

Village of Valders Biological Phosphorus Removal Aeration & Mixing Upgrade with Chemical Addition

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Introduction

The Village of Valders, WI, completed energy-saving, process-enhancing upgrades to its wastewater treatment plant by converting from the conventional activated sludge process to the simultaneous nitrification-denitrification (SNDN) process.

The goals of the upgrades in 2018 and 2019 achieved were:

1. Remove both phosphorus and nitrogen biologically.
2. Minimize chemical addition for phosphorus removal.
3. Reduced energy consumption.

Valders WWTP

Conventional Activated Sludge

2 Sanitaire Package Plants
(Mark IVs)

Design Flow: 0.255 MGD

Peak Flow: 0.536 MGD



Valders WWTP

WDNR required total phosphorus effluent concentrations down to 0.1 ppm (mg/l) as a 6-month average in 2017 by 2022

Plant started with aeration maintenance and added mixers in 2018 & 2019

Both Plants 1 & 2 received aeration upgrades and new mixers were added in 2018 & 2019



Plant Operation

- 200-250k daily influent flow into Splitter Box
- Split between 2 Sanitaire Package Plants - Plant 1 & Plant 2
- 1973 was plug feed; 1994 changed to step feed
- Now modified step feed - changed from 3 drops to 2 drops
- Starts Anaerobic; then Aerated Anoxic; last Aerobic Zone
- 30 hp blower at max turn down @ 20 hertz
- Flows into stilling well, settles & flows out to Unnamed Tributary of Manitowoc River (Outfall #1)
- Future: 20 hp blower for more turndown & energy savings

Plant Operation

General Data:

Influent TP was 3-4 mg/l & Interim eff TP limit 2.3 mg/l from 2017-22
Schedule for phos compliance started in 2017; MDV pending in 2022
With minor mods, achieved eff TP below 0.5 mg/l since July 2019
Current TP concentrations – influent – 3 – 4 mg/l
Current TP concentrations – effluent – below 0.5 mg/l

Alternatives:

Chemical bench and pilot tested multiple chemicals
Tertiary treatment - sand or cloth filters may not be needed
Blower downsizing for turndown – energy savings
Control and electrical upgrades – to optimize

Goals

1. Begin removing phosphorus and nitrogen biologically.
2. Minimize chemical addition for phosphorus removal.
3. Reduce maintenance by mixing with lower-energy submersible mixers vs. the higher-energy aeration system.

Methodology

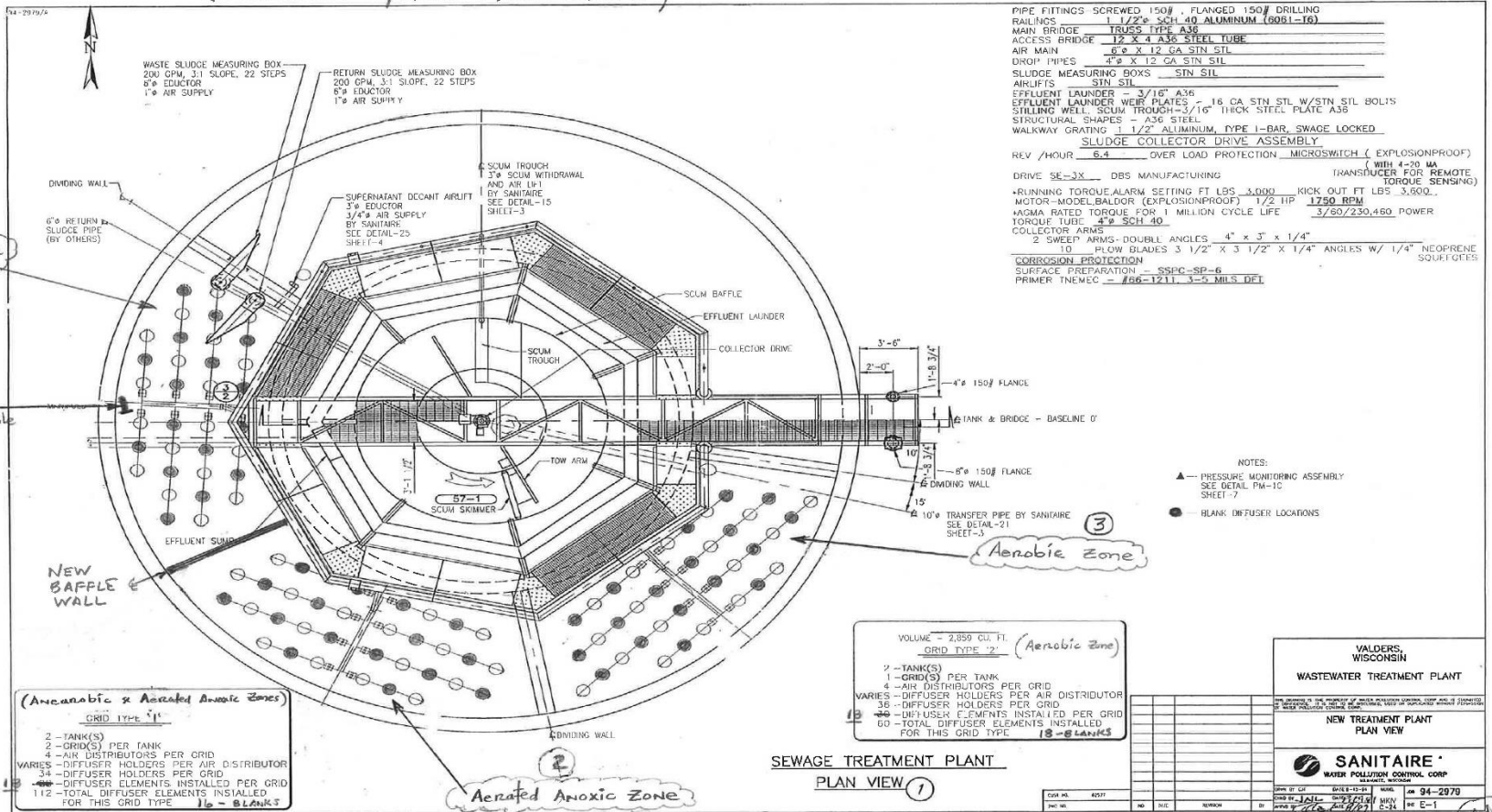
The existing conventional 2-zone aeration basin was sub-divided and re-purposed into 3 zones:

- 1) Anaerobic Zone - aeration & mixing
- 2) Aerated-Anoxic Zone – aeration (on or off)
- 3) Oxid/Aerated Zone – aeration

This arrangement, also known as A₃O or SNDN, creates conditions for both phosphorus-removal and nitrogen-removal. A baffle-wall was added to subdivide one zone into two, for a total of three biological treatment zones.

Anaerobic, Aerated Anoxic, Aerobic

(Aeration System Modifications)



Methodology

A baffle-wall was added to subdivide one zone into two, for a total of three biological treatment zones.



Methodology

The first zone, Anaerobic, is equipped with a high-efficiency submersible horizontal low-speed mixer.

This enables good mixing without aeration, yielding anaerobic conditions favorable for phosphorus release and later phosphorus uptake.

Diffuser blanks were installed to each grid to decrease air and reduce overaerating.



Methodology

The second zone (Aerated-Anoxic) has the flexibility of aerating when needed to balance and provide anoxic conditions.

This balance is needed to enable conditions favorable for simultaneous nitrification-denitrification.

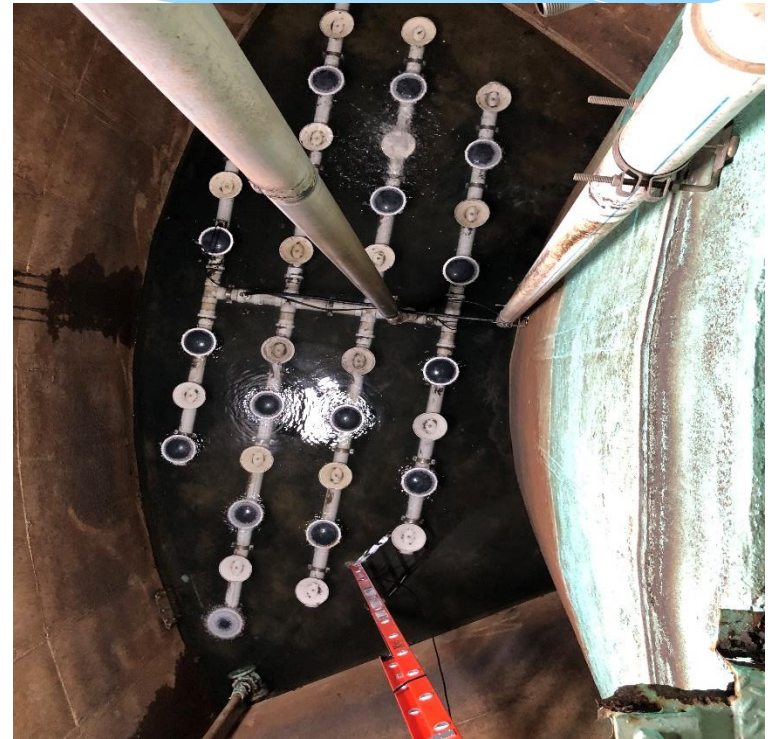


Methodology

The third zone, Oxidic-Aerated, is fully aerated, enabling phosphorus uptake and ammonia removal.

The existing fine bubble aeration membranes were replaced and about 50% blanks/grid were added.

Aeration is turned down and is cycled on and off to optimize and balance anaerobic, anoxic and aerated conditions.

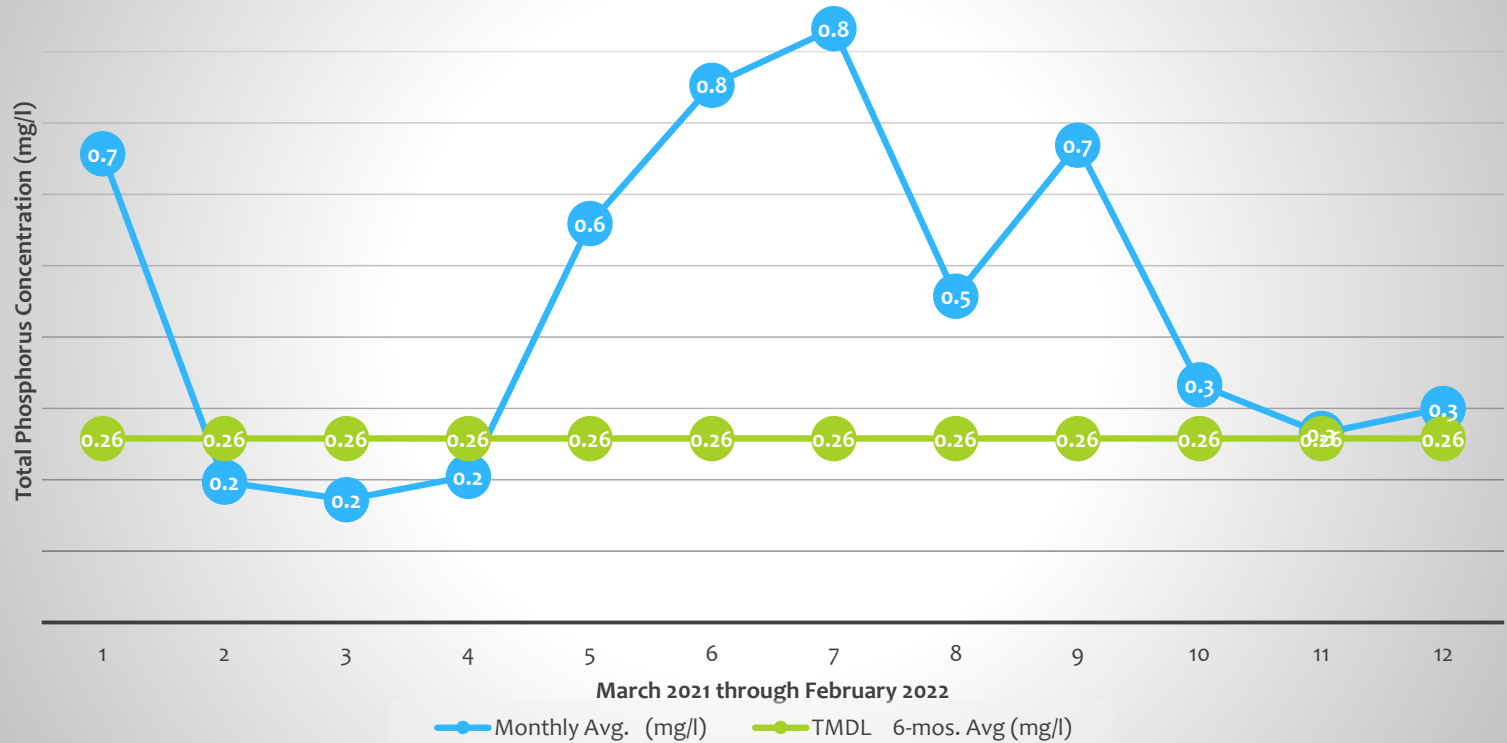


Results

1. Effluent Treatment results:
Total Phosphorus was reduced from about 2.0 to 0.8 to 0.2 mg/l.
2. Energy savings: estimated \$2,000/year due to mixers and aeration optimization.
3. Maintenance cost reduced due to mixers, pulsing aeration and reduced blower use.

Total Phosphorus Concentrations

Effluent Total Phosphorus Concentrations (5th Year)



Conclusion

Results were successful and equipment was installed without issue. Phosphorus removal & energy savings were better than expected.

Results lead to ORP and DO controls installed in the Aerobic Zone with SCADA to optimize phosphorous and nitrogen removal and energy savings which is on-going. Payback for changes with the energy savings is estimated at ~8 to 10 years and on-going.

Further upgrades such as air valves, blower controls, etc., have been and will continued to be evaluated with the next plant upgrade.

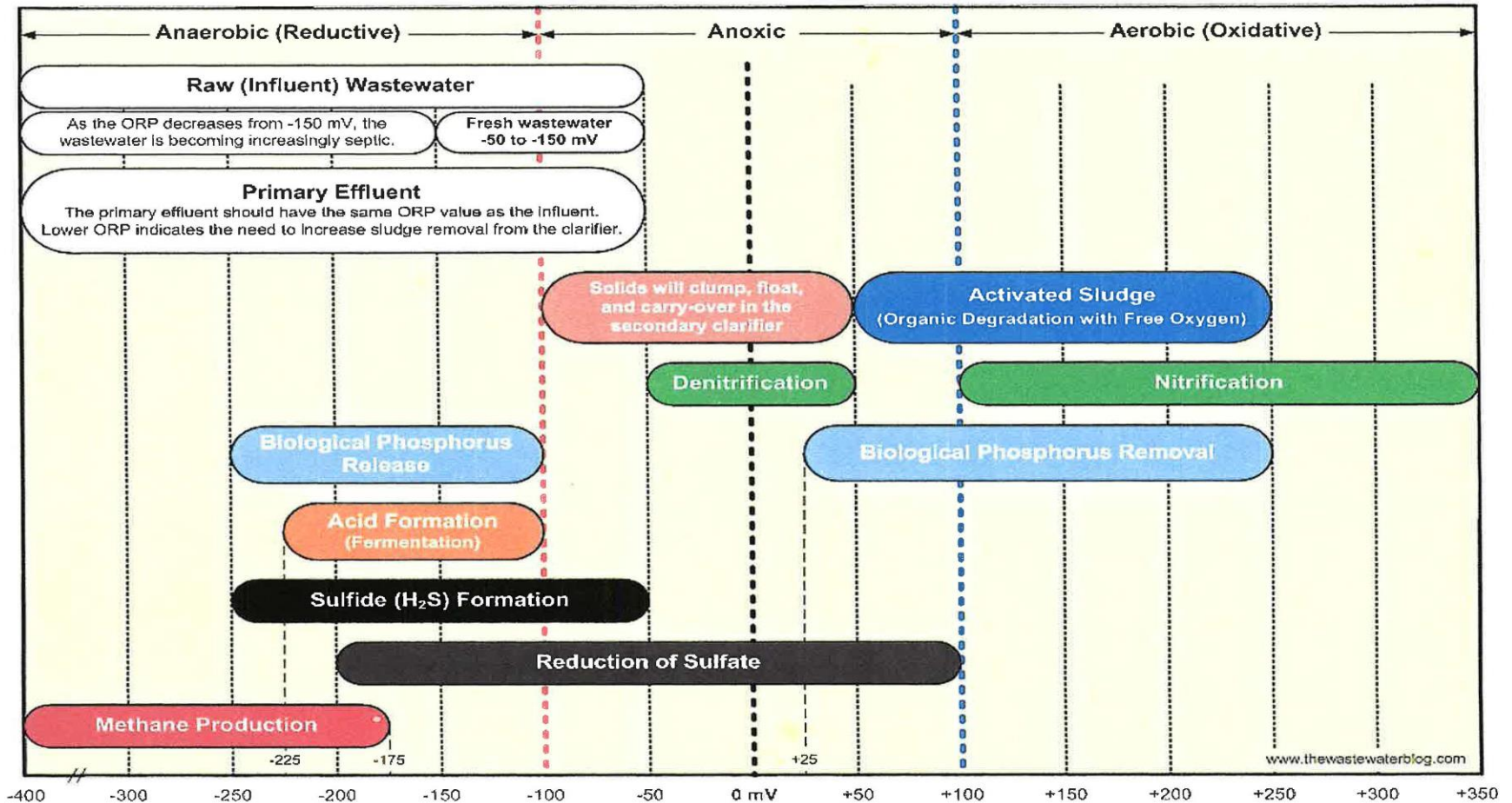
Conclusion

Biological phosphorus removal was better than expected. Reducing total phosphorus to less than 0.5 mg/l by adding mixers, baffle-walls, new membrane diffusers, blanks, aeration system maintenance, air-control, ORP and DO control are providing good results.

ORP data continues to be evaluated and optimized with SCADA.

Conclusion

Wastewater ORP Ranges



NE Lakeshore TMDL (6-month)

Municipal Facilities		Total Phosphorus (TP)							Total Suspended Solids (TSS)						
Facility Name	Permit No.	Baseline Flow (MGD)	TMDL TP WLA (lbs per year)	TP Month Limit (lbs/day)	TP 6-mo Limit (lbs/day)	TP Equivalent Monthly Concentration - Baseline flow (mg/L)	TP Equivalent 6-Month Concentration - Baseline flow (mg/L)	TMDL TSS WLA (lbs per year)	TSS Limit Mo avg (lbs/day)	TSS Limit weekly avg (lbs/day)	TSS Limit daily max (lbs/day)	TSS Equivalent Monthly Concentration (mg/L)	TSS Equivalent weekly Concentration (mg/L)	TSS Equivalent Daily Concentration (mg/L)	
CEDAR GROVE WASTEWATER TRTMT FACILITY	0020711	0.4000	157	1.678	0.559	0.503	0.168	6637	29	43		9	13		
CHILTON WASTEWATER TREATMENT FACILITY	0022799	1.1890	517	4.965	1.655	0.501	0.167	19727	79	112		8	11		
CLARKS MILLS SANITARY DISTRICT	0036030	0.0180	10	0.105	0.035	0.699	0.233	973	5	8		34	55		
DENMARK WASTEWATER TREATMENT FACILITY	0021741	0.7250	436	4.334	1.445	0.717	0.239	35573	143	202		24	33		
HILBERT WASTEWATER TREATMENT FACILITY	0021270	0.3260	218	2.171	0.724	0.798	0.266	5409	24	35		9	13		
HOWARDS GROVE WASTEWATER TRTMT FAC	0021679	0.4467	308	2.957	0.986	0.794	0.265	7411	30	42		8	11		
LAKELAND UNIVERSITY	0029335	0.0830	40	0.431	0.144	0.623	0.208	7073	31	46		44	66		
MOUNT CALVARY WASTEWATER TREATMENT FACILITY	0035963	0.1952	93	0.990	0.330	0.608	0.203	11089	48	72		30	44		
NEW HOLSTEIN WASTEWATER TREATMENT FACILITY	0020893	1.3300	1002	9.627	3.209	0.868	0.138	22067	89	125		8	11		
ONION RIVER WASTEWATER COMMISSION	0036811	0.1577	42	0.448	0.149	0.341	0.114	6137	25	35		19	26		
OOSTBURG WASTEWATER TREATMENT PLANT	0022233	0.4400	198	2.117	0.706	0.577	0.192	26824	108	152		29	41		
PLYMOUTH UTILITIES WWTF	0030031	1.9332	1,325	12.738	4.246	0.790	0.263	32074	119	156		7	10		
REEDSVILLE WASTEWATER TREATMENT FACILITY	0021342	0.3073	180	1.927	0.642	0.752	0.251	5099	22	33		9	13		
ROCKLAND SD1 WASTEWATER TREATMENT FACILITY	0022802	0.0250	15	0.157	0.052	0.752	0.251	1351	7	12		34	55		
ST CLOUD VILLAGE UTILITY COMMISSION	0026867	0.1700	82	0.879	0.293	0.620	0.207	4604	24	39		17	28		
VALDERS WASTEWATER TREATMENT FACILITY	0021831	0.2777	168	1.791	0.597	0.773	0.258	4608	20	30		9	13		
WALDO WASTEWATER UTILITY	0022471	0.1000	48	0.510	0.170	0.612	0.204	3892	17	25		20	30		

Questions ??????????

Thank you for attending WWOA LMD's Meeting!

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