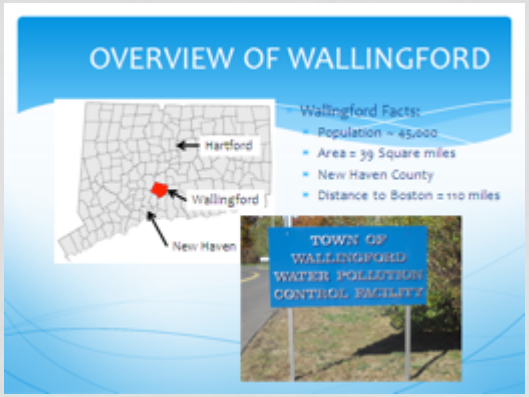
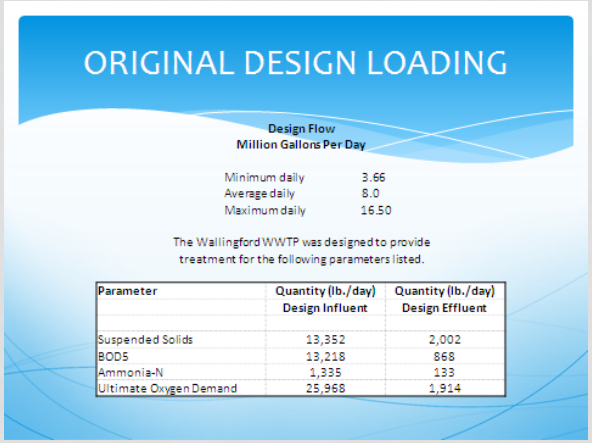
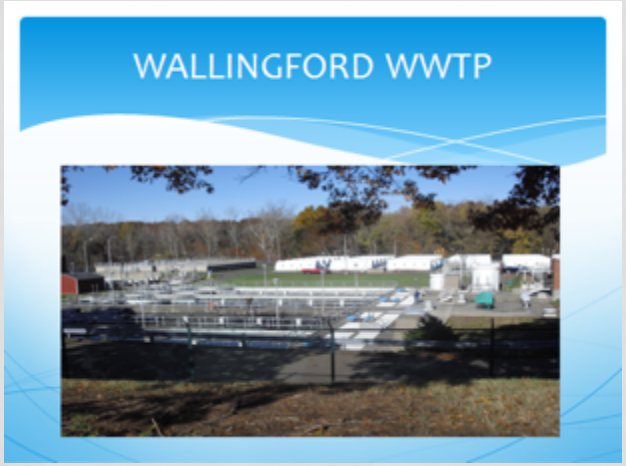

Adventures in
Phosphorus
Removal
NEWEA 2016 Annual Conference
January 26, 2016
Boston, Massachusetts



- 2010 permit expired
- Talk of Phosphorous limit in new permit
- Early 2012, Superintendent and myself attended 8hr phos. Seminar
- Manual exp chemical precipitation with ferric & alum
- 4 examples of Bio P with diagrams
- We had already decided on alum past issues ferric and UV
- Started design of temp Alum and permeant alum system
- Looking into possibility of running Bio P



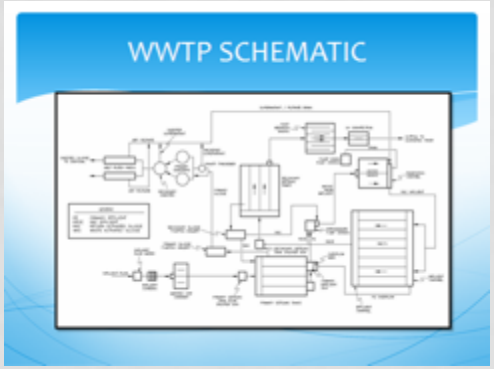
- Wallingford 8 MGD RBC plant
- Nite/Denite UV disinfection
- Discharges Quinnipiac River
- RBC not designed carry solids or return solids
- Sec clarifiers shallow 8ft deep
- Waste pumps are undersized



- 2005 Nitrification/Denitrification was added
- 0.6 MGD storm tank was covered and converted to anoxic tank

16 MGD Pump station was added to pump RBC eff and Pri eff to anoxic tank

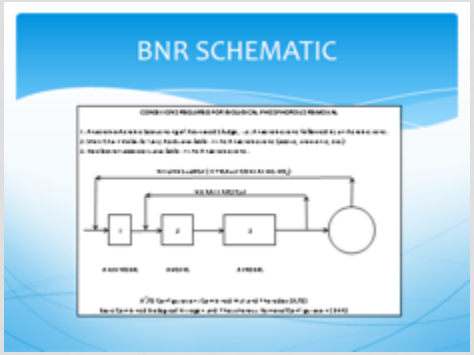
- Started carrying solids in secondary to build MLSS needed for Nite/Denite
- This required carrying 2 ft blankets in 8 ft deep secondary clarifiers
- Converting waste pumps to RAS pumps
- All 6 needed to run to achieve necessary return rate for Nite/Denite



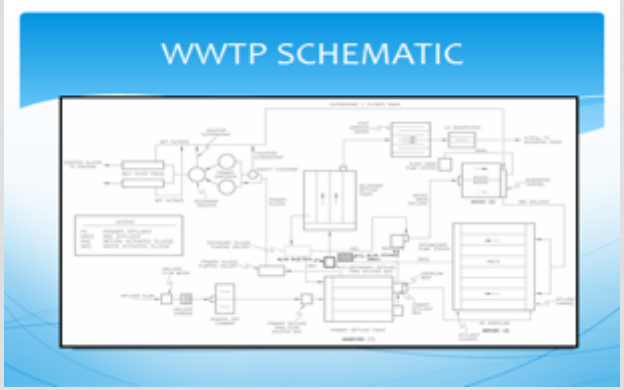
- Early 2012 look at ways of running Bio P
- Had 2 empty Primaries taken off line
  low summer flow 4 mgd
- 1 row RBC taken off line when nite/ denite was started
- Never came up to run bio p utilizing these empty tanks

Out came manual received at phos seminar

- Found diagram of MLE and Phordox process
- Shows anaerobic zone with RAS
- Anoxic zone with nitrate return
- Followed by aerobic zone
- We could fit this in our plant

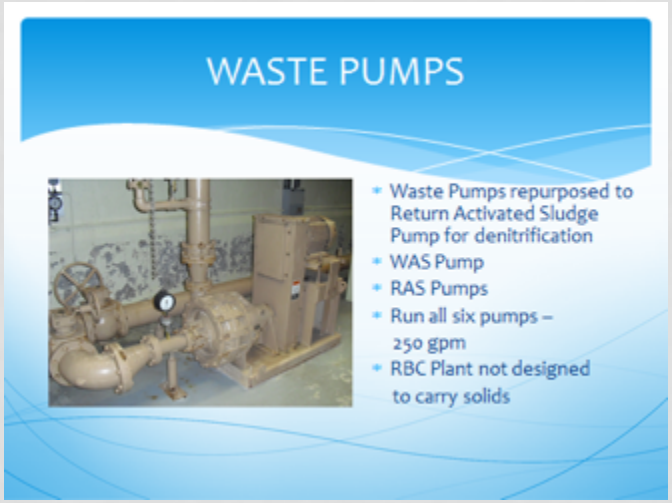


- We have anoxic zone with nitrate return
- We have aerobic zone RBC
- We need anaerobic zone with return in front of these process we have that ability



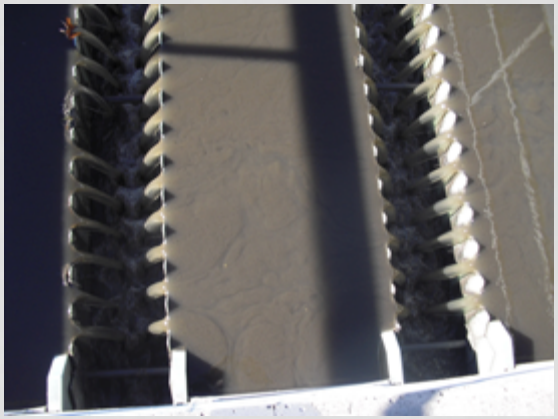
Utilizing primary tanks

We redirected RAS to head of primary tank

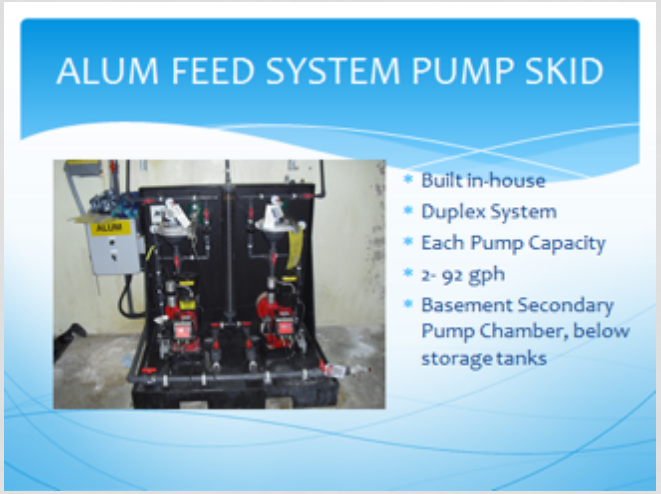


Turned drain pump on for mixing

- Built MLSS 4000 to 5000 in primaries
- Waited to see if it would go anaerobic and release phos
- Bio P requires organisms to release phos in anaerobic zone and they will take up more phos then released in Anoxic/aerobic zones.
- Inf phos 4-6 MG/L
- Started taking DO and Ortho reading twice a day
- In a week had Ortho leaving primaries of 10 to 12 MG/L
- Produced a plant EFF of approx. 1 MG/L
- We knew we could achieve some Bio p and shut it down in OCT



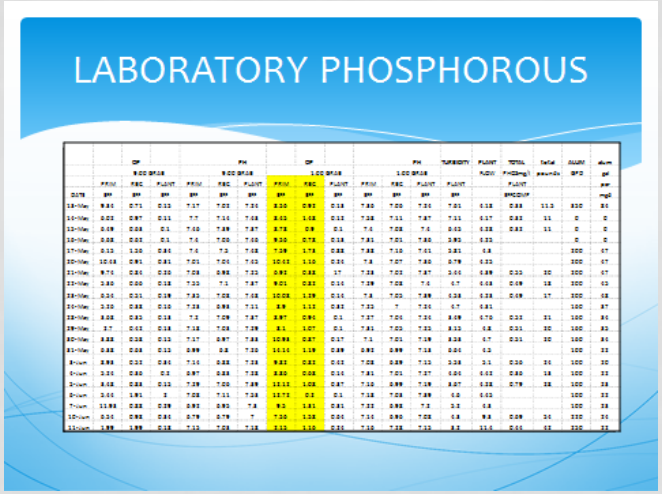
- March 2013 we started Bio p back up
- Temp alum system installed by plant maint



Went out to bid for permanent alum tank installation

1.We started Ortho and PH readings twice a day

2. Primary eff ortho for phos release
3. RBC eff ortho for phos uptake and alum feed
4. Plant EFF for compliance



- May 2013 our new permit was issued
- .7 MG/L two month rolling avg for month April thru OCT till 2022
- Goes to 8.95 pounds

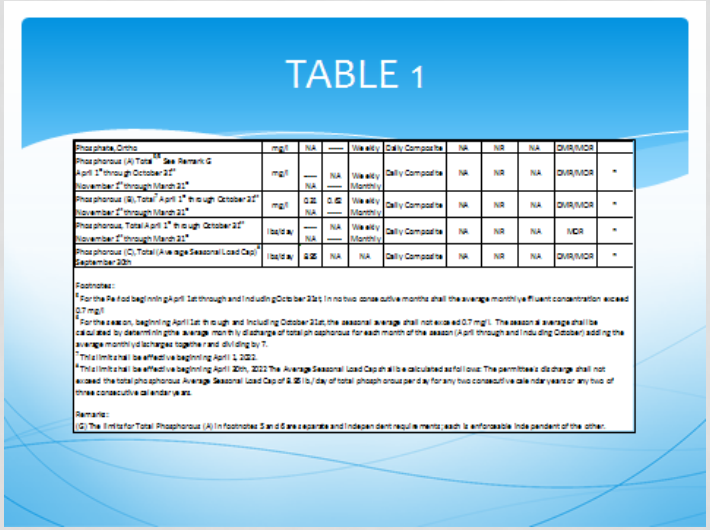


TABLE 1

Phosphate, Ortho	mg/l	NA	——	We ekly	Daily Composite	NA	NR	NA	DMR/MOR	
Phosphorous (A) Total [E] See Remark G April 1st through October 31st November 1st through March 31st	mg/l	—— NA	NA ——	We ekly Monthly	Daily Composite	NA	NR	NA	DMR/MOR	*
Phosphorous (B), Total [F] April 1st th ough October 31st November 1st through March 31st	mg/l	0.7[2] NA	0.7[2] ——	We ekly Monthly	Daily Composite	NA	NR	NA	DMR/MOR	*
Phosphorous, Total April 1st th ough October 31st November 1st through March 31st	lbs/d ay	—— NA	NA ——	We ekly Monthly	Daily Composite	NA	NR	NA	MOR	*
Phosphorous (C), Total (Ave age Seasonal Load Cap) [G] September 20th	lbs/d ay	8.95	NA	NA	Daily Composite	NA	NR	NA	DMR/MOR	*

Footnotes:

[E] For the Pe iod beginning April 1st through and Including October 31st; I n no two consecutive months shall the average monthly e ffluent concentration exceed 0.7 mg/l

[F] For the s eason, beginning April 1st th ough and Including October 31st, the seasonal average shall not exce ed 0.7 mg/l. The seasonal average shall be calculated by determining the average mon thly discharge of total ph osphorous for each month of the season (April through and Including October) adding the average monthly d ischarges together a nd dividing by 7.

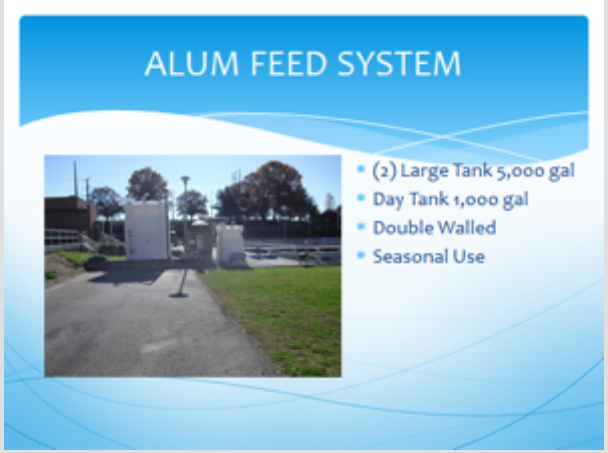
[G] This limit s hall be effective beginning April 1, 2022.

[H] This limit s hall be effective beginning April 20th, 2022 The Average Seasonal Load Cap sh all be calculated as follows: The permittee s dis charge shall not exceed the total pho sphorous Average Seasonal Load Cap of 8.95 lb./day of total phosph orous per d ay for any two consecutive cale ndar years or any two of three consecutive calendar ye ars.

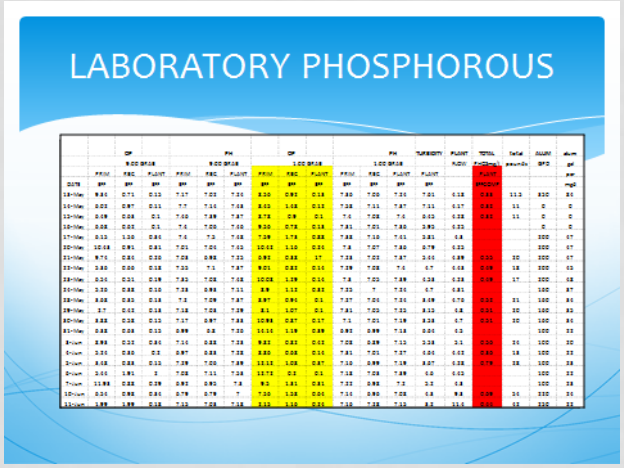
Remarks:

(G) The limits for Total Phosphorous (A) In footnotes 5 an d 6 are separate and Indepen dent requi e ments; each is enforceable Inde pendent of the other.

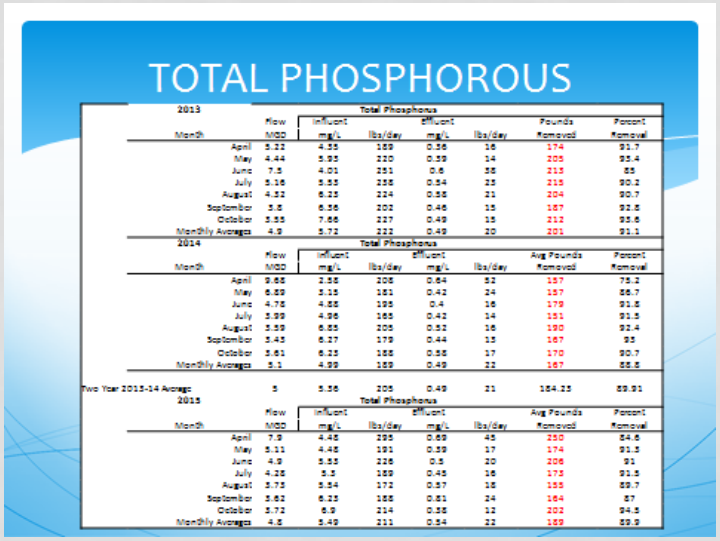
2014 completed permanent installation of Alum tanks



Through 2013 and 2014 we ran bio P and Alum in this manner
Meeting our .7 Eff phos limit



With avg 89% removal



TOTAL PHOSPHOROUS

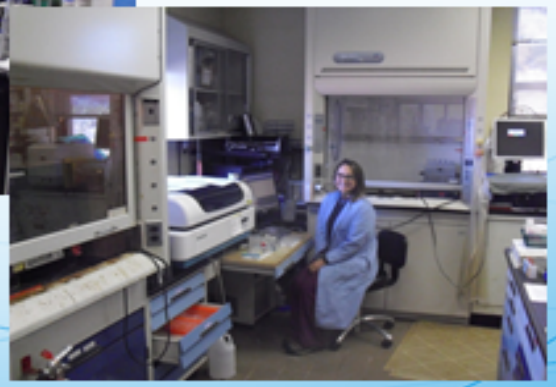
2013		Total Phosphorus					
	Flow	influent		effluent		Pounds	Percent
Month	MGD	mg/L	lbs/day	mg/L	lbs/day	Removed	Removal
April	5.22	4.35	189	0.56	16	174	91.7
May	4.44	5.95	220	0.59	14	205	93.4
June	7.5	4.01	251	0.6	38	213	85
July	5.16	5.55	238	0.54	25	213	90.2
August	4.32	6.25	224	0.56	21	204	90.7
September	5.8	6.56	203	0.46	15	187	92.5
October	5.55	7.66	227	0.49	15	212	93.6
Monthly Averages	4.9	5.72	222	0.49	20	201	91.1

2014		Total Phosphorus					
	Flow	influent		effluent		Avg Pounds	Percent
Month	MGD	mg/L	lbs/day	mg/L	lbs/day	Removed	Removal
April	9.66	2.55	206	0.64	52	157	75.2
May	6.89	5.15	181	0.42	24	157	86.7
June	4.75	4.85	195	0.4	16	179	91.8
July	3.99	4.96	165	0.42	14	151	91.5
August	5.59	6.65	205	0.52	16	190	92.4
September	5.45	6.27	179	0.44	13	167	93
October	5.61	6.25	188	0.56	17	170	90.7
Monthly Averages	5.1	4.99	189	0.49	22	167	88.6
Two Year 2013-14 Averages	5	5.36	205	0.49	21	184.25	89.91

2015		Total Phosphorus					
	Flow	influent		effluent		Avg Pounds	Percent
Month	MGD	mg/L	lbs/day	mg/L	lbs/day	Removed	Removal
April	7.9	4.45	295	0.69	45	250	84.6
May	5.11	4.45	191	0.59	17	174	91.5
June	4.9	5.55	226	0.5	20	206	91
July	4.25	5.3	188	0.45	15	173	91.5
August	3.75	5.54	172	0.57	15	155	89.7
September	5.62	6.25	188	0.61	24	164	87
October	5.72	6.9	214	0.58	12	202	94.5
Monthly Averages	4.8	5.49	211	0.54	22	189	89.9

WWTP LABORATORY

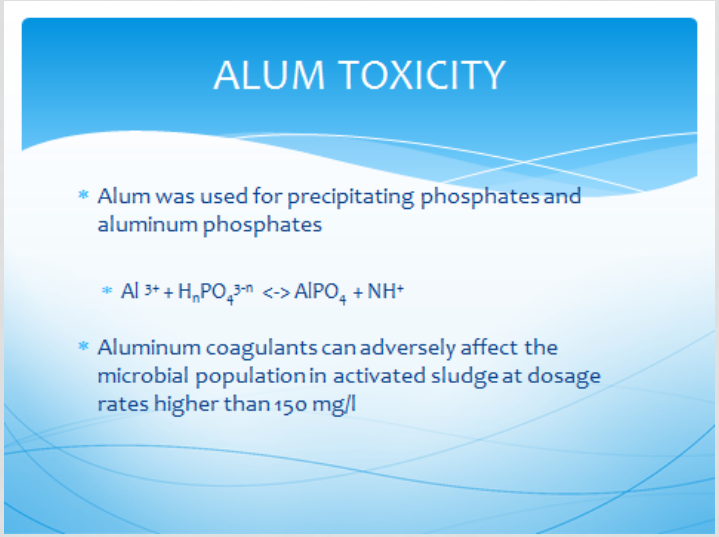
Maintains a State of CT Certification as an Environmental Public Health Lab



Provides data, feedback and graphical analysis

What went wrong March 2015
Started bio P
And alum up at 50 gallons per million gals based on the previous 2 years feed rate
Took PH and Ortho readings twice a day
Avg .4 eff ortho meant .6 to .7 total phos
Everything going along smooth until
May ammonia started to increase
Figured do to bio p and Alum

Next week ammonia conversion was non existent
Started to investigate lab ran residual alum in plant it was 1000 MG/L
This shouldn't be with .4 otho should still have a demand
Turned out ortho reading was plant eff not RBC as in past 2 years
Ran ortho on RBC eff it was .1 meant there was no demand



- Alum at 150 MG/L toxic to nitrifieres
- Shut alum off
- It took 2 months for Nite/denite to recover
- There was no negative impact to TSS or BOD

LESSONS LEARNED 1

* Use RBC effluent orthophosphate measurements in the future to determine the correct alum feed rate
* Aluminum residual in WWTP not to exceed 100 mg/l in effluent
* Purchase ORP meter to measure polyphosphate release at RBC Effluent Channel
* Evaluate the use of wall mixers for keeping solids in suspension (primary settling tank)
* If drain/mixing pump located in the Primary Pump Chamber trips or is off a long period of time, a greater release of phosphorous is observed

Why .4 eff ortho when RBC eff .1 detention time in sec to long getting rerelease in sec take one off line.

•Volatility of sludge decreased seen 60%

•Dt time with drain pump RAS pump and plant flow less then 1hr

LESSONS LEARNED 2

* When flows decrease the extended detention time in the secondary tank may cause a rerelease of phosphorous so tanks may need to be taken offline
* Add polymers at the head of the secondary tank to reduce pin floc in the effluent
* Be innovative and willing to make operational adjustments
* Develop a standard operating protocol to account for seasonal and yearly flow variations

ADVICE

* Keep DEEP in the loop
* Research biological removal of phosphorous
* Network with other operators
* Don't be afraid to experiment!

THANK YOU

* Terry Smith, Superintendent Wallingford WPCF
* Kim Maloney, Lab Director Wallingford Water & Sewer
* Brain Hickey, Engineer CDM
* Seth Lentz, Engineer Wallingford Water & Sewer
* Plant staff, Wallingford WPCF