Not so long ago at a water treatment plant far, far away…

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PNWS-AWWA
BOISE 2016

Treatment Plant Washwater Recovery to Achieve Zero Liquid Discharge

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Paradise Irrigation District

AECOM

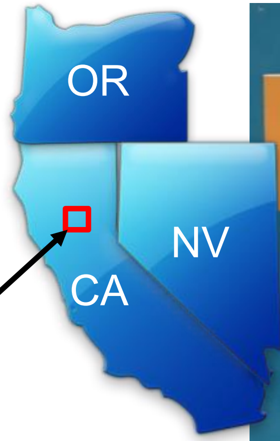
Discussion Topics

- Project Introduction and Key Issues
- WTP Process Overview
- Pilot Testing Plan
- Testing Results and Summary
- Recommendations and Next Steps

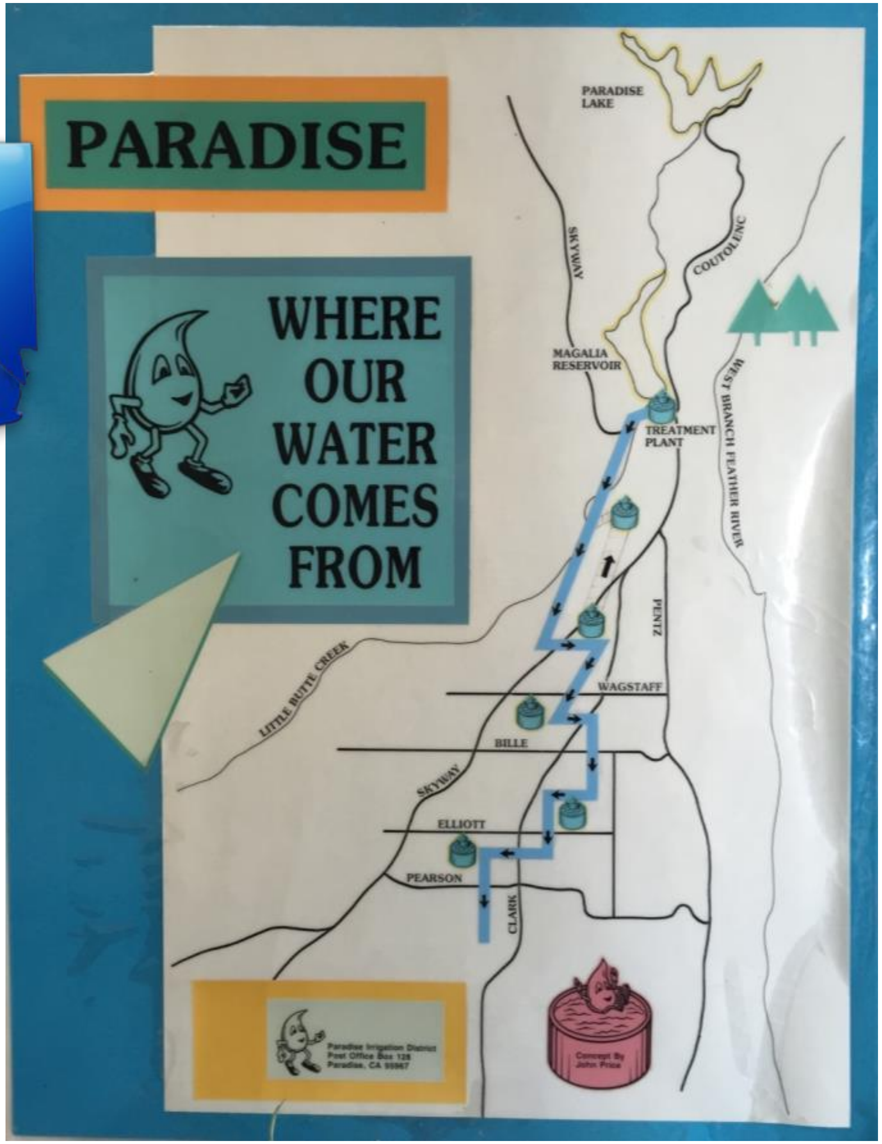
Discussion Topics

- Project Introduction and Key Issues

Introduction

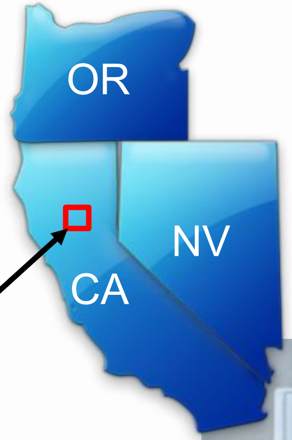


Paradise Irrigation District, Paradise, CA



- Paradise Irrigation District
  - Surface water supply
    - Paradise Lake
    - Magalia Reservoir
  - 19 MGD Paradise WTP

Introduction



- Paradise Irrigation District
  - Surface water supply
    - Paradise Lake
    - Magalia Reservoir
  - 19 MGD Paradise WTP
- WTP Washwater Discharge
  - NPDES permit challenges
    - Total aluminum
    - Dichlorobromomethane (DCBM)

Key Project Issues

PID Washwater Results

- Jul 2010 – Jul 2014
- Jan 2008 – Nov 2009

- WTP Washwater Discharge
  - NPDES permit challenges
  - Washwater discharge to Magalia Reservoir (CA Toxics Rule)
    - Total aluminum (0.077 mg/L month avg; 0.123 mg/L max day)

      0.9 | 0.35 | 1.3 | 3.6

    - DCBM (0.56 µg/L month avg; 1.12 µg/L max day)
  - Permit Time Schedule Order (TSO): Discharge Treatment Required
- Large Volume of Low-TSS Washwater
- Way Forward?
  - Implement washwater treatment
  - Discontinue discharge

Discussion Topics

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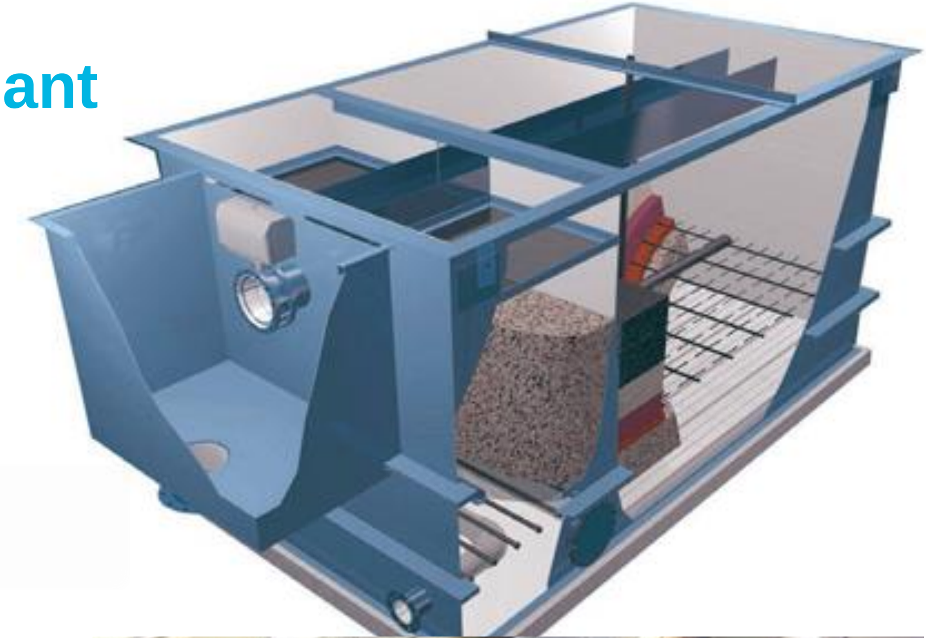
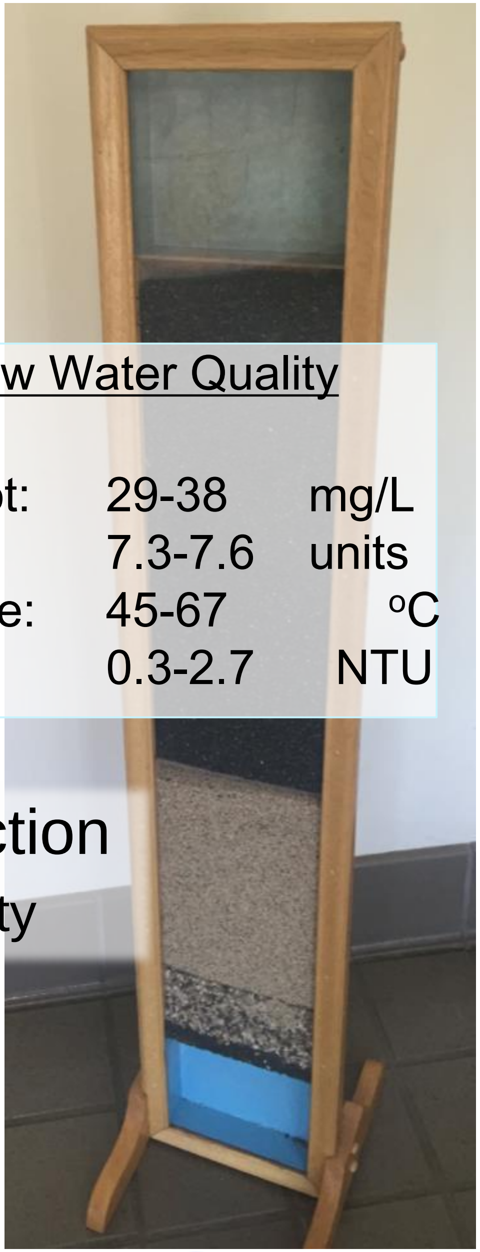
Paradise Water Treatment Plant

- Alternative Treatment
  - Upflow ContaClarifier
    - Roberts Filter (3 ea.)
    - Non-buoyant coarse media
  - Filtration
    - Dual media filtration (6 ea.)
    - Anthracite over sand



Paradise Water Treatment Plant



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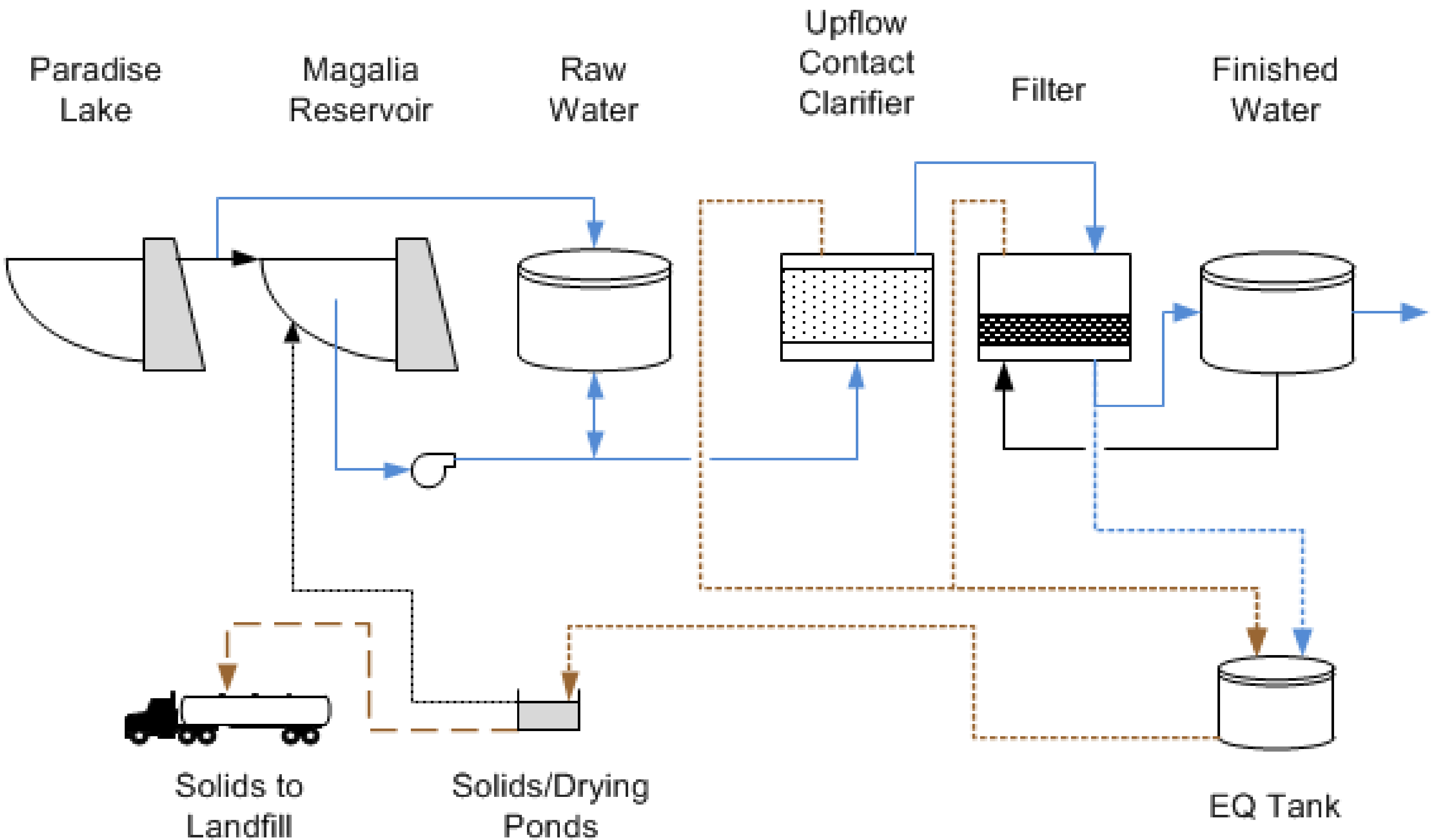
2015 Raw Water Quality

Alkalinity, tot:	29-38	mg/L
pH:	7.3-7.6	units
Temperature:	45-67	ºC
Turbidity:	0.3-2.7	NTU

- Very Low Chemical Feed & Residual Production
  - Alum (0.8 to 3.3 mg/L): destroys ~1.5 mg/L Alkalinity
  - ACH (0.6 to 1.8 mg/L)
  - Cationic polymer (0.6 to 1.7 mg/L)
  - Anionic filter aid polymer (0.009 to 0.023 mg/L)
  - Estimated 30-40 lb/MG solids produced

Paradise Water Treatment Plant



Paradise Water Treatment Plant

- ContacClarifier Washwater Design Considerations
  - Approximately 80,000 gallons/flush
    - 60-80 NTU in the first 2 minutes
    - Remaining turbidity <20 NTU (~15 minutes total)
    - <50 pounds of solids/flush (TSS between 0.006% to 0.007%)
  - Up to 12 flushes/day (from 160,000 to 1,200,000 GPD)
- Filter Backwash Design Considerations
  - Approximately 1 backwash every two days
  - Three filters operating in winter
  - Six filters operating in summer
  - 140,000 gal/backwash (TSS between 0.002% to 0.005%)
    - Filter backwash water
    - Filter to waste water

Discussion Topics

- Project Introduction and Key Issues
- WTP Process Overview
- Pilot Testing Plan

Pilot Testing Plan

- Goal: Zero Discharge
  - Treat all washwater from clarifier and filters
  - Process solids on-site
  - Assess liquid-solid separation of lamella plates
  - Determine thickening capability of lamella-settled solids

HLR = Hydraulic Loading Rate

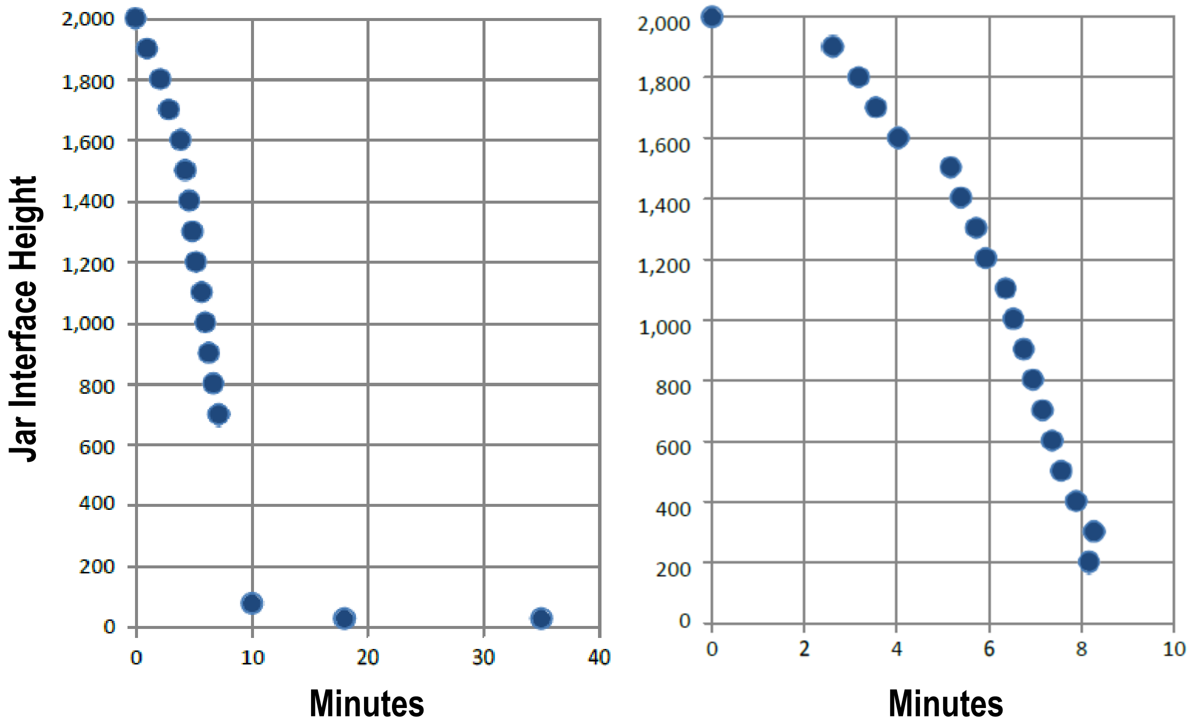
- Lamella Plate Settling
  - Recycling of supernatant to the head of the WTP
  - Possible use of supernatant as clarifier flush water supply
  - Suitability of separated solids to be thickened and meet proper consistency for efficient mechanical dewatering
  - Simulate failure mechanisms (high HLR and/or improper polymer/coagulant dose) to characterize process upsets
  - Obtain HLR / sizing, design criteria

Pilot Testing Plan, continued

- Operations and Regulatory Requirements
- USEPA Filter Backwash Recycling Rule
  - Supernatant return to head of WTP
  - Flow restriction
  - Turbidity restriction
- DBPs
  - Will levels rise during recycling/reuse practice?
- Supernatant and Solids
  - Supernatant turbidity targets: ≤2 NTU (90^{th} percentile)
  - Supernatant flow target (for design): 10% instantaneous
  - Solids thickening goals: >20% solids

Pilot Testing Plan, continued

- Preliminary Bench-Scale Screening
  - Anionic and Cationic polymers tested
  - Anionic polymers were not able to reduce turbidity <2 NTU
  - Cationic polymers best (based on settling, final supernatant turbidity)



Pilot Testing Plan, continued

- Testing Matrix
  - Lamella
    - HLR: 0.2 – 0.6 GPM/sf
    - Thickener Blowdown Rate: 3 – 30 % of feed flow
    - Solids Recirculation Rate: 0 – 3 % of feed flow
  - Chemical Dosing
    - Coagulant (Aluminum Sulphate): 0 – 7.5 mg/L
    - Cationic Polymer (ZetaFloc): 0.5 – 100 mg/L
    - Cationic Polymer (SuperFloc*): 0.001 – 5 mg/L
    - Anionic Polymer (AE212*): 0.02 – 6 mg/L
  - Simulate process upset
    - Washwater return causing turbidity spike

** SuperFloc and AE212 are polyacrylamide polymers; requiring a maximum WTP dosage of 1 mg/L (based upon full WTP flow)*

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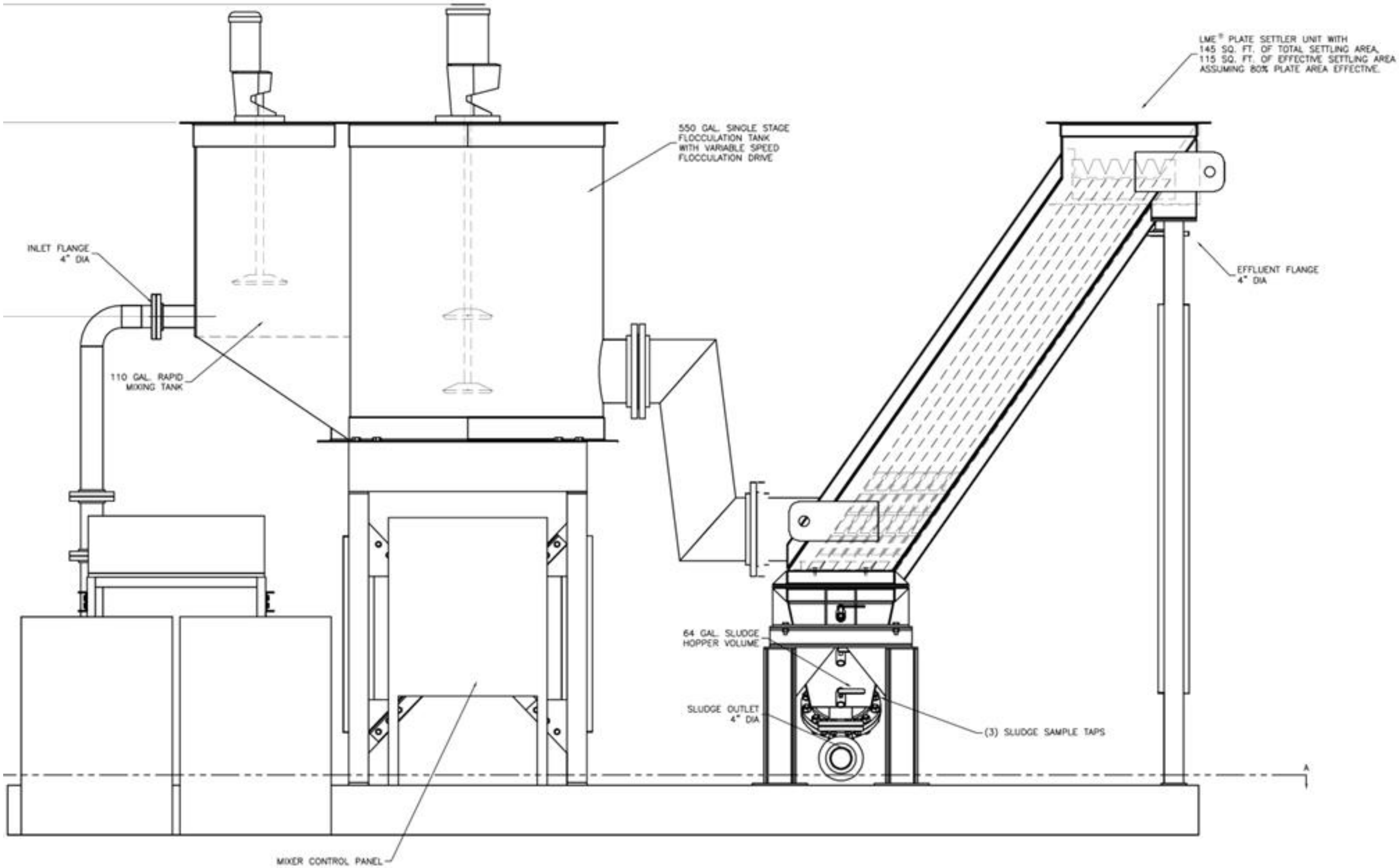
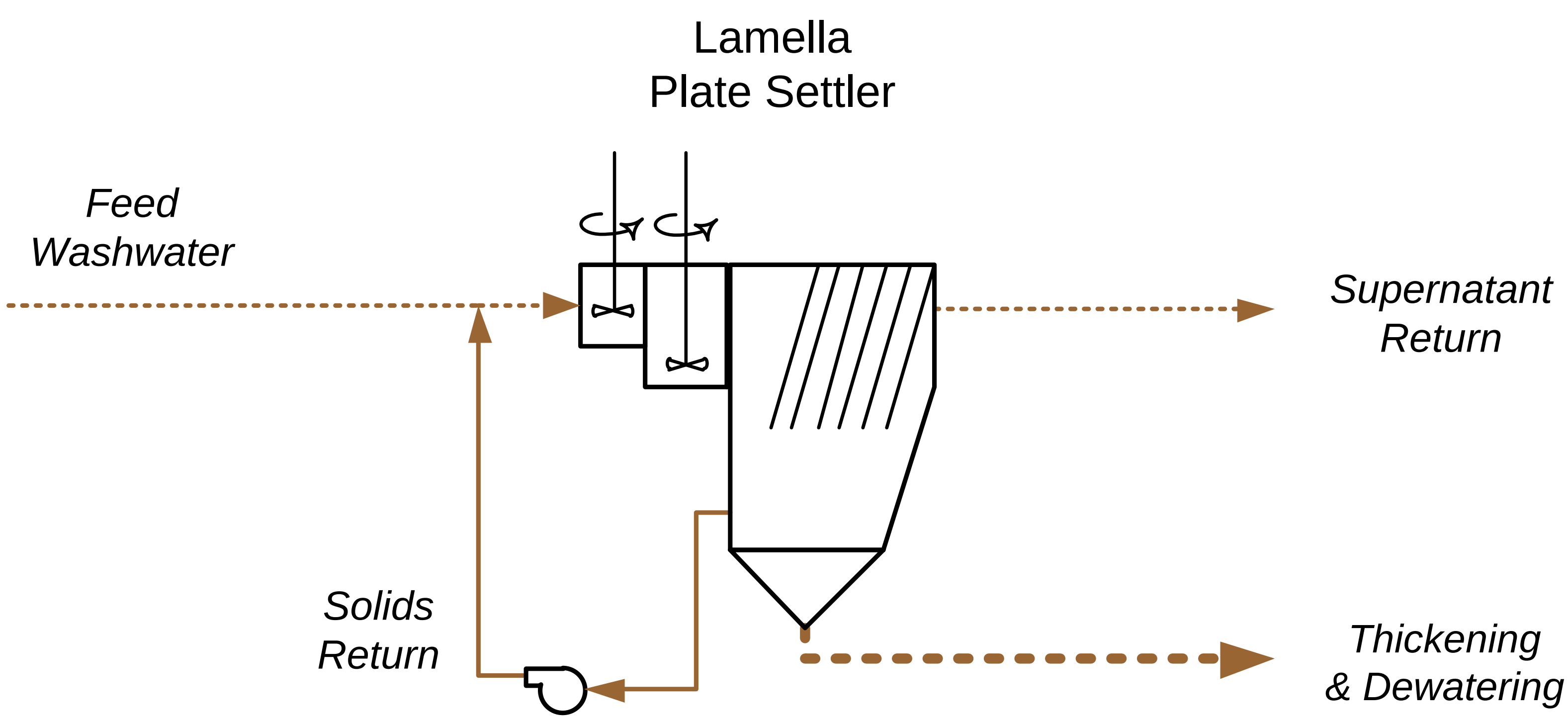
- Recommendations and Next Steps

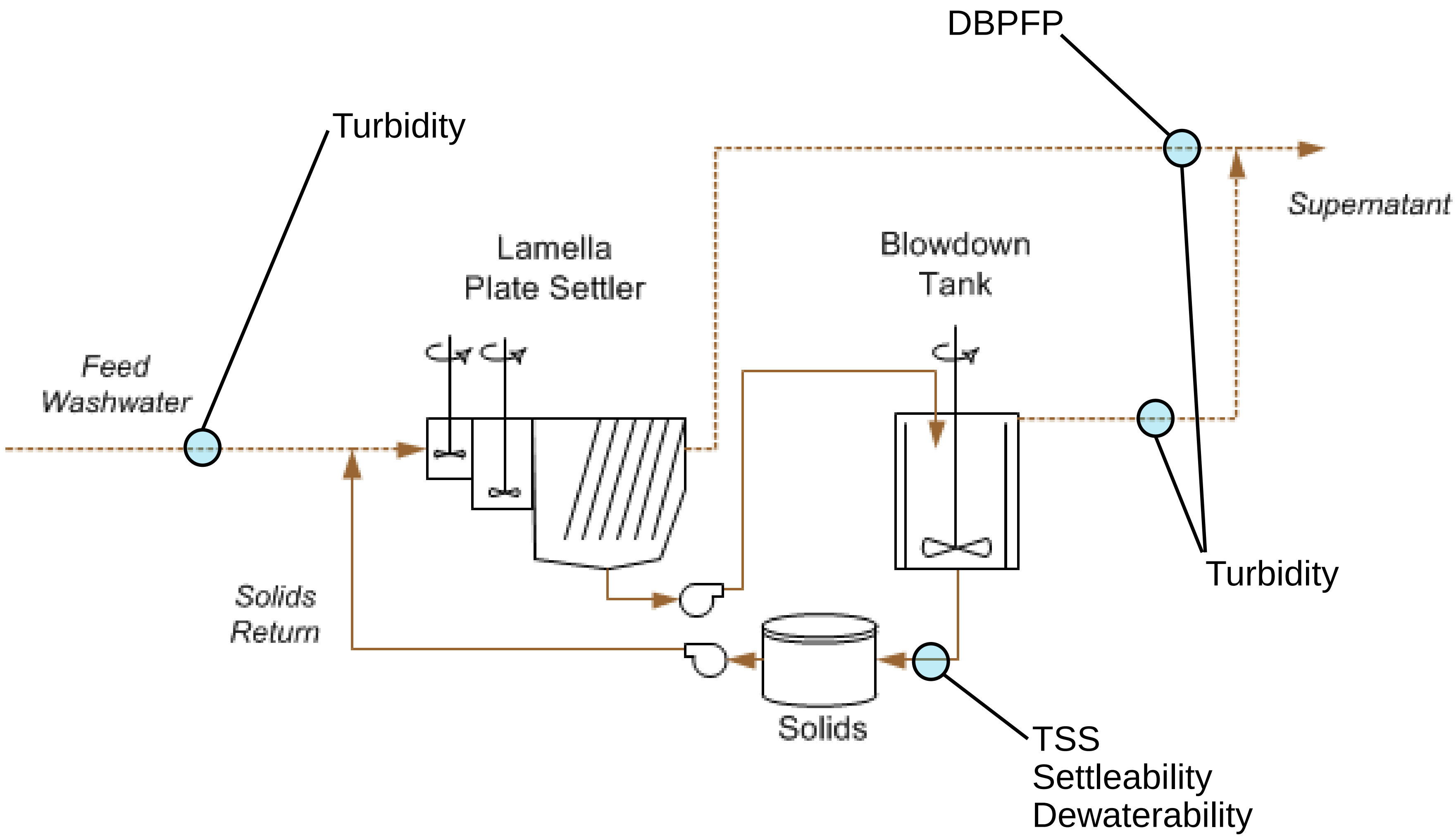
Pilot Plant Setup



Full-Scale Design Representation



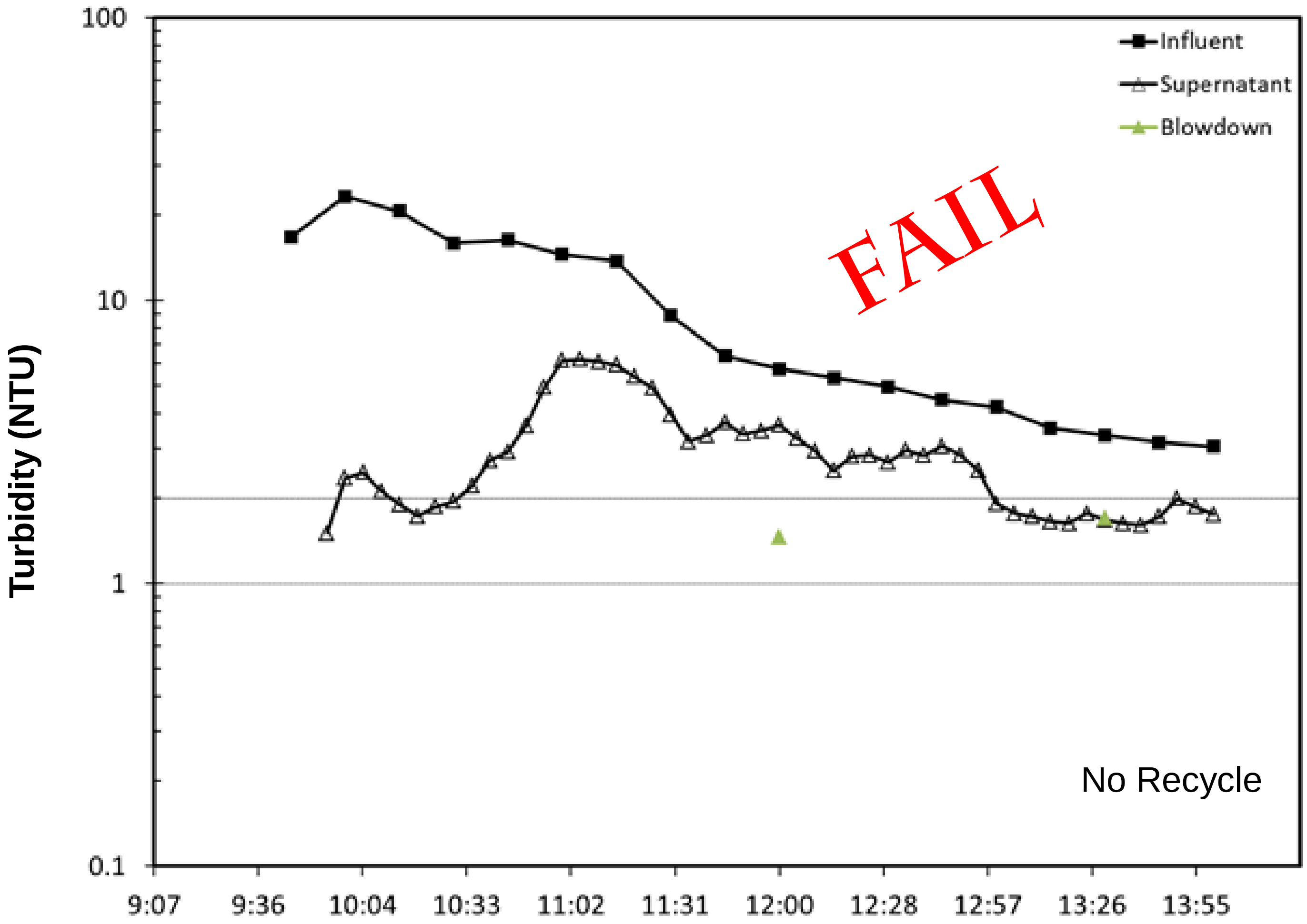
Actual Process Tested



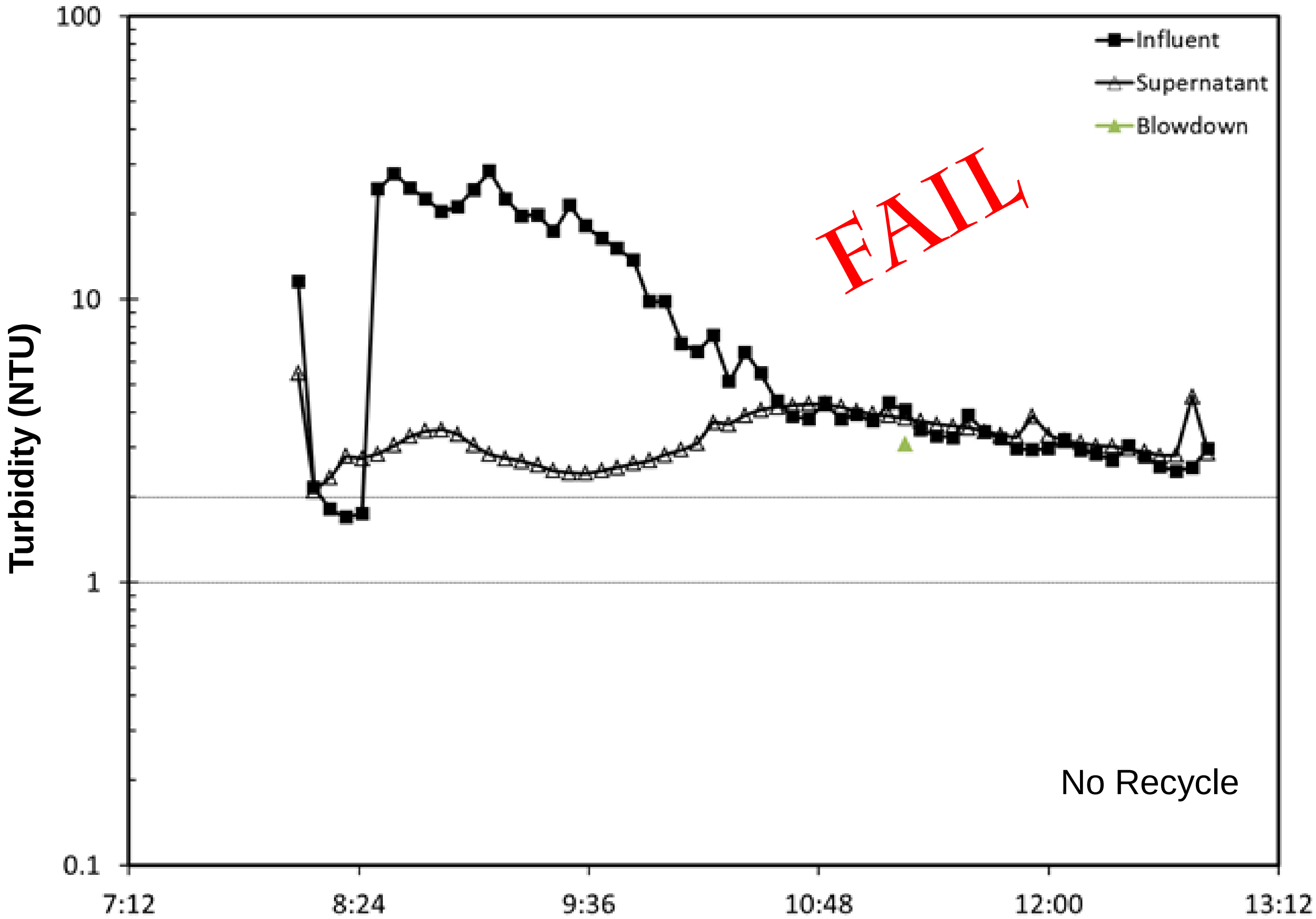
Actual Process Tested

Solids
Recirc

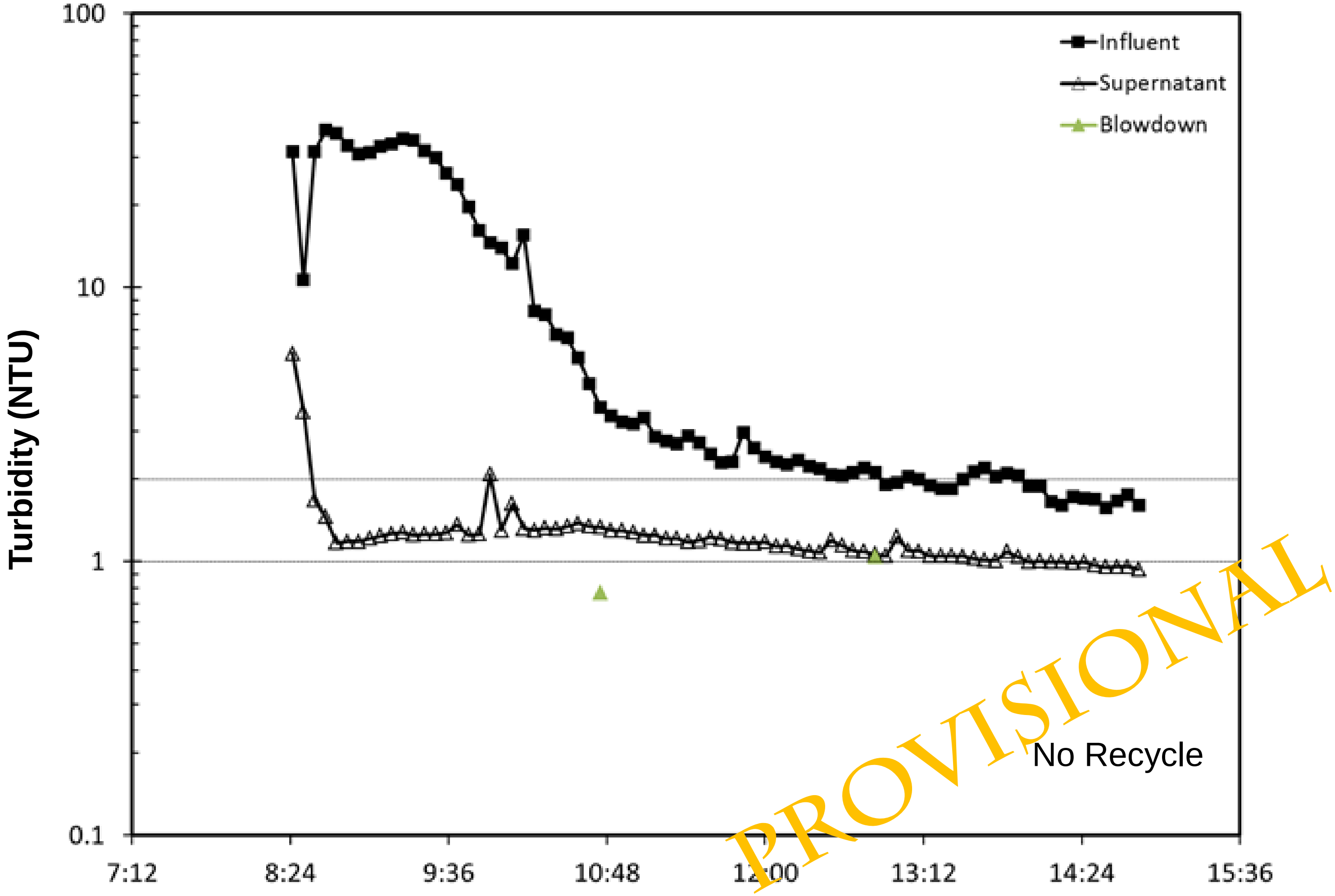
Pilot Test Results
Anionic Polymer & Alum



Pilot Test Results
Zetafloc Cationic Polymer & Alum



Pilot Test Results
4 mg/L SuperFloc Cationic Polymer & 3 mg/L Alum



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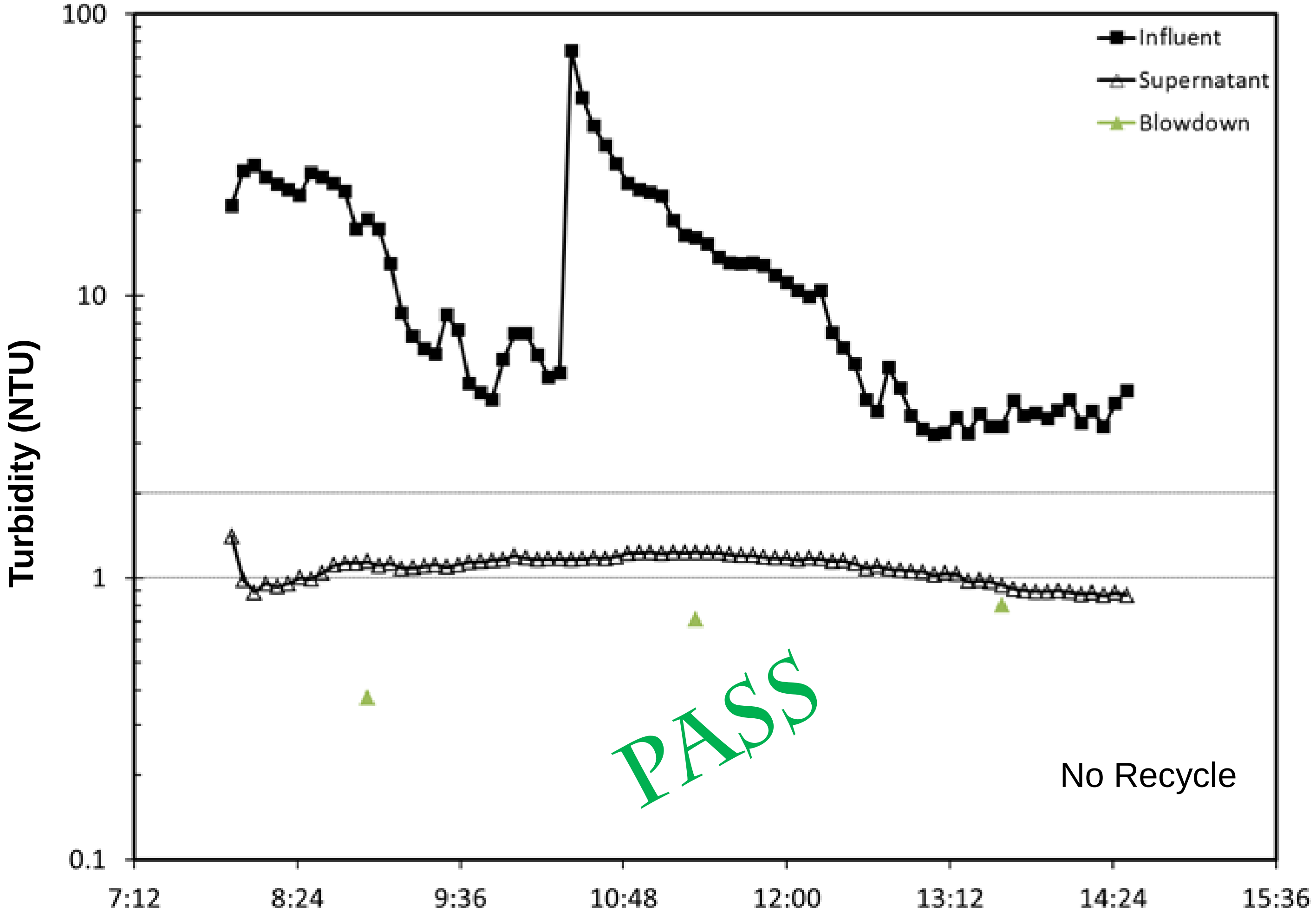
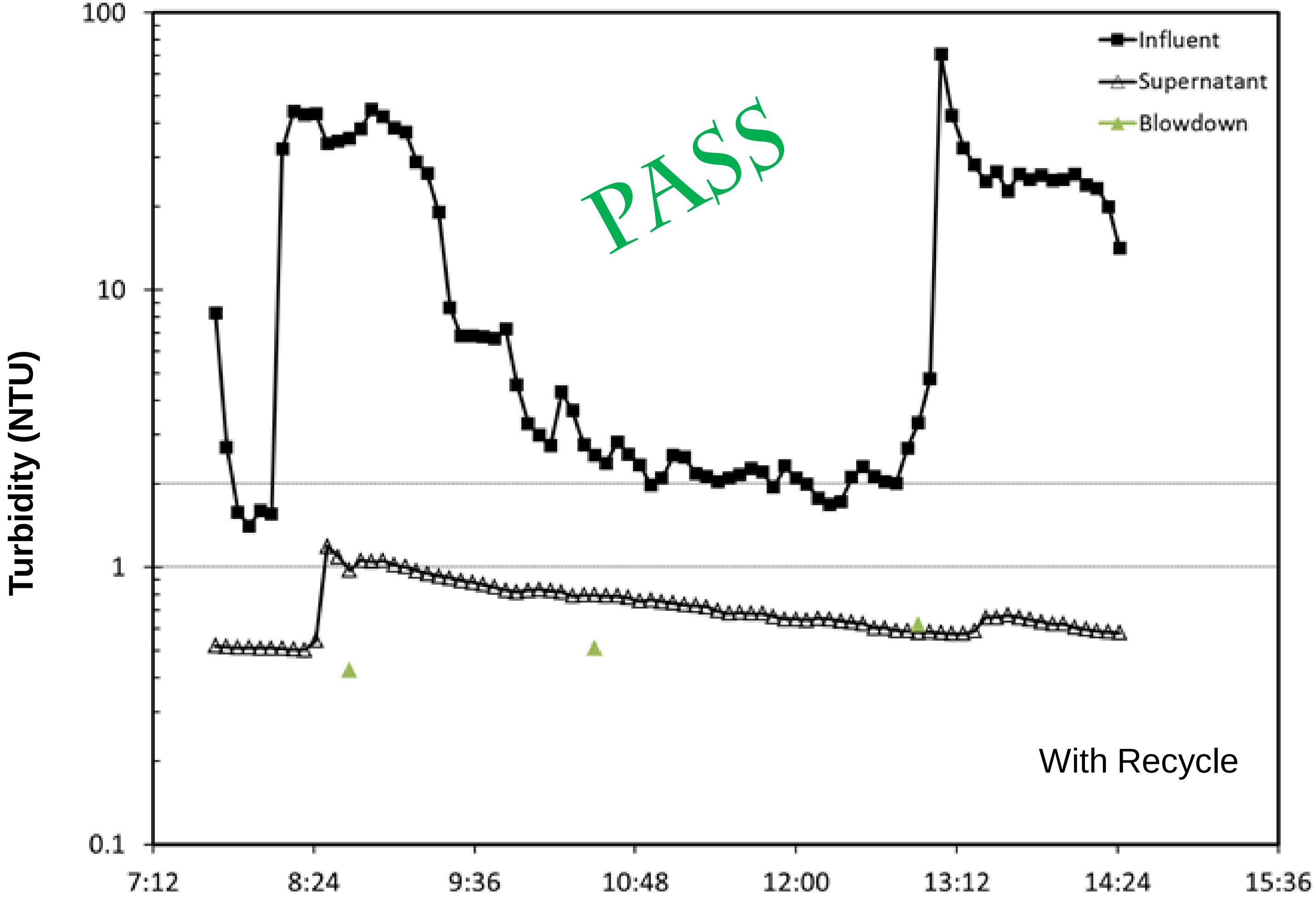
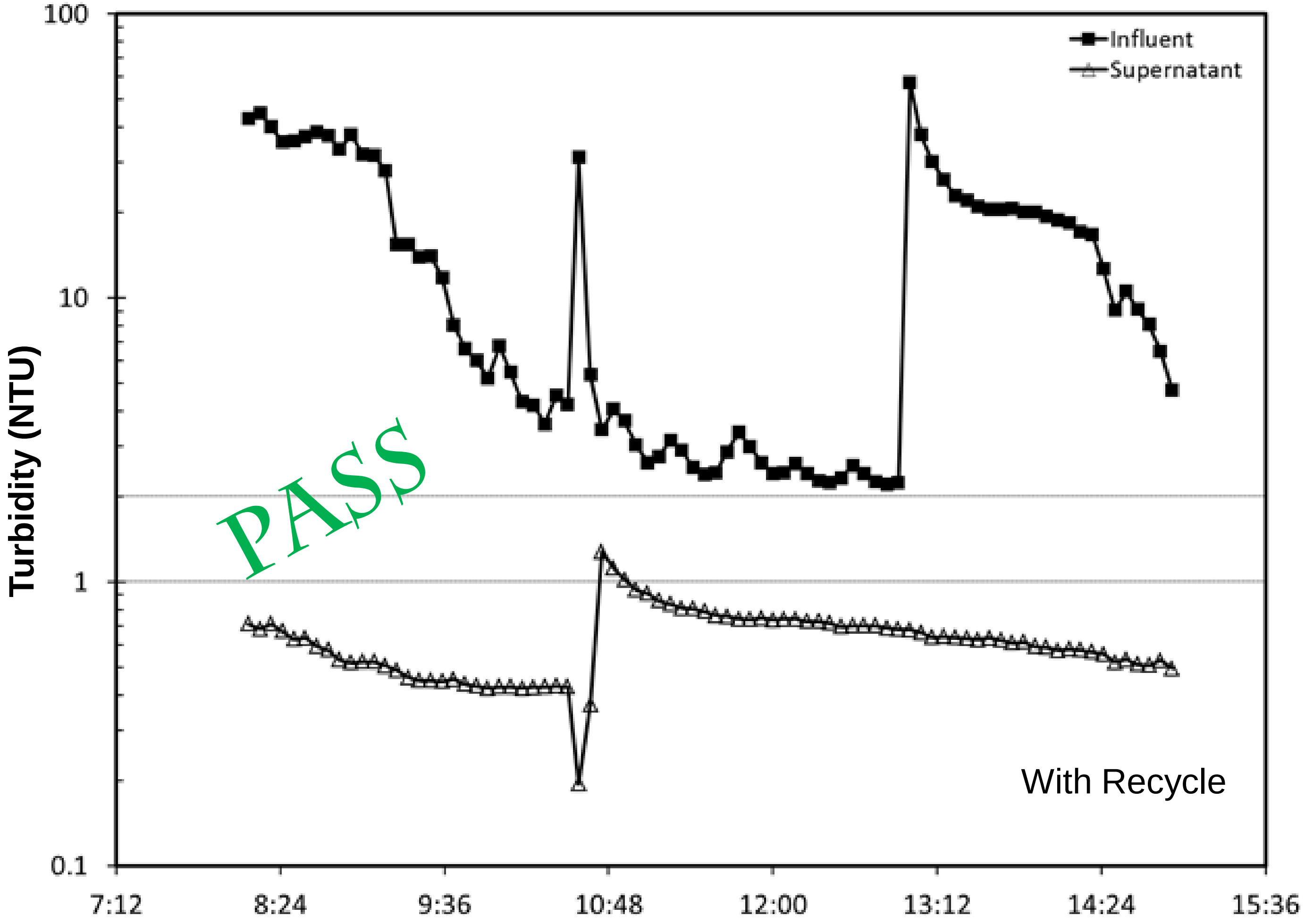
Pilot Test Results
5 mg/L SuperFloc Cationic Polymer & 3 mg/L Alum



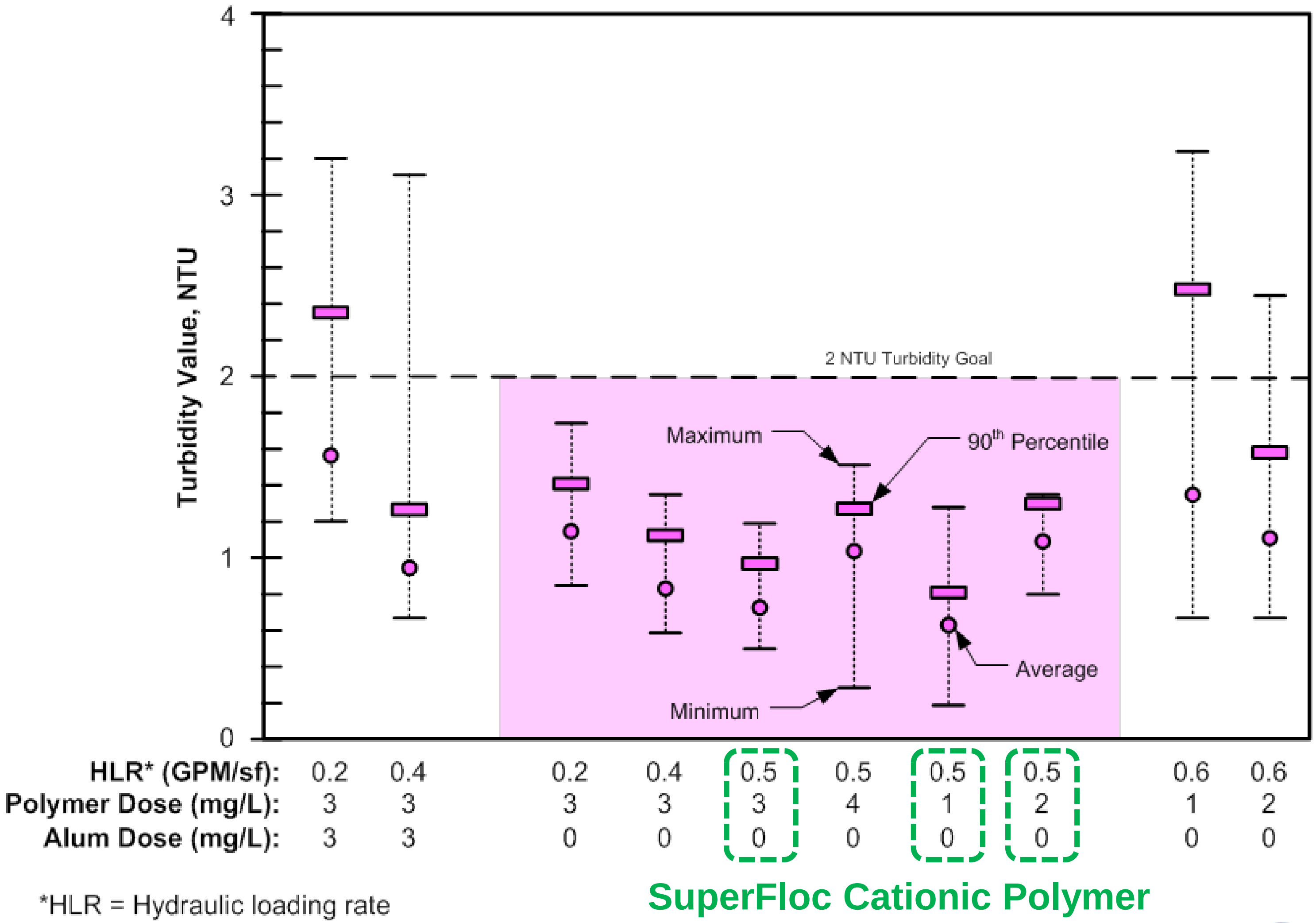
Pilot Test Results
3 mg/L SuperFloc Cationic Polymer



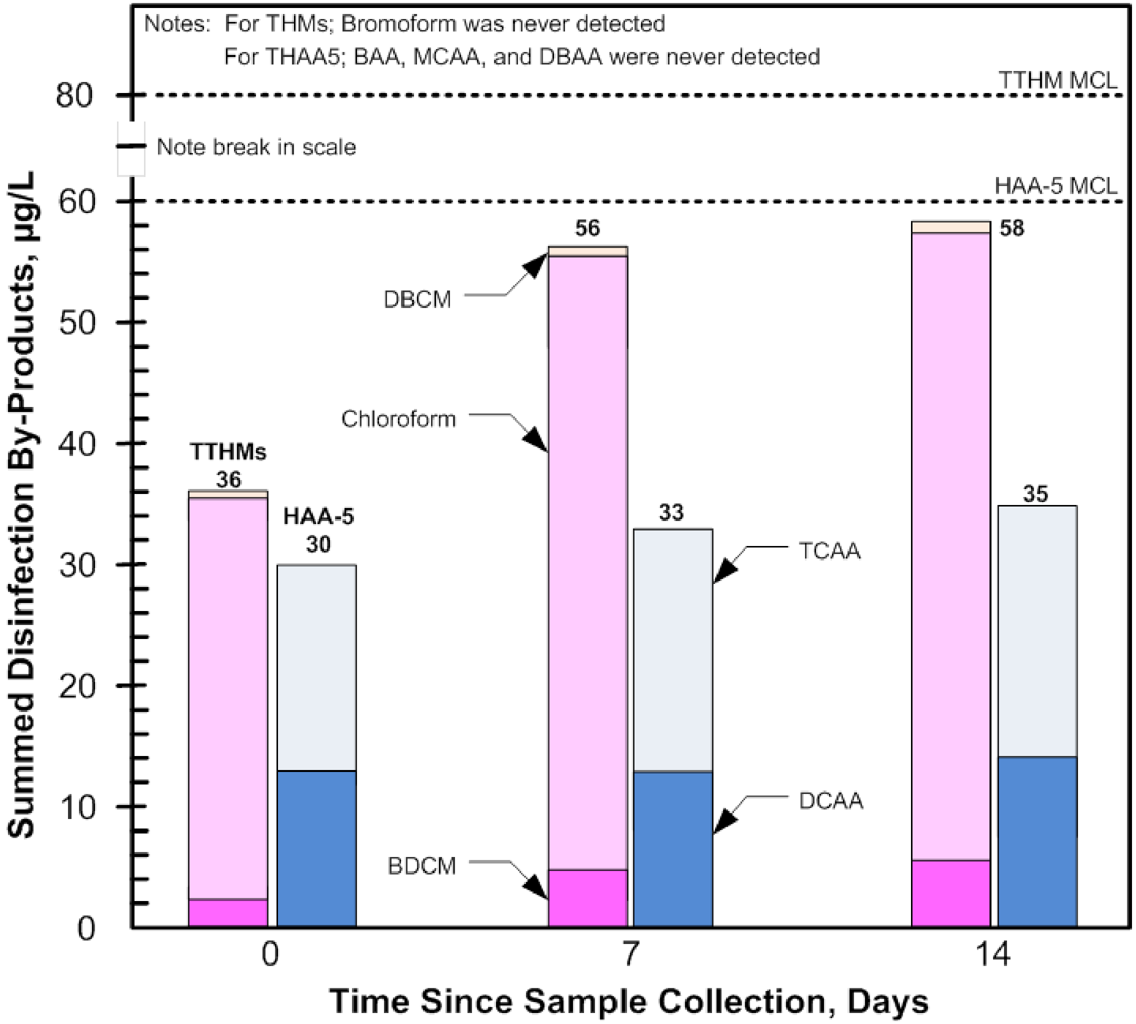
Pilot Test Results
1 mg/L SuperFloc Cationic Polymer



Pilot Test Results
Summary of Test Conditions



Pilot Test Results
DBP Bench Testing



CONDITIONS

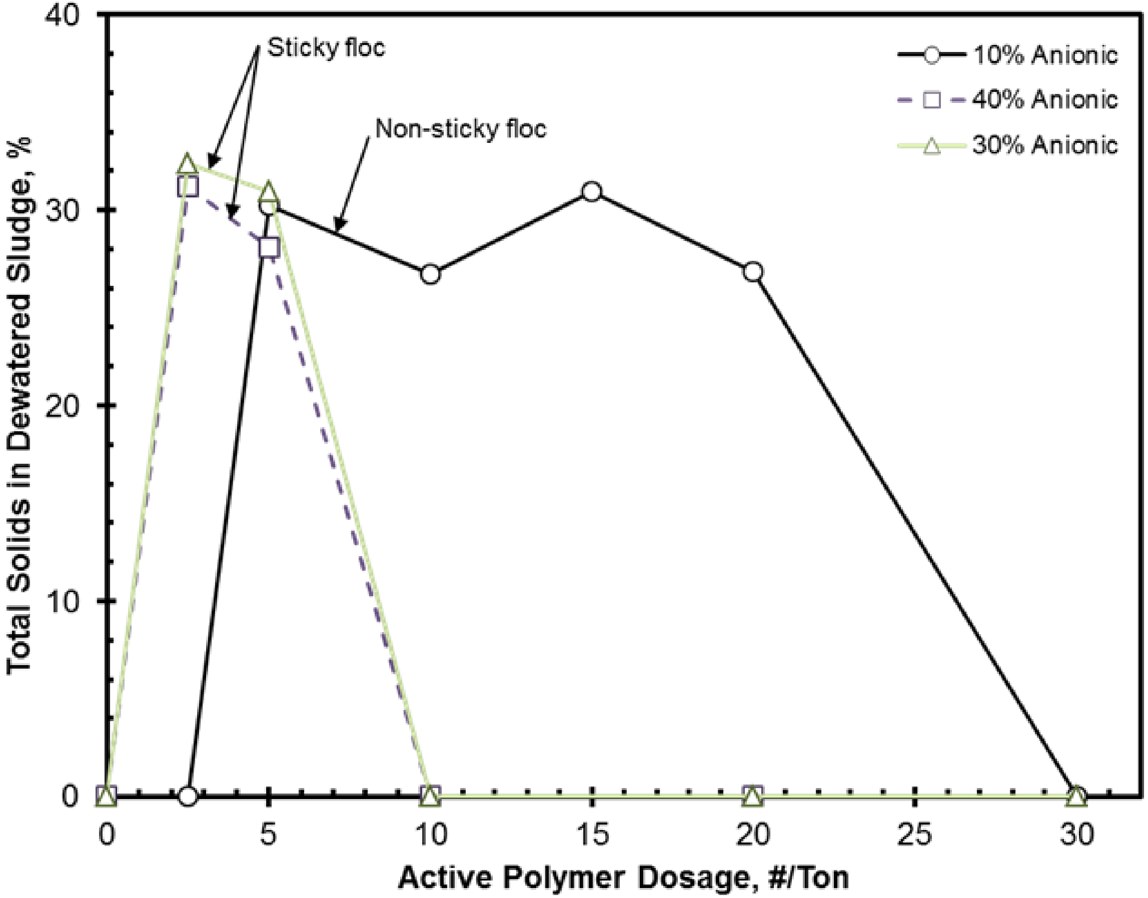
1. Duplicate tests, collected after lamella
2. Stored in the lab in amber, Cl_2- demand-free glass
3. Tests at 7 & 14 days storage

RESULTS

1. Starting residual at ~0.25 mg/L
2. No residual Cl_2 after 14 days
3. DBPs not considered to be an issue (will only become a small portion of treated water)

Pilot Test Results
Dewatering Bench Testing

1. Jar testing to generate flocculated, solid mass
2. Solids squeezed through filtration cloth
3. Dewatered cakes tested for %TS



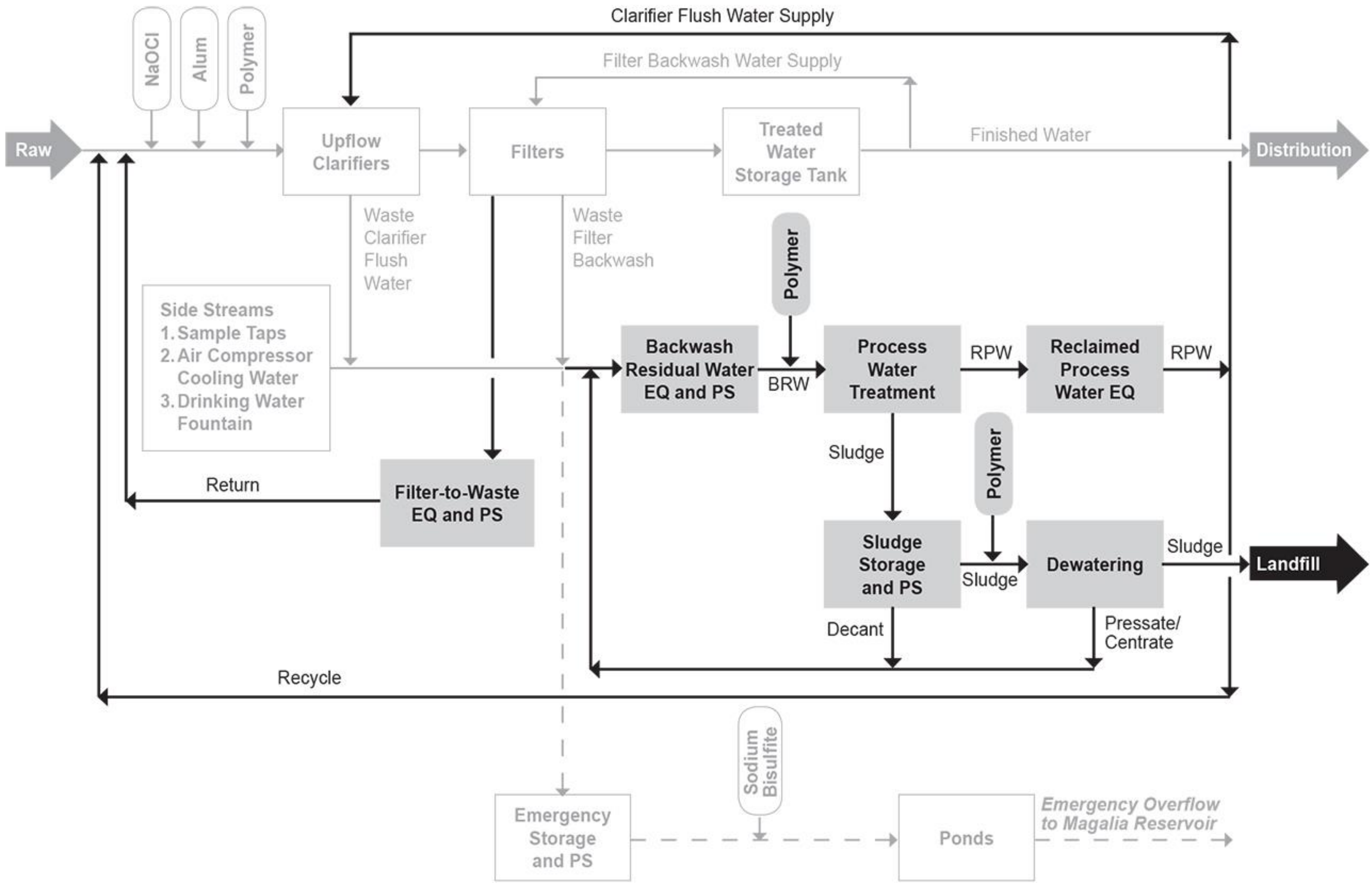
Recommendations and Next Steps

- Lamella Results
  - Several conditions met 2 NTU goal
    - HLR can operate from 0.4-0.5 GPM/sf
    - 1 – 3 mg/L SuperFloc Cationic Polymer
    - Alum not required
  - DBPs not an issue
    - <60 TTHMs & <40 HAA5
    - Recirculated volume with these values is very, very a small portion of flow
- Dewatering Results
  - 30% TS achievable with anionic polymer
  - Confirm results and optimize polymer dose at full-scale

Recommendations and Next Steps, continued

- Operations and Regulatory Conditions
  - Allowed to increase flow above 10% instantaneous (for short periods)
  - Allowed to recycle to head of WTP (meeting 2 NTU goal)
  - Allowed to use as ContaClarifier washwater
- Design Moving Forward
  - Flow equalization is a major focus of design & future operations
  - Prevention of hydraulic surges

Recommendations and Next Steps, continued



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Thank You!

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