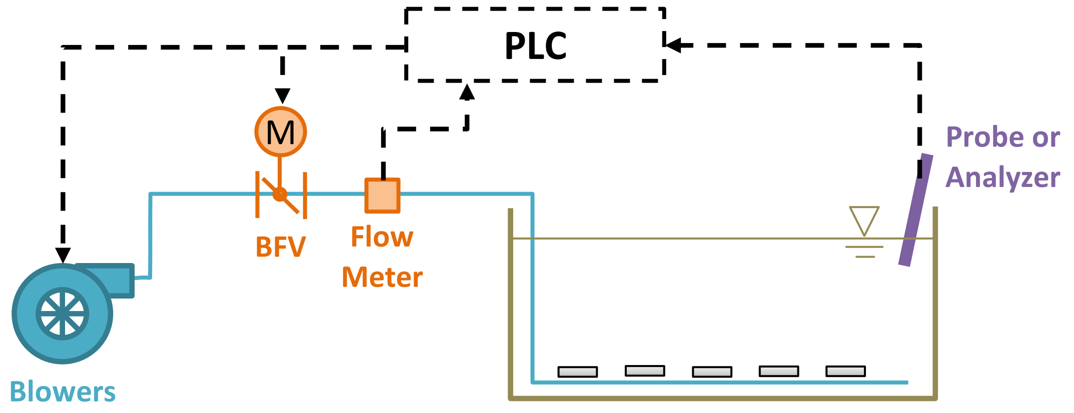
- Capital and O&M costs
- Maintenance requirements
- System tuning

Aeration Control System

Alternatives

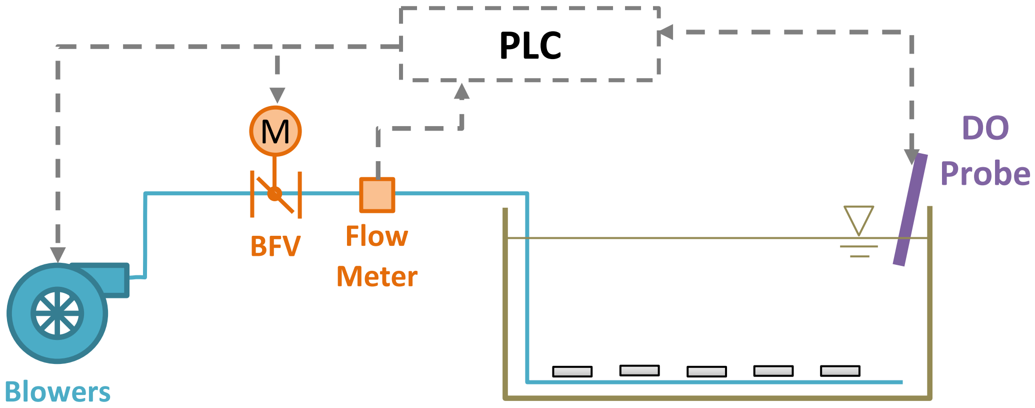
- Dissolved oxygen-based aeration control ("DO control")
- Ammonia-based aeration control ("ABAC")

General Arrangement



Aeration Control System

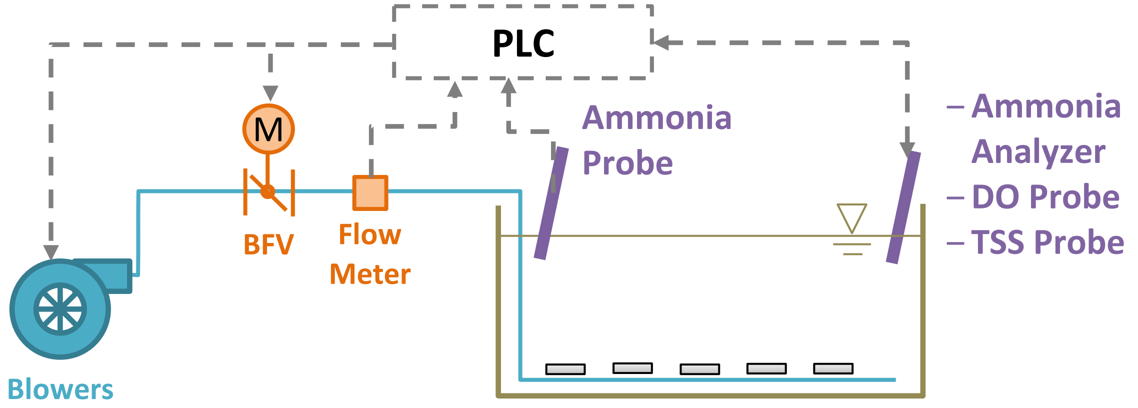
Dissolved Oxygen (DO)-Based Aeration Control



- DO probe at the end of each basin (typ.)
- Operator sets DO setpoint
- Airflow adjusted to reach desired setpoint
  - Modulating BFV
  - Blower output
- DO set point adjusted as necessary to meet treatment goals during fluctuating loads and seasons

Aeration Control System

Ammonia-Based Aeration Control (ABAC)



Feedforward and Feedback, Cascade Control

- Operator selects effluent ammonia setpoint
- DO set point based on desired ammonia conc.
- If effluent ammonia > setpoint, DO setpoint increased, airflow increased
- If effluent ammonia < setpoint, DO setpoint decreased, airflow decreased
- Influent ammonia probe used for early detection of slug loads

ABAC- Instrumentation

Ammonia Ion Selective Probe

Hach AISE sc

- Recalibration
- Sensor replacement
- Typ. 1-100 mg/L N range
- Experiences issues for low ammonia (0-2 mg/L N)

Recommended for inlet of aeration basin where ammonia conc. is high

Ammonia Wet Chemistry Analyzer

Hach AMTAX sc

- Autocalibration
- Reagent replenishment
- Typ. 0.05-20 mg/L N range
- Works well for low ammonia conc.
- Higher capital cost

Recommended for end of aeration basin where ammonia conc. is low

TSS Probe

Hach SOLITAX sc

- Recalibration
- Wiper replacement
- Typ. 0.001 mg/L – 50 g/L range

Needed to measure MLSS in aeration basin

Aeration Control System

DO Control

- Fewer instruments
- Lower capital and O&M costs
- Less energy savings compared to ABAC
- Lower performance

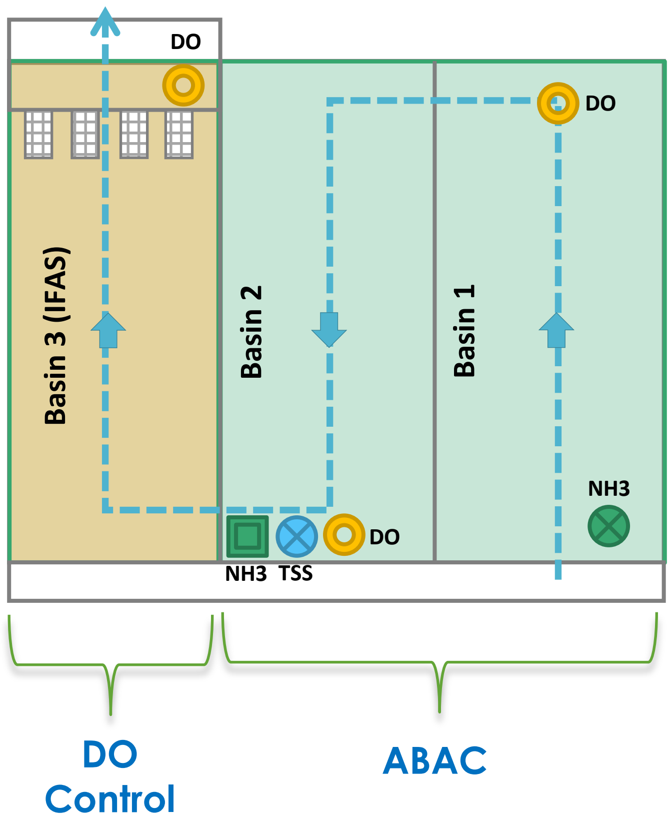
Meeting DO setpoint ≠ meeting ammonia limit

ABAC

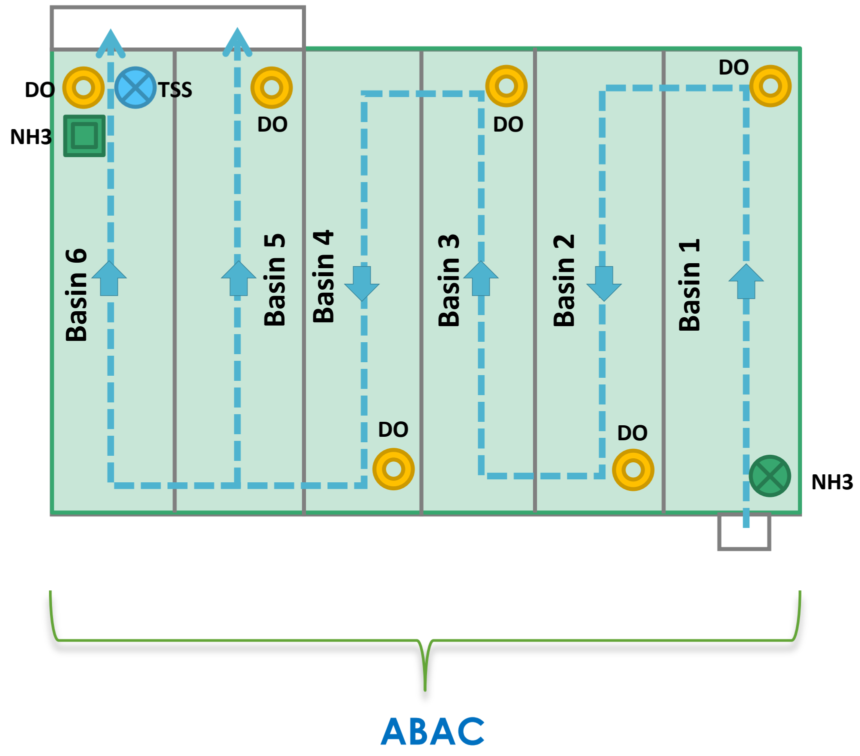
- More instruments than DO control
- Higher capital and O&M costs
- Higher energy savings
- Higher performance
- Proactive process control

Allison WRRF – Proposed Aeration Control System

West Aeration Basins



East Aeration Basins



Conclusion

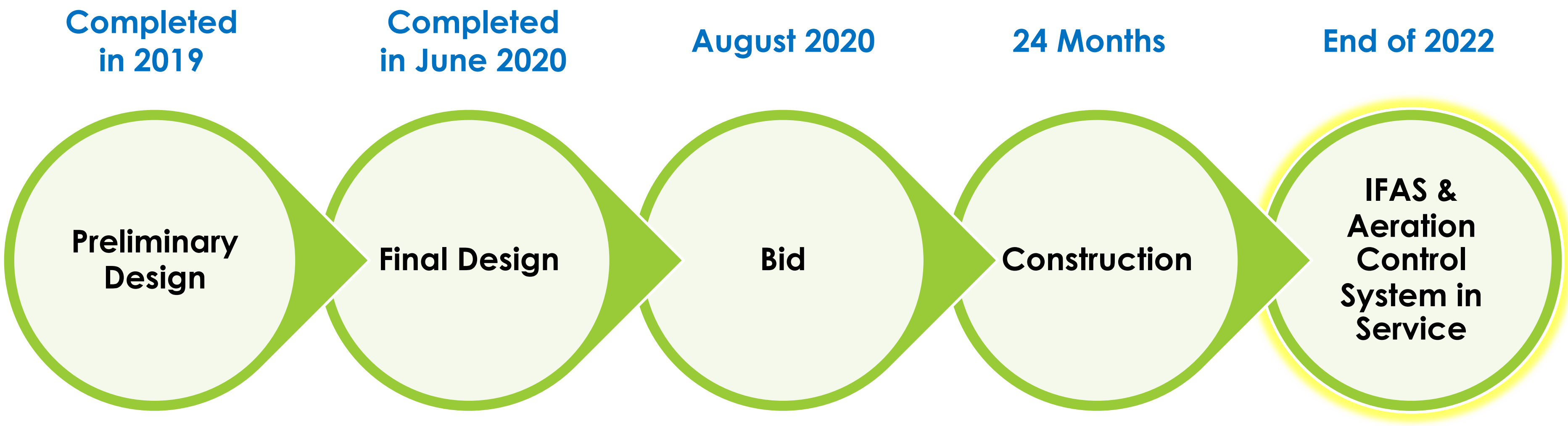
IFAS

- ✓ Lowest capital Cost alternative
- ✓ Utilize existing infrastructure
- ✓ No additional basins needed
- ✓ Provides resiliency to toxic and slug loads

Advanced Aeration Control

- ✓ Energy savings
- ✓ Improve process control
- ✓ Enhance resiliency
- ✓ Proactive slug load management

Project Status



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