[11/29/22]

2022 LAGOON BIOAUGMENTATION PROGRAM

VILLAGE OF HAMLER

WATER CYCLE TECHNOLOGIES
A Division of Kleinfelder
INDUSTRIAL FLUID MANAGEMENT
A DIVISION OF KLEINFELDER
PROJECT # 16271

Contents

Conclusion

It is important to have a maintenance program in place to create and keep a healthy lagoon system and to help aid in overall wastewater treatment. Kleinfelder-IFM has provided a program proven to be successful at maintaining or reducing sludge levels, increasing detention time throughout a wastewater system, and aiding in the removal of nutrients for an overall improvement in water quality and helping to meet effluent limitations.
The average sludge blankets in both lagoons have been increasing slightly since 2019, but both remain below a foot.

Figure 1 below exhibits the trend for the average sludge depths over the years. No data was collected in 2021.

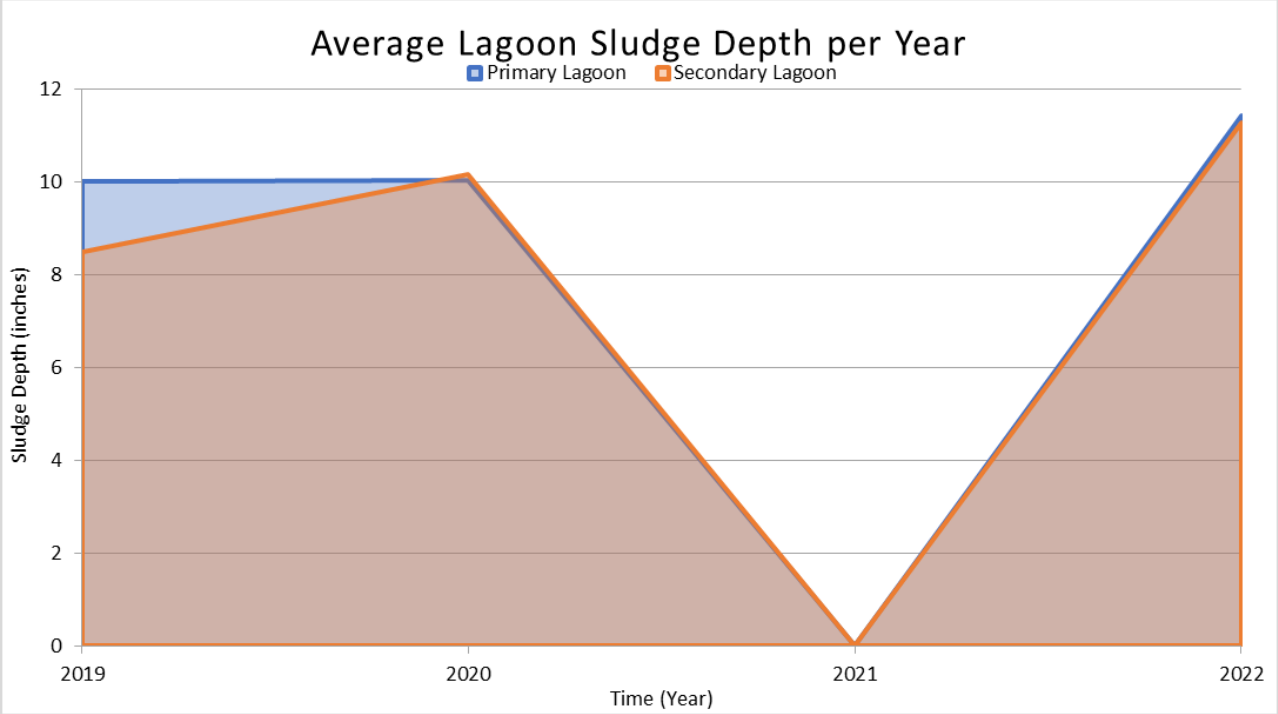

Figure 1: Average Lagoon Sludge Depths per Year

Bioaugmentation Evaluation

To properly monitor the program, the following actions were taken:

- Staked the banks of the primary and secondary lagoons to form reference points so correlating data can be collected.
- Measured sludge depth at marked points on several occasions throughout the project period.
- Inoculated the lagoons with Kleinfelder-IFM's bacteria cultures.
- Village personnel added a maintenance dose of bacteria into the lagoons.
- Performed laboratory examination of sludge content consisting of volatiles and solids.
- Periodic analysis of both primary and secondary lagoon water to ensure proper nutrients are available for microbes.

Primary Lagoons

Sludge Measurements

As seen in Figure 2 and Table 1, the sludge thickness decreased at most of the point locations by the end of the program. This desired effect created an overall average sludge level around 11.42 feet in the primary lagoon which is a slight increase in the average since 2020.

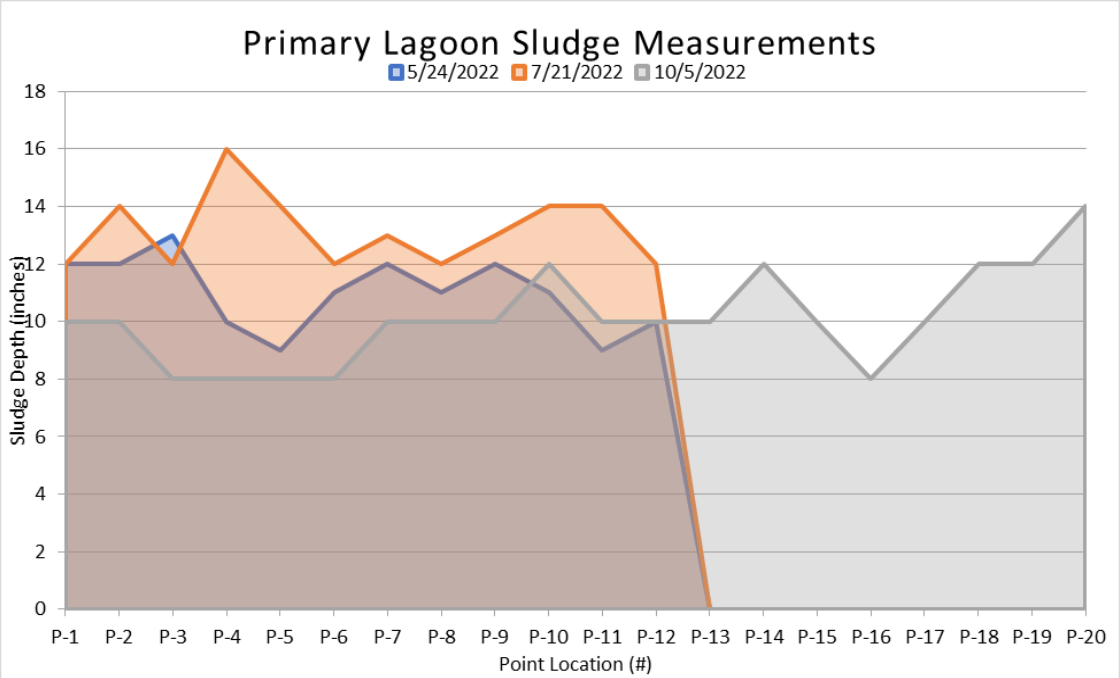

Figure 2: Primary Lagoon Sludge Measurements

Table 1: Primary Lagoon Sludge Measurements (Inches)

Point Location	5/24/22	7/21/22	10/5/22
P-1	12	12	10
P-2	12	14	10
P-3	13	12	8
P-4	10	16	8
P-5	9	14	8
P-6	11	12	8
P-7	12	13	10
P-8	11	12	10
P-9	12	13	10
P-10	11	14	12
P-11	9	14	10
P-12	10	12	10
P-13			10
P-14			12

P-15			10
P-16			8
P-17			10
P-18			12
P-19			12
P-20			14
Average	**11**	**13.17**	**10.1**

Analytical Results

Along with measurements taken during each visit, Kleinfelder-IFM also grabbed sludge and water samples to be taken back to the lab for analysis. The results of both will help indicate the condition of the lagoon throughout the year while also to determine if any treatment changes are needed for the next year.

Table 2: Primary Lagoon Sludge Analysis

Date	% Solids	% Volatile Solids
5/24/22	10%	24%
7/21/22	9.8%	25%
10/5/22	6.02%	29%

Table 3: Primary Lagoon Water Analysis

Parameter	Test Method	5/24/22	7/21/22	10/5/22
pH	150.2	8.2 su*	9.2 su*	8.8 su*
Ammonia	4500-NH3D-2011	10.3 mg/L	0.94 mg/L	0.8 mg/L
Total Suspended Solids	SM 2540 D	53.3 mg/L	110.0 mg/L	79.0 mg/L
Total Phosphorus	HACH 8190	4.2 mg/L	2.8 mg/L	3.2 mg/L
COD	HACH 8000	200 mg/L	155 mg/L	190 mg/L

*EST – Analysis performed beyond recommended holding time

Secondary Lagoon

Sludge Measurements

As seen in Figure 3 and Table 4, the sludge thickness increased between the first and second visit then decreased at most point locations by the end of the program. The overall average increased since 2020 but remains below a foot.

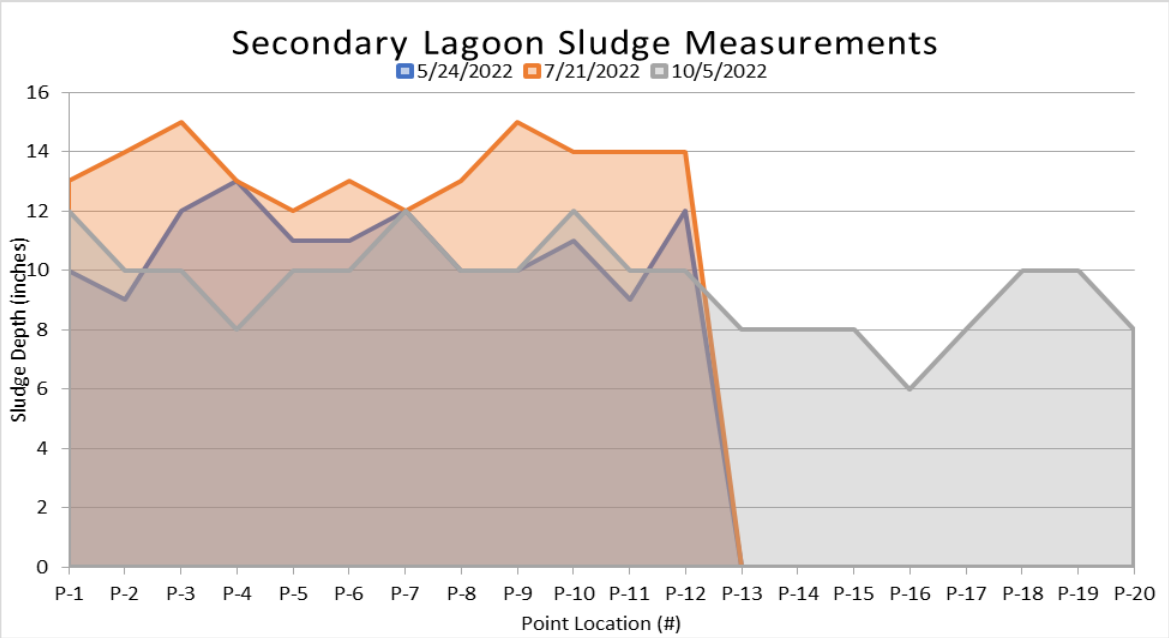

Figure 3: Secondary Lagoon Sludge Measurements

Table 4: Secondary Lagoon Sludge Measurements (Inches)

Point Location	5/24/22	7/21/22	10/5/22
P-1	10	13	12
P-2	9	14	10
P-3	12	15	10
P-4	13	13	8
P-5	11	12	10
P-6	11	13	10
P-7	12	12	12
P-8	10	13	10
P-9	10	15	10
P-10	11	14	12
P-11	9	14	10
P-12	12	14	10
P-13			8
P-14			8
P-15			8
P-16			6
P-17			8
P-18			10
P-19			10
P-20			8
Average	**10.83**	**13.5**	**9.5**

Analytical Results

Along with measurements taken during each visit, Kleinfelder-IFM also grabbed sludge and water samples to be taken back to the lab for analysis. The results of both will help indicate the condition of the lagoon throughout the year while also to determine if any treatment changes are needed for the following year.

Table 5: Secondary Lagoon Sludge Analysis

Date	% Solids	% Volatile Solids
5/24/22	8.2%	22%
7/21/22	7.2%	28%
10/522	6.04%	27%

**EST-Reported as an estimate due to duplicate sample results not within control limits

Table 6: Secondary Lagoon Water Analysis

Parameter	Test Method	5/24/22	7/21/22	10/5/22
pH	150.2	9.2 su*	9.1 su*	9.1 su*
Ammonia	4500-NH3D-2011	<0.5 mg/L	<0.4 mg/L	1.4 mg/L
Total Suspended Solids	SM 2540 D	78.0 mg/L	86.7 mg/L	94.0 mg/L
Total Phosphorus	HACH 8190	2.2 mg/L	2.2 mg/L	2.9 mg/L
COD	HACH 8000	130 mg/L	88 mg/L	190 mg/L

*EST-- Analysis performed beyond recommended holding time

Recommendations

To achieve the full benefit of using natural beneficial bacteria to help reduce sludge levels and increase detention time in the lagoon system, Kleinfelder-IFM recommends participating in the full bio-augmentation program in 2023. The 2023 plan should consist of 5 cases of the BioSpikes 5000; 3 cases in the spring (2 cases in the primary and 1 case in the secondary) and 1 case in each in the summer. The BioRemove COD should also be added by the Village per the proposal.

Enclosed is a proposal for your 2023 program. Please let me know if you have any questions or would like pricing on other options and items.

Thank you for your continued participation in the lagoon program.

Enclosure,

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