## PART 6 - STANDARD DESIGN AND CALCULATION FORMS

## 6.8 WASTEWATER TREATMENT PLANT DESIGN CALCULATION SHEET

Municipality, County & Sewer District _____

Address of Treatment Facility _____

Original Lot & Tract No. _____

Engineer _____

Date _____

Name & Address of Governmental Agency for Approval _____

_____

Design period: _____ First phase _____

Ultimate _____

Number of persons to be served: _____ First phase _____

Ultimate _____

Average Daily Design Hydraulic Flow (ADDF): _____ gal./day

Design $BOD_5$ loading: _____lbs. $BOD_5$/day

Significant Runoff Period (SRP): _____ hours

Peak Factor (PF): _____ unitless

Peak Influent Flow Rate (PIR):

$$\frac{\text{ADDF gal./day} \times \text{PF}}{\text{SRP hours} \times 60 \text{ min.}} = \_\_\_\_\_ \text{ gal./min}$$

If an equalization basin is to be used, its volume will be _____ gal.

Air to be supplied: _____ cu. ft./min. (with largest blower out of service)

Plant influent pumping station: Yes _____ No _____

Number of pumps _____ Type of pumps _____

Influent Pumping Rate (IPR): _____ gal./min. (with largest pump out of service)

**NOTE:** Influent pumping facilities shall be capable of pumping the Peak Influent Rate (PIR) with the largest pump out of service, unless a flow equalization basin is installed. Include here the wet well calculations for the pumping station - 7.601.

Pretreatment devices:

Trash trap: Yes _____ No _____ Capacity _____ gal.

Comminutor with bar screen bypass: Yes _____ No _____

Other _____

Design capacity of comminutor _____ gal./min.

Method of flow division where parallel aeration unit arrangements are planned. Describe:

_____

_____

Aeration chamber volume: (based on 80 cu. ft./lb. $BOD_5$)

_____ lb. $BOD_5$/day x 80 cu. ft. x 7.48 gal./cu. ft. = _____ gal.

_____ gallons supplied

Aeration detention time:

$$\frac{\text{Chamber volume gal. x 24 hours}}{\text{ADDF _____ gal./day}} = \text{_____ hours}$$

Are the dimensions and proportions of the aeration tanks such as to maintain effective mixture and utilization of air, to prevent unaerated sections and noticeable channeling, and to maintain velocities sufficient to prevent deposition of solids?

Yes _____ No _____

Are inlets and outlets for each aeration tank provided with valves, gates, stop-planks, weirs, or other devices to permit flexibility in controlling the flow to any unit to maintain a reasonable constant water level and to permit cleaning of individual units?

Yes _____ No _____

Amount of air required: (based on 2600 cu. ft./lb. $BOD_5$/day)

$$\frac{\text{lbs. } BOD_5 \text{ /day x 2600 cu. ft.}}{\text{1440 min./day}} = \text{_____ cu. ft./min.}$$

Amount of air supplied: _____ cu. ft./min. (with largest blower out of service)

**NOTE:** Additional capacity should be provided to operate airlifts and skimmers.

Are the aeration plates, tubes, or jets used for the introduction of air to mixed liquor removable for inspection, maintenance, and replacement without de-watering the tank?

Yes _____ No _____ N/A _____

If mechanical aerators are to be used, the oxygen required will be:

_____ lbs.$BOD_5$/day x 2 = _____lbs. $0_2$/day

**NOTE**: Calculations and data should be included to verify the $0_2$ transfer rate used to compute the supplied amount of $0_2$/day.

Settling chamber volume: _____ gallons

Settling chamber detention time:

$$\frac{\text{Chamber volume gal. x 24 hours}}{\text{ADDF}\_\_\_\_\_\text{ gal./day}} = \_\_\_\_\_ \text{ hours}$$

**NOTE:** Non-mechanical hoppered tanks only may include the upper 1/3 (by height) of the hopper(s) in computing detention time.

Surface settling rate:

$$\frac{\text{ADDF gal./day}}{\text{Surface area }\_\_\_\_\_\text{sq. ft.}} = \_\_\_\_\_ \text{ GPD/sq. ft.}$$

At peak flow:

$$\frac{\text{PIR gal./min/ x 1400}}{\text{Surface area }\_\_\_\_\_\text{sq. ft.}} = \_\_\_\_\_ \text{ GPD/sq. ft.}$$

**NOTE:** If the Influent Pumping Rate (IPR) exceeds the peak Influent Flow Rate (PIR), then it should be substituted in the above equation for (PIR).

Weir overflow rate:

a. At peak flow:

$$\frac{\text{PIR gal./min/ x 1400}}{\text{Total weir length }\_\_\_\_\_\text{feet}} = \_\_\_\_\_ \text{ GPD/lin. ft.}$$

**NOTE:** If the Influent Pumping Rate (IPR) exceeds the Peak Influent Flow Rate (PIR), then it should be substituted in the above equation for (PIR).

b. Are the weirs adjustable? Yes _____ No _____

Describe method of scum removal and disposal: _____

_____

_____

_____

Scum storage capacity _____

Describe method and frequency of sludge removal and method and location of sludge disposal:

_____

_____

Amount of sludge to be removed _____ lbs./day.

If a sludge storage tank is to be installed, the volume of the tank(s) will be: (based on at least 10% of design loading).

$$\frac{\text{Design } BOD_5 \text{ loading lbs./day} \times 100 \times 10\%}{0.167 \text{ lbs. } BOD_5\text{/population equivalent}} = \text{_____ gal. (minimum)}$$

Aeration tank vol. x 10% _____ gallons supplied

a. Air supply: _____ cu. ft./min. (with largest blower out of service)

**Note:** A minimum storage volume of 1,000 gallons will be required for plants with a design flow of less than 10,000 gal. day.

If aerobic digestion of sludge is to be utilized, the volume of the tank(s) will be: (based on three cubic feet per population equivalent)

$$\frac{\text{Design } BOD_5 \text{ loading lbs./day} \times 3 \times 7.48}{0.167 \text{ lbs. } BOD_5\text{/population equivalent}} = \text{_____ gal. (minimum)}$$

_____ gallons supplied

a. Air supply: (based on 20 cu. ft./min. per 100 cu. ft. of volume)

$$\frac{\text{gallons supplied} \times 20 \text{ cu. ft./min.}}{7.48 \text{ gal./cu. ft.} \times 1{,}000 \text{ cu. ft.}} = \text{_____ cu. ft./min.}$$

Air supplied: _____ cu. ft./min. (with largest blower our of service)

If anaerobic digestion of sludge is to be utilized, the volume of the tank(s) will be:

_____ gal.

**NOTE:** Basis of design and calculations must be submitted for the above volume.

If sludge drying beds are to be installed, the area provided shall be: (based on one square foot per population equivalent)

$$\frac{\text{Design } BOD_5 \text{ loading} \quad \text{lbs./day}}{0.167 \text{ lbs./population equivalent}} = \_\_\_\_\_ \text{ sq. ft.}$$

_____square feet provided _____ number of beds

**NOTE:** Where phosphate removal or other chemical treatment processes are to be utilized, design of sludge handling facilities must take into account possible increased sludge production.

Check which of the following modes of advanced treatment of effluent disposal are to be installed:

_____ Surface slow sand filter

_____ Rapid sand gravity filter

_____ Microstrainers

_____ Lagoons

_____ Other:

If surface slow sand filters are to be installed, the area provided shall be: (Based on 11.5 gallons per square foot per day)

$$\frac{\text{ADDF} \quad \text{gal./day}}{11.5 \text{ gal./sq. ft./day}} = \_\_\_\_\_ \text{ sq. ft}$$

_____square feet provided _____ number of beds

a. Capacity of dosing chamber shall be: _____ gallons

b. Size of dosing pumps: _____ gal./min. (with largest pump out of service)

**NOTE:** Dosing chamber and pumps must be sized to dose half of the total filter to depth of three (3) inches within 10 to 15 minutes.

c. Dosing siphon height above sand beds: _____ feet

If rapid sand gravity filters are to be installed, the area provided shall be: (based on 3.33 gpm/sq. ft. at the peak flow rate)

$$\frac{\text{Peak flow rate*} \quad \text{gal./min.}}{\text{3.3 gpm/sq. ft.}} = \_\_\_\_\_ \text{ sq. ft}$$

_____square feet provided _____ number of cells

***NOTE:** The peak flow rate shall be equal to the maximum rate of the pumping facilities preceding filtering.

a. Clearwell capacity: _____ gallons

b. Rate of backwash: _____ gpm/sq. ft.

c. Duration of backwash: _____ minutes

d. Number of backwash pumps: _____ @ _____ gal./min.

e. Mudwell capacity: _____ gallons

**NOTE:** Please refer to Part II of Ohio EPA's "Recommended Engineering Procedures and Design Guidelines Relative to Advanced Wastewater Treatment" in designing rapid sand gravity filters.

If microstrainers are to be installed, the net submerged effective area of the microstrainer fabric shall be: (based on 3.33 gpm/sq. ft. at the peak flow rate).

$$\frac{\text{Peak flow rate*} \quad \text{gal./min.}}{\text{3.3 gpm/sq. ft.}} = \_\_\_\_\_ \text{ sq. ft}$$

_____submerged square feet provided

_____total square feet provided

_____number of microstrainers

***NOTE:** The peak flow rate shall be equal to the maximum rate of the pumping facilities preceding the microstrainers.

a. Continuous backwash rate: _____ gal./min./ft. of microstrainer length.

b. Number of backwash pumps: _____ @ _____ gal./min.

**NOTE:** Please refer to Part II of Ohio EPA's "Recommended Engineering Procedures and Design Guidelines Relative to Advanced Wastewater Treatment" in designing microstrainers.

If lagoons are to be utilized, their total volume will be: (based on five (5) days detention)

Design hydraulic flow _____ gal./day x 5 = _____ gal.

_____ gallons supplied

Average design flow depth: _____ feet

Number of cells: _____

Minimum freeboard of _____ feet will be provided.

The embankments of the lagoons shall have a minimum slope of _____ vertical to

_____ horizontal.

Does the overflow structure provide flexible water depth control and operation of facilities?

Yes _____ No _____

**NOTE:** Prior to designing tertiary lagoons, contact the Division of Waste Management and Engineering in the appropriate District Office for information relative to the acceptability of the proposal.

What type of disinfection process will be employed?

Chlorination _____ Ozone _____ Other _____

Describe: _____

_____

_____

_____

If chlorination is to be used, in what form will it be?

Gas _____ Powder _____ Tablet _____

Volume of contact tank(s): (based on 15 minutes retention at the peak flow rate)

Peak flow rate* _____ gal./min. x 15 min. = _____ gal.

_____ gallons supplied

***NOTE:** The peak flow rate shall be equal to the maximum rate of the pumping facilities preceding the contact chamber.

Are the tank(s) baffled or so constructed as to reduce short circuiting of flow to a minimum?

Yes _____ No _____

Describe provisions for cleaning tank(s) and for maintaining adequate disinfection during cleaning operations:

_____

_____

_____

Chlorine dosage rate: _____ mg/l (at peak flow rate)

Will duplicate chlorinators be providers? Yes _____ No _____

Will the chlorinator be housed? Yes _____ No _____

Describe: _____

_____

_____

What type of flow measurement device, if any, will be installed?

Describe: (indicating, recording, totalizing, etc.) _____

_____

_____

What laboratory facilities or other types of monitoring equipment will be provided? Describe:

_____

_____

What is the estimated cost of the above proposed wastewater treatment facility? $ _____

Will a certified operator be employed to run the proposed treatment works?

Yes _____ No _____ If yes: full-time _____

part-time _____

Grade certification level _____

Is the site for the proposed treatment works subject to flooding?

Yes _____ No _____ If yes, what measures will be taken to protect mechanical equipment?

What provisions, if any, will be made to provide standby power for electrical equipment?

Describe: _____

_____

_____

_____

_____

Should include capacity.