Successful Strategies for Meeting Nutrient Removal Standards

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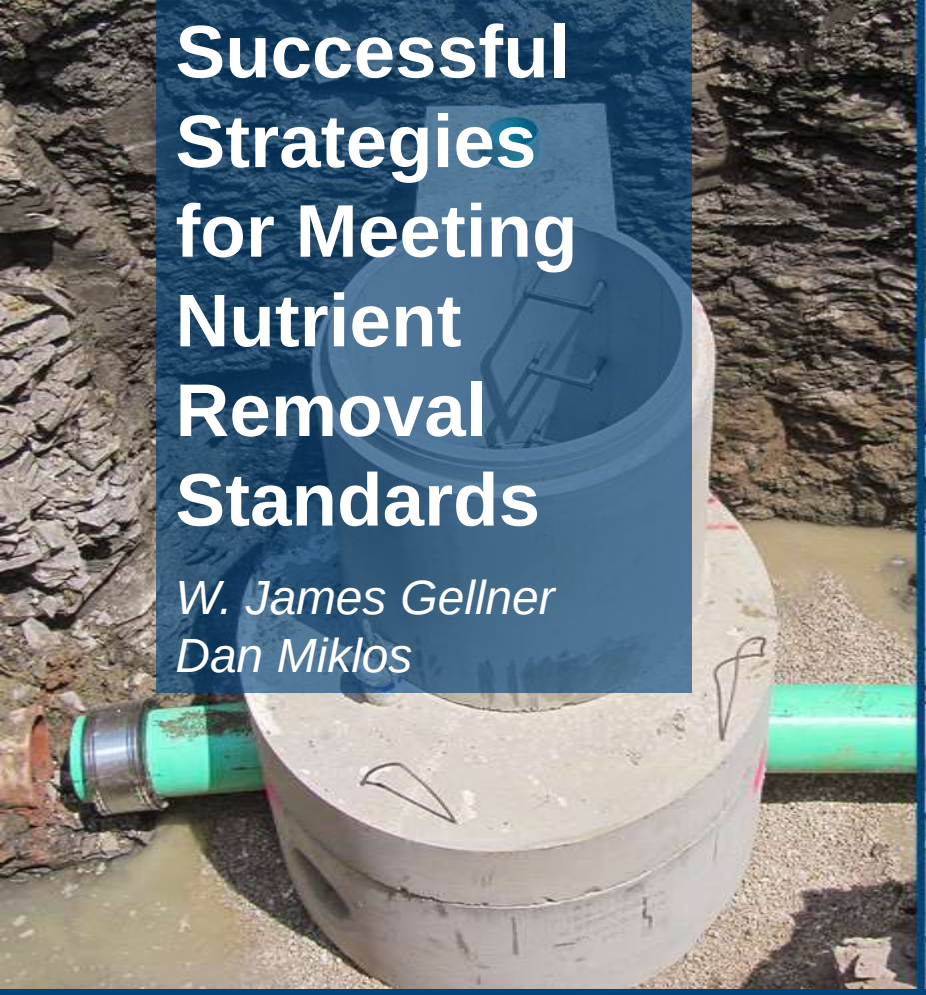
Dan Miklos



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'60 '70 '80 '90 '00 '10 '20

Ohio

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Presentation Overview

- Introduction
- Case Studies
  - LeSourdsville WRF (Design)
  - Upper Mill Creek WRF (Study)
  - North Olmsted WWTP (Design)
  - Floyds Fork WWQTC (Study)
- Summary

It's only 45 minutes…..

Acknowledgements

- Dan is on assignment…..

ODOR TRACK'R™

Libresse Odor Fighter! Save the World

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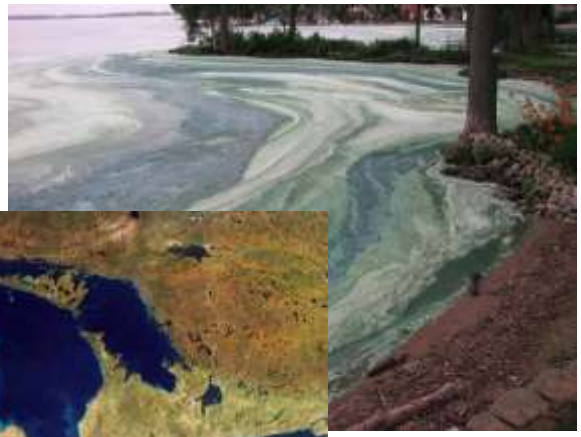
We're all heading there…..

- Ohio HB 1 / SB 61
- Toxic algal blooms
- LGMR consortium
- Gulf hypoxia



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The Nuts and Bolts

- The concepts are well publicized / discussed
- 2 designs / 2 studies
- Design
  - Implementation decisions (f)
    - Site constraints
    - Existing facilities
    - Cost
    - Future objectives
- Studies – Optimization / Options
  - Key understanding of process influences

Anything But…….

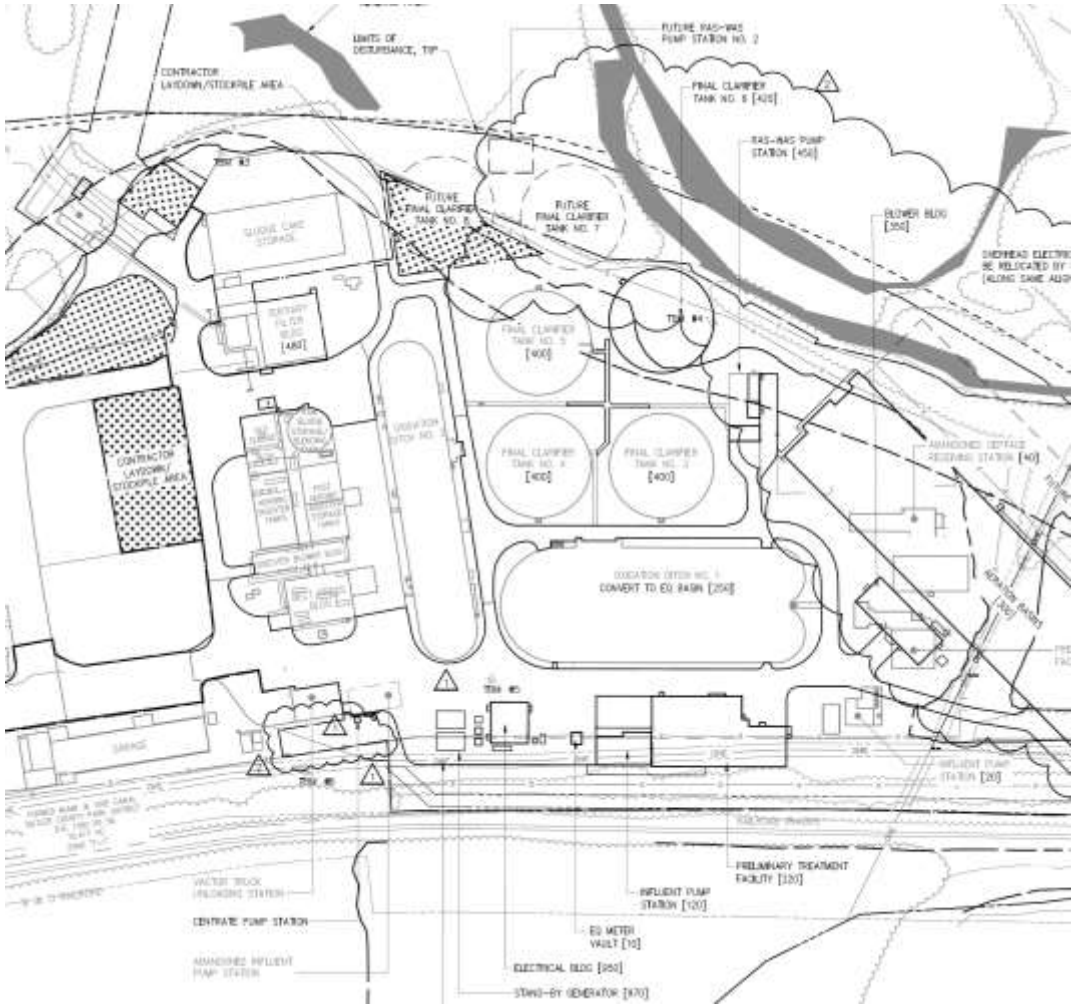
LeSourdsville WRF (BCWS)

- Master plan and detailed design
- Upgrades from 12 to 15 MGD (dry)
- Increase from 32 MGD to 70 MGD (wet)
- Flexibility for 18 /140 MGD
- Flexibility for future N & P removal

Evaluate / implement upgrades for current and future increases in service area

Plant Overview (Prior to Upgrades)

- One main OD
- Summer nitrification
- Peak wet weather flow – 32 MGD
- Landfilled solids

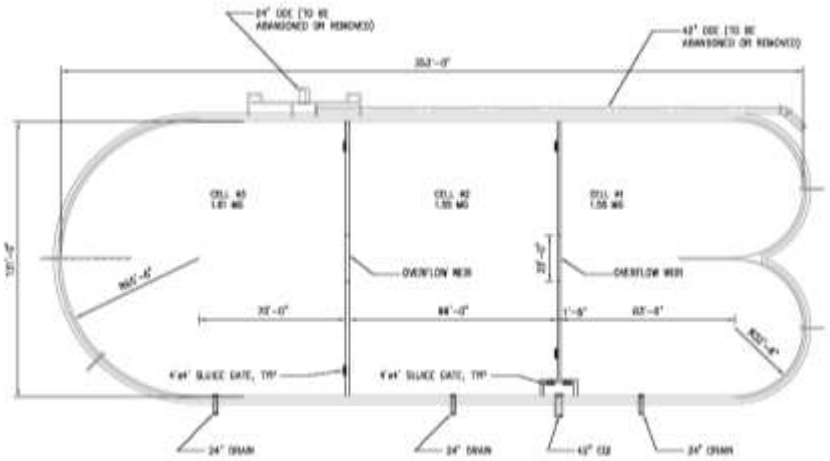


Permit Limits Used for Planning

	Current Permit		Phase 2 Limits (15 MGD)	Future Limits (BADCT)	Future Limits (N&P)
	Weekly	Monthly		Short-Term	Long-Term
TSS, mg/L	24.0	16.0	13	12	
CBOD, mg/L *Summer*	17.25	11.5	9	10	
CBOD, mg/L *Winter*	18.75	12.5	10	10	
NH3, mg/L *Summer*	5.25	3.5	1	1	
NH3, mg/L *Winter*	15.75	10.5	3	3	
TP, mg/L	-	-	X	2.0	<0.5
TN, mg/L	-	-		10.0	<5

OD vs Plug Flow Activated Sludge

- One 5.1 MGD ditch
  - 2.2 MGD ditch could be brought on line as needed
- Needed flow EQ
- Conventional PF tanks
  - Increased reliability
  - Future nutrient flexibility

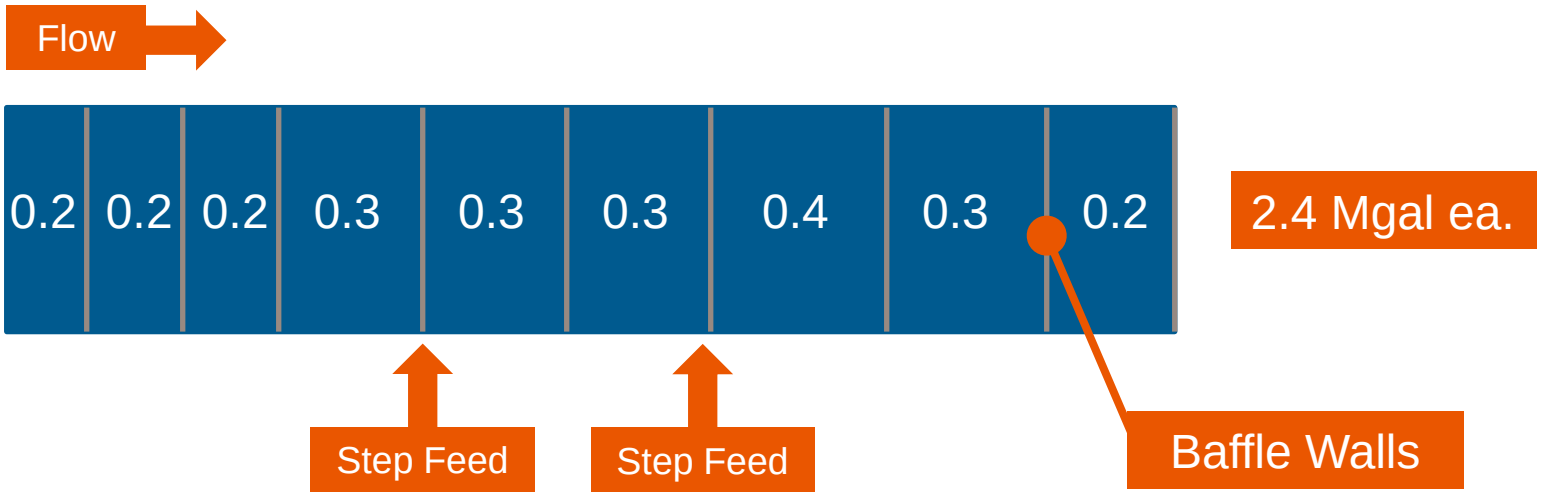


A Ditch in Time Saves $9M

…well not really (break even), but I've been dying to use this phrase

AT Design Criteria

- Current summer nitrification (1 mg/l), 3 mg/l in winter
- Year round nitrification
- Nutrients
  - Less stringent (TP = 1 mg/l, TN 8-10 mg/l)
  - More stringent (TP <0.5 mg/l, TN < 5mg/l)
  - Wet weather step feed
- Future capacity increase to 18 MGD



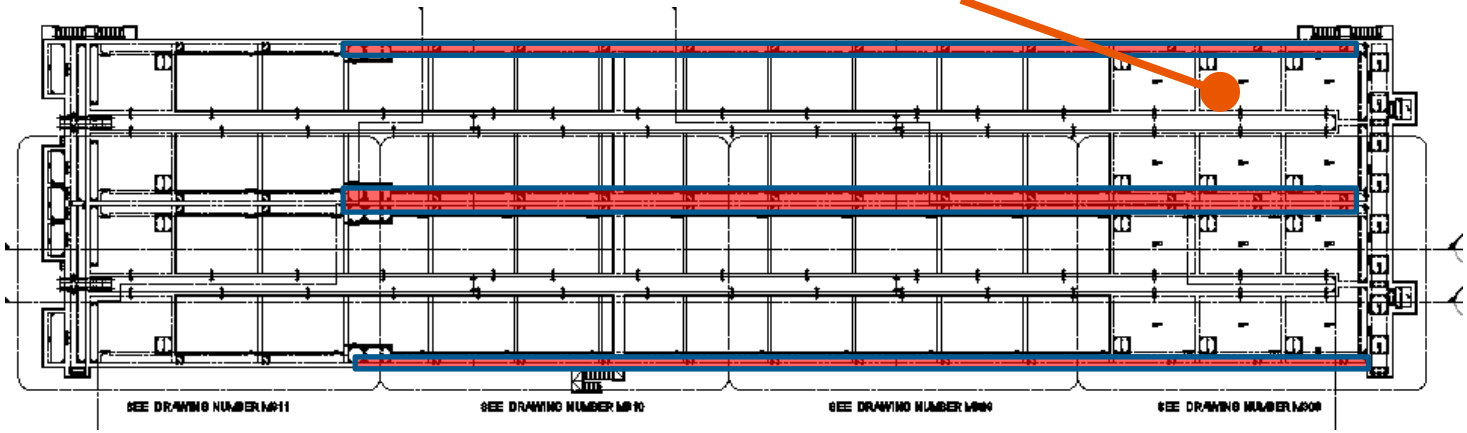
Future Flexibility

- Up to 7 basins
  - Numbers and zone operation depend on limits and loadings
- TP < 0.5 mg/l, TN 10 mg/l
- If 18 MGD and TN,10 mg/l, consider IFAS

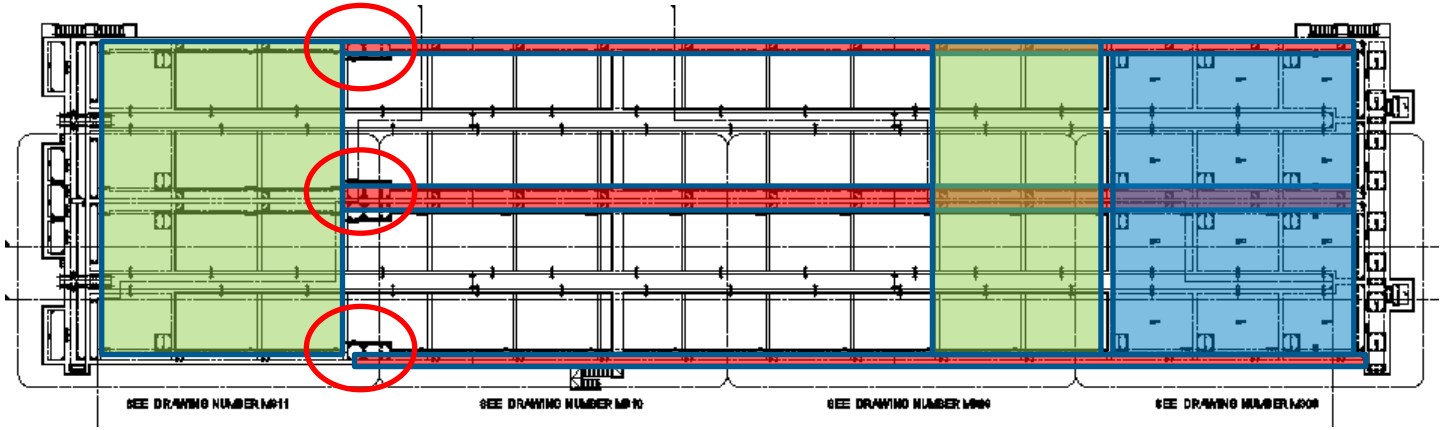
“Double Duty” for Cost Savings

Unaerated with mixing

Now
Step Feed



Future
Nitrate
Recyle



Implementation

- Completing construction (part of plant-wide upgrade)
- ATs partially complete
- Effective nitrification / evaluating BioP performance

Construction Cost - $42M

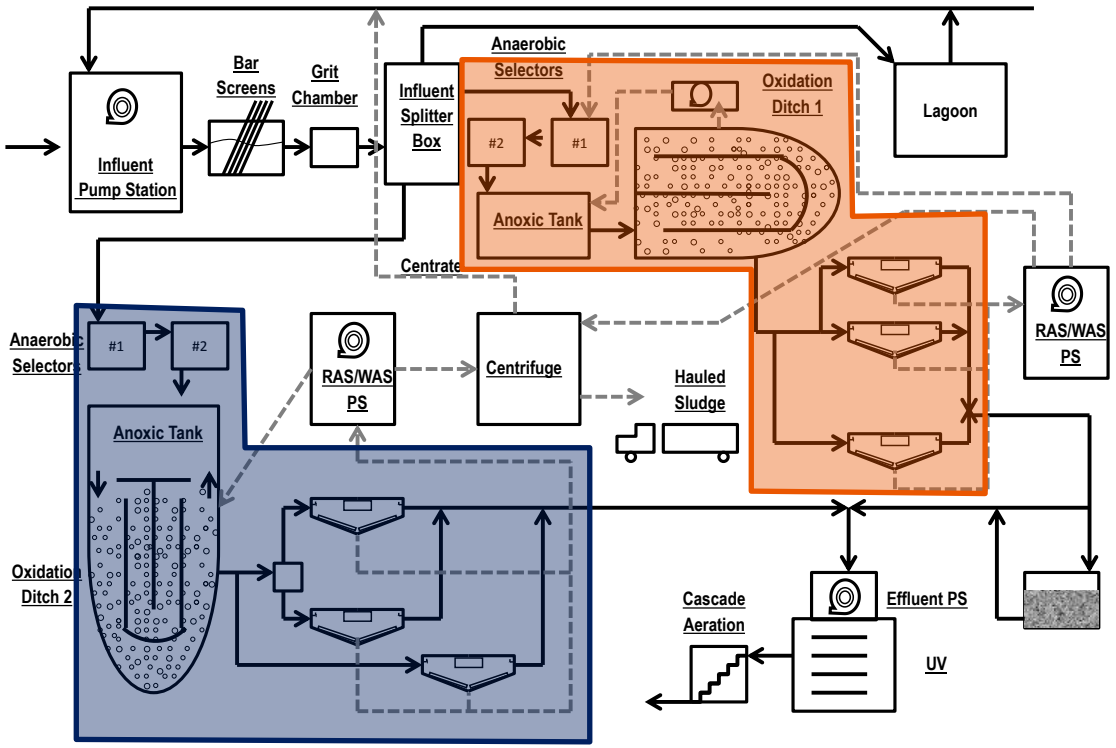
Upper Mill Creek WRF (BCWS)

- 16 MGD
- N & P limits
  - 1 mg/l TP
  - 5 mg/l NO3
- P excursions

Troubleshoot and assist in optimization of current nutrient removal

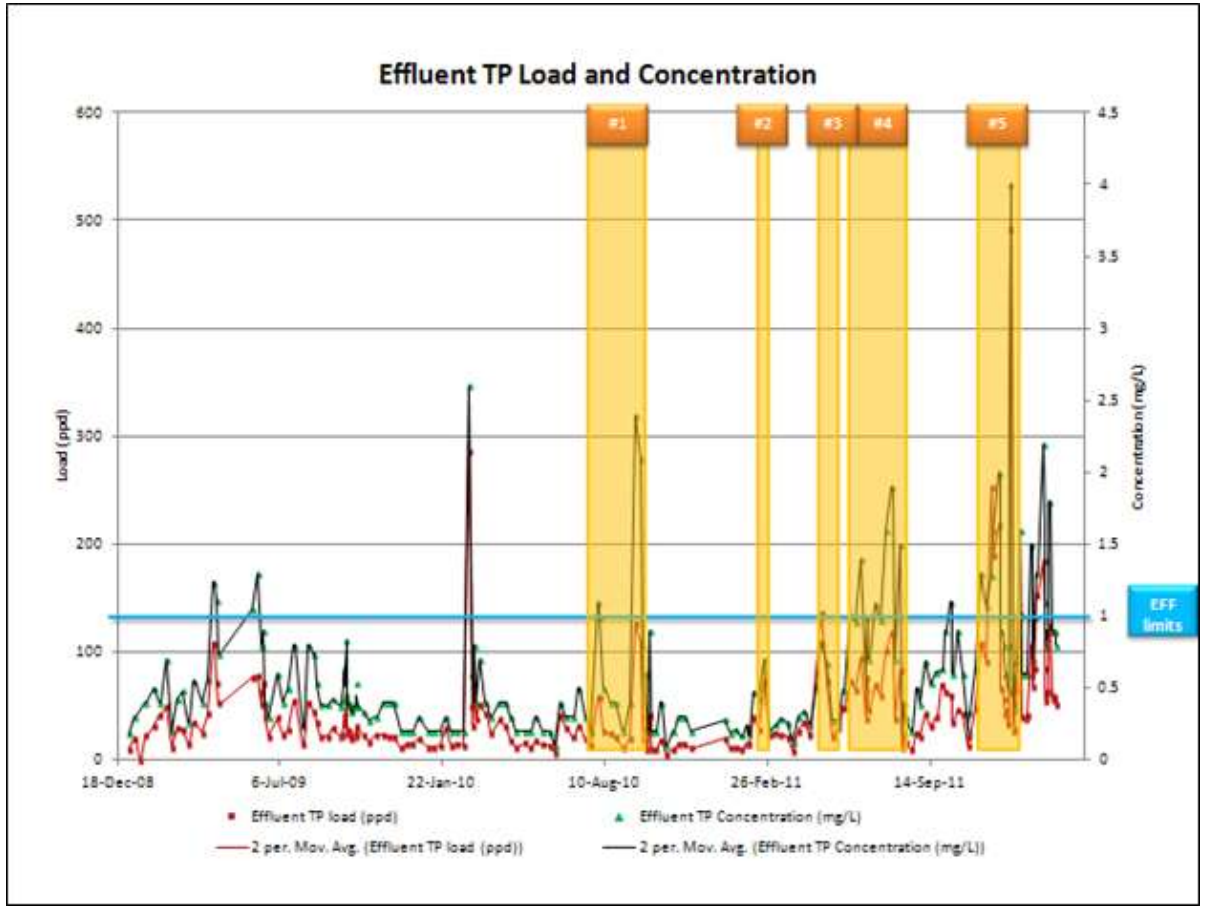
Plant Overview

- Two trains – 8 MGD each
- Current flow ~ 8 MGD
- Filter part of flow
- Chemical trim at FCs (chemscan)
- Landfill solids



Analysis of Effluent Excursions

- 2012
- SNC
- Multiple plant re-seeding to restore PAOs



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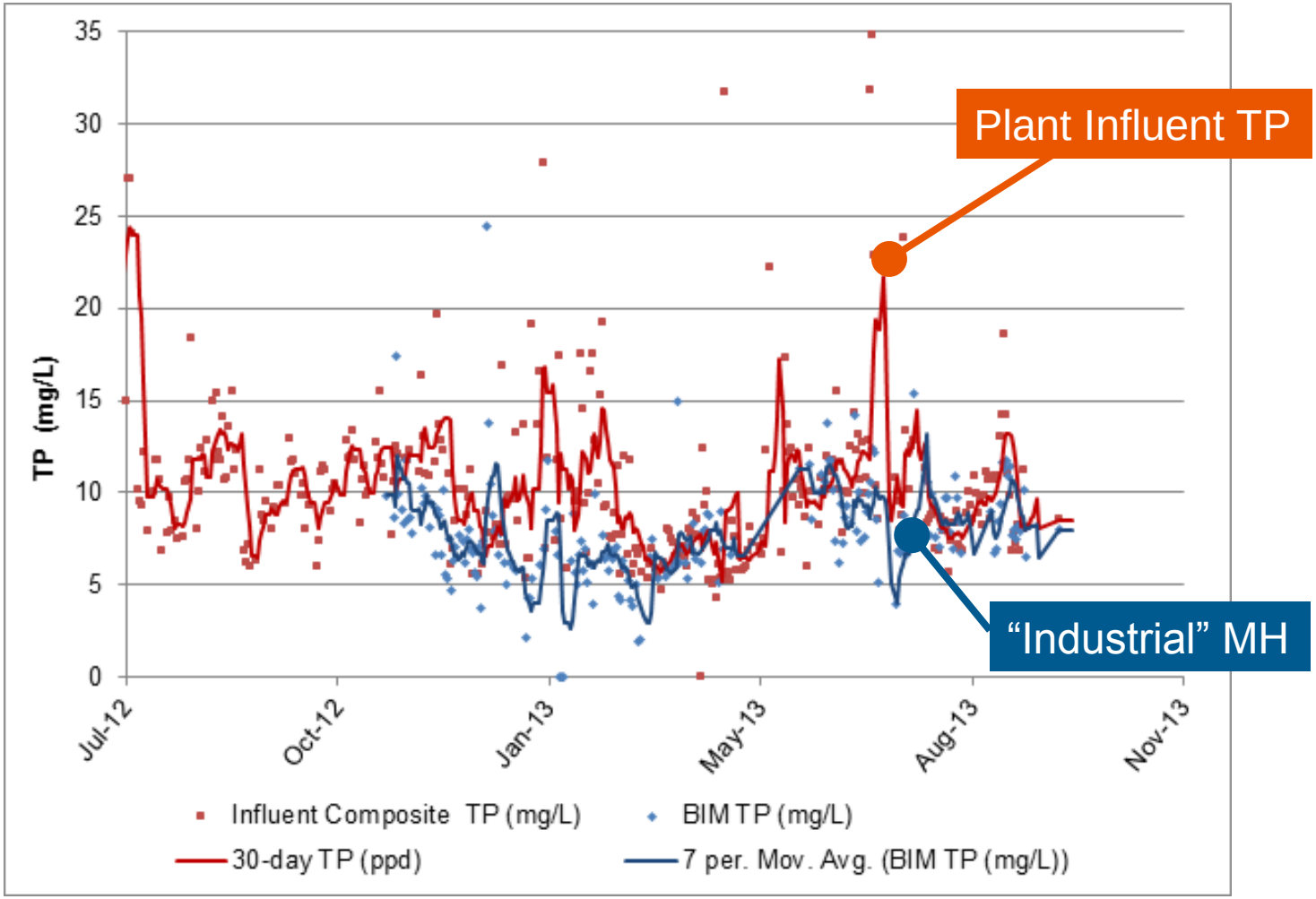
Variable TP…..from Industries and Sidestreams



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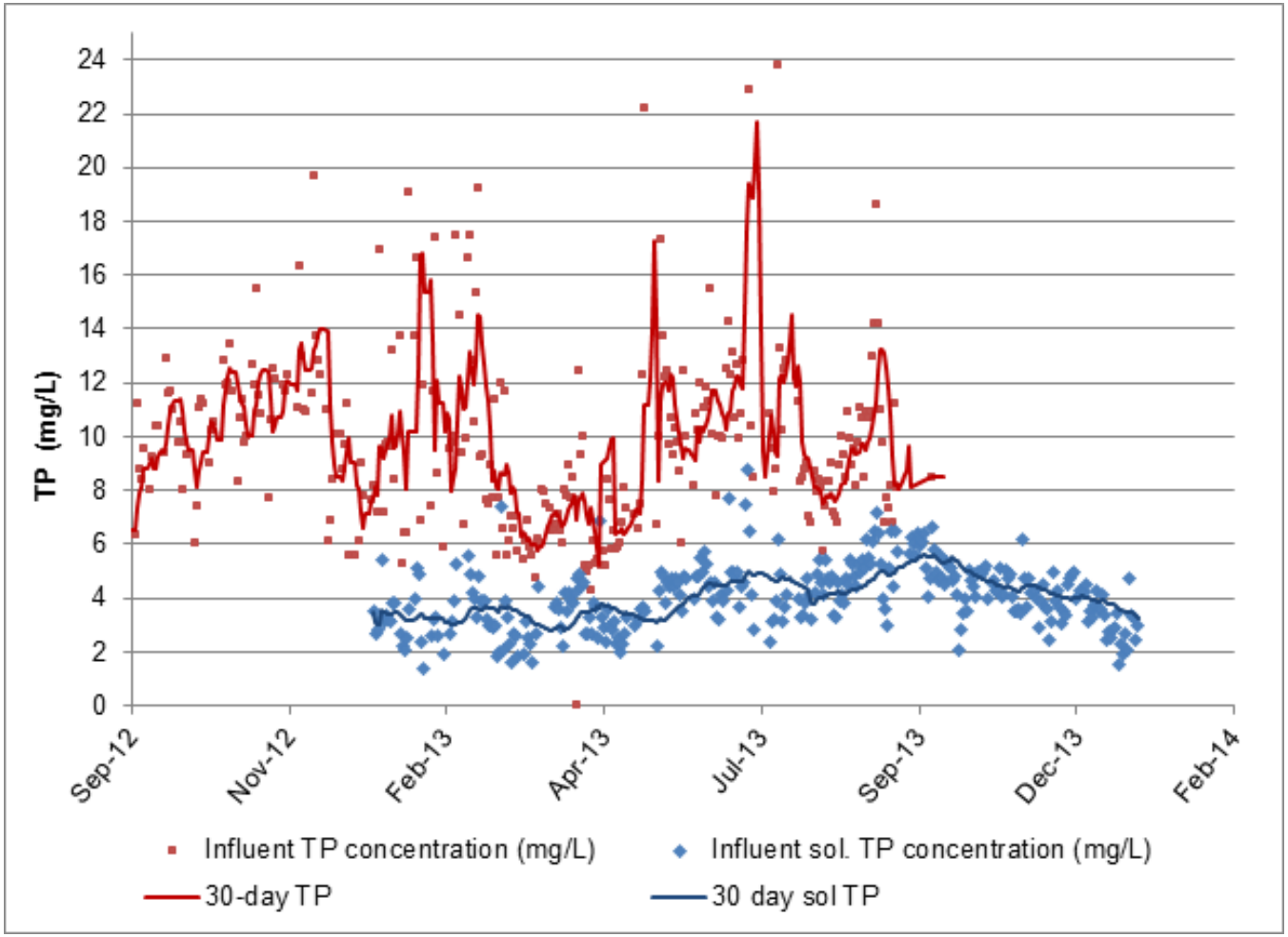
Less Variable Soluble, But…….



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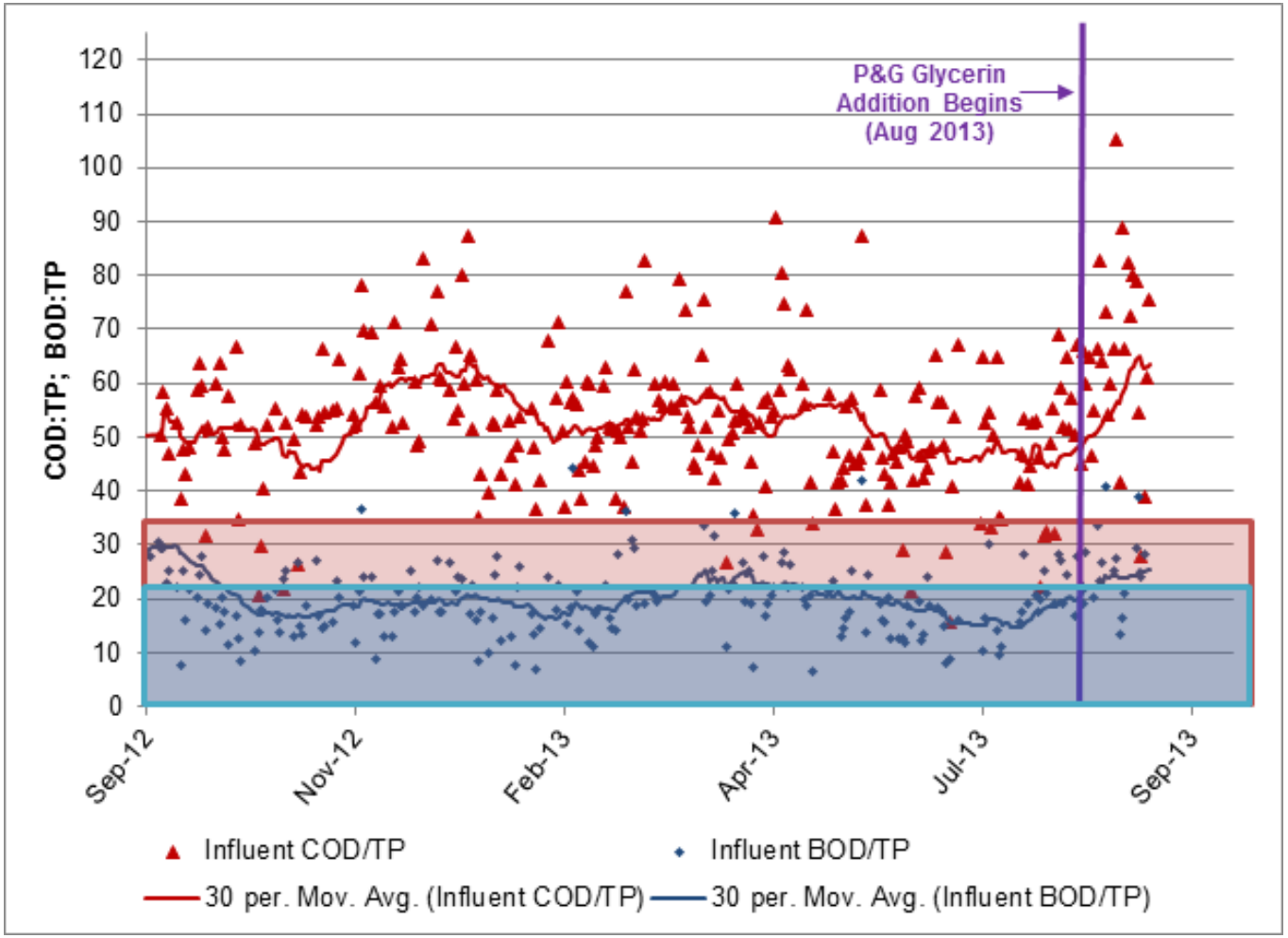
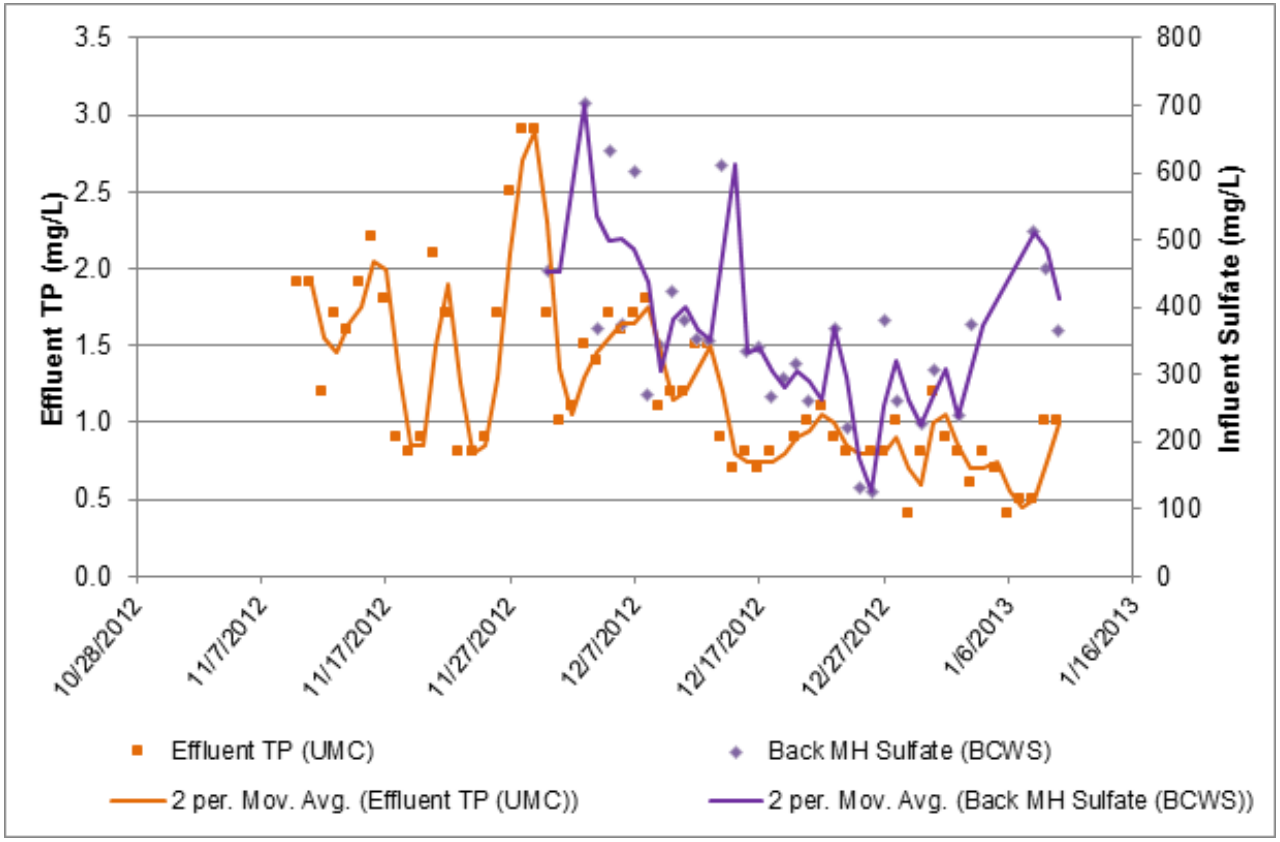
Marginal Carbon for Bio P



Potential Influence of Sulfate



- SRBs can outcompete PAOs in presence of high sulfates
- Progressive depletion of PAOs due to sulfates and overshoot of chemical

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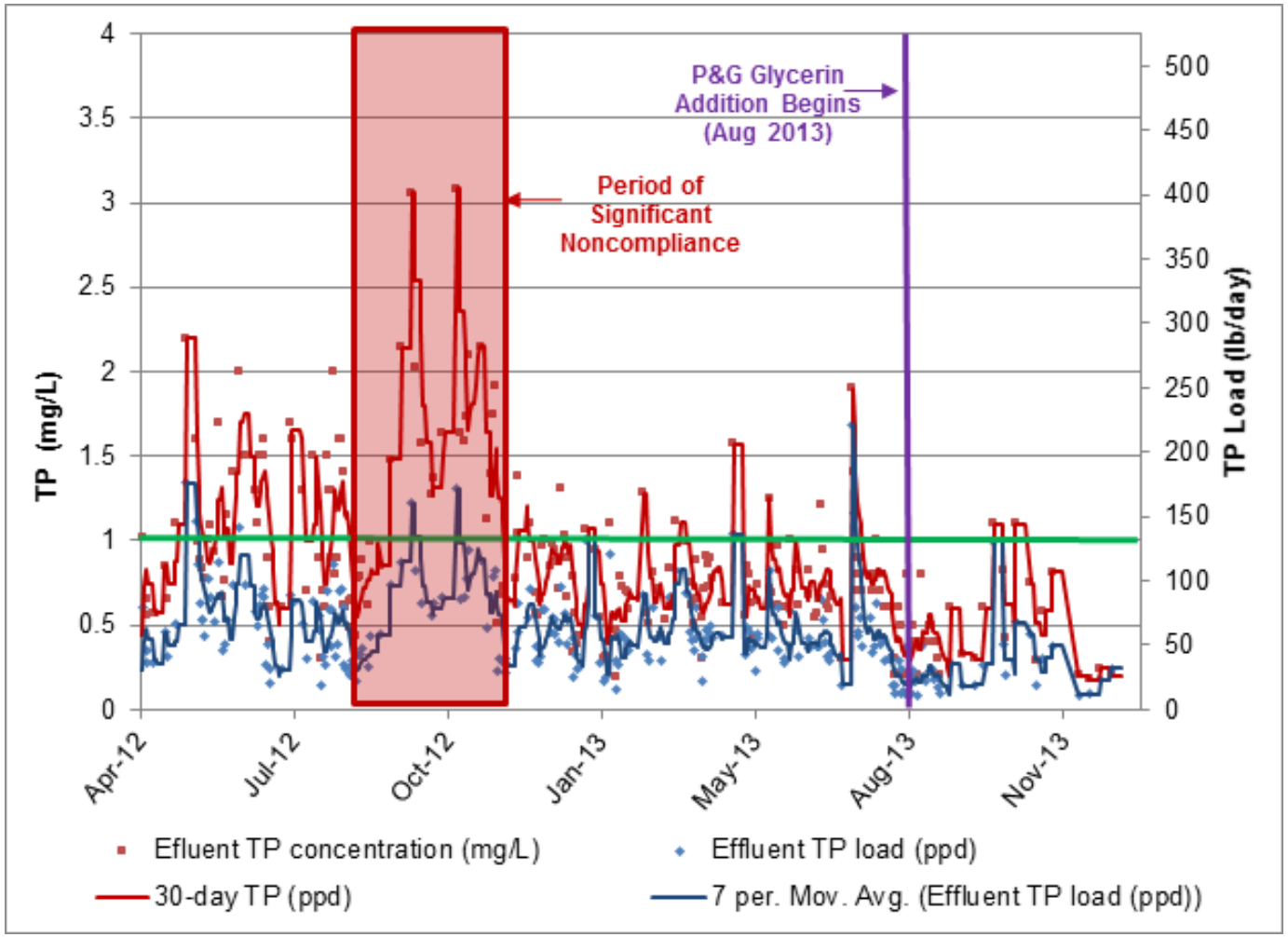
More Carbon Helped....



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Summary / Recommendations

Influences

- Variable influent P from industries
- Variable influent P from sidestreams
- DO sags in OD ditches during high demand
- Over/under with sodium aluminate
- Periods of low COD:TP
- Swings in TDS discharge

Optimization Suggestions

- Regular samples of back manhole
- Move sampling location for sodium aluminate prior to feed
- Higher capacity sodium aluminate feed
- Continue to import carbon when possible
- Increased process control sampling (OP)

North Olmsted, OH WWTP

- Improvements by 12/31/2014 (wet weather SSOs)
- Increase peak capacity from 20 MGD to 40 MGD
- Provide flexibility for future nutrient removal
- Eliminate offsite odors
- Fixed budget driven by rates

Determine and implement upgrades for increased wet weather capacity and future permit requirements

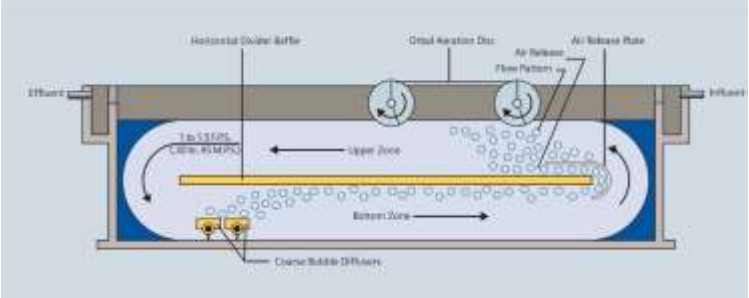
Plant Overview Prior to Upgrades

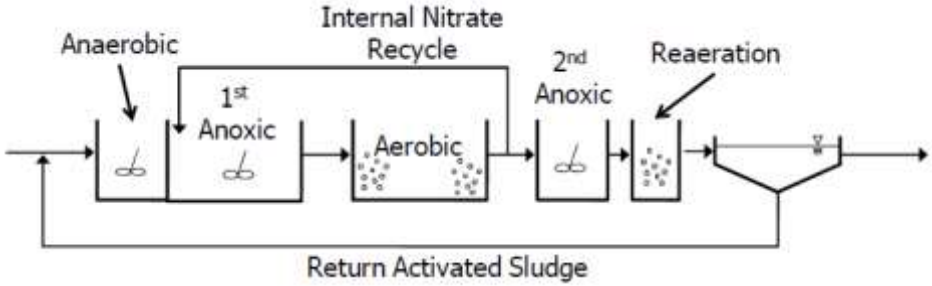
- 7 MGD capacity
  - 20 MGD wet weather
- Manual screens
- Primary clarifiers
- Aeration tanks with limited volume (1.4 Mgal)
- Primary effluent bypass
- TP = 1 mg/l
- Wedgewire screens
- Sodium aluminate added at primaries and secondaries
- Landfill dewatered solids

Limited plant area bounded by steep grade on N and W, stream bank on E, park on S

Biological Treatment Options

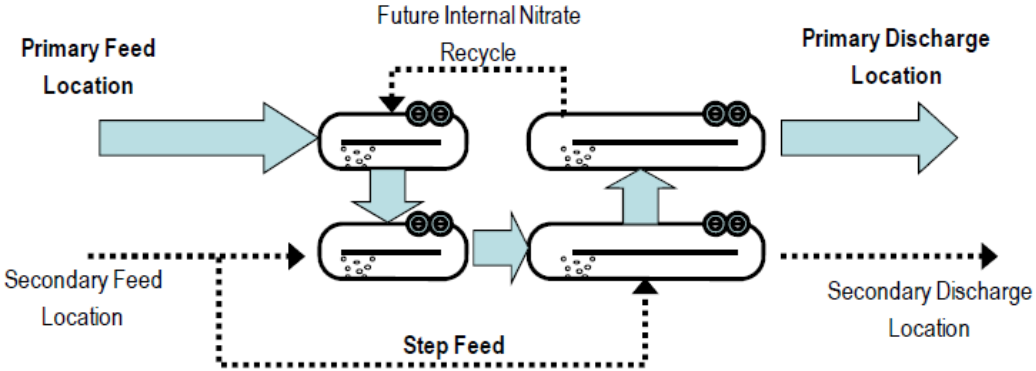
- Design Conditions
  - Eliminate PCs
  - Present: TP = 1mg/l and year round nitrification
  - Long-term: TP < 0.5 mg/l, TN < 5 mg/l
- Vertical Loop Reactor (VLR)
- Conventional Activated Sludge
- MBBR/IFAS

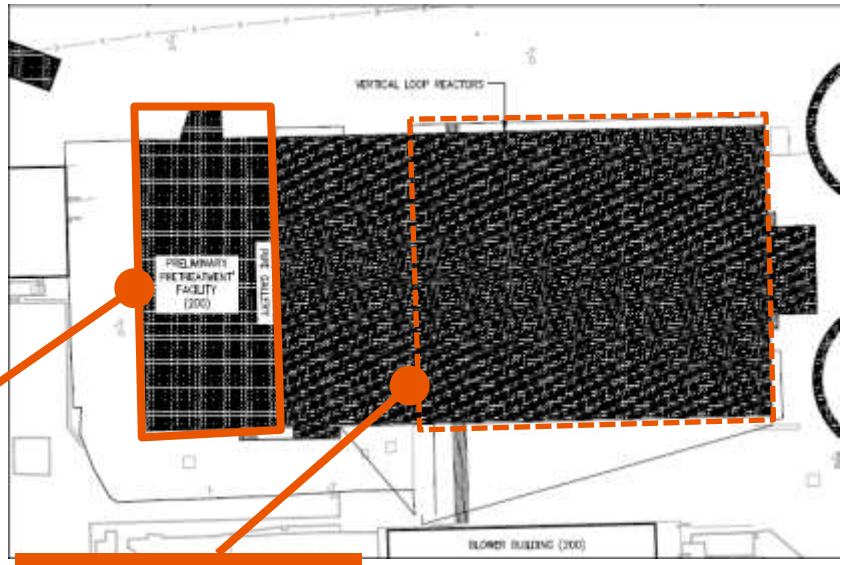




VLR

- 4 trains
- Total volume – 3.8 Mgal
  - 4 @0.67 Mgal
  - 4 @0.29 Mgal
- Future N&P
  - Add internal recycle (4Q)
  - Increase MLSS to 4500 mg/l





Headworks

Footprint of existing ATs

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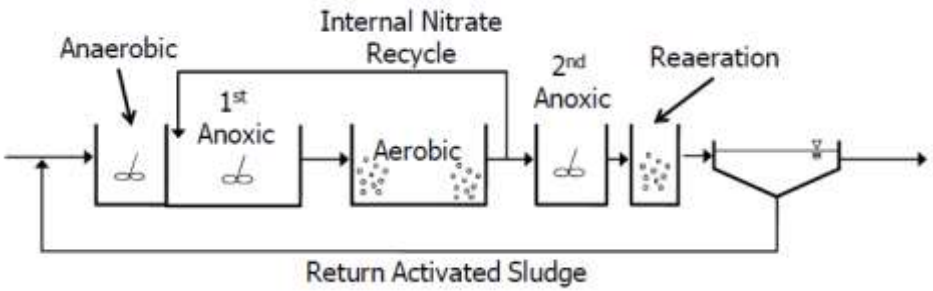
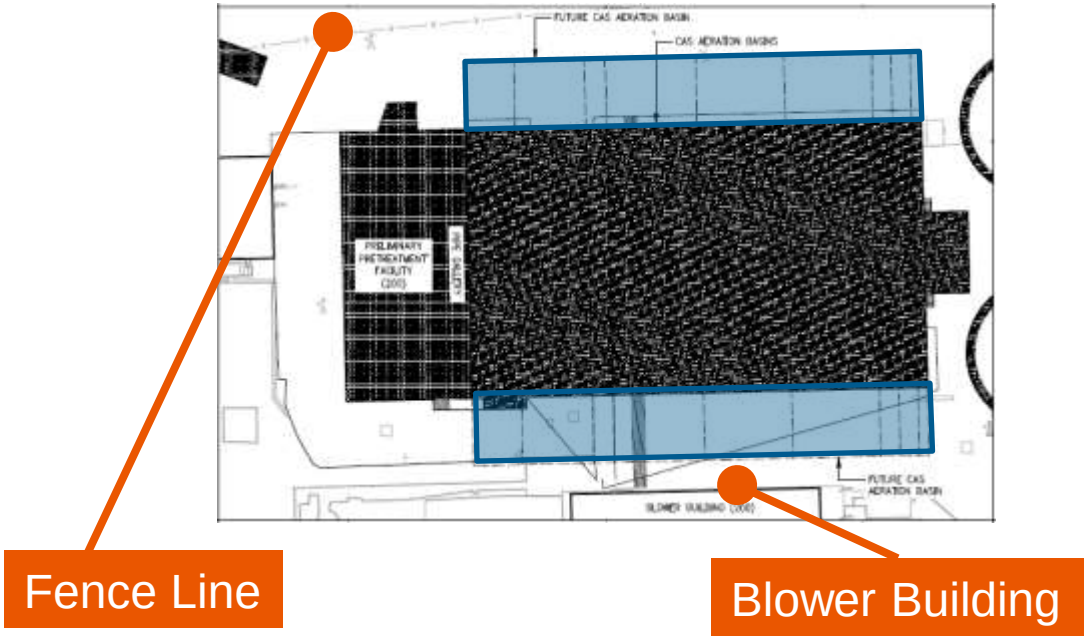
Conventional Activated Sludge

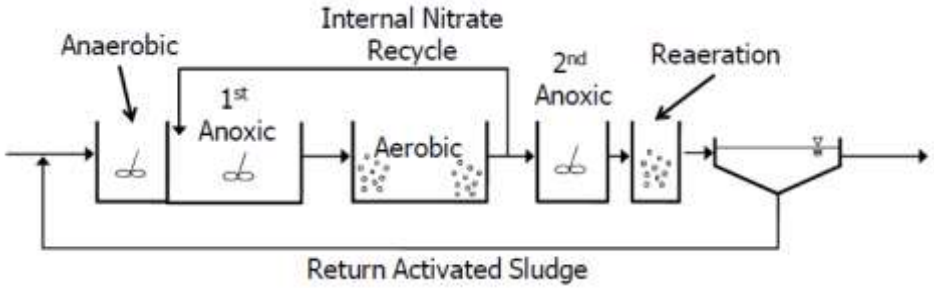
- Initially 4 tanks @ 0.9 Mgal each (3.6 Mgal)
  - ANO_2 zone
- Future
  - 2 additional tanks @ 0.9 Mgal
  - 5.4 Mgal total
  - Add 1st and 2nd anoxic

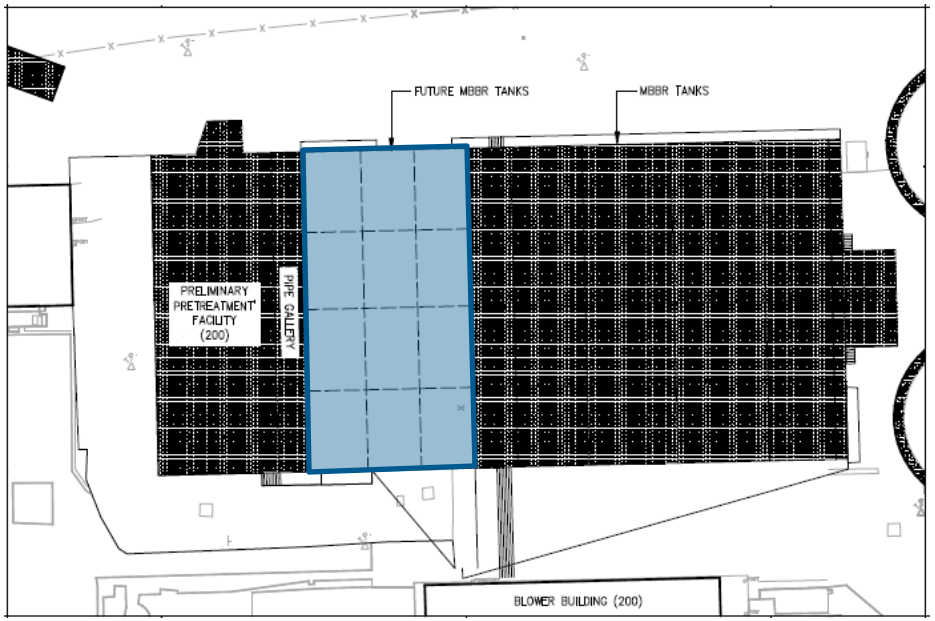




IFAS

- Use media in aerobic zones
- Current – 2.5 Mgal total
- Future – 3.8 Mgal total
- More aeration
- Media containment





Alternative Cost Comparison

Alternative	Current Capital Cost (yr round nit. & TP=1)	Future Capital Cost (TP <0.5 mg/l, TN < 1 mg/l)
VLR	$7.1 M	+10-15%
Conventional AS	$6.3 M	+40-50%
IFAS	$9.3 M	+30-40%

Implementation

- VLR option
- RAS conditioning
- Chemical trim at final clarifiers and dewatering return
- In operation since mid 2014
- Operation at up to 6000 mg/l (due to construction)
- Well below permit limits
  - NH_3 << 0.5 mg/l
  - TP << 1mg/l

Construction Cost - $38.5M

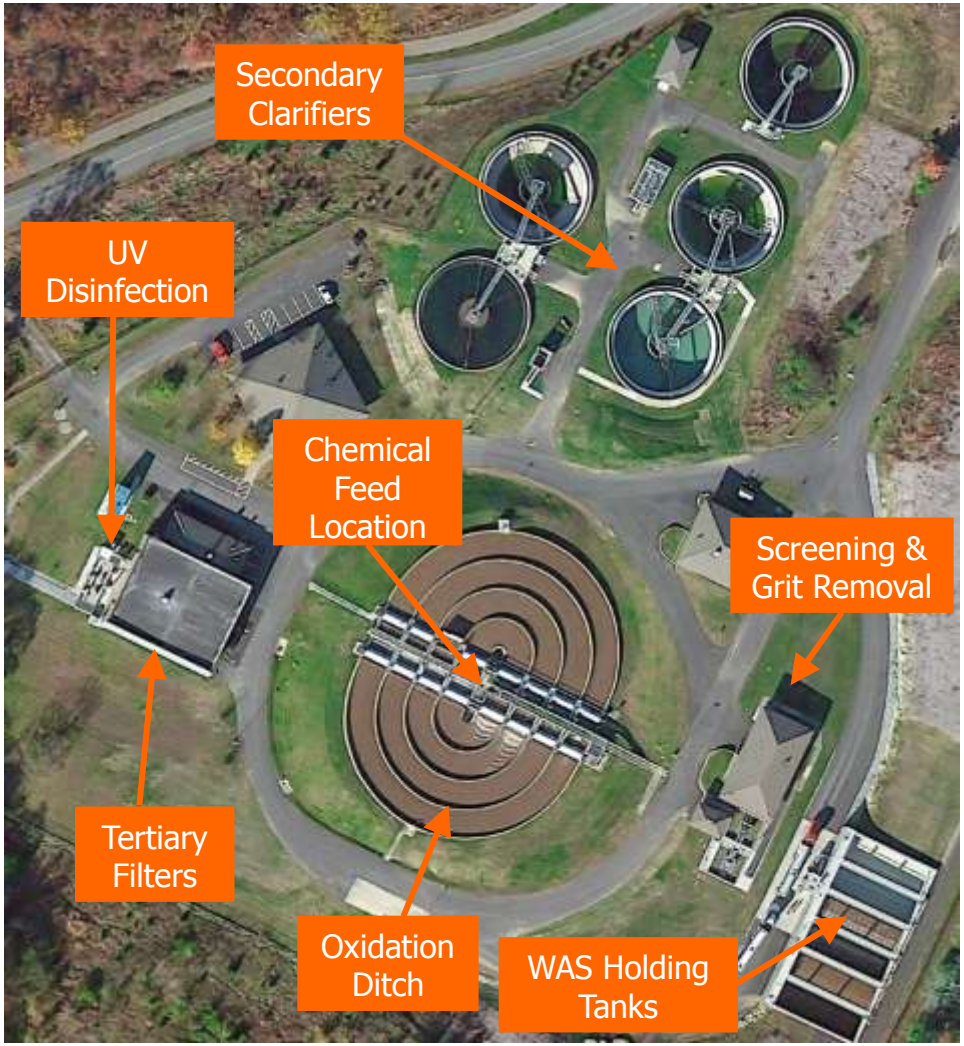
Floyd's Fork WQTC - LMSD

- 3.25 to 6.5 MGD capacity
- Increasing flows/loadings
- Lower P limit (1.0 to 0.5 mg/l) anticipated
- High expenditures for chemical feed

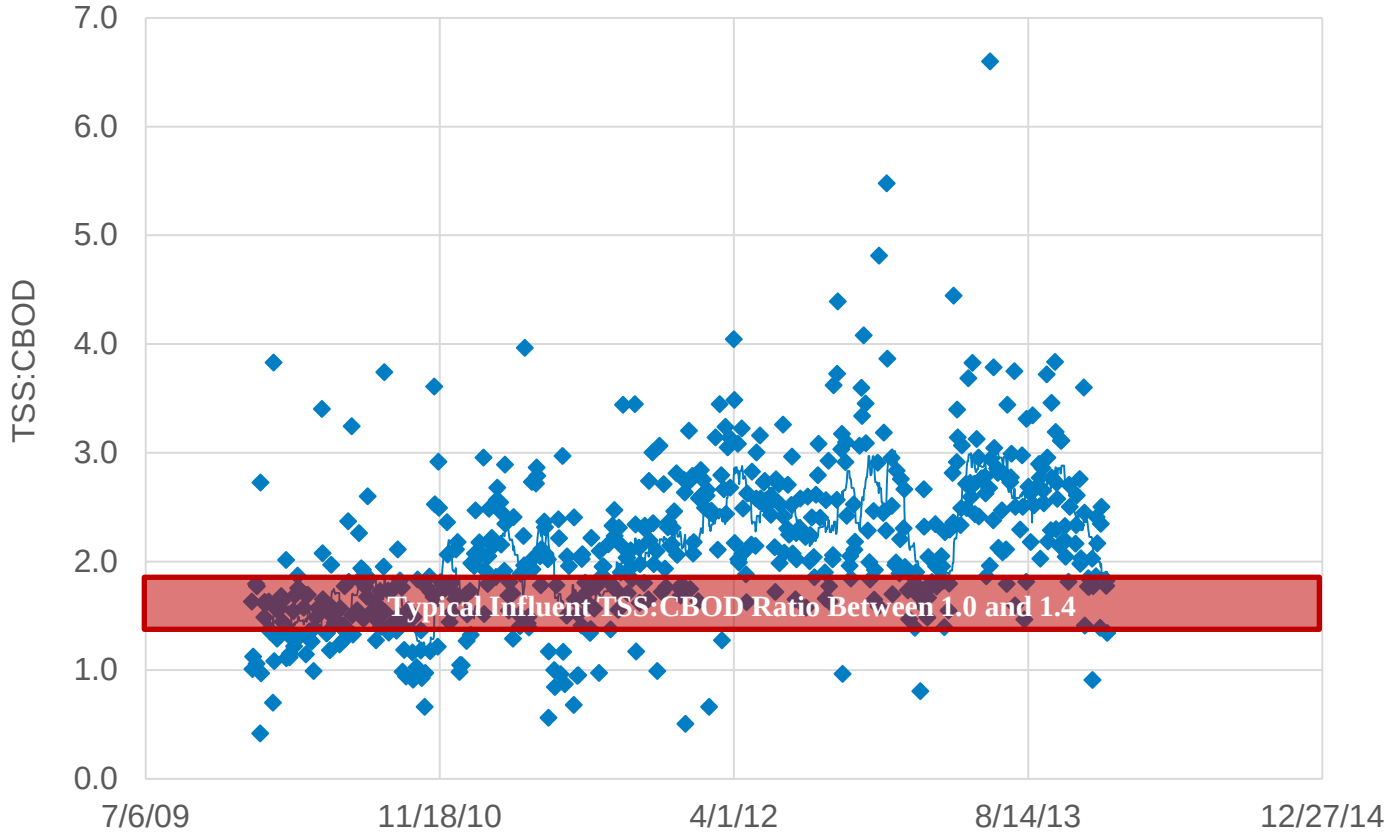
Evaluate feasibility of consistent bio-P and reduction of chemical usage

Plant Overview

- 4 ring orbal – total volume – 3.3 Mgal
- Sodium aluminate feed in inner ring based on effluent OP
- WAS hauled to MFWWQTC for processing
- Effluent sand filters



Evaluation of Available Carbon



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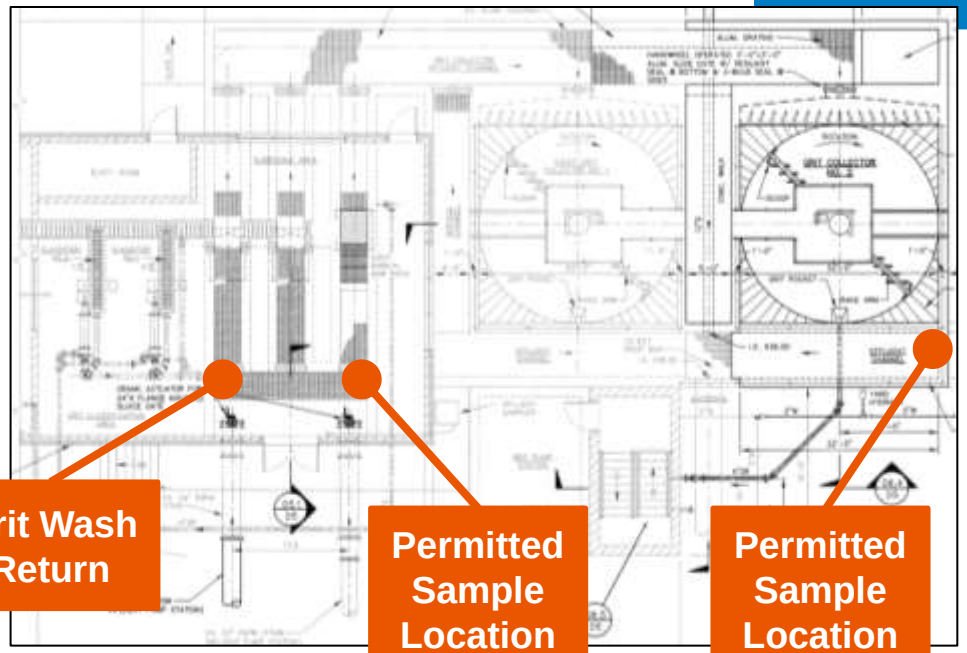
Influent Characterization Bias

Average Concentrations	Sampling Location		% Reduction
	Permitted Influent	Post-Grit	
TSS (mg/L)	367	209	43%
Unfiltered CBOD (mg/L)	173	107	38%
Unfiltered COD (mg/L)	486	319	34%

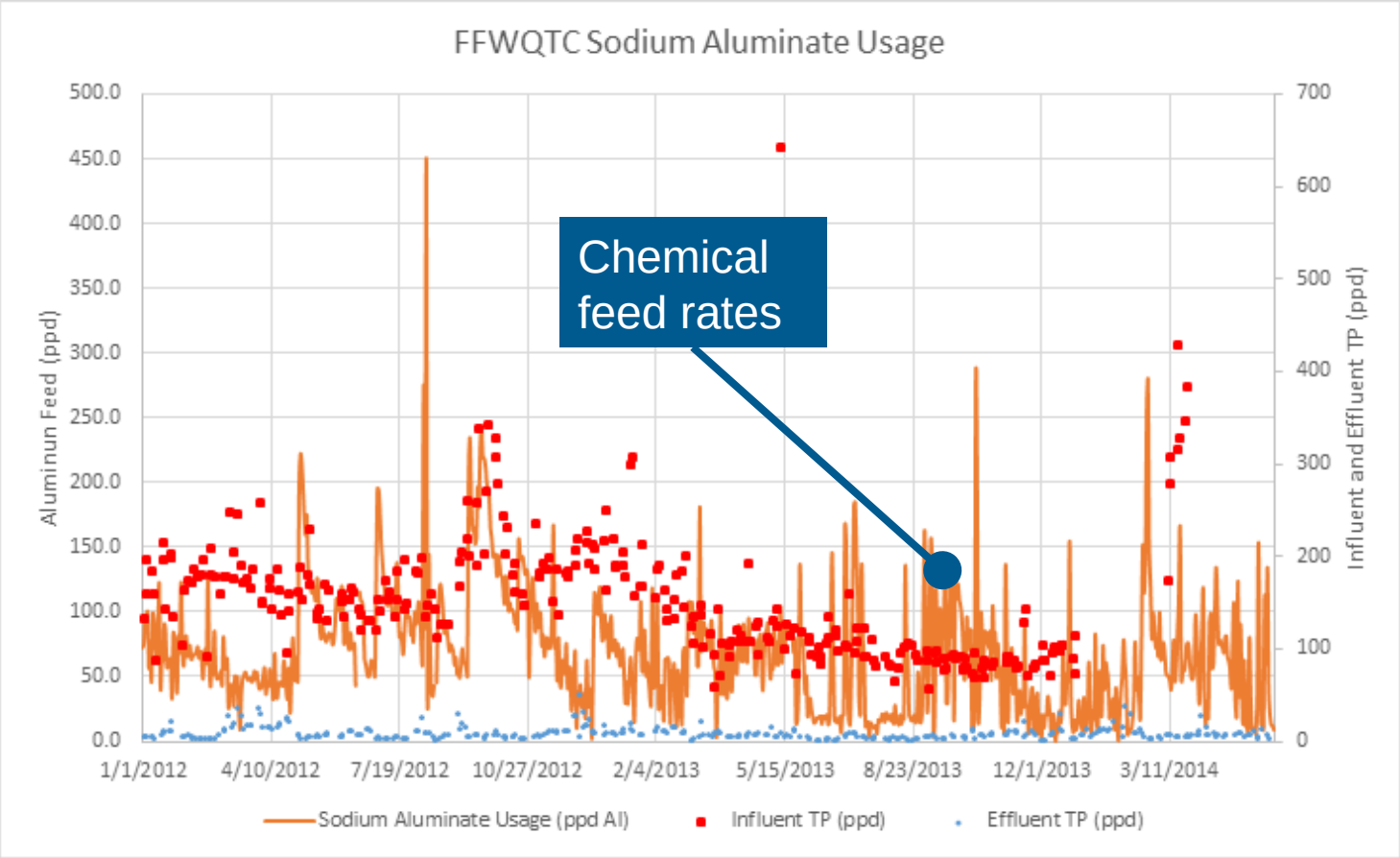


Adjusted historical COD/CBOD based on reductions

Sufficient Carbon for EPBR

Ratio	Minimum Recommended Value	Measured Value
CBOD:TP	25:1	33:1
COD:TP	45:1	94:1
rbCOD:TP	15:1	9:1

Erratic Chemical Feed



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DO Sag in ODs

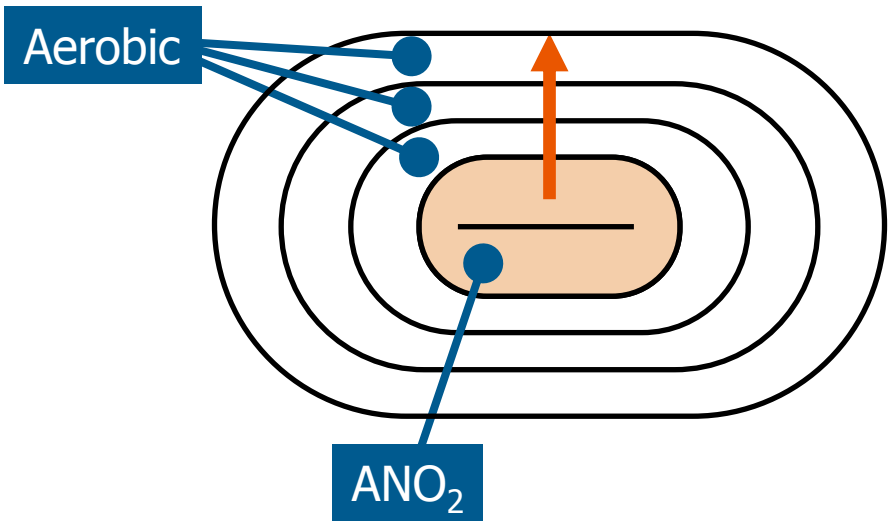
Date	Influent TP (mg/L)	Ring 4 OP (mg/l)	Ring 3 Orthophosphate (mg/L)	Ring 2 Orthophosphate (mg/L)	Ring 1 Orthophosphate (mg/L)	Daily Chemical Feed Rate (gpd)
5/27/14	4.14	6.5	7.2	6.73	4.76	30.8
5/28/14	3.27	4.06	2.6	0.134	0.137	15.1
5/29/14	Not Sampled	5.71	2.19	0.05	0.283	9.9

Outer → Inner

- Plant does have PAOs/EBPR
- Large load – sag in DO causes P release (PAOs present)
- Spike in sodium aluminate feed
- Hard to “catch up” once sag occurs

Recommendations

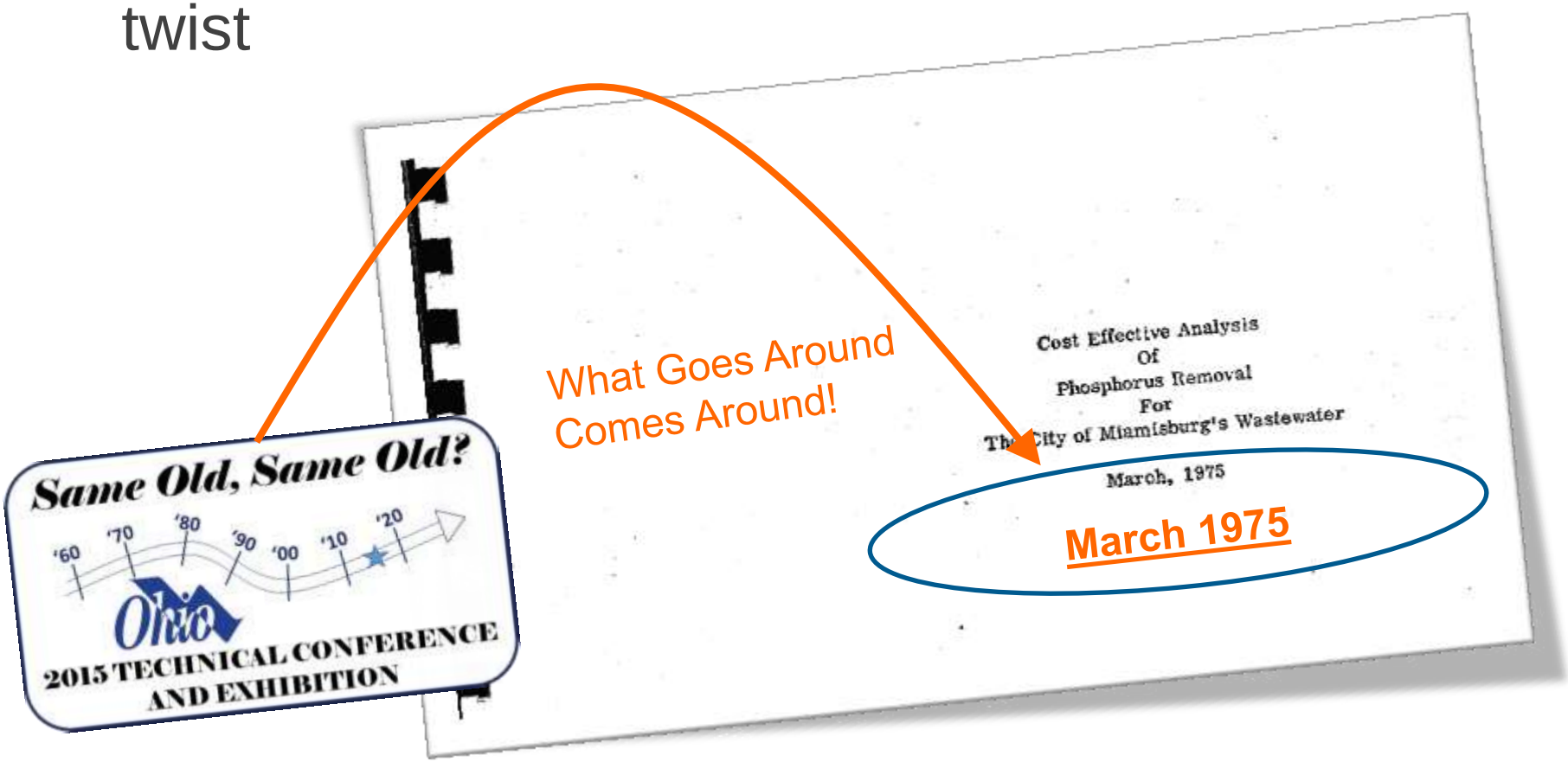
- Move influent sampler to post grit
- Convert OD to outside-in arrangement
- Modify rotor aerators for O2 demand
- Install feed forward control and multiple feed locations for Alum



Estimated capital cost - $425,000
Chemical usage for 1 mg/l - $42,000/yr

Conclusions

- It's the same ol', same ol', but ALWAYS with a twist



Questions?

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