


Appendix G: Facultative Sludge Lagoon Calculations

CALCULATION COVER PAGE

	JOB NO. 60001707	DEPARTMENT/ DISCIPLINE/ TECHNOLOGY Wastewater	REVISION NO. 0
SUBJECT/ TITLE			
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CALCULATION DESCRIPTION The purpose of this calculation is to determine whether the existing stabilization ponds can be converted to a facultative sludge lagoon. The proposed facultative lagoon will be sized to receive WAS from a 650,000 gpd plant. The calculations are for a PER level of effort, thus, calculations are cursory.			
CALCULATION METHODOLOGY/ ASSUMPTIONS The calculation methodology begins by determining the amount of sludge produce by an extended aeration activated sludge. The WAS amount will be used to determine the size of the facultative sludge lagoon. This sludge will be used to size The following design criteria will be used: Solids loading rates: 20-50 lbs VSS/1000 square foot/day Depth: 5 feet. Existing stabilization pond total volume (two ponds) : 1.694 million gallons Existing side water depth: 5 feet Existing pond surface area total: 1.42 acres			
CODES / REFERENCES / INPUTS M&E Textbook, 4 th edition			
CONCLUSIONS See calculations below.			

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Part 1. Introduction

The purpose of this calculation is to determine whether the existing stabilization ponds at Honokaa WWTP can be converted to a facultative sludge lagoon..

Part 2. Design Criteria

The M&E Textbook, 4th edition provides the necessary design criteria for sizing the facultative sludge lagoon. Definition of variables are as follows:

- WAS = waste activated sludge
MassVSS_{was} = Mass of WAS = 80 percent of 70 percent of the influent BOD to the plant.
TSS_{was} = concentration of was = 0.5 percent unthickened.
Q_{was} = flow rate of was to be determined
SLR = solids loading rate to sludge lagoon
D = depth of lagoon
SA = surface area of lagoon
Det_{lagoon} = detention time of the lagoon
V_{lagoon} = volume of sludge lagoon required
Q_{plant} = Flow rate into WWTP
BOD_{inf} = BOD concentration into the WWTP

Determine WAS mass and flowrate:

$$\frac{\text{gpm}}{\text{min}} := \frac{\text{gal}}{\text{min}} \quad \text{mgd} := \frac{\text{gal} \cdot 10^6}{\text{day}} \quad \text{gpd} := \frac{\text{gal}}{\text{day}} \quad \text{ppd} := \frac{\text{lb}}{\text{day}} \quad \text{MG} := \text{gal} \cdot 10^6$$

$$Q_{\text{plant}} := 650000 \text{ gpd} \quad \text{BOD}_{\text{inf}} := 250 \frac{\text{mg}}{\text{L}} \quad Q_{\text{plant}} = 0.65 \text{ mgd}$$

$$\text{MassVSS}_{\text{was}} := 0.80 \cdot 0.70 \cdot (Q_{\text{plant}} \cdot \text{BOD}_{\text{inf}}) \quad \text{MassVSS}_{\text{was}} = 759.432 \text{ ppd}$$

$$\text{Assume} \quad \text{TSS}_{\text{was}} := 5000 \frac{\text{mg}}{\text{L}}$$

$$Q_{\text{was}} := \frac{\text{MassVSS}_{\text{was}}}{\text{TSS}_{\text{was}}} \quad Q_{\text{was}} = 12.639 \text{ gpm}$$

Determine facultative sludge lagoon surface area and volume:

$$\text{From M\&E textbook, 4th edition:} \quad \text{SLR}_{\text{vss}} := 25 \frac{\text{lb}}{1000\text{ft}^2 \cdot \text{day}} \quad \text{Range 20 to 50}$$

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Surface Area:

$$SA_{\text{lagoon}} := \frac{\text{MassVSS}_{\text{was}}}{\text{SLR}_{\text{vss}}} \quad SA_{\text{lagoon}} = 0.697 \text{ acre}$$

$$D_{\text{lagoon}} := 5 \text{ ft} \quad V_{\text{lagoon}} := SA_{\text{lagoon}} \cdot D_{\text{lagoon}} \quad V_{\text{lagoon}} = 1.136 \times 10^6 \text{ gal}$$

Compare with existing lagoon:

Existing Lagoon surface area total: 1.42 acres

Facultative Lagoon surface area required: $SA_{\text{lagoon}} = 0.697 \text{ acre}$

Existing Lagoon volume: 1.694 million gallons

Facultative sludge lagoon volume required: $V_{\text{lagoon}} = 1.136 \text{ MG}$

Determine detention time for sludge:

$$\text{Det}_{\text{lagoon}} := \frac{V_{\text{lagoon}}}{Q_{\text{was}}} \quad \text{Det}_{\text{lagoon}} = 62.428 \text{ day}$$

Part 4. Recommendations

It is feasible to convert the existing stabilization pond for use as a facultative sludge lagoon. Both existing ponds may be required for the facultative sludge lagoon based on volume. Based on surface area, only one pond is required. If this process is selected for construction, detailed design calculations, beyond what is presented herein, are required.