

Optimization of Nitrification and Airflow

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Driven to DiscoverSM

Motivations for Change

- Excess air use in aeration tanks
- Air reductions possible due to lack of ammonia discharge permits during winter months

Motivations for Change

	NH₄-N Discharge Limit
Month	[mg/L]
January	Monitor Only
February	Monitor Only
March	Monitor Only
April	Monitor Only
May	13
June	8
July	5
August	5
September	5
October	9
November	21
December	Monitor Only

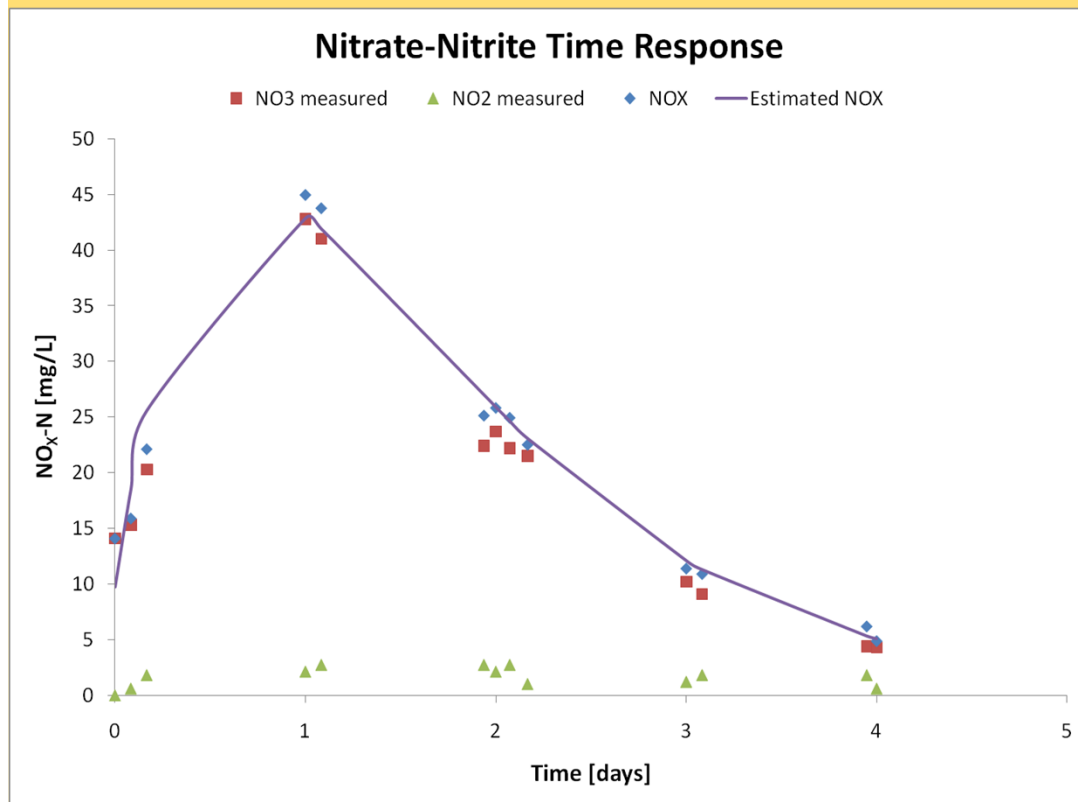
Approach

- Adjustment of dissolved oxygen set-points and air flows in southeast quadrant
- Northeast quadrant acts as control
- Washout bioassay test
- Aeration tank profiles

Washout Bioassay



Washout Bioassay



	Trial 1	Trial 2
Specific Growth Rate	0.84	0.47
SRT	3.65	6.52

Aeration Tank Profiling: Issues/Complications

- Power outages
- Filamentous bacteria growths
(bleaching requirements)
- Bad probes
- Flooding

Aeration Tank Profiling



Baseline

	Airflow		Electrical Use		Cost (Estimate)	
	[scfm]		kWh/month		\$/month	
Zone	AT 11	AT 15	AT 11	AT 15	AT 11	AT 15
1	8.3	88.7	176	1,869	\$11.41	\$121.48
2-4	248.4	4.6	5,231	97	\$340.03	\$6.31
5	1,499.10	2,206.90	31,572	46,479	\$2,052.19	\$3,021.11
6	1,496.30	2,954.10	31,513	62,215	\$2,048.35	\$4,043.94
7-12	5,352.90	6,697.90	112,735	141,062	\$7,327.75	\$9,169.01
Total	8,605	11,952	181,227	251,721	\$11,779.74	\$16,361.86

Reduction Trial 1

- DO to 1.5 and 1.0 mg/L in Zones 5 and 8
- Change was a starting point suggested by process engineers

Reduction Trial 2

- DO to 1.0 and 1.0 mg/L in Zones 5 and 8
- Change was due to success of Reduction Trial 1

Reduction Trial 3

- DO to 2.0 and 0.5 mg/L in Zones 5 and 8
- Zone 5 change done to ensure proper treatment
- Zone 8 change for ease of implementation

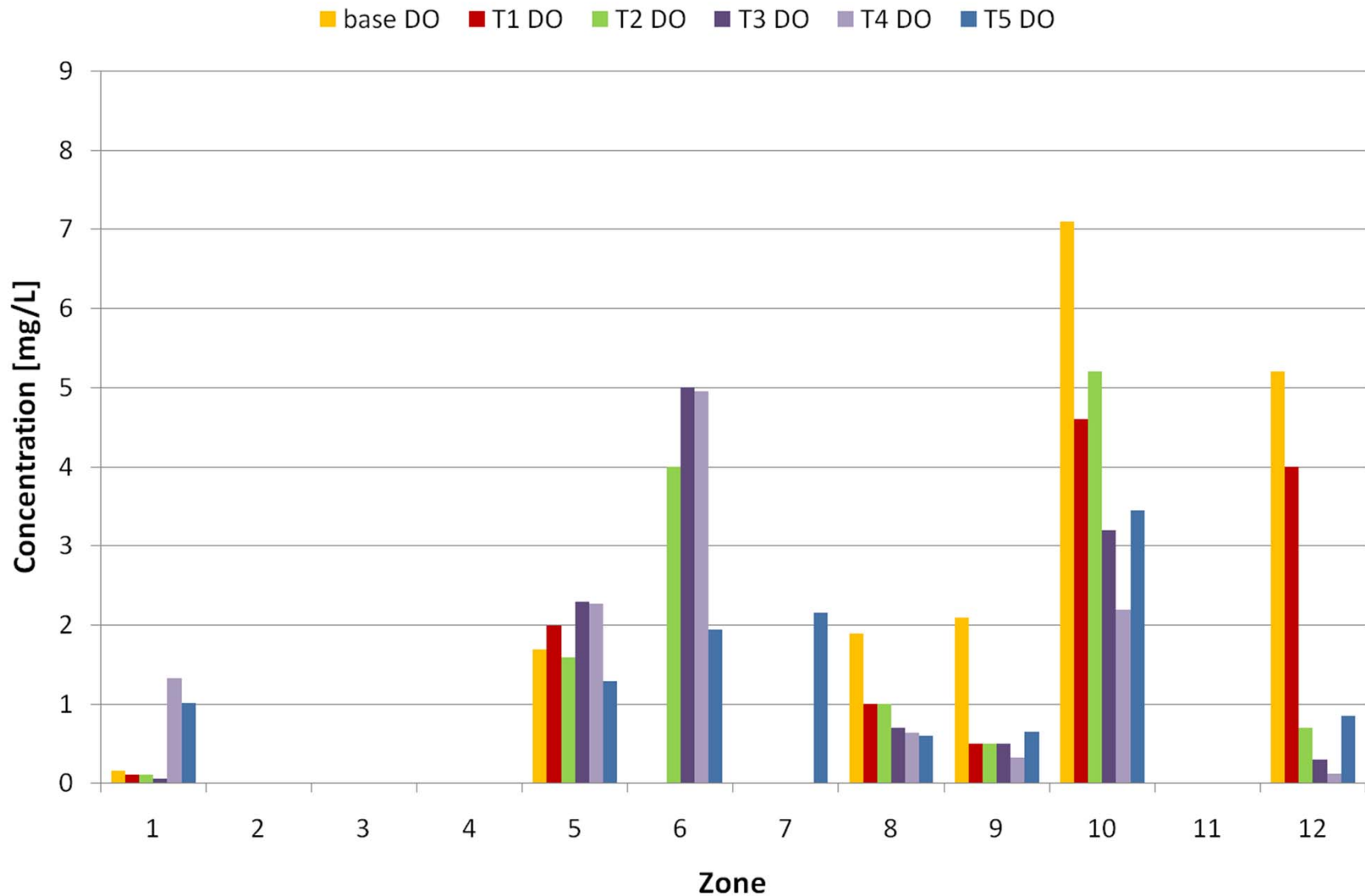
Reduction Trial 4

- DO to 2.0, 2.0, and 0.5 mg/L in Zones 1, 5, and 8
- Air to Zone 1 to help prevent filamentous bacteria growths

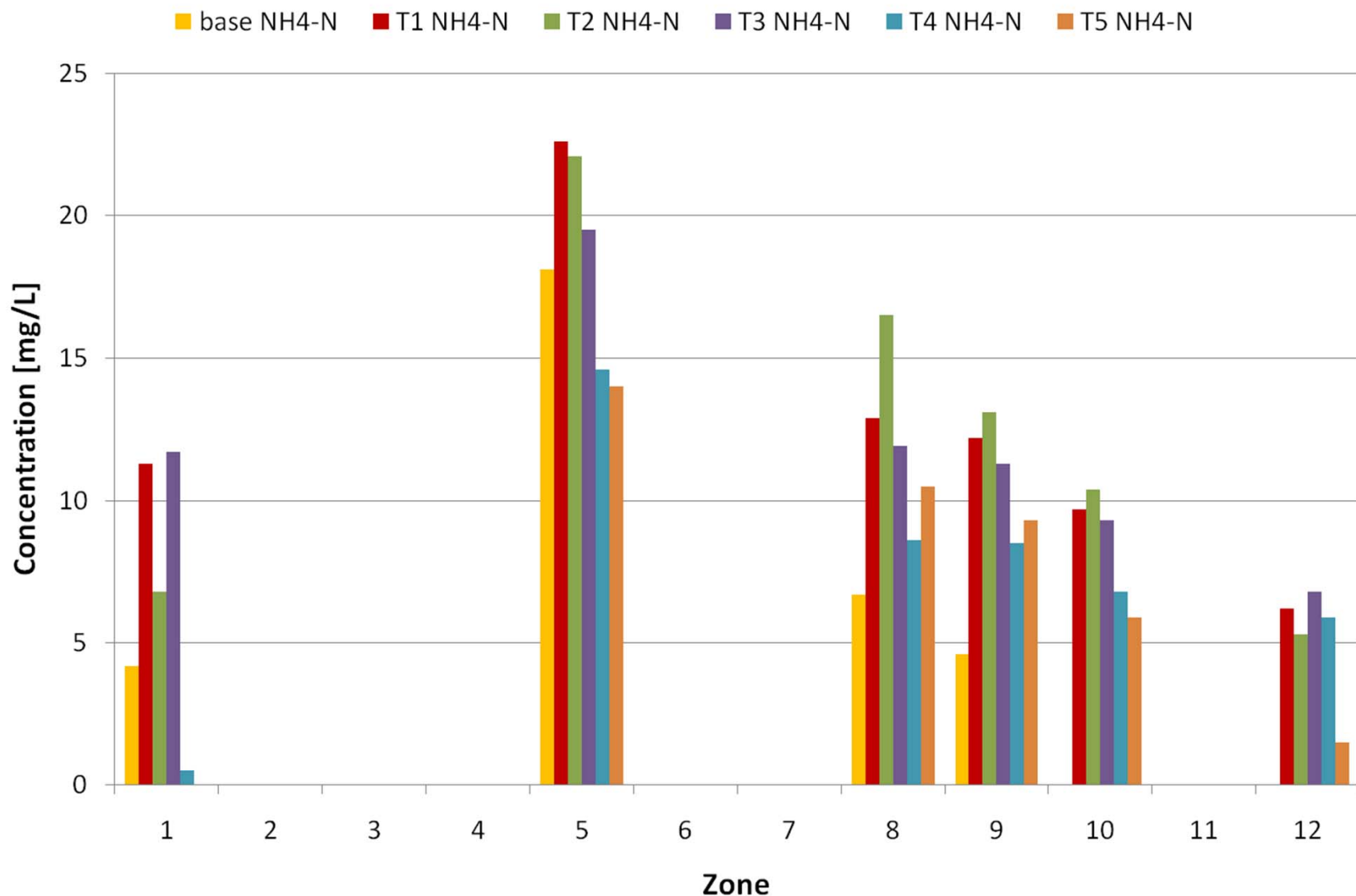
Reduction Trial 5

- Reduction Trial 4 settings
- Zone 6 Airflow to 66% Zone 5
- Zone 6 identified as having high DO levels

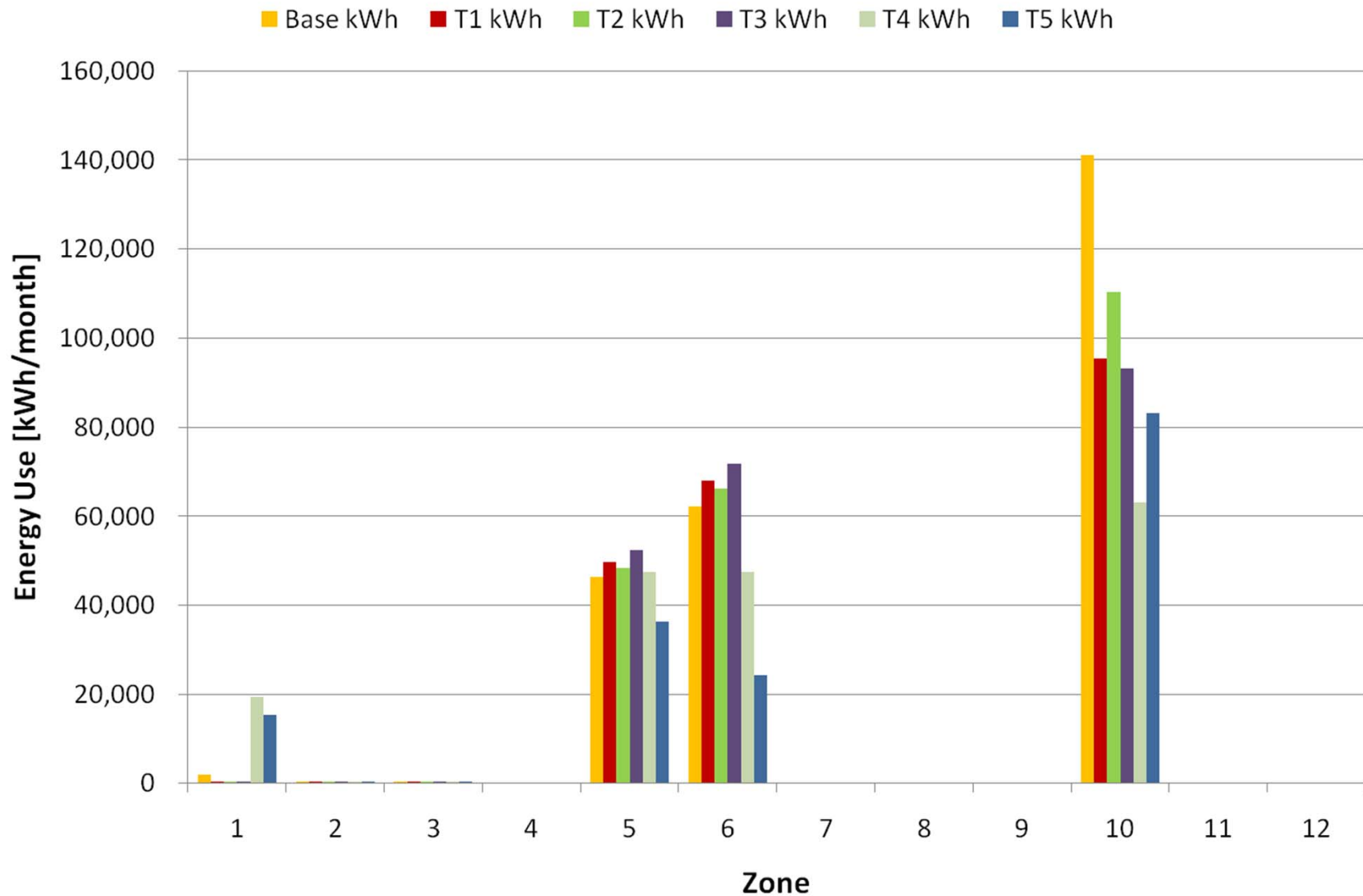
DO as a function of trial, by zone, Tank 15



NH₄-N as a function of trial, by zone, Tank 15



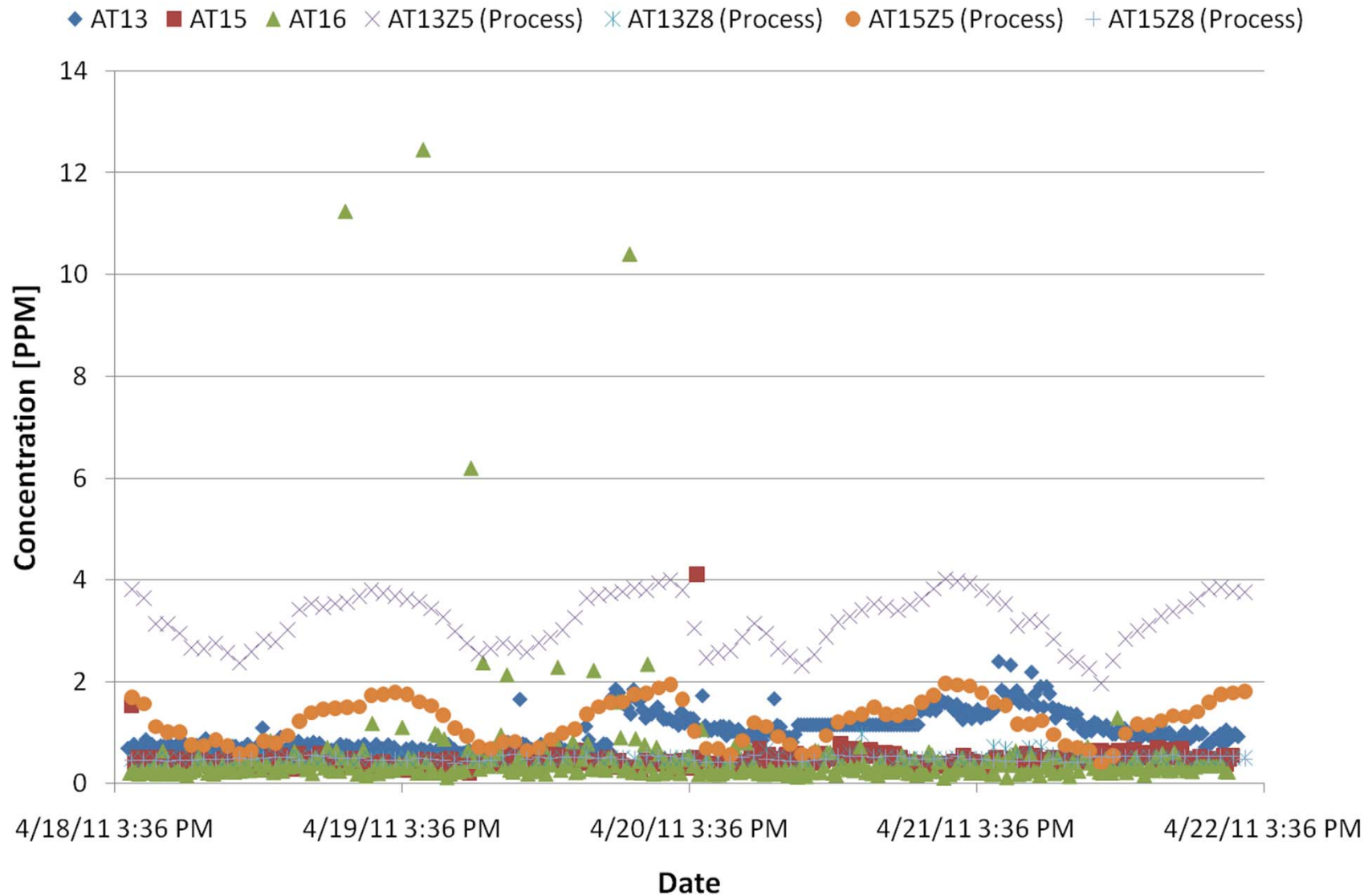
kWh/month as a function of trial, by zone, Tank 15



Tank 15 DO Measurements

	Dissolved Oxygen Set-Point			Measured Dissolved Oxygen Concentration				
	[PPM]			Portable Probe [PPM]			Process Probe [PPM]	
Trial	Zone 1	Zone 5	Zone 8	Zone 1	Zone 5	Zone 8	Zone 5 (Process)	Zone 8 (Process)
Baseline	0	2	2	0.15	1.7	1.9	1.2	1.9
1	0	1.5	1	0.1	2	1	1.5	1
2	0	1	1	0.1	1.6	1	1	1
3	0	2	0.5	0.05	2.3	0.7	1.7	0.4
4	2	2	0.5	1.33	2.28	0.64	2.05	0.63
5	2	2	0.5	1.02	1.3	0.6	0.8	0.5

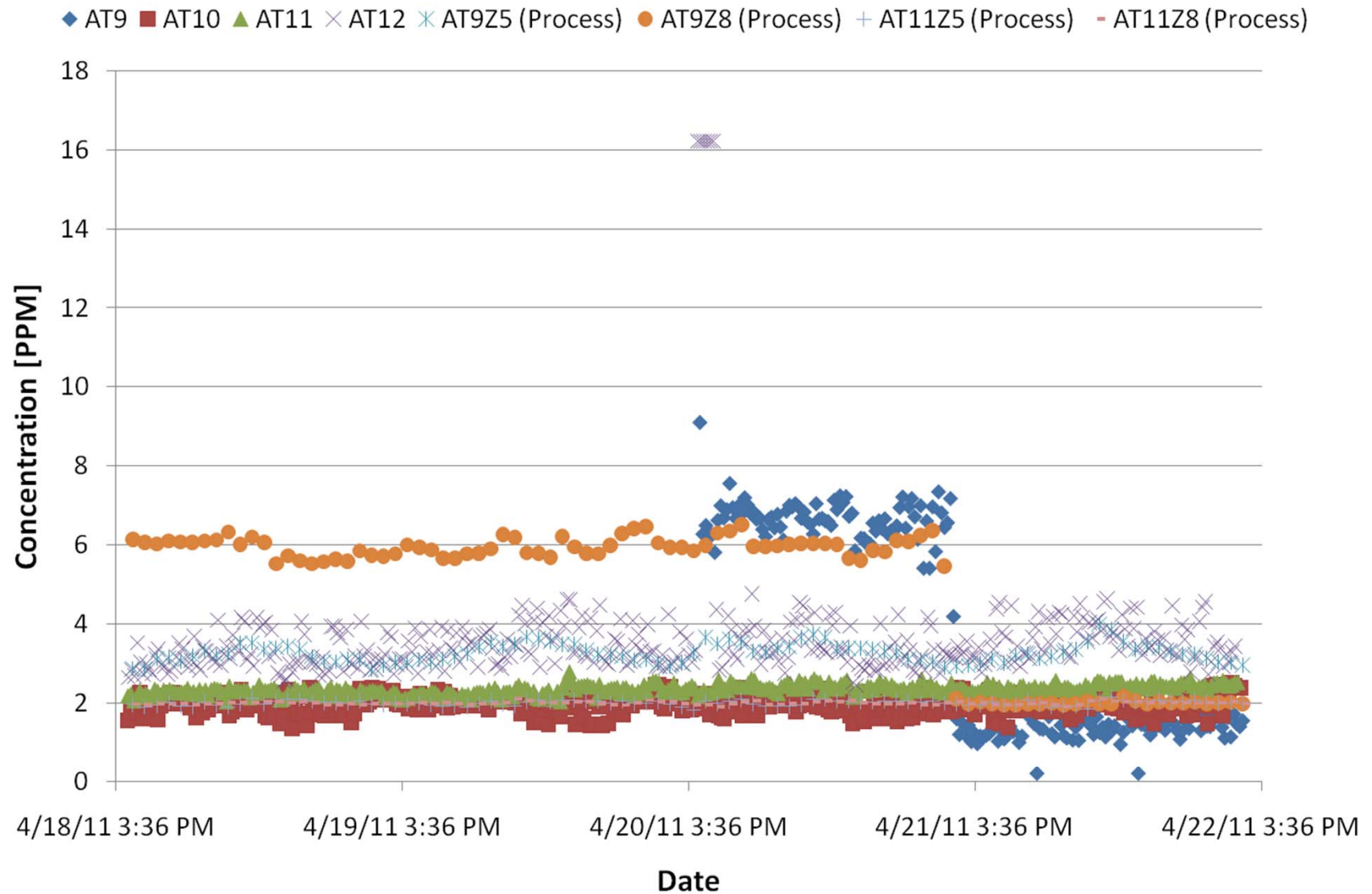
SE Zone 8 Dissolved Oxygen Measurements



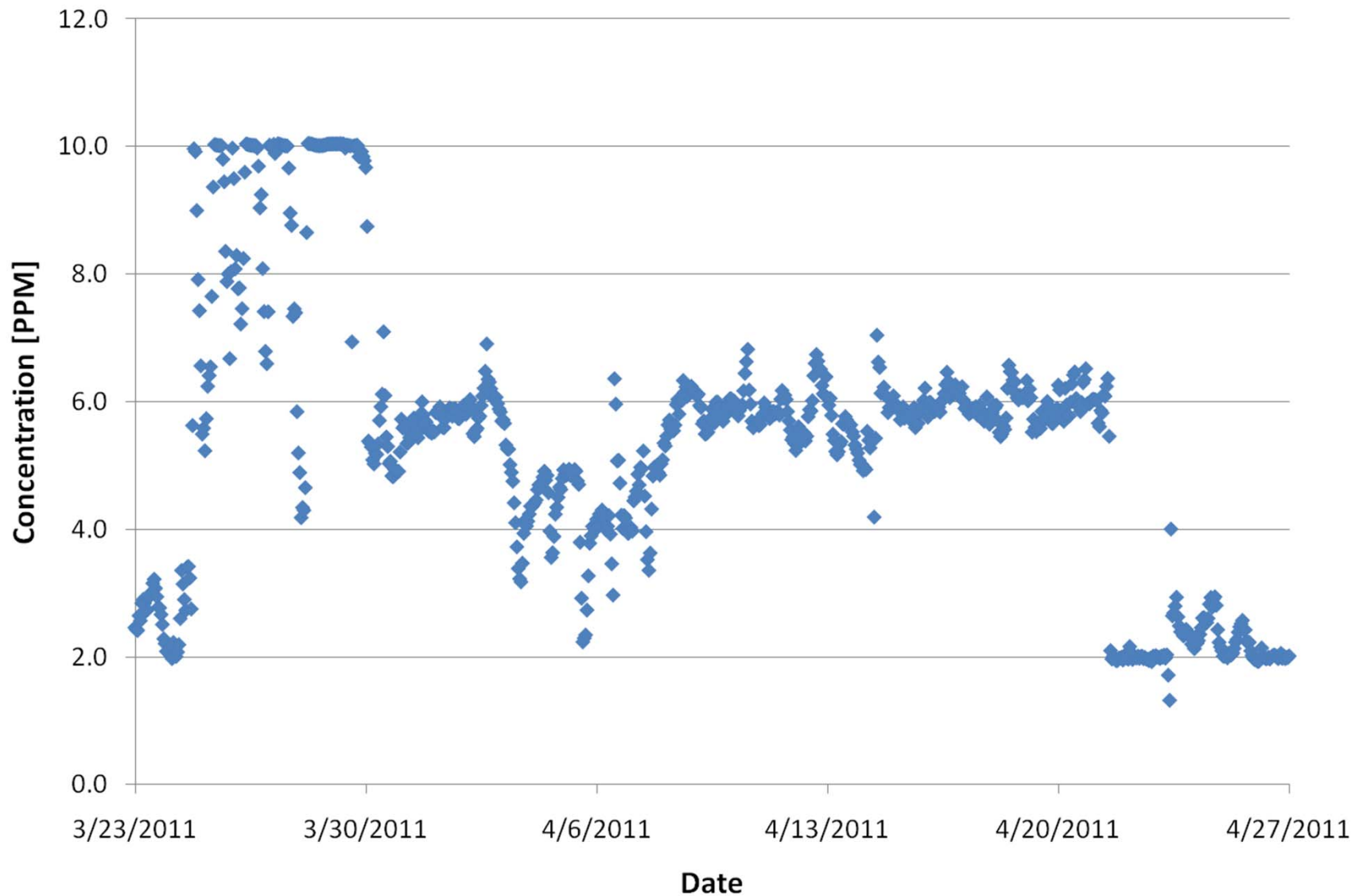
Tank 11 DO Measurements

	Dissolved Oxygen Set-Point			Measured Dissolved Oxygen Concentration				
	[PPM]			Portable Probe [PPM]			Process Probe [PPM]	
Trial	Zone 1	Zone 5	Zone 8	Zone 1	Zone 5	Zone 8	Zone 5 (Process)	Zone 8 (Process)
Baseline	0	2	2	0.11	2.06	1.97	1.99	1.96
1	0	2	2	0.19	2.44	2.24	2.04	2.07
2	0	2	2	0.15	2.5	1.7	2.15	1.9
3	0	2	2	0.12	2.6	1.85	2	2.1
4	2	2	2	0.41	2.4	1.29	2.1	2.03
5	2	2	2	1.17	2.2	1.07	2.2	0.89

NE Zone 8 Dissolved Oxygen Measurements



Aeration Tank 9 Zone 8 Dissolved Oxygen Levels



Results of Reduction Trial 5

	Electrical Use				
	kWh/month		Savings		
Zone	Baseline	Reduction Trial 5	One Month	Annually (6 months)	Annually (16 Tanks)
1	1869	15,477	-13,608	-81,649	-1,306,377
2-4	97	119	-22	-132	-2,112
5	46479	36,293	10,186	61,114	977,818
6	62215	24,256	37,959	227,751	3,644,017
7-12	141062	83,112	57,950	347,698	5,563,172
Total	251721	159,257	92,464	554,783	8,876,530

Results of Reduction Trial 5

	Cost Estimates				
	\$ /month		Savings		
Zone	Baseline	Reduction Trial 5	One Month	Annually (6 months)	Annually (16 Tanks)
1	\$121	\$1,006	(\$885)	(\$5,307)	(\$84,912)
2-4	\$6	\$8	(\$1)	(\$9)	(\$137)
5	\$3,021	\$2,359	\$662	\$3,972	\$63,558
6	\$4,044	\$1,577	\$2,467	\$14,804	\$236,863
7-12	\$9,169	\$5,402	\$3,767	\$22,600	\$361,603
Total	\$16,362	\$10,352	\$6,010	\$36,059	\$576,947

Recommendations

Waste reduction trial/option	Waste Reduced, kWh (Annual)		Cost Savings (Annual)	
	Single Tank	Sixteen Tanks	Single Tank	Sixteen Tanks
Reduction Trial 5 Settings (Also, zone 5 DO at 1.5 mg/L)	552,000	8,832,000	\$36,000	\$576,000
Maintain dissolved oxygen process probes/installation of individual probes	NA	NA	NA	NA
Improved Monitoring of “Lag-Lead” Set-up	397,200 (month)	NA	\$25,900 (month)	NA

Personal Benefits

- Real-world experience to compliment classes in the field
- Problem solving skills
- Field and lab work & hands-on experience

Questions?

