Maximize Oxidation Ditch Bio-P Performance

By

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Ripon WWTF

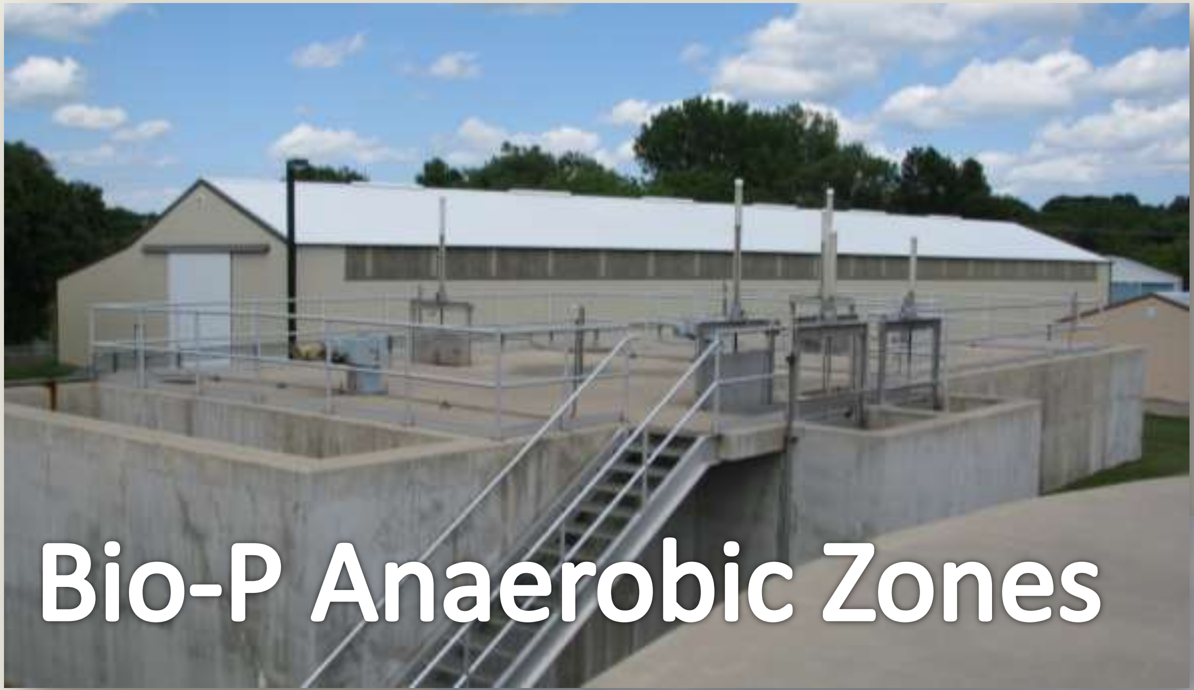
Design 1.8 MGD

Discharge Limits

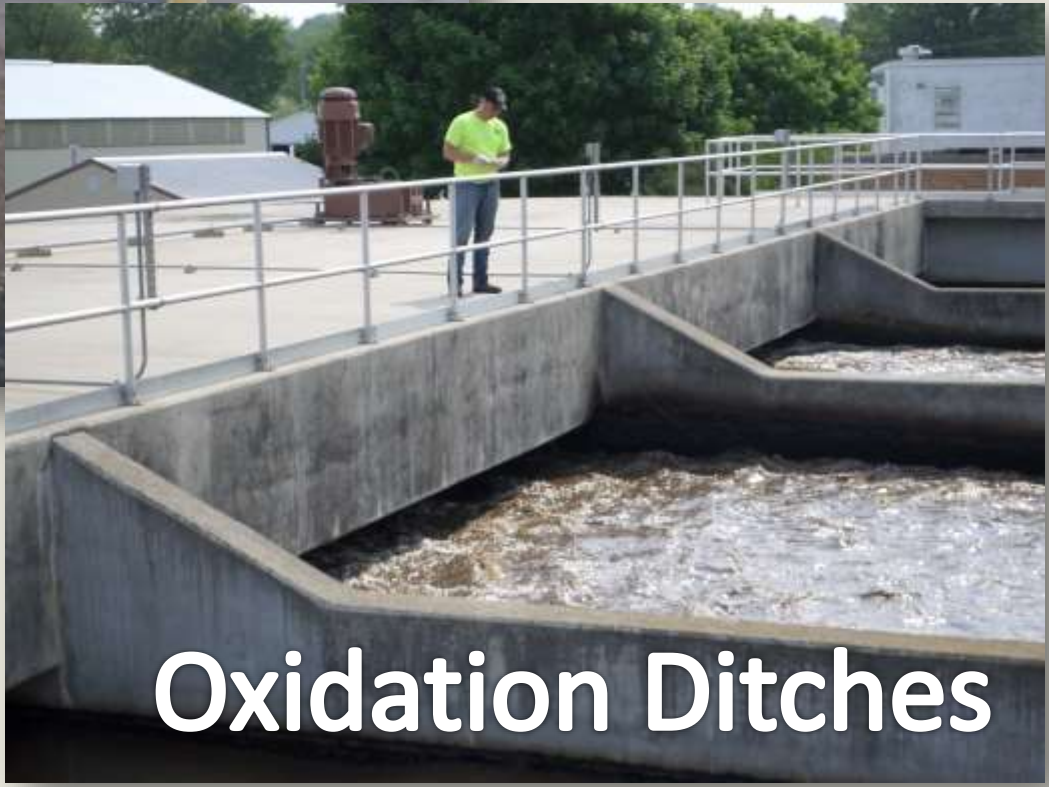
Parameter	Week Average Limit	Monthly Average Limit
BOD, mg/l (Varying based on time of year)	8.2-16	8.2-16
TSS, mg/l	10	10
Ammonia, mg/L (Varying based on time of year)	2.2-5.1	2.2-5.1
Total Phosphorus, mg/L	--	1.0

Ripon WWTF

- 1 Manager and 3 Operators
- Onsite Laboratory
  - BOD/TSS/TP/NH3-N/pH
  - Various process control testing to optimizing system
- 2003-2004 Upgrade
  - Fine Screen
  - 2 parallel oxidation ditches
  - 2 new final clarifiers
  - Biological Phosphorus Removal anaerobic zones ahead of ditches
  - UV Disinfection
  - Upgrade tertiary filtration – installed different media


Bio-P Anaerobic Zones


Headworks


Oxidation Ditches


Covered Final Clarifiers


UV/Plant Discharge

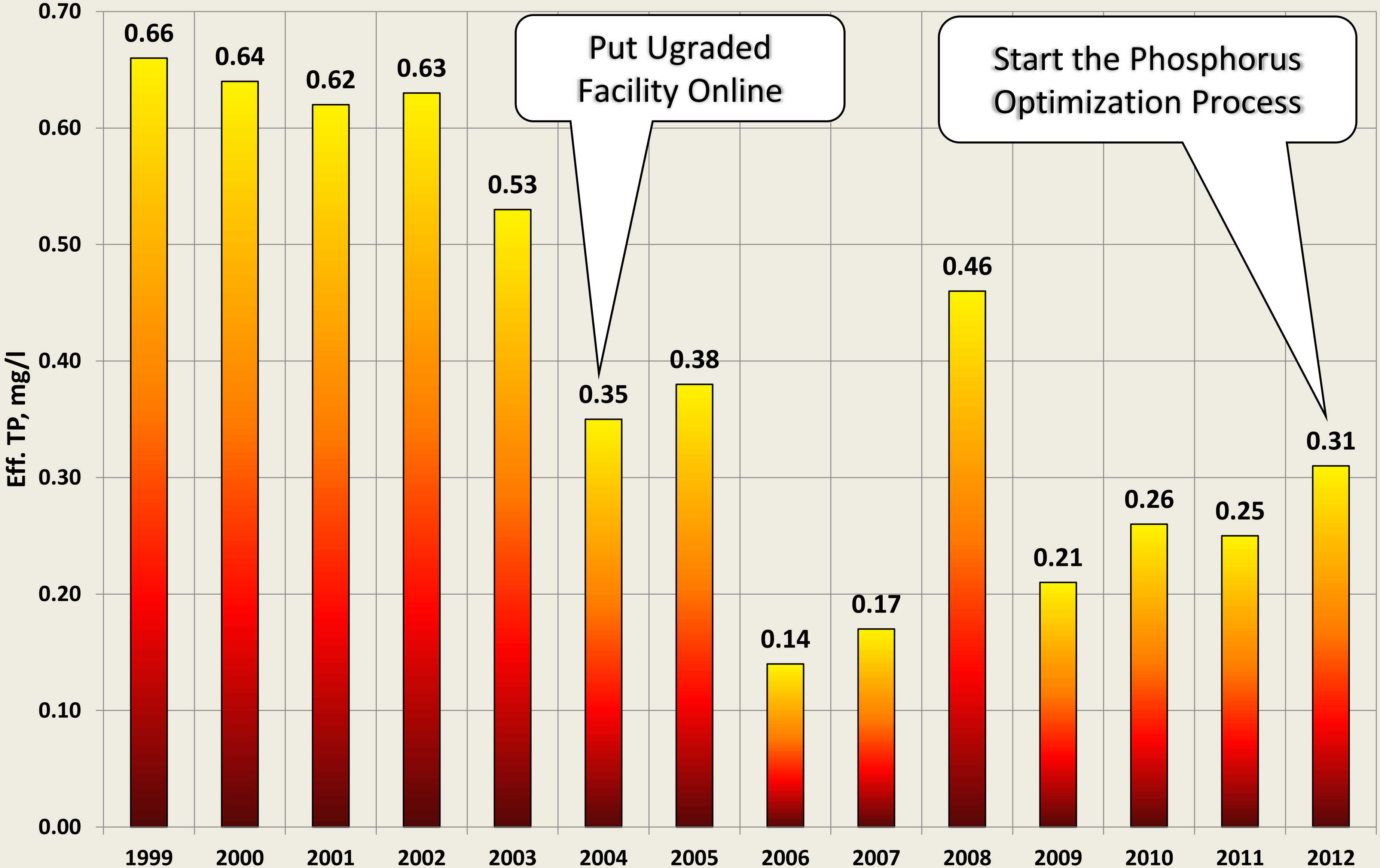

GBT

Major Contributors

Starting Optimization

- Staff started phosphorus optimization moves in 2012 in anticipation of its upcoming DNR discharge permit
- New permit was issued in 2014
- Permit requires compliance with a 0.075 mg/l TP limit in 2023

Starting Point - BEFORE Optimization



Optimization Challenges

- Focus on Bio-P and Final Filtrate vs. Chemical Optimization
- The following questions came up as staff looked in Bio-P optimization….
  - How can we reduce the impact of side stream nitrates(NO_3-N) and ortho-phosphorus (PO_4-P) on Bio-P system?
  - How can we improve the anaerobic and anoxic zones in the Bio-P system?

Possible Options for Changes in Operations

- Reduce NO_3-N and PO_4-P in GBT filtrate
  - ➢Holding tank operation
  - ➢General GBT maintenance

Possible Options for Changes in Operations

- Ways to improve anaerobic and anoxic zones in Bio-P system
  - RAS Control
  - ORP and D.O. control in ditches
- Review effluent tertiary filter operation for possible improvement in performance

Why explore the side streams?

- For every lb. of NO_3-N in the side stream you will use up 4 lbs. of influent BOD denitrifying the NO_3-N in the anaerobic zone
- For every lb. of PO_4-P in the side stream you need an additional 20 lbs. more of influent BOD to biologically treat the P

Why explore the side streams?

- Jun '12 noticed difference in GBT filtrate PO_4-P concentrations, mg/l
  - Holding tank #1 – 3.3
  - Holding tank #2 – 14.1 - blower was offline
- Jul '12
  - GBT filtrate – 28.4 and 34.6

Why explore the side streams?

- Jul ‘12 in the GBT filtrate the NO_3-N concentration was an average <u>80 mg/l</u>
- These high concentration of NO_3-N & PO_4-P have an adverse affect on the Bio-P

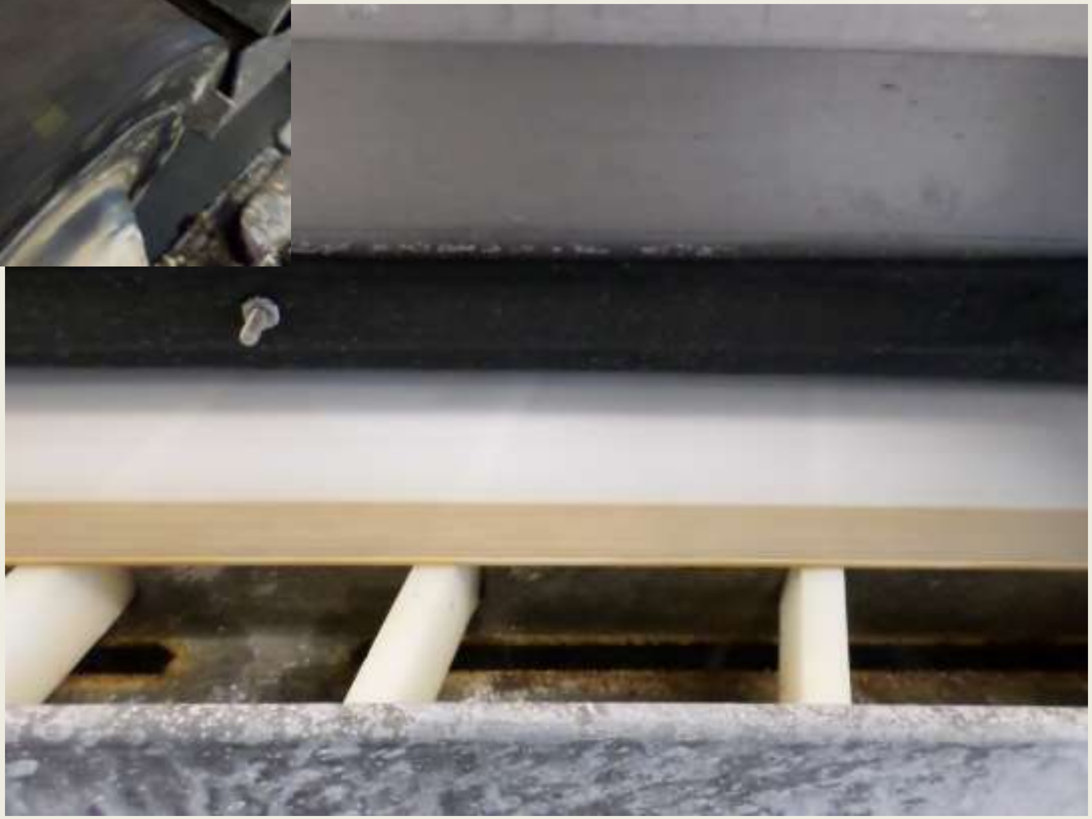
Efforts to reduce GBT NO_3-N and PO_4-P concentration

- Maintain adequate D.O. in holding so P does not release in holding tank
- Decreased Hydraulic Retention Time (HRT) by reducing operating level in holding tank
    - Reduces conversion of organic nitrogen to ammonia and then NO_3-N

Efforts to reduce GBT NO_3-N and PO_4-P concentration

- Staff experimented with GBT maintenance to reduce PO_4-P
- Changed rubber seals and scrapers more often
- Staff cleaned belt more often
- Together both have improved the quality of the GBT filtrate resulting in less PO_4-P being recycled. It also resulted in lower polymer consumption

GBT SEALS



Efforts to Improve Anaerobic Zone

- Experimented with slowing the RAS flow rate
- Rational - reducing RAS flow will increase RAS sludge retention time in the final clarifier blanket helping to reduce ORP. When RAS sludge arrives in anaerobic zone it has a lower ORP improving the anaerobic zone quality
- Controlled as % of Influent – initial setting 70%
- After months of adjustment setting now at 55%

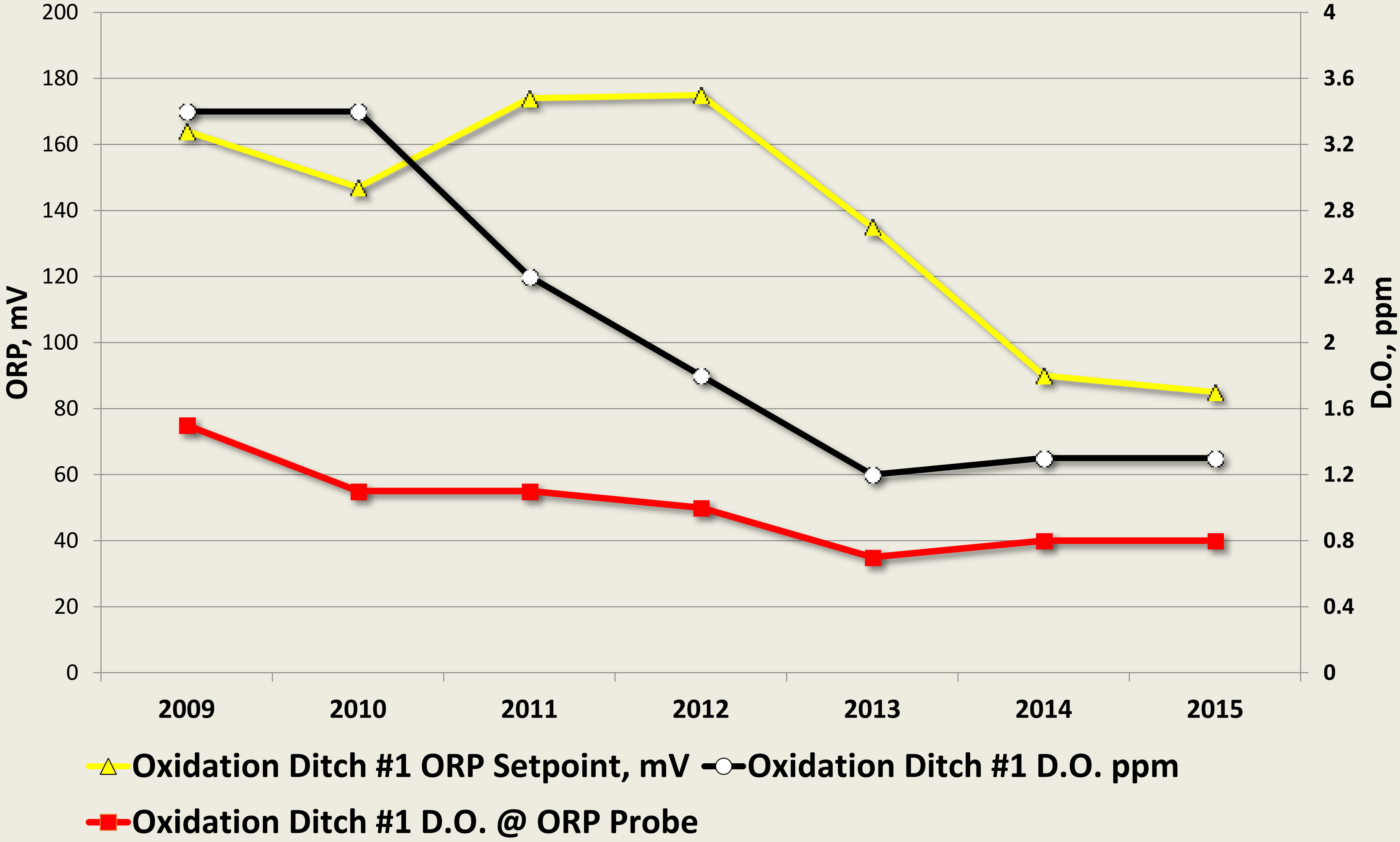
Efforts to Improve Anaerobic and Anoxic Zones

- **Aeration Control – Inline ORP Probe with set point**
- **Any inline probe needs routine maintenance/cleaning**
- **Oxidation Ditch D.O. are measured 7 days/week**

Efforts to Improve Anaerobic and Anoxic Zones

- 2012 D.O. was 1.0 ppm at the tail end of oxidation just before the secondary aerator
- In 2012 the ORP control set point for the aerator's was 170 mV this would achieve the desired 1.0 ppm D.O.
- Over the course of time staff experimented with a lower D.O. and ORP in the ditch
- Present D.O. target is 0.7 ppm and ORP aerator set point control is 93 mV

Effectives of Reduced ORP Set Point



Efforts to Improve Anaerobic and Anoxic Zones

Rational – Reducing the D.O. (ORP) in the ditch accomplishes two things;

1. Help to create a condition (lower ORP) for the DENITRIFYING organisms to act on NO_3-N
2. Bring the overall ORP lower in BPR system (oxidation ditch/final clarifier sludge blanket/anaerobic zones). This helps provide better performance in the anaerobic zone – PUSHING IT MORE ANAEROBIC

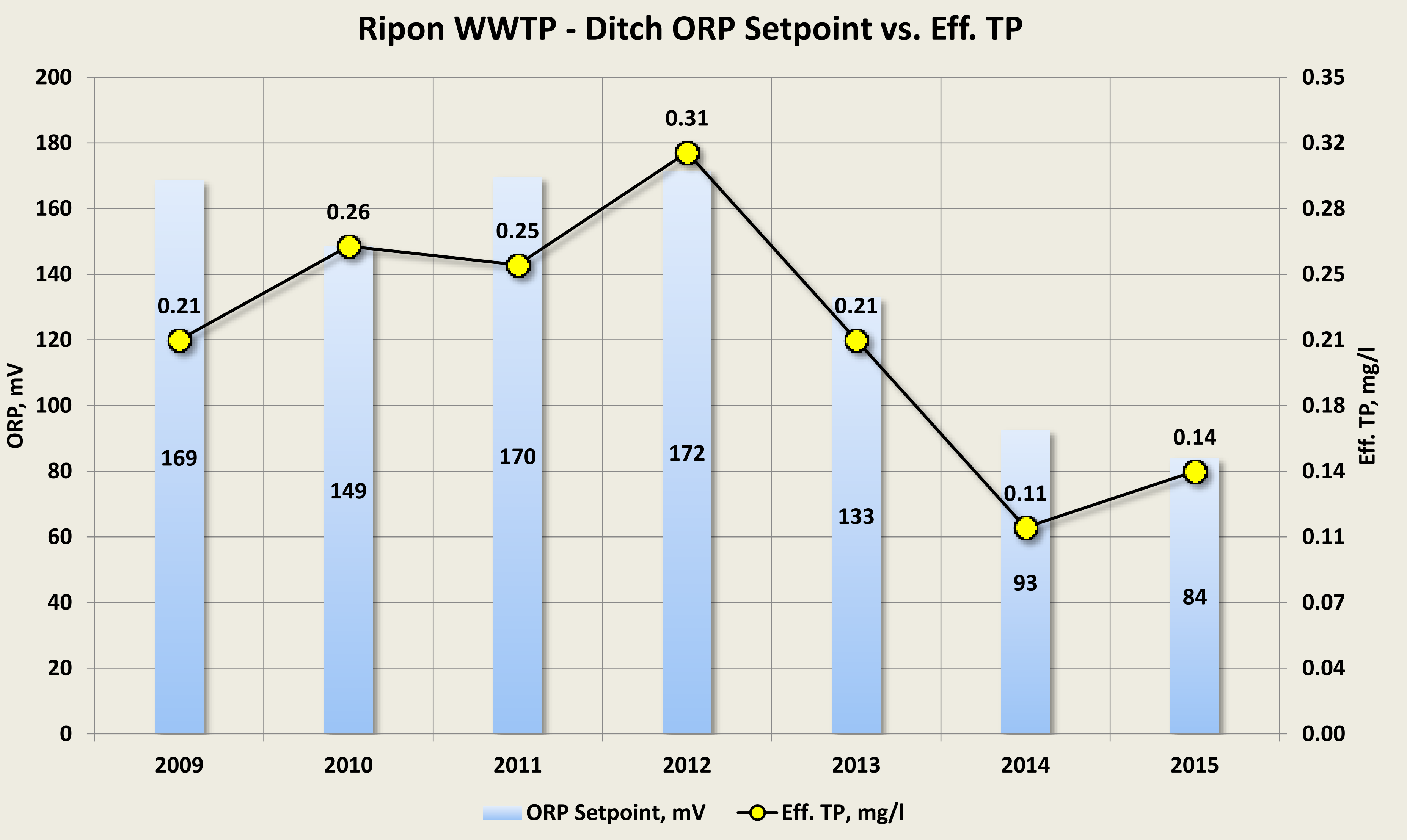
Last But Not Least – Optimize Effluent Tertiary Filter System

- Before 2012 staff experimented with effluent tertiary filter backwashing to reduce effluent TSS and in turn reduce effluent TP.
- Through experimentation staff found back washing each filter (there are 4 filters) everyday (manual mode vs. auto) improved effluent TSS and in turn effluent TP
- Staff also found out that organisms growing in the filters can effect the activated sludge - filaments

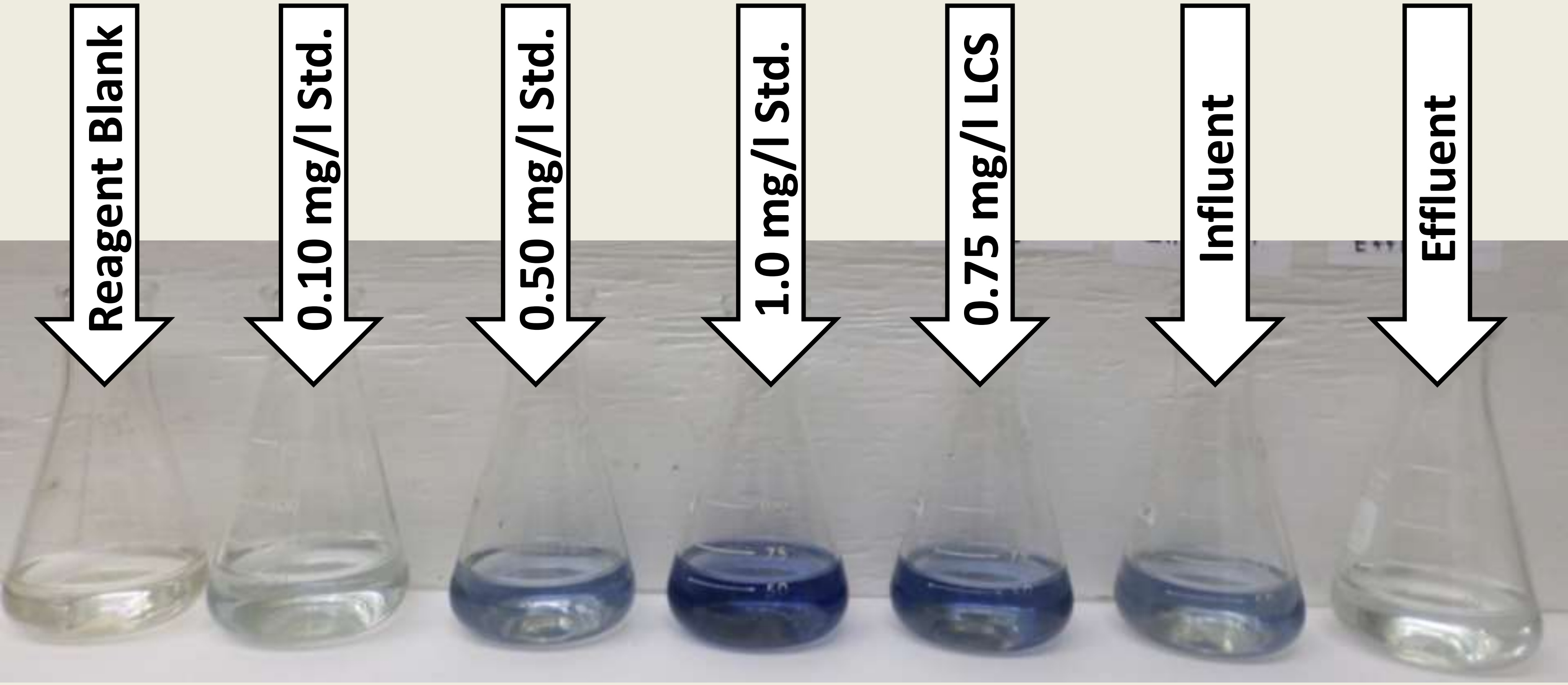
Results of Operational Changes

- A combination of the following items all attributed to an improved Bio-P performance
- Reducing HRT in holding tank
- Increased levels of maintenance on GBT
- Reduce RAS flow rate
- Decrease both D.O. and ORP levels in the oxidation ditches – <u>This option seemed to have the largest impact on increasing Bio-P performance</u>
- Increase effluent tertiary filter backwashing

Ripon WWTF Ditch ORP Set Point vs. Effluent TP



Total Phosphorus
5-5-2015



Treatment Plant: Ripon Wastewater Treatment Plant Analyst:

Sample Location (Specific): Raw Site #1 on Flow Schematic, QA Document

Final Site #2 on Flow Schematic, QA Document

Sampling Type: 24 Hr Composite 24-hr. Comp. X 3 Hr. Composite Grab ______

Sampling Date: 5.4.15 Testing Date: 5.5.15

Sample Collection Time: Begin 7:00 A.M. End 7:01 A.M.

Sample Testing Time: Begin 0720 End 1635

Analytical Method Used: Standard Methods 20th Edition, Method 4500 E

Preservation Technique Used: Refrigeration 4° C

Standard/Reagent Traceability: Chemical log book 1 & Chemical log book 2

LABORATORY DATA

Sample	Sample Size (mls)	Absorbance	Conc. (mg/l)
Standard 0.10 mg/l	25	,034	
Standard 0.50 mg/l	25	,173	
Standard 1.00 mg/l	25	,360	
Blank	25	,001	0.01
LCS 0.75 mg/l	25	,264	0.74
Raw	25 10x	,149	4.20
Final	25	.020	0.06
Duplicate			

T.S.S.
5-5-2015

Distilled Water Blank

Influent

Effluent

*** TOTAL SUSPENDED SOLIDS ***

(Total Nonfilterable Residue)

Treatment Plant: Ripon Wastewater Treatment Plant

Analyst: JW

Sample Location (specific):

Raw: Site #1 on Flow Schematic, QA Document

Primary: ________

Final: Site #2 on Flow Schematic, QA Document

Other: ________

Sample Type: 24 Hr. Composite X 3 Hr. Composite ______ Grab ______

Sampling Date: 5.5.15 Testing Date: 5.6.15

Sample Collection Time: Begin 7:00 AM End 7:01 AM

Sample Testing Time: Begin 0729 End 1019

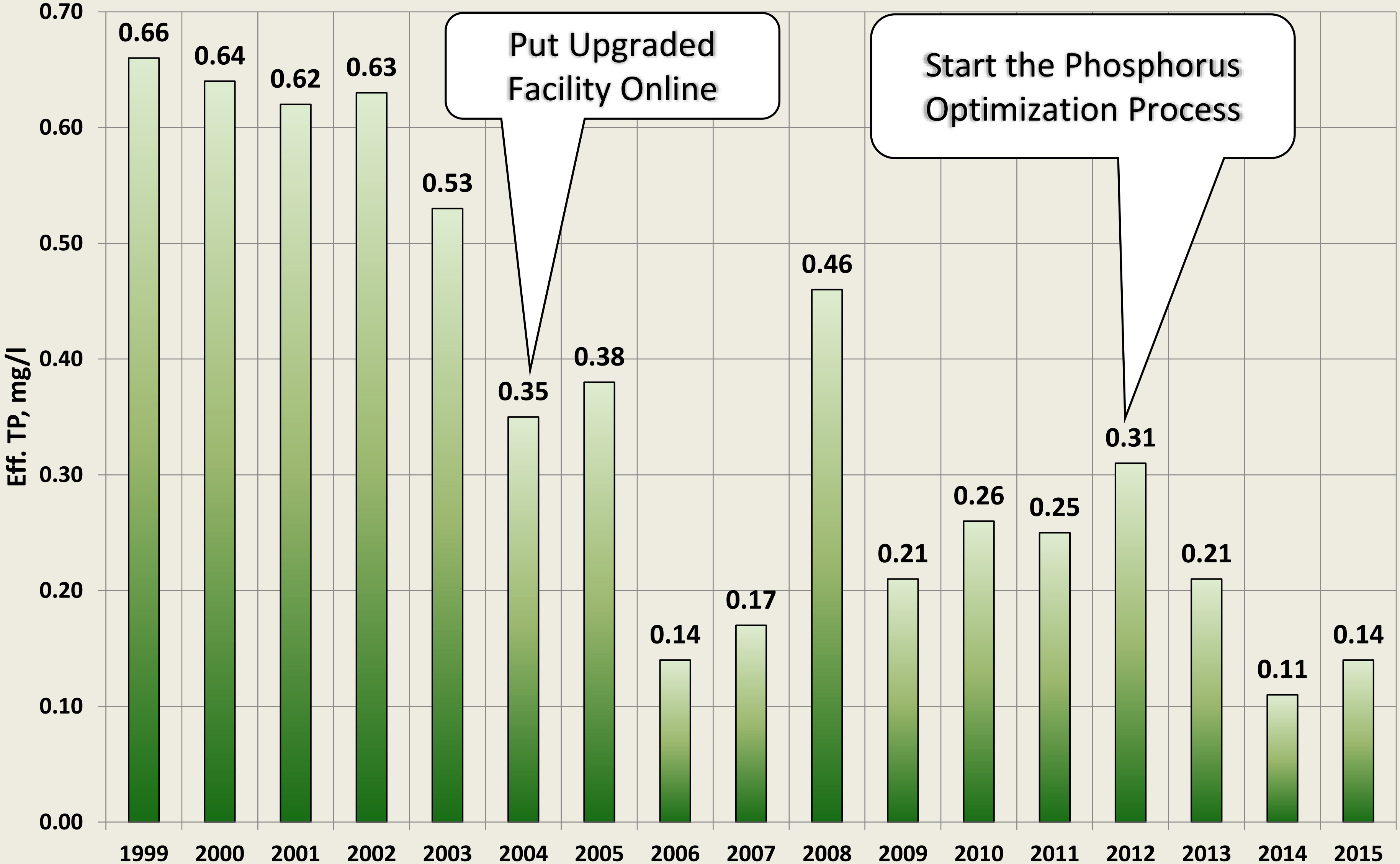
Repeat Testing Time: Begin 1025 End 1133

Analytical Method Used: Standard Methods, 20th Edition, Method 2540 D

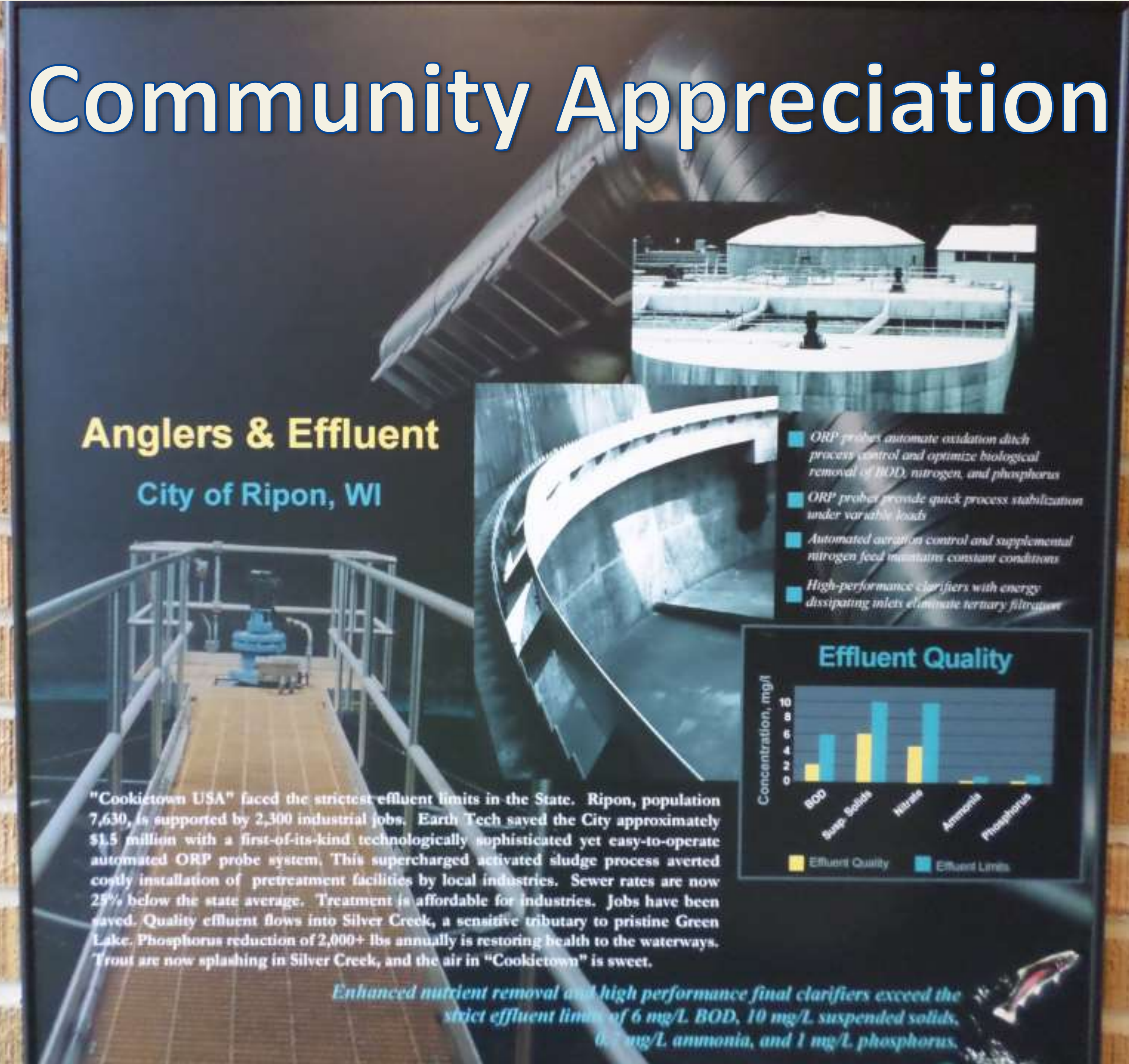
Preservation Technique Used: Refrigeration 4° C

NUMBER/SIZE ml	TYPE	SAMPLE LOCATION	PAPER GRAMS	INT. PAPER SAMPLE – GRAMS	REPEAT PAPER SAMPLE GR.	INT. S.S. mg/l	REPEAT S.S. mg/l
1/100	D.W.	ROUNDY'S	[illegible]	[illegible]	[illegible]	0	0
2/500	FINAL	SAMPLER	1.4541	1.4551	1.4551	2.0	2.0
3/500	FINAL/DUP	SAMPLER	—	—			
4/50	RAW	SAMPLER	1.3761	1.3824	1.3823	126	124
5/50	RAW/DUP	SAMPLER	1.4536	1.4607	1.4605	142	138
6/100	MLSS-1	DITCH-1	0.5928	0.9204		3276	
7/100	MLSS-2	DITCH-2	0.5970	0.9019		3049	
8/50	RAS	BLDG 45					
9/250	FCL 1	BLDG 45					
10/250	FCL 2	BLDG 45					
11/50	DIG 1	5W-8W					

AFTER Optimization



Community Appreciation



Conclusion

- Ripon’s staff found that through a variety of operational changes they were able to drive the *Biology* and have noticeable impact on the Bio-P performance of their system
- Educated experimentation in an orderly fashion with your Bio-P system can have positive effects on Bio-P performance