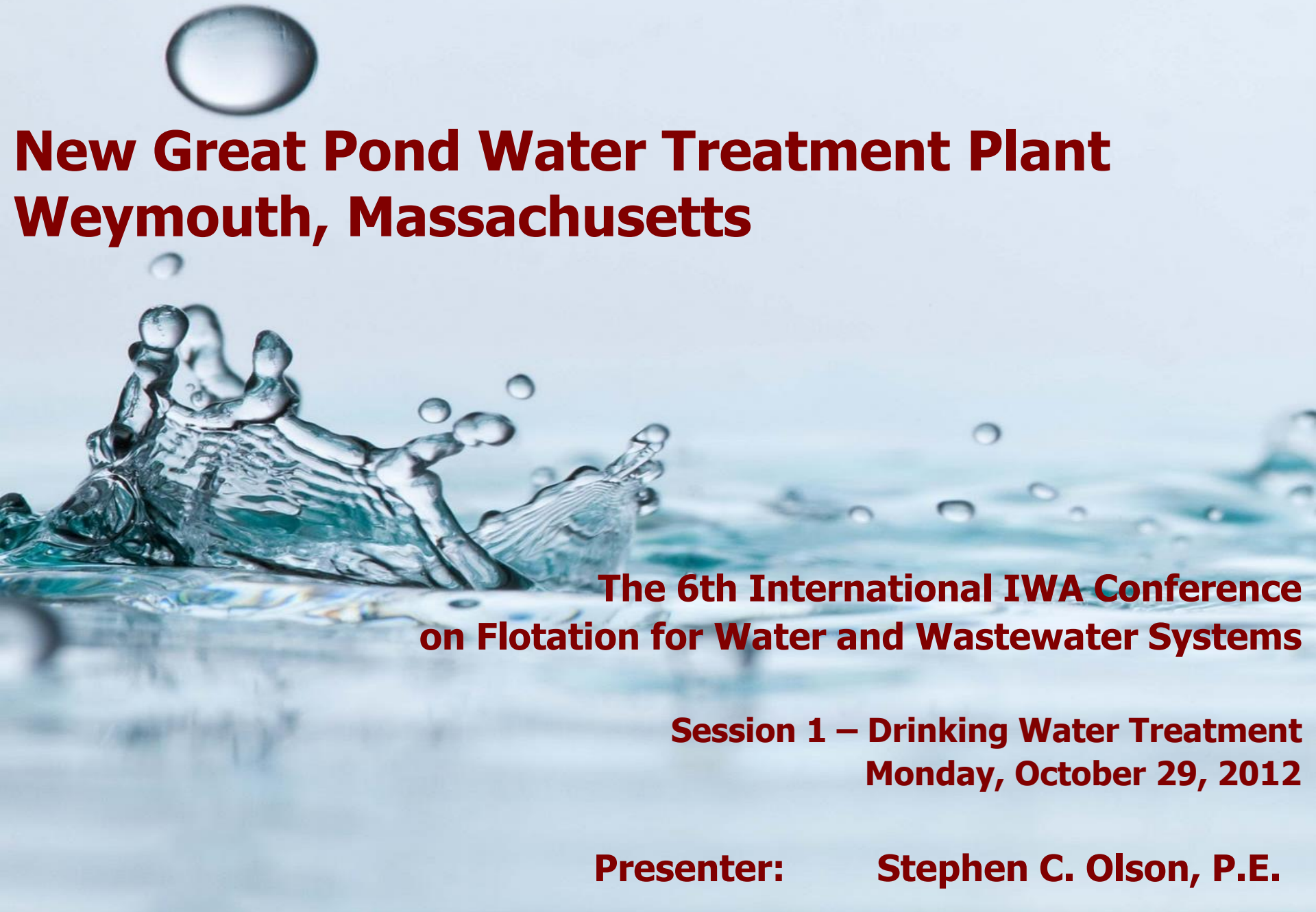


New Great Pond Water Treatment Plant
Weymouth, Massachusetts

The 6th International IWA Conference
on Flotation for Water and Wastewater Systems

Session 1 – Drinking Water Treatment
Monday, October 29, 2012

Presenter: Stephen C. Olson, P.E.

Presentation Overview

- **New Great Pond WTP**
- **Background Information**
  - Weymouth Water System
  - Raw Water Quality
- **Pilot Studies**
- **Design**
- **Construction**
- **Operations**
- **Performance**

New Great Pond WTP Project

Original Great Pond WTP constructed in 1935

Renovations/Upgrades/Modifications: 1967, 1986, 1993, 2004

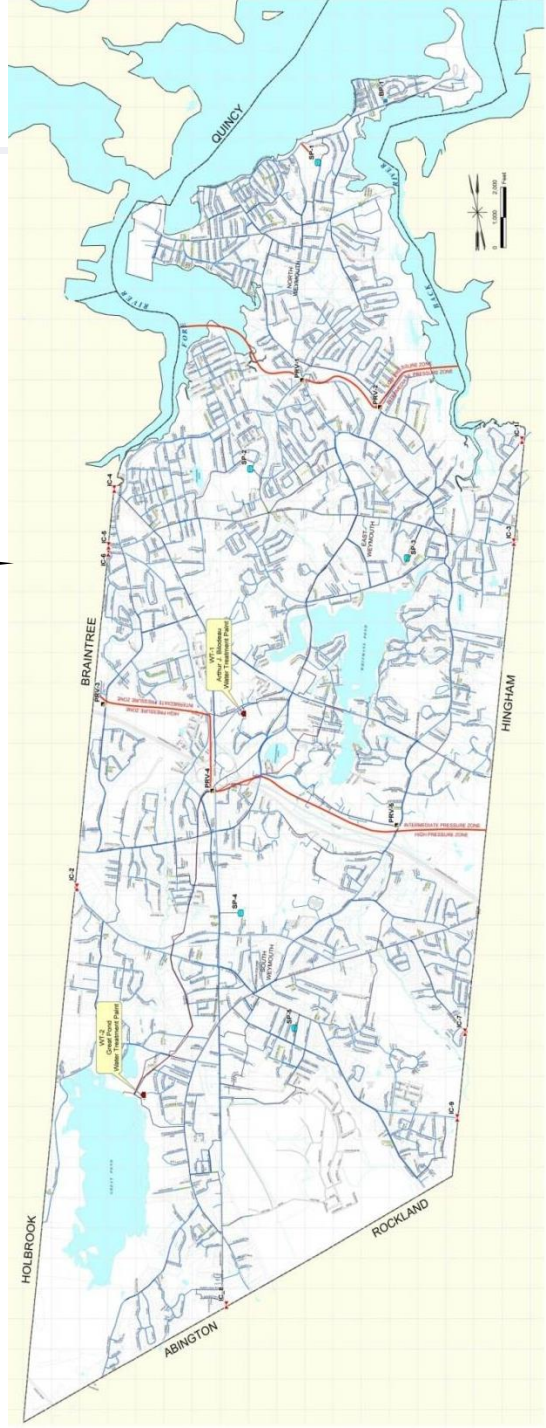
The facility had exceeded its useful service life and was not projected to comply with future drinking water regulations

<u>Project Scope:</u>

Replace existing 8 MGD Great Pond WTP

Project Phasing	Time Line
Preliminary Project Planning	October 2004 – December 2004
Pilot Studies (DAF, and others)	January 2005 – January 2006
Conceptual Design & Planning	March 2006 – August 2006
Schematic Design - DAF Procurement	September 2006 – January 2007
Final Design & Permitting	January 2007 – October 2007
Procurement (Prequalification of Bidders)	September 2007 – March 2008
Construction	July 2008 – September 2010
Facilities Placed On-Line	September 2010

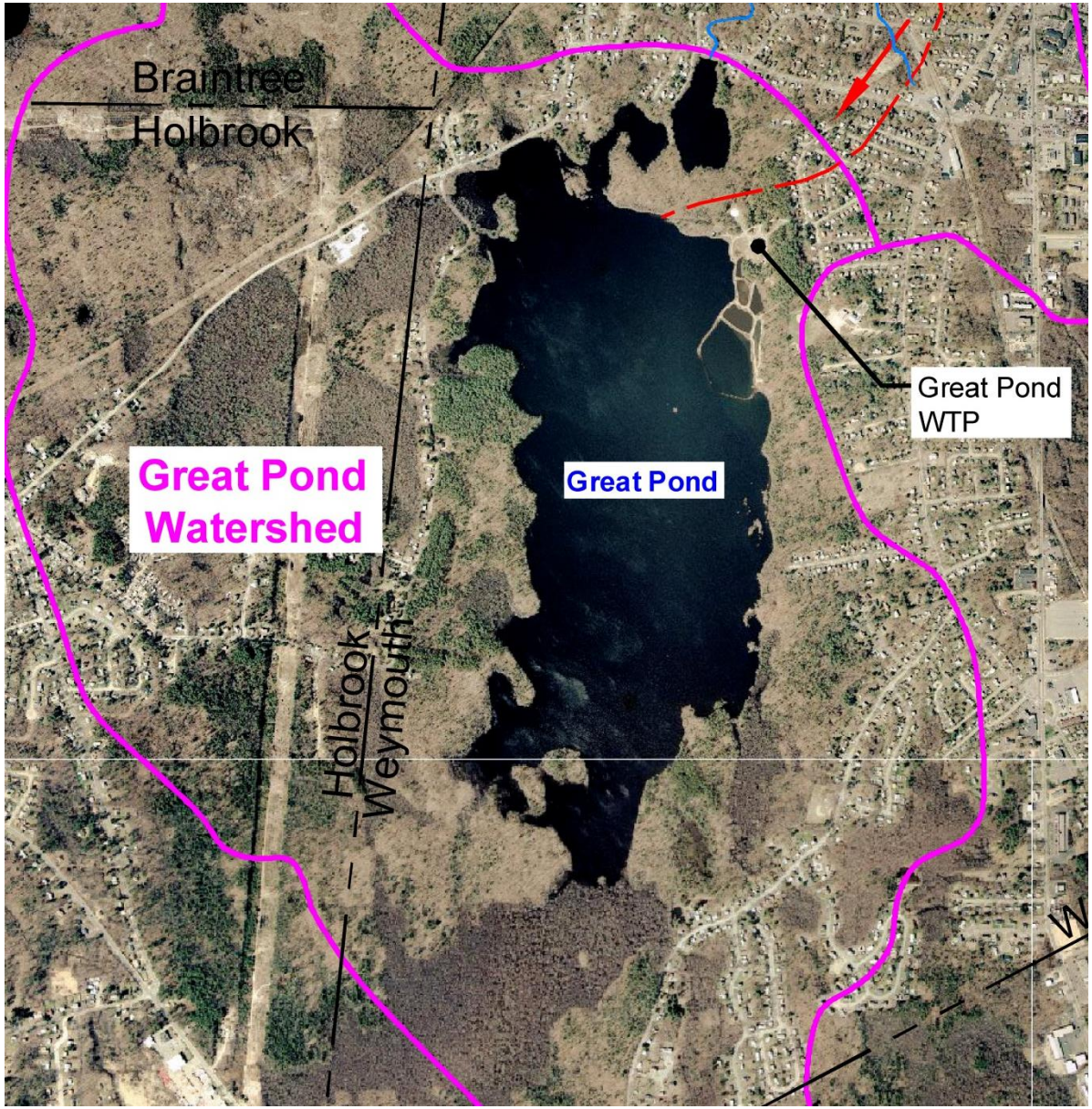
Background Information



Town of Weymouth

- Eastern Shore of Massachusetts
- Water Customers - 5,970
- Service Population – 53,700
- Average Demand – 4.2 MGD
- 2 Water Treatment Plants
- 3 Distribution Pressure Zones
- 4 Water Storage Tanks

Background Information



Great Pond Water Supply

- Surface Water
- 1.2 Billion Gallons
- Safe Yield (3.63 MGD)
- Treated at Great Pond WTP
- Provides ~85% Town's Drinking Water

Great Pond Source Water Quality

"Great Pond is a seasonally variable surface water supply with low turbidity (1 NTU), low pH (5.5 to 6.5), low alkalinity (2 to 10 mg/L $CaCO_3$), moderate to high levels of natural organic matter (TOC: 4 to 15 mg/L), seasonally high levels of iron and manganese (Fe > 0.3, Mn > 0.1), and seasonal episodes of algal blooms."

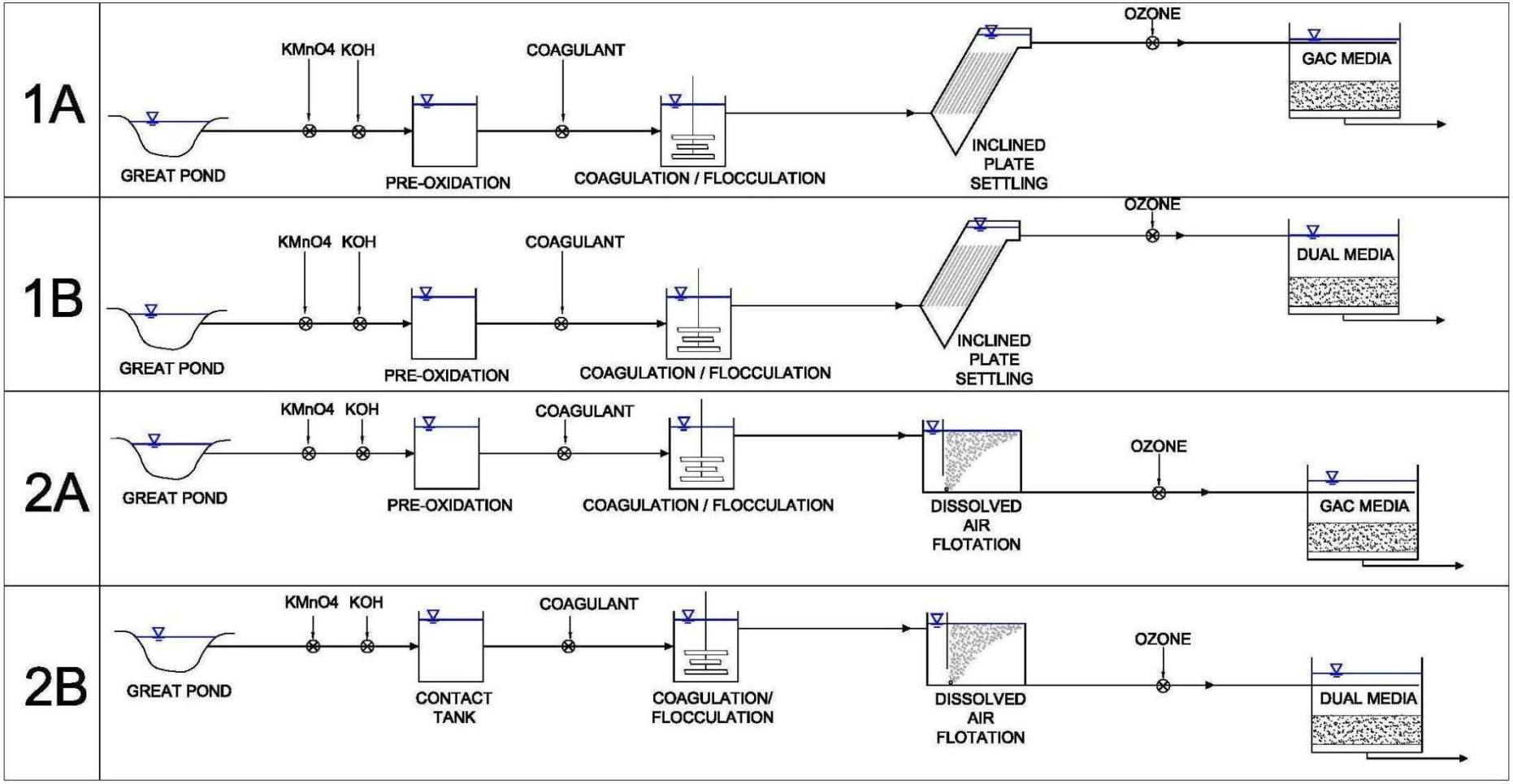
Great Pond Source Water Quality

		Historic
Temperature (°C)	Average	14.2
	Range	3.5 - 28.5
pH (s.u.)	Average	6.4
	Range	5.5 - 6.9
Alkalinity (mg/L CaCO3)	Average	8.0
	Range	2 - 11
Turbidity (NTU)	Average	1.0
	Range	0.4 - 4.3
Color (s.u.)	Average	57
	Range	26 - 105
UV-254 (1/cm)	Average	0.27
	Range	0.18 - 0.33
TOC (mg/L)	Average	8.13
	Range	3.5 - 15
Fe (total) (mg/L)	Average	0.19
	Range	ND - 0.51
Mn (total) (mg/L)	Average	0.07
	Range	ND - 0.78
Algae (cells/L)	Average	300,000
	Range	150,000 – 1,200,000

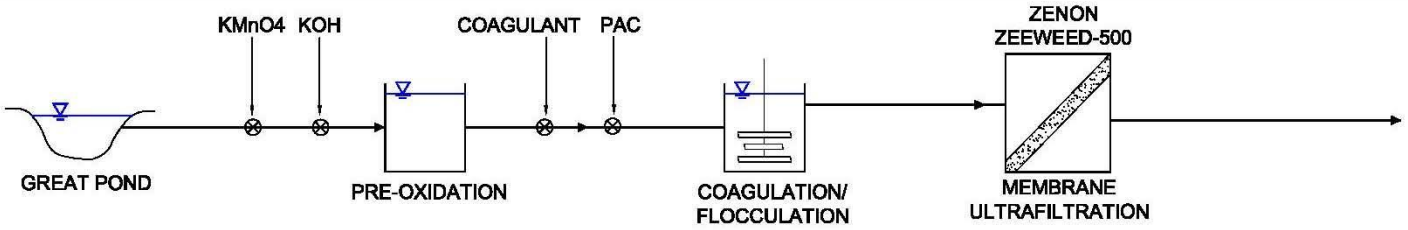
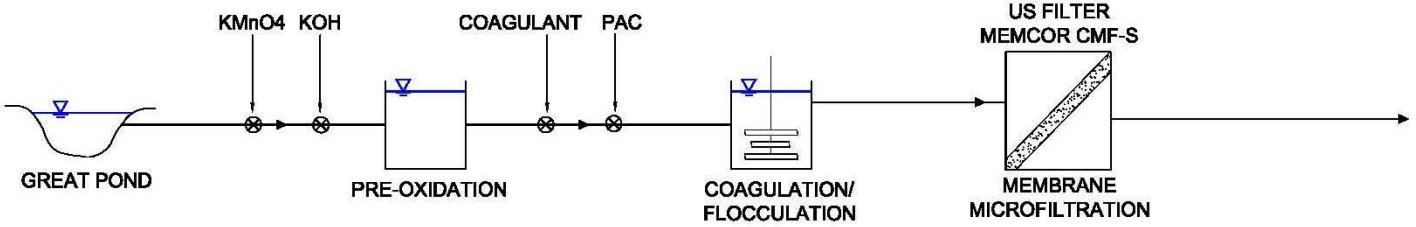
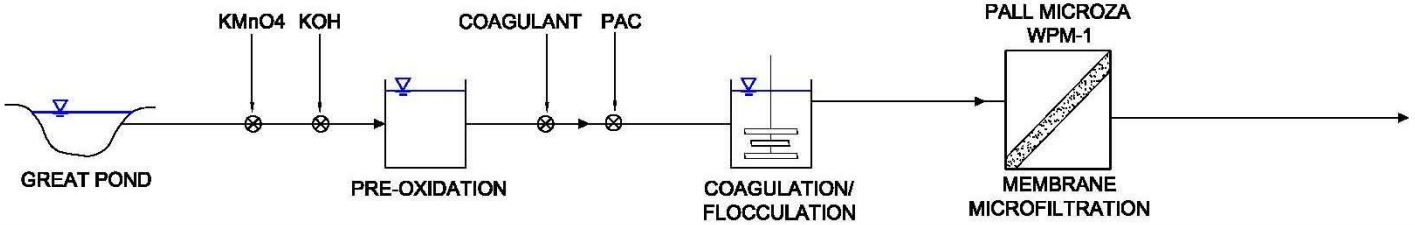
Great Pond Pilot Studies

Pilot Period	Piloting Duration
Pilot Study #1 Cold Water	January 2005 – March 2005
Pilot Study #1 Warm Water	July 2005 – September 2005
Pilot Study #2 Warm Water	August 2005 – October 2005
Pilot Study #2 Cold Water	December 2005 – January 2006

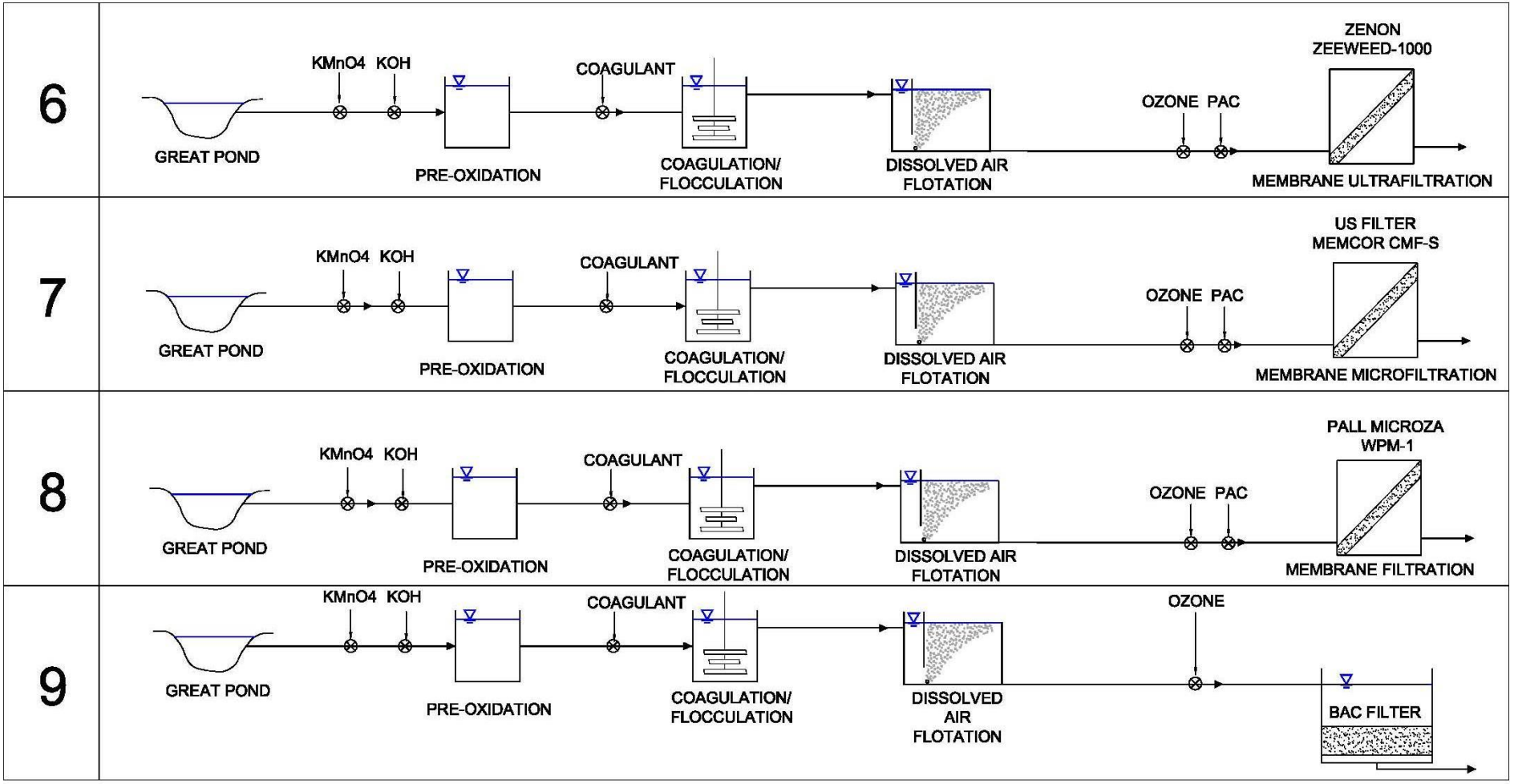
Pilot Study #1 Technologies



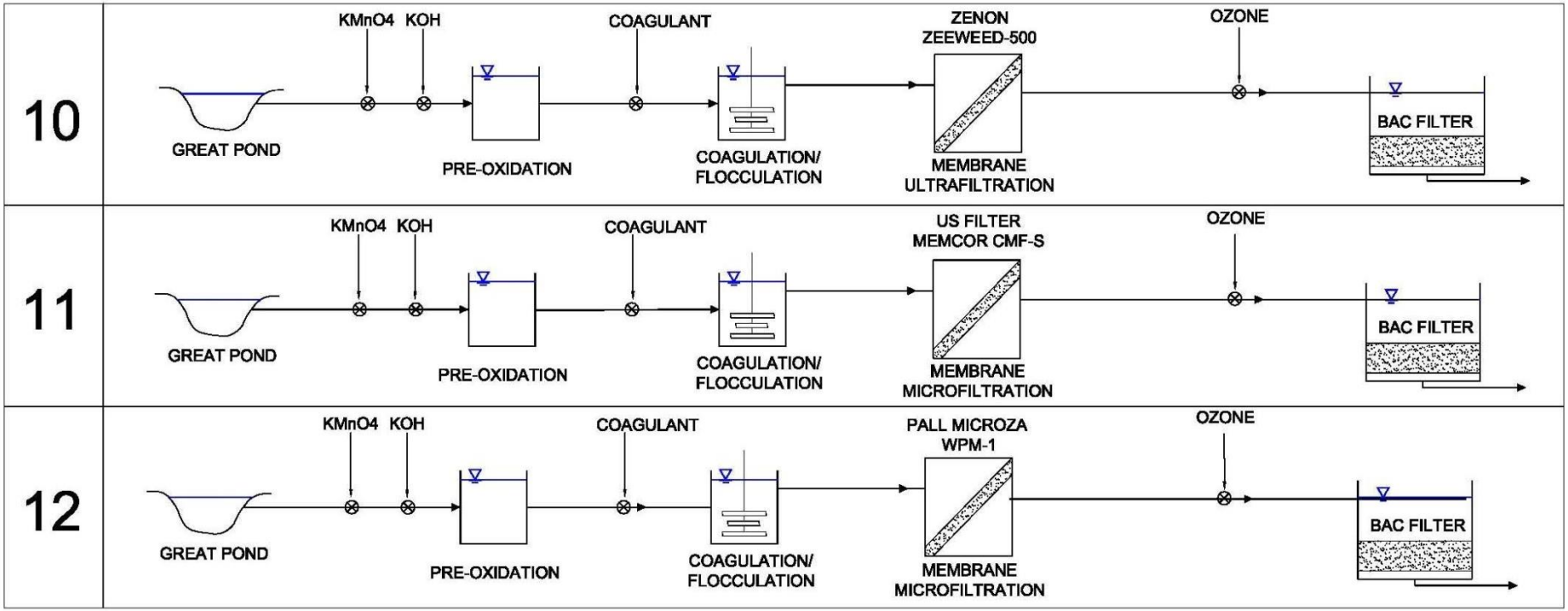
Pilot Study #1 Technologies

3	
4	
5	

Pilot Study #2 Technologies



Pilot Study #2 Technologies



DAF Piloting

1. DAF Vendors: Leopold (**Clari-DAF**) and Infilco Degremont (**AquaDAF**)
2. Coagulation – Polyaluminum Chloride, product dosage 75 mg/L, pH 6.5 to 6.9
3. Flocculation – 8 to 20 minutes
4. Loading Rates (Calculation Comparison)

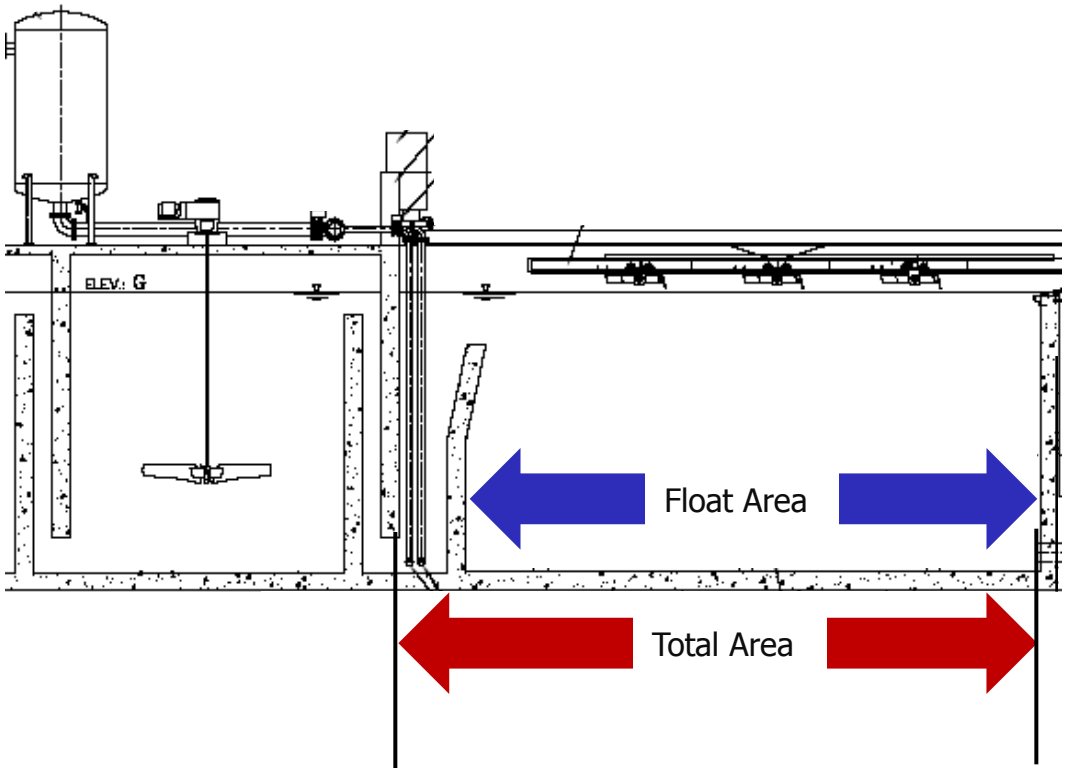
   Leopold: 4 to 8 gpm/sf
   Infilco Degremont: 4 to 18 gpm/sf

Leopold Loading Rates		**IDI Loading Rates**	
(Total Area*)	(Float Area)	(Total Area)	**(Float Area*)**
(gpm/sf)*	(gpm/sf)	(gpm/sf)	**(gpm/sf)***
4	5.5	5.3	**6**
6	8.2	7.1	**8**
8	10.9	8.9	**10**
10	13.6	10.7	**12**
12	16.4	12.5	**14**

*reported vendor rates

5. Recycle Rates

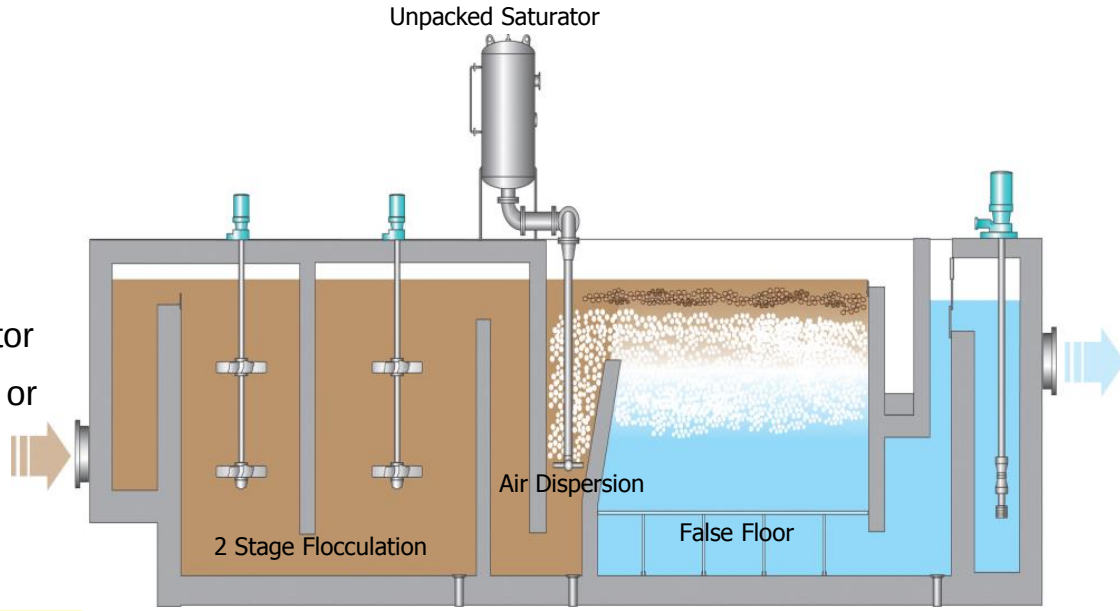
   Leopold: 6% to 12%
   Infilco Degremont: 10% to 16%



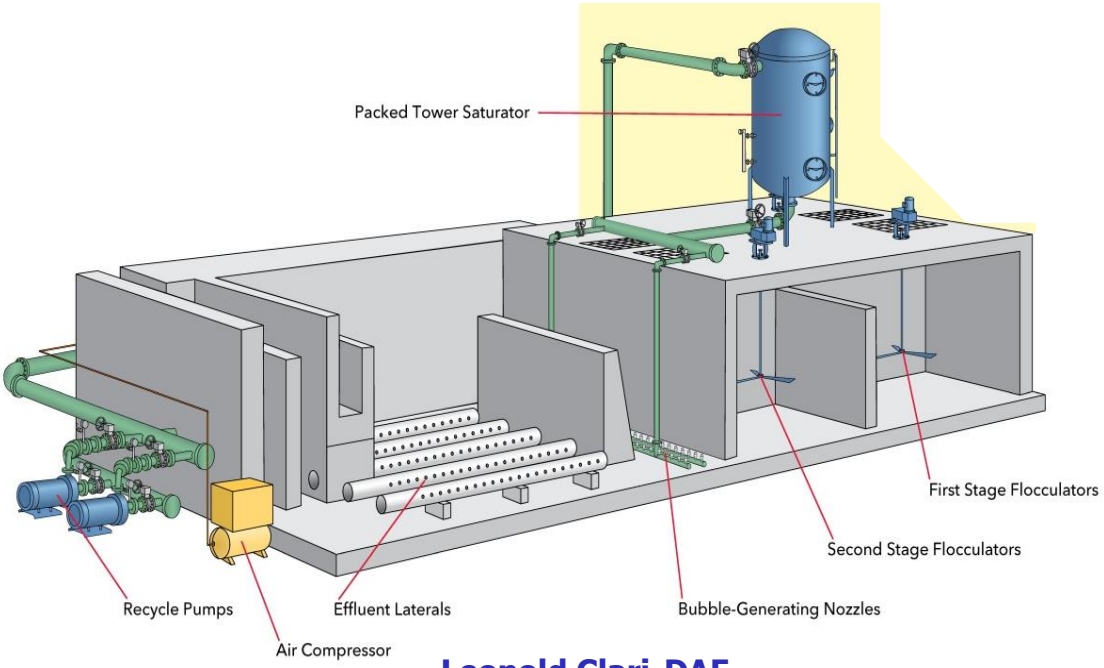
Comparison of DAF Systems

Design Comparison

- Both use 2-stage flocculation
- Both use inclined baffle wall
- Both use dual laterals for air dispersion/injection
- Leopold collection laterals, IDI false floor
- Leopold packed saturator, IDI un-packed saturator
- Both have option for either mechanical or hydraulic sludge collection/removal



Infilco Degremont AquaDAF



Leopold Clari-DAF

DAF Pilot Turbidity Results

Warm Water:

Leopold		Infilco Degremont	
Loading Rate (gpm/sf)	Turbidity (NTU)	Loading Rate (gpm/sf)	Turbidity (NTU)
4	0.2	8	0.35
6	0.2	10	0.4
8	0.2	12	0.45
		14	0.5
		16	0.5
		18	0.5

Cold Water:

Leopold		Infilco Degremont	
Loading Rate (gpm/sf)	Turbidity (NTU)	Loading Rate (gpm/sf)	Turbidity (NTU)
4	0.25	8	0.4 - 0.6
6	0.5	10	0.5 - 1.5
8	1.2	12	0.5 - 1.0
		14	0.5 - 1.0
		16	0.6 - 1.0

Pilot Treatment Performance Assessment

Only 4 process trains were able to meet all of the Pilot Study Water Quality Goals

1.Direct membrane filtration – intermediate ozone – BAC filtration

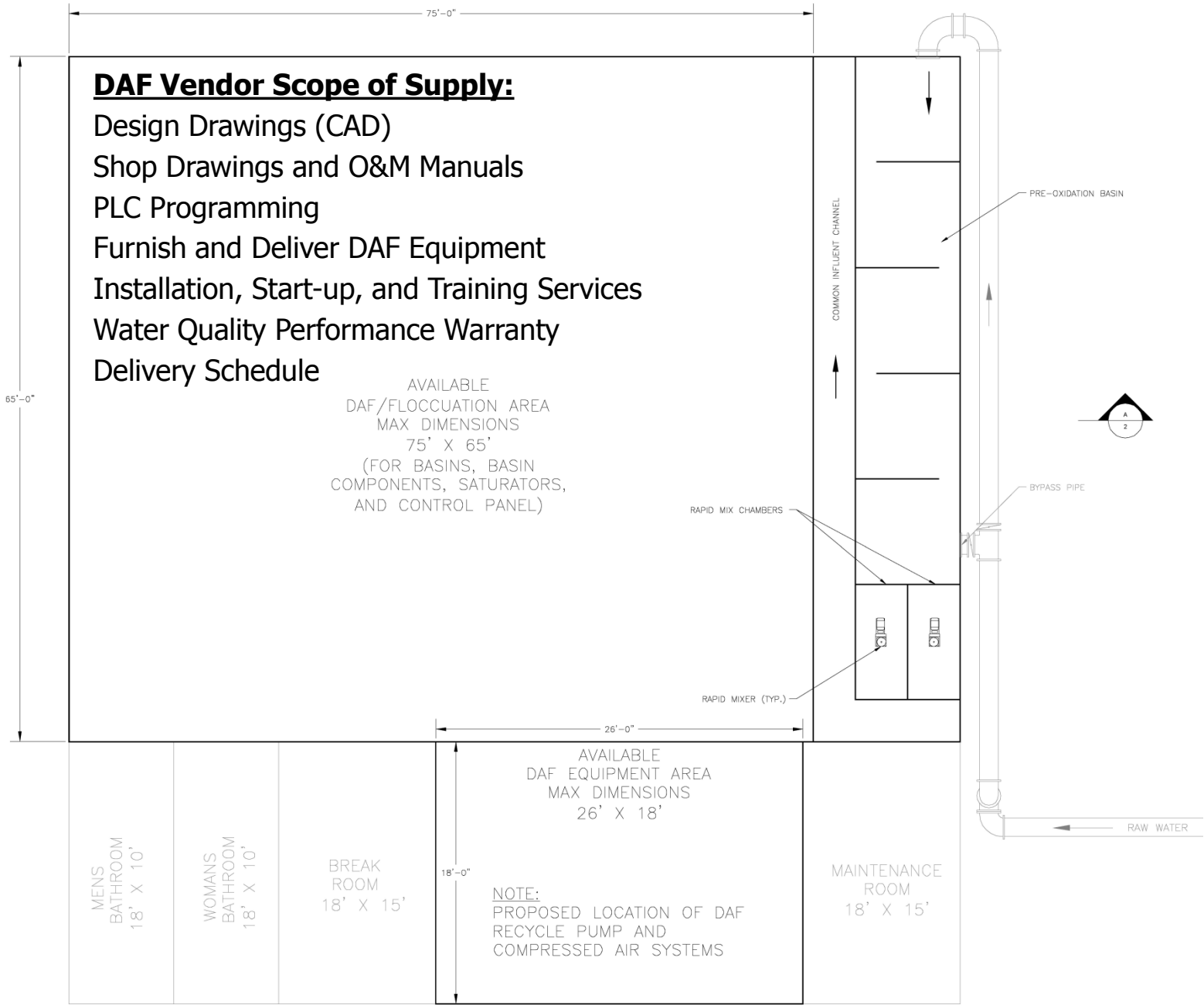
2.Dissolved air flotation – intermediate ozone – membrane filtration

3.Dissolved air flotation – intermediate ozone – PAC addition – membrane filtration

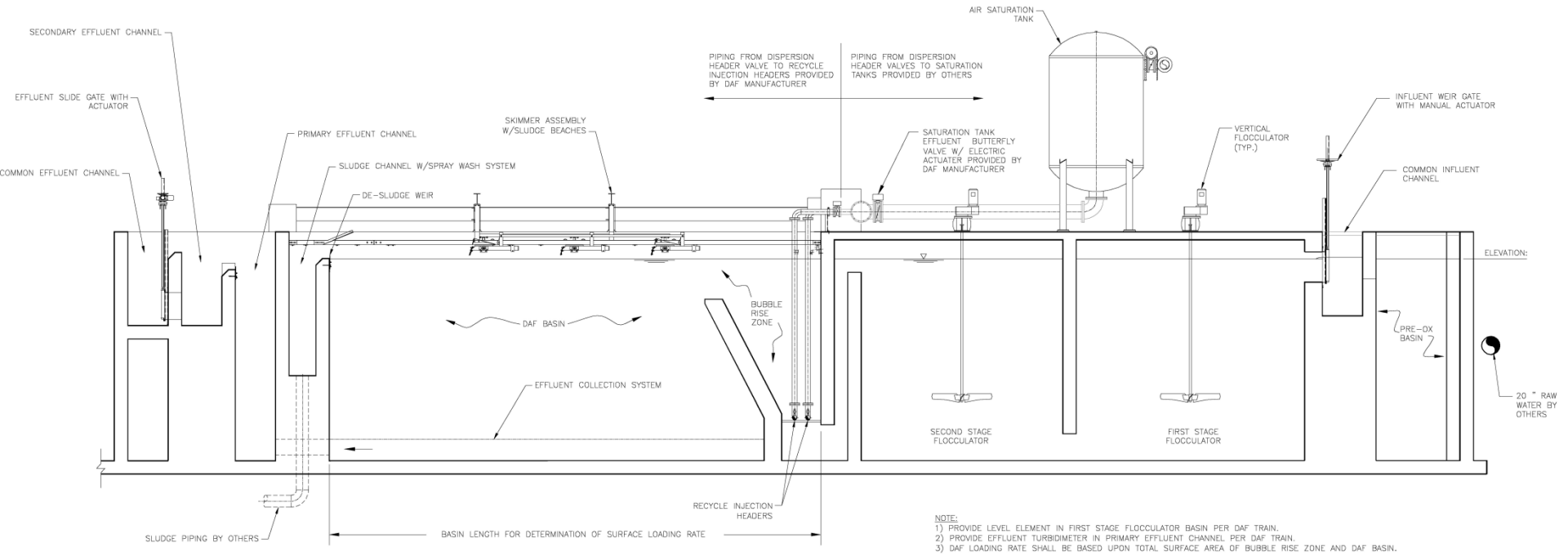
4.Dissolved air flotation – intermediate ozone – GAC/BAC filtration

Based on an evaluation of capital and O&M costs, DAF – Intermediate ozone – BAC filtration was selected for design.

Schematic Design - DAF Procurement



DAF Procurement



DAF Vendor Bid Submittal:

Qualifications Statement

Conceptual Design Drawings

Minimum Pass/Fail Criteria

3 Cost Components (Equipment, Concrete, Live Cycle Electrical Costs)

2-Year Process Performance Warranty (Turbidity < 1 NTU, 95% in 24 hours)

Award based on ranking of Qualifications and Costs

DAF Procurement

Award based on Ranking of Qualifications and Costs

F.B. Leopold identified as the lowest responsible and eligible bidder

Category	Pass/Fail	Bid	Maximum Points	Score
1. DAF system equipment costs	Pass	N/A, based on subtotal	N/A	***N/A***
2. Post award DAF system submittals	Pass	N/A, based on subtotal	N/A	***N/A***
3. Post award DAF system services	Pass	N/A, based on subtotal	N/A	***N/A***
Subtotal (DAF system costs, 000303, Part I)		**$1,146,922**	**50**	***50***
4. Life cycle electrical costs **(000303, Part II)**	Pass	**$520,610**	**5**	***5***
5. Equivalent concrete costs **(000303, Part III)**	Pass	**$113,000**	**5**	***4.5***
6. References	Pass	Refer to Quals	**8**	***6***
7. Corporate stability and financial ability	Pass	Refer to Quals	**8**	***8***
8. Project Team (Staffing)	Pass	Refer to Quals	**8**	***8***
9. Project Work Plan	Pass	Refer to Quals	**8**	***8***
10. Equipment maintenance history	Pass	Refer to Quals	**8**	***8***
Result Total	Pass	**N/A**	**100**	***97.5***

Other Design Goals and Objectives

1. Maximize treated water quality effectiveness, operational flexibility, facility reliability/dependability, and cost effectiveness
2. Incorporate existing facilities (Intake Structure, Residuals Pump Station, Residuals Lagoons)
3. Value Engineering Results: reduce footprint by 25%, eliminate geothermal, alternative building materials, eliminate raw water VFDS, diesel generators

New Great Pond WTP – Process Flow Schematic

RAW WATER INTAKE
OF SCREENS: 2
CAPACITY: 4.2 MGD (EACH)

RAW WATER PUMPING
OF PUMPS: 4
CAPACITY: 2800 gpm @ 55' TDH
DRIVE: CONSTANT

PRE-OXIDATION
TYPE: INLET BAFFLE WALL
CONTACT TIME: 5 MIN. @ PEAK FLOW

RAPID MIXING
OF MIXERS: 2
TYPE: TOP-ENTRY MECHANICAL
CONTACT TIME: 30 SEC. @ PEAK FLOW

FLOCCULATION
OF TRAINS: 3
TYPE: 2 STAGE, VARIABLE SPEED
CAPACITY: 4.2 MGD (EACH)
OF FLOCCULATORS: 12
FLOC TIME: 13.3 MIN. @ PEAK FLOW

DISSOLVED AIR FLOTATION
OF TRAINS: 3
CAPACITY: 4.2 MGD (EACH)
LOADING RATE: 6 GPM/SF @ PEAK FLOW
RECYCLE RATE: 12% @ PEAK FLOW
OF RECYCLE PUMPS: 3
SATURATORS: 2
OF COMPRESSORS: 2

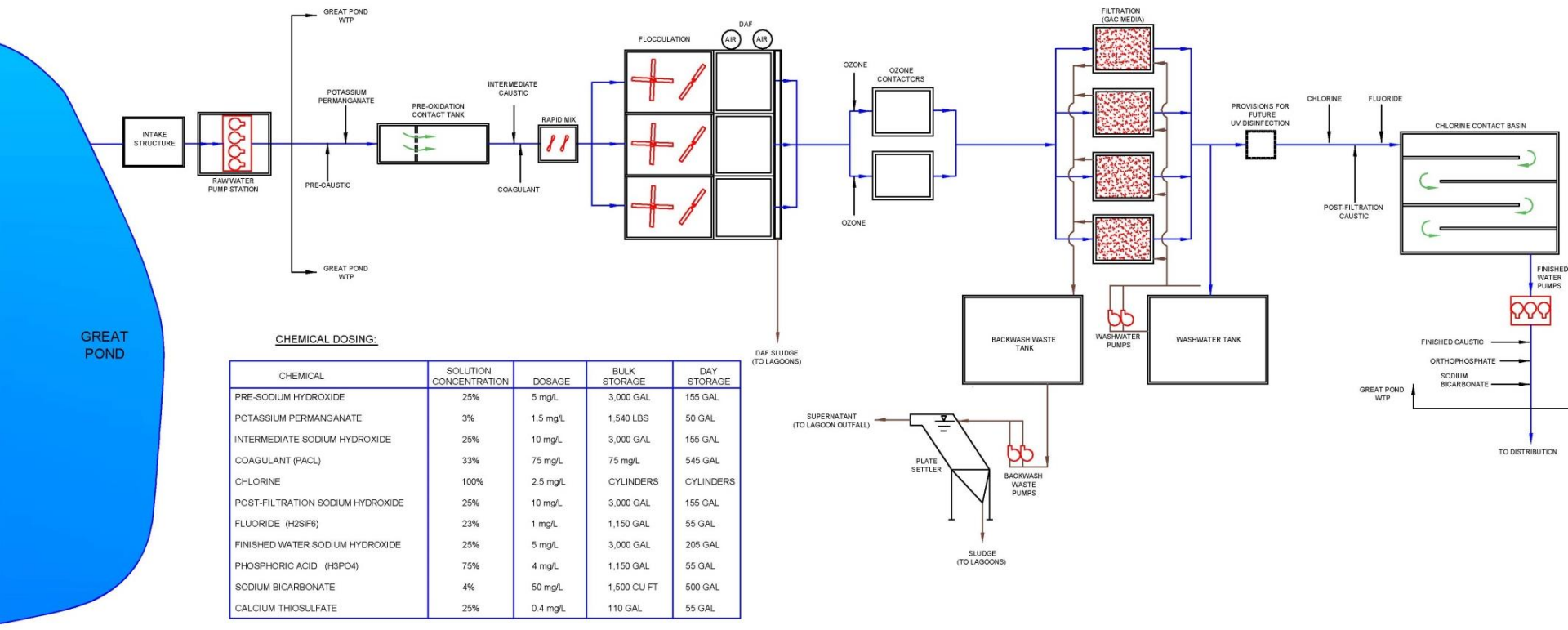
OZONATION
OF TRAINS: 2
CAPACITY: 4.2 MGD (EACH)
CONTACT TIME: 10 MIN. @ PEAK FLOW
BAFFLED TANK

FILTRATION
OF FILTERS: 4
TYPE: 60" GAC, 12" SAND
LOADING RATE: 4 GPM/SF
WASH WATER: FILTERED WATER
OF WASHWATER PUMPS: 2
BACKWASH RATE LOW: 8 GPM/SF
BACKWASH RATE HIGH: 22 GPM/SF

PROVISIONS FOR FUTURE UV
FLANGED CONNECTIONS

SECONDARY DISINFECTION
OF TANKS: 2 BAFFLED TANKS

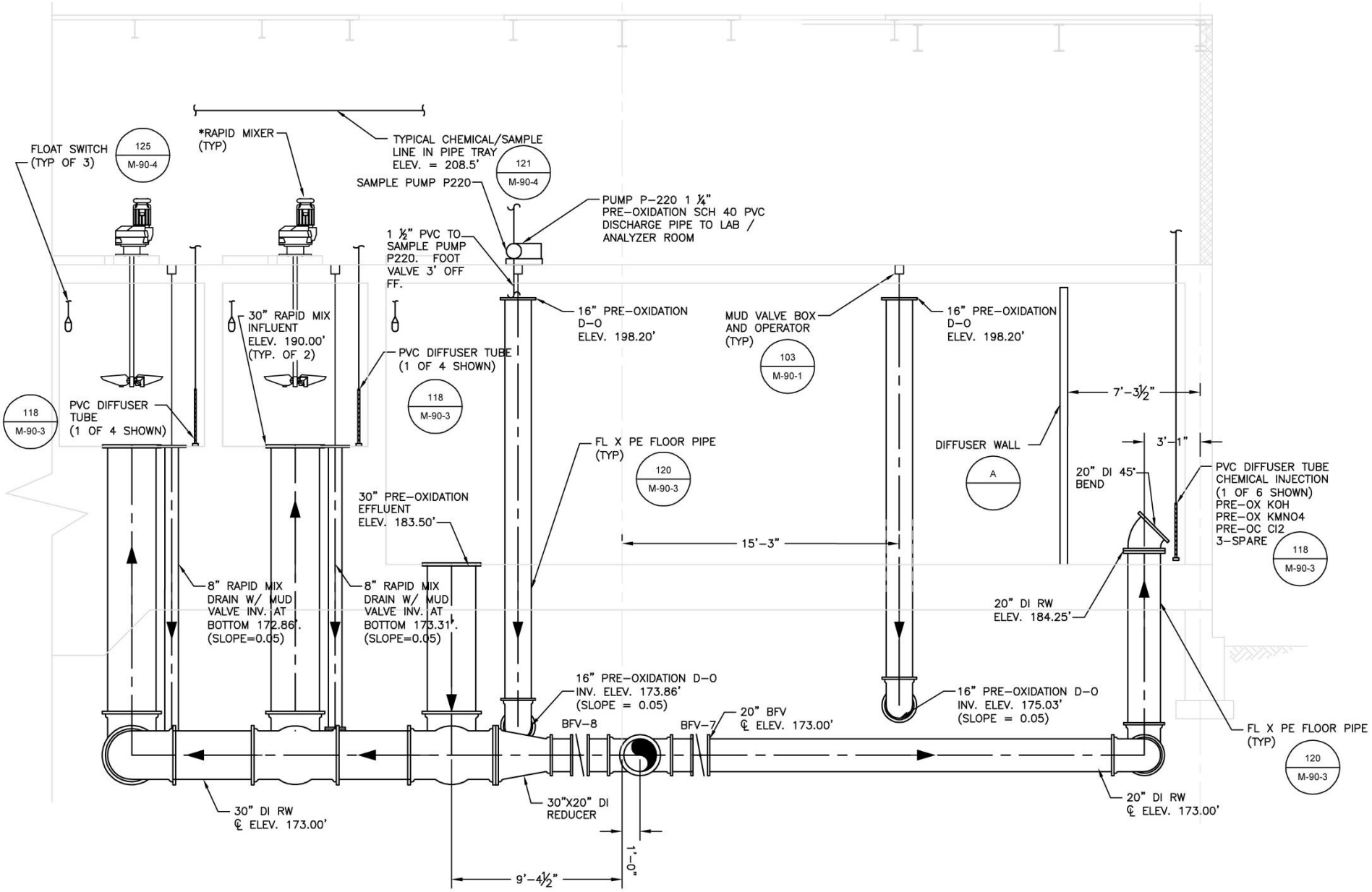
FINISHED WATER PUMPS
OF PUMPS: 3
CAPACITY: 3000 GPM @ 205' TDH
DRIVE: VARIABLE



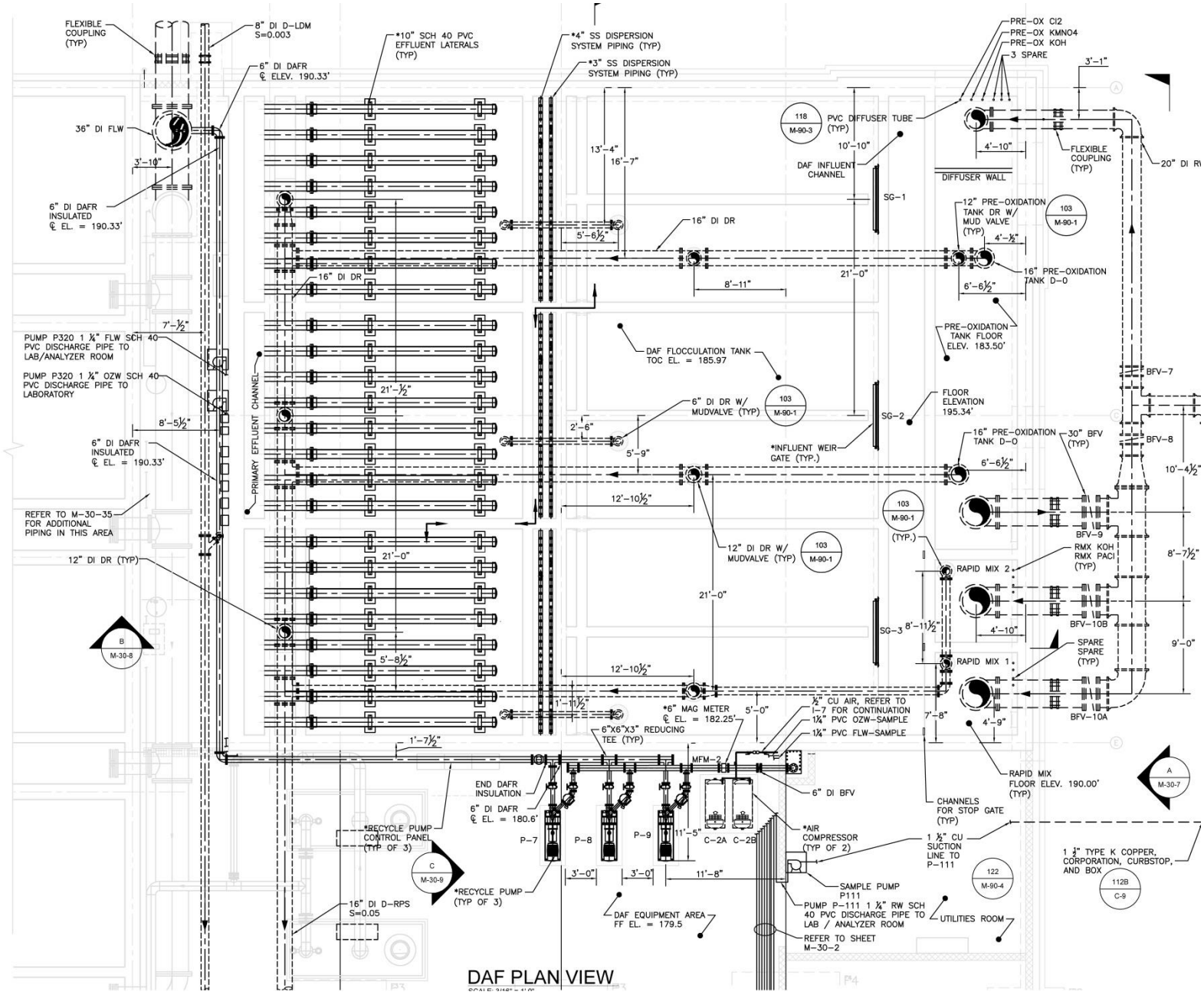
CHEMICAL DOSING:

CHEMICAL	SOLUTION CONCENTRATION	DOSAGE	BULK STORAGE	DAY STORAGE
PRE-SODIUM HYDROXIDE	25%	5 mg/L	3,000 GAL	155 GAL
POTASSIUM PERMANGANATE	3%	1.5 mg/L	1,540 LBS	50 GAL
INTERMEDIATE SODIUM HYDROXIDE	25%	10 mg/L	3,000 GAL	155 GAL
COAGULANT (PACL)	33%	75 mg/L	75 mg/L	545 GAL
CHLORINE	100%	2.5 mg/L	CYLINDERS	CYLINDERS
POST-FILTRATION SODIUM HYDROXIDE	25%	10 mg/L	3,000 GAL	155 GAL
FLUORIDE (H2SiF6)	23%	1 mg/L	1,150 GAL	55 GAL
FINISHED WATER SODIUM HYDROXIDE	25%	5 mg/L	3,000 GAL	205 GAL
PHOSPHORIC ACID (H3PO4)	75%	4 mg/L	1,150 GAL	55 GAL
SODIUM BICARBONATE	4%	50 mg/L	1,500 CU FT	500 GAL
CALCIUM THIOSULFATE	25%	0.4 mg/L	110 GAL	55 GAL

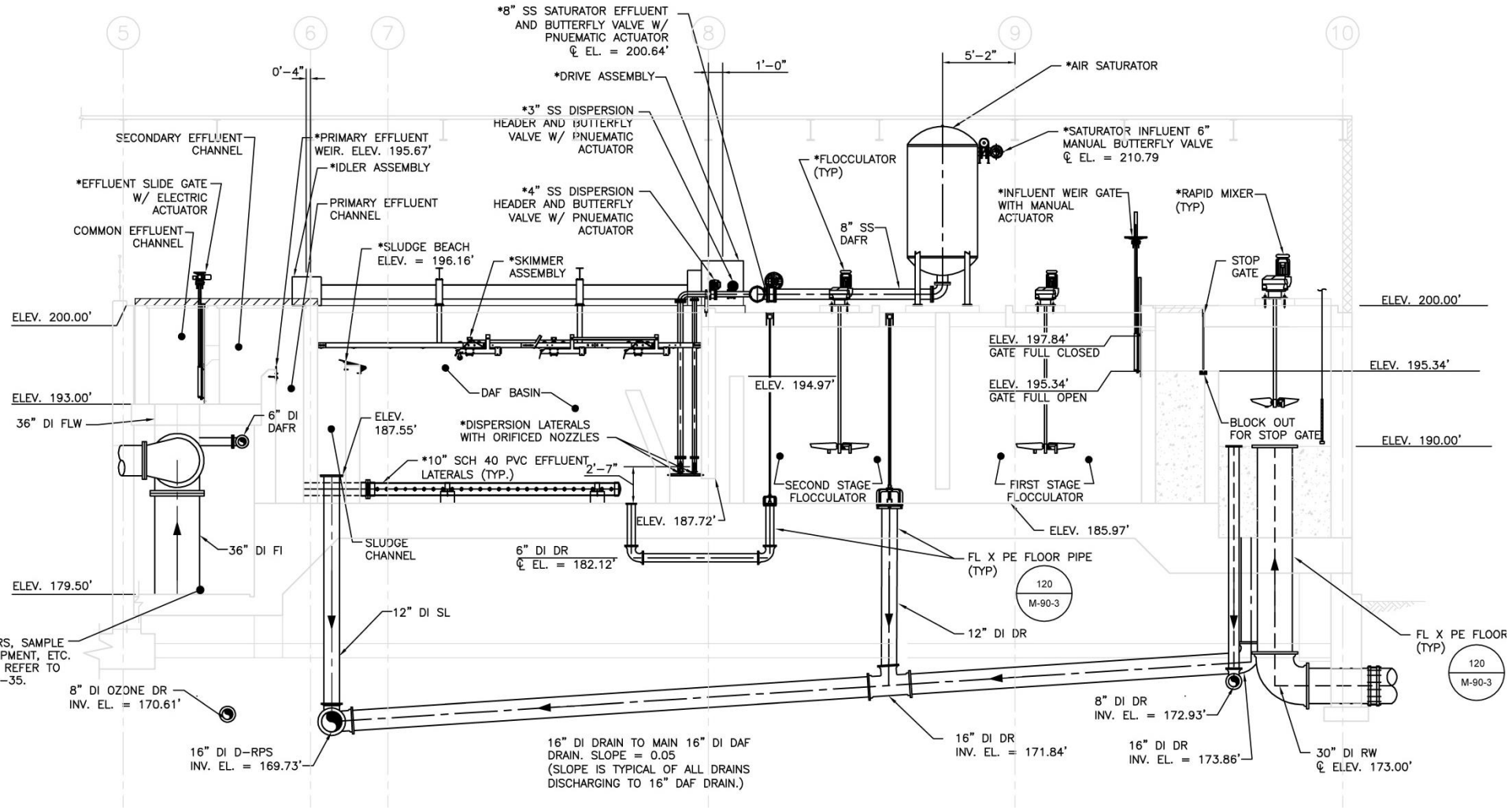
Pretreatment - Section View



DAF Design - Plan View



DAF Design - Section View



- **Air Dispersion Headers**
- **Sludge Removal (brushes, spray water)**
- **Tank Draining**

Construction

1. Site Preparation: October 2007 – May 2008
2. Facility Construction (including DAF): July 2008 – September 2010
3. Demolition: May 2011 – August 2011
4. Site Restoration: September 2011 – May 2012

Site Preparation

Facility Construction

Facility Construction

Facility Construction

July 2009

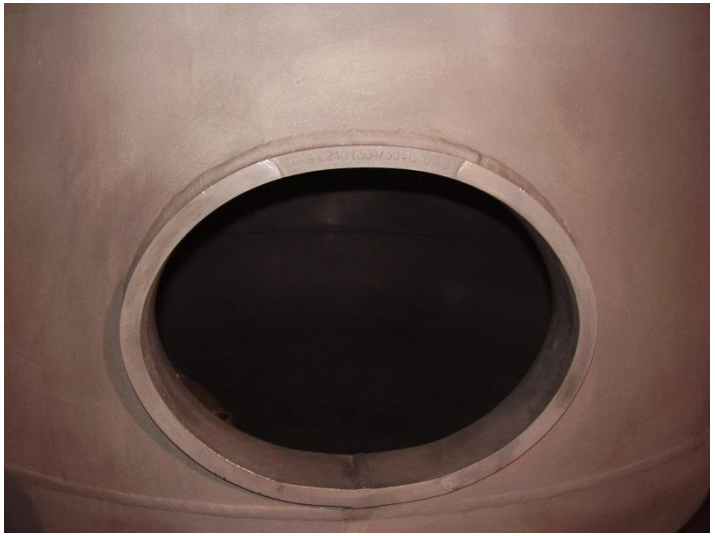
Facility Construction

Environmental Partners GROUP
A partnership for engineering solutions.

Facility Construction

Construction Challenges

Construction Issues



Facility Construction

May 2010

On-Line

September 15 2010

Demolition

Site Restoration

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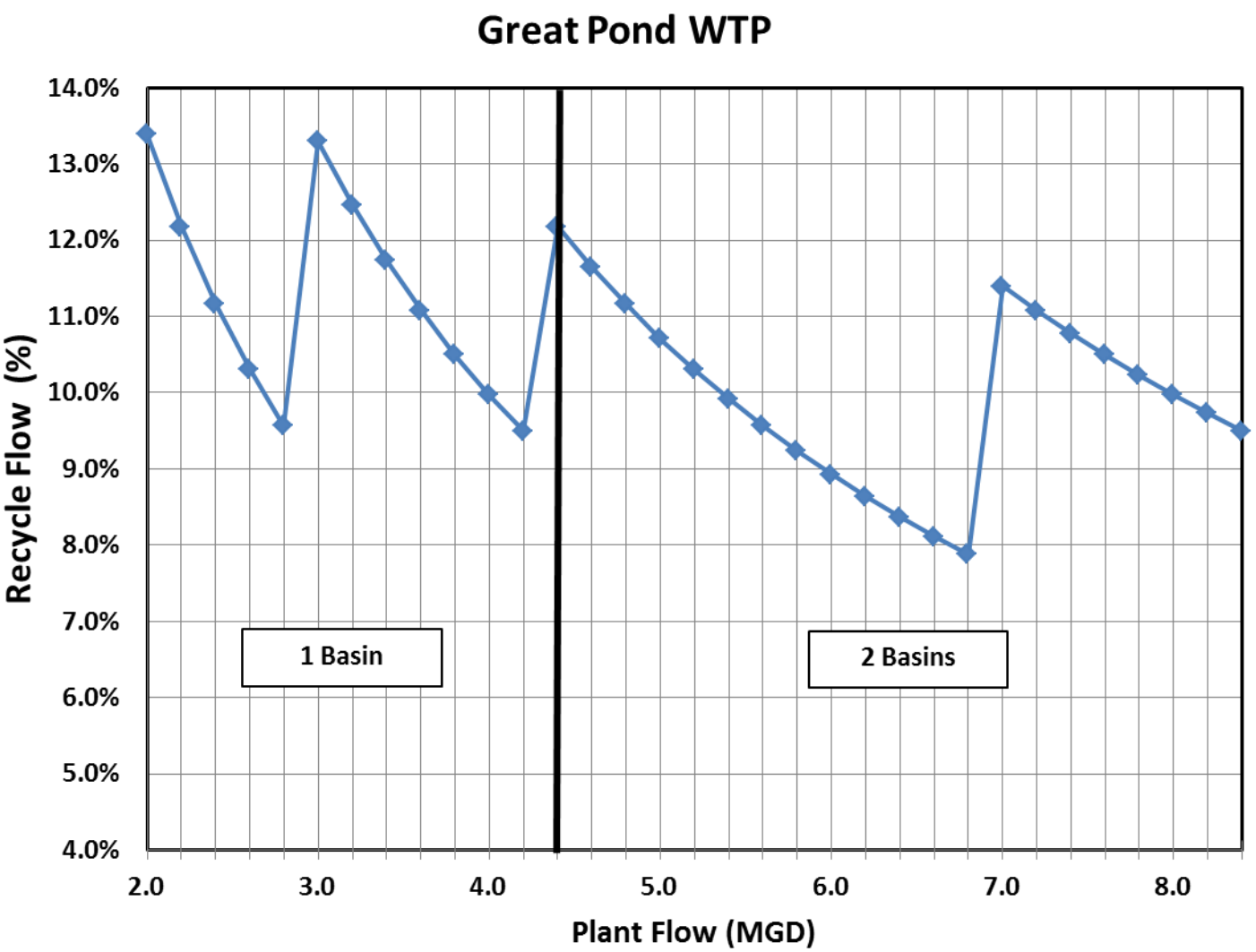
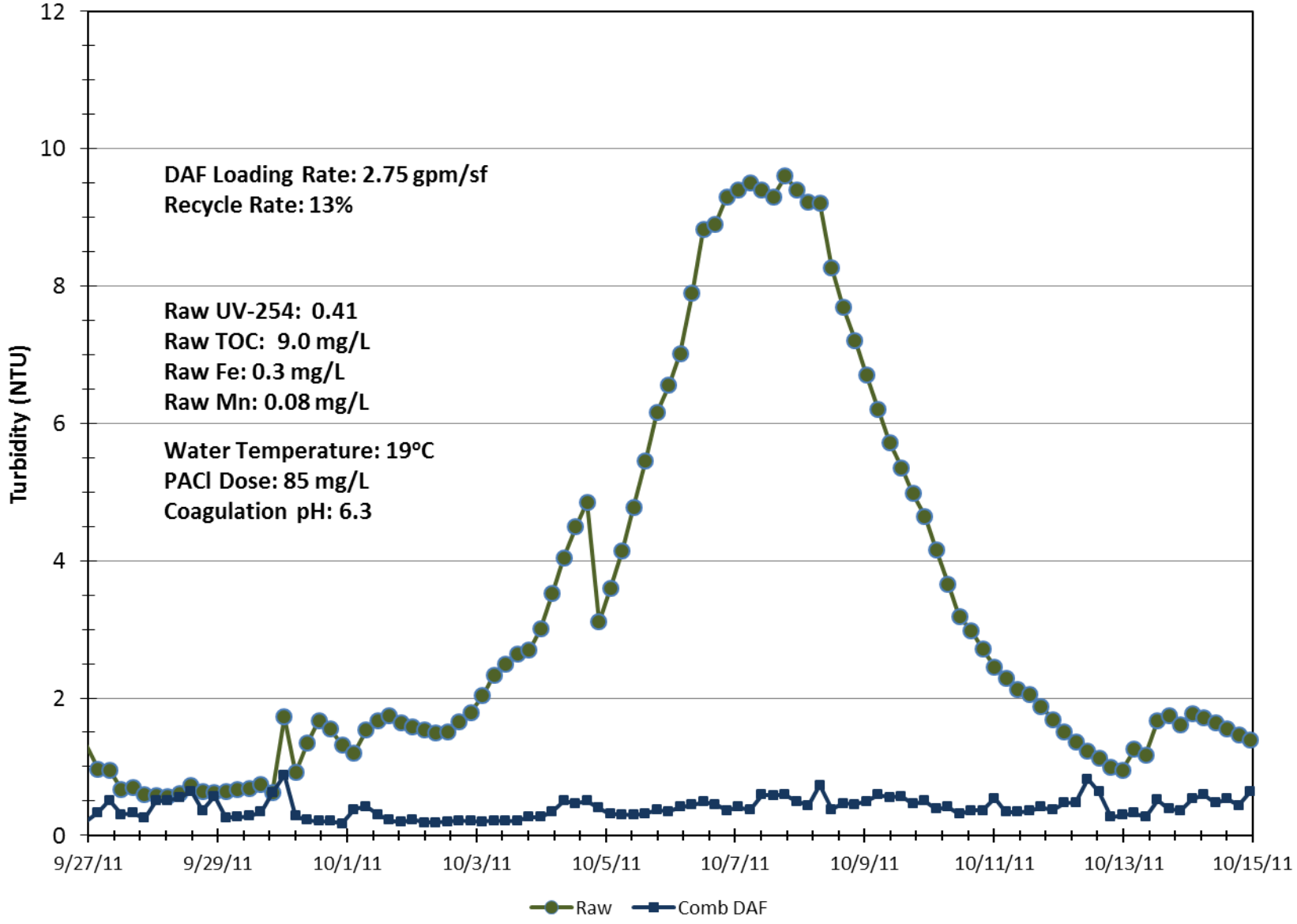
DAF Basins and Equipment

DAF Basins and Equipment

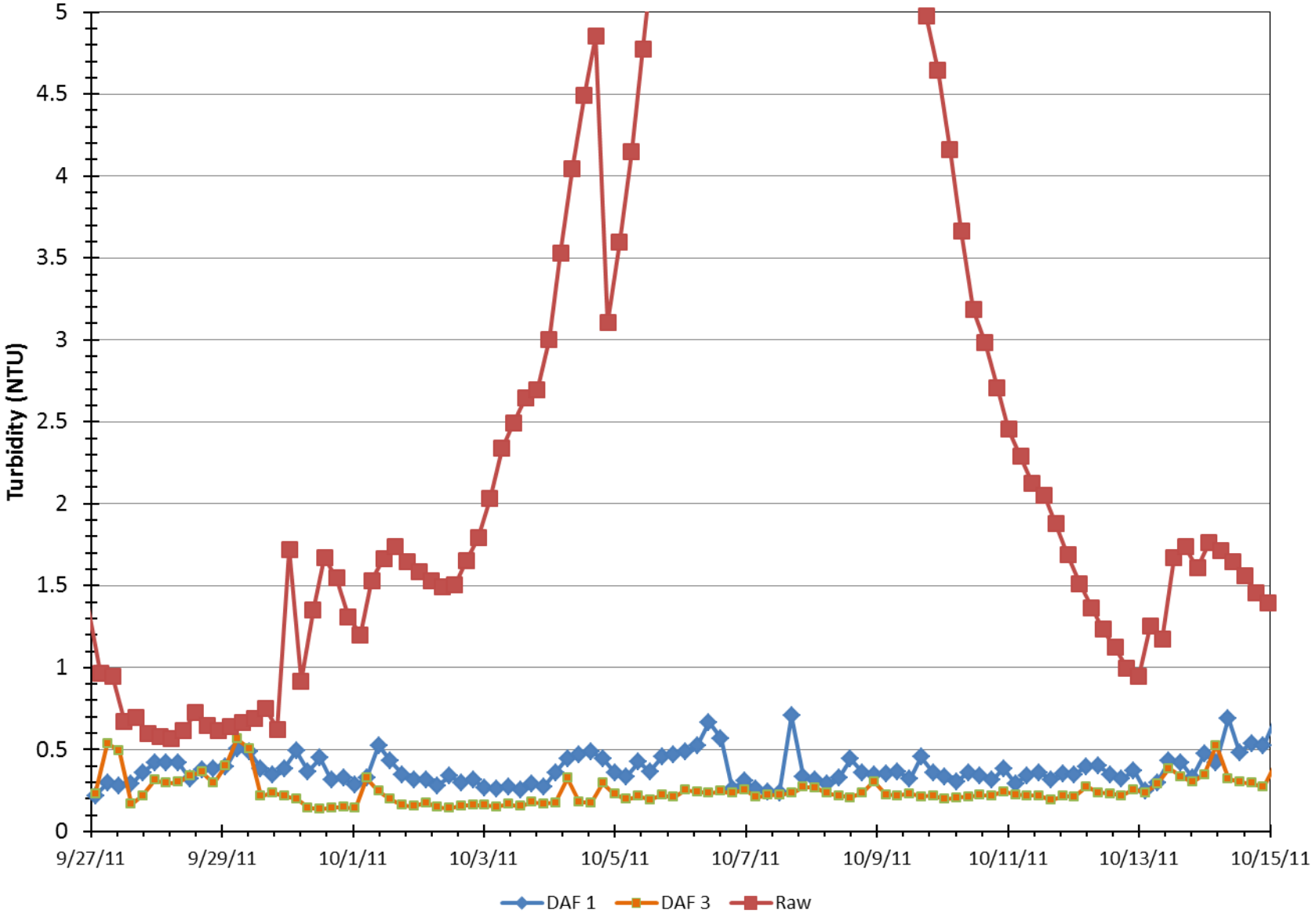
Operations - Recycle Control



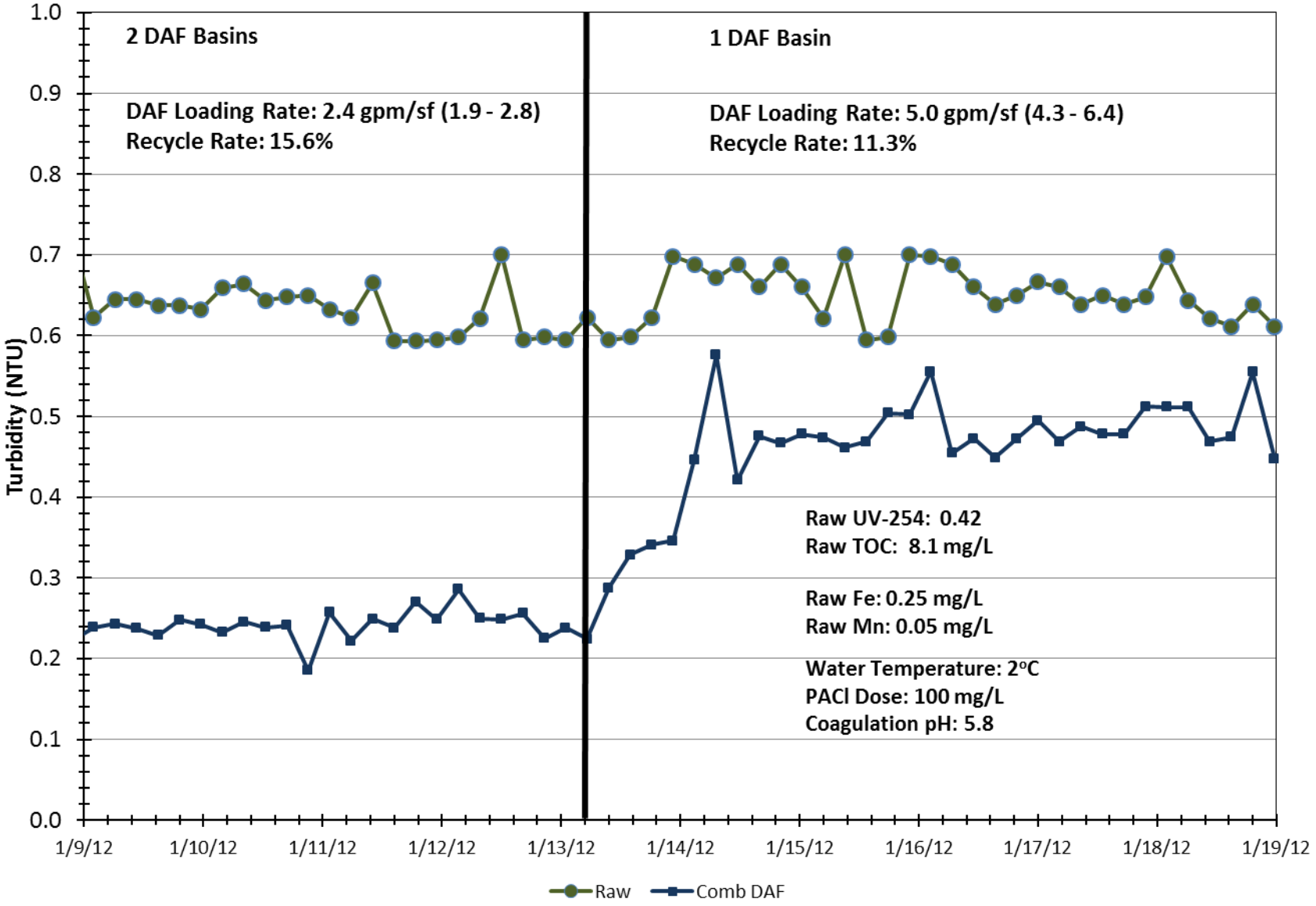
DAF Turbidity Performance – October 2011



DAF Turbidity Performance – October 2011

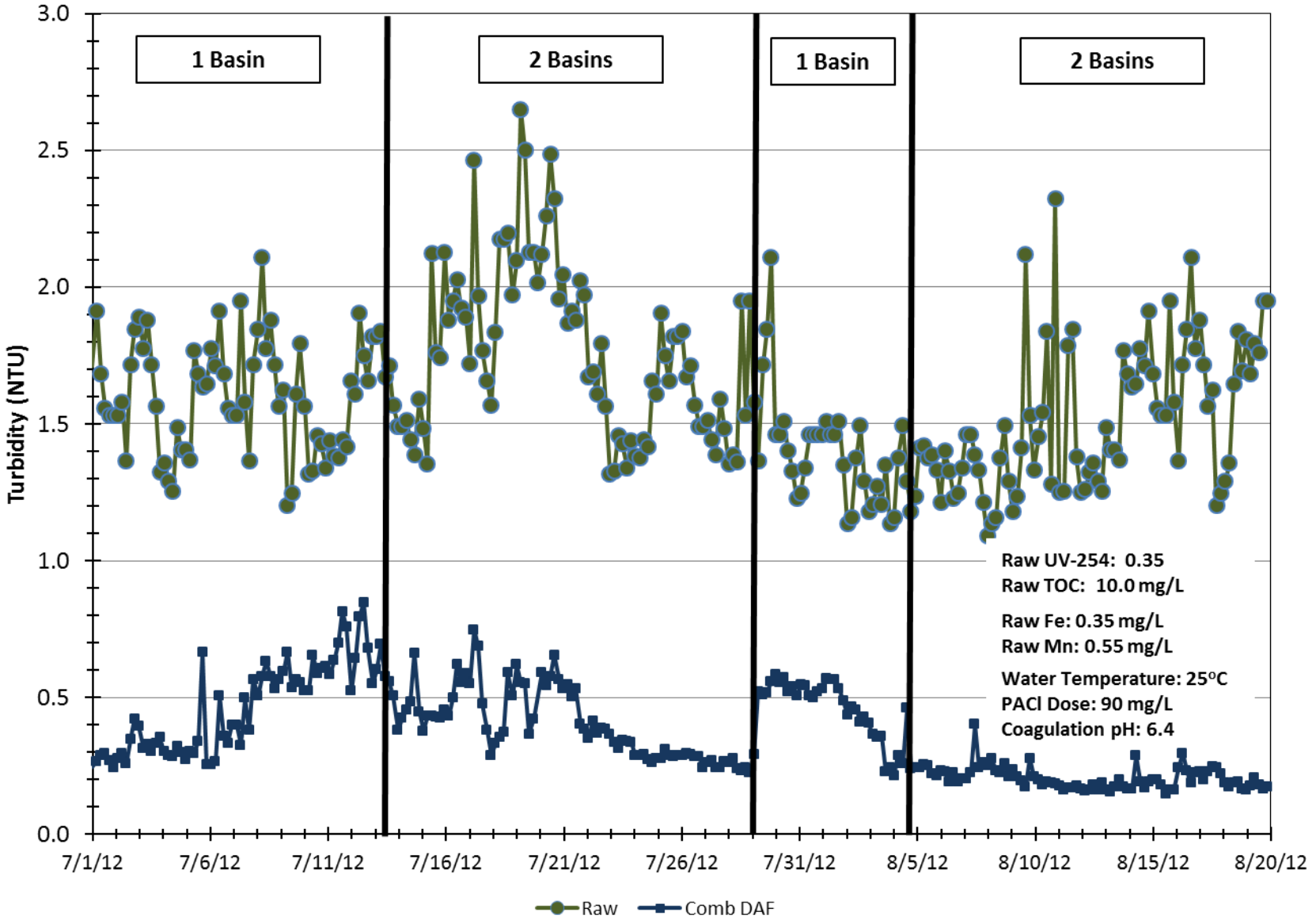


DAF Turbidity Performance – January 2012



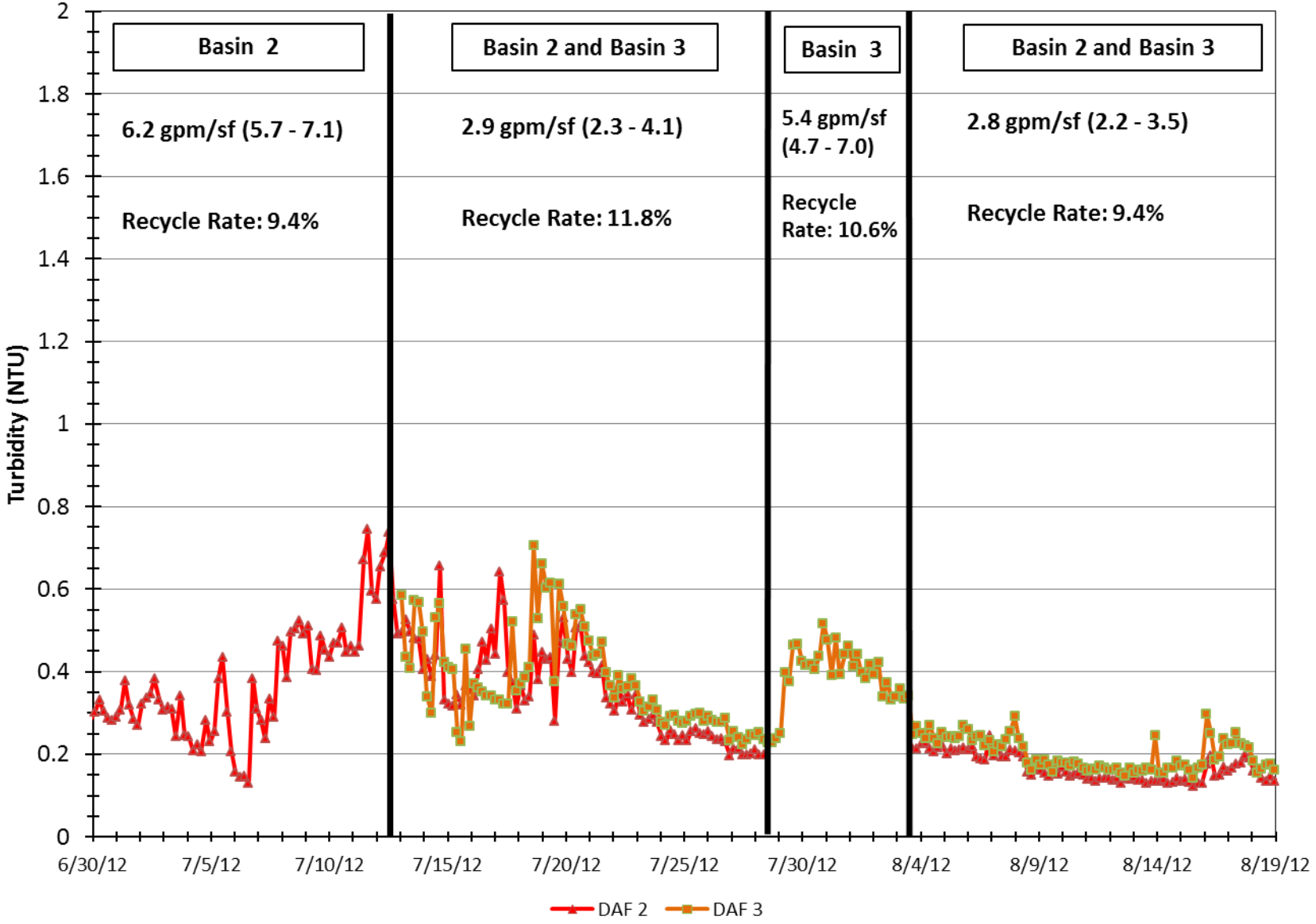
Flow = 3.5 MGD

DAF Turbidity Performance – July/August 2012



Flow = 3.5 MGD to 6.0 MGD

DAF Turbidity Performance – July/August 2012



Project Team

- Weymouth Technical Advisory Committee
  - Current: Jeff Bina, Al Cowing, Andrew Fontaine, Frank Sheppard
  - Former: Mike Chiasson, Bob O'Connor, Jim Wilson, Scott Bois, Dan Annaccone, Brad Hayes
- Environmental Partners Group, Inc.
  - Project Management; Pilot Studies; Design & Construction of Civil/Site, Process Treatment, SCADA, I&C; Bidding/Procurement; Start-up and Training; Operations Assistance
- Dr. John Tobiason (University of Massachusetts)
  - Pilot Studies
- CH2MHILL
  - Pilot Studies; Design and Construction – Architectural, Plumbing, Electrical, HVAC, Ozone, Filters
- LIN Associates
  - Design and Construction – Structural
- Woodard & Curran
  - PLC and SCADA Programming

Acknowledgements

Mayor's Office
Town Council
Construction Steering Committee
Technical Advisory Committee
Department of Public Works
Water Department Staff
Water Treatment Facility Staff
Engineering Team

Contractors:
Site Preparation – T. Ford, Inc.
DAF Equipment – F.B. Leopold Inc.
Construction – C.H. Nickerson & Co., Inc.
Demolition – S&R Corporation, Inc.
Site Restoration – E. Watson Excavating, Inc.