



Delegated Agency Training: How to Design & Review an Onsite Wastewater Treatment Facility for a Truck Stop with a Restaurant (Part Two)



Administrative Code Review





Design Summary

- Design Summary:
 - Design Flow – 19,496 gpd ADWF; 24,370 gpd PDWF
 - BOD5 – 876 mg/l (178 # @ 24,370 gpd)
 - TN – 74 mg/l (15# @ 24,370 gpd)
 - Soil – Loam; Moderate Structure
 - SAR – 0.60 gpd/sf
 - SARa – 1.29 gpd/sf





Design Summary

In developing our design of an Onsite Wastewater Treatment Facility (OWTF) for a truck stop with a restaurant, we need to keep in mind that we will be using three different wastewater flows. I have defined those flows as follows:

- Design flow in terms of the average daily wastewater flow (ADWF).
- Design flow in terms of peak flows (Peaking Factor of 1.25) to account for unusually high business volume during a given time period such as a weekly or monthly time period to calculate the daily average flow. Signified by peak daily wastewater flow (PDWF)
- Treatment capacity flow (TCF) in terms of what wastewater flows the treatment equipment can process to produce a given quality of effluent.

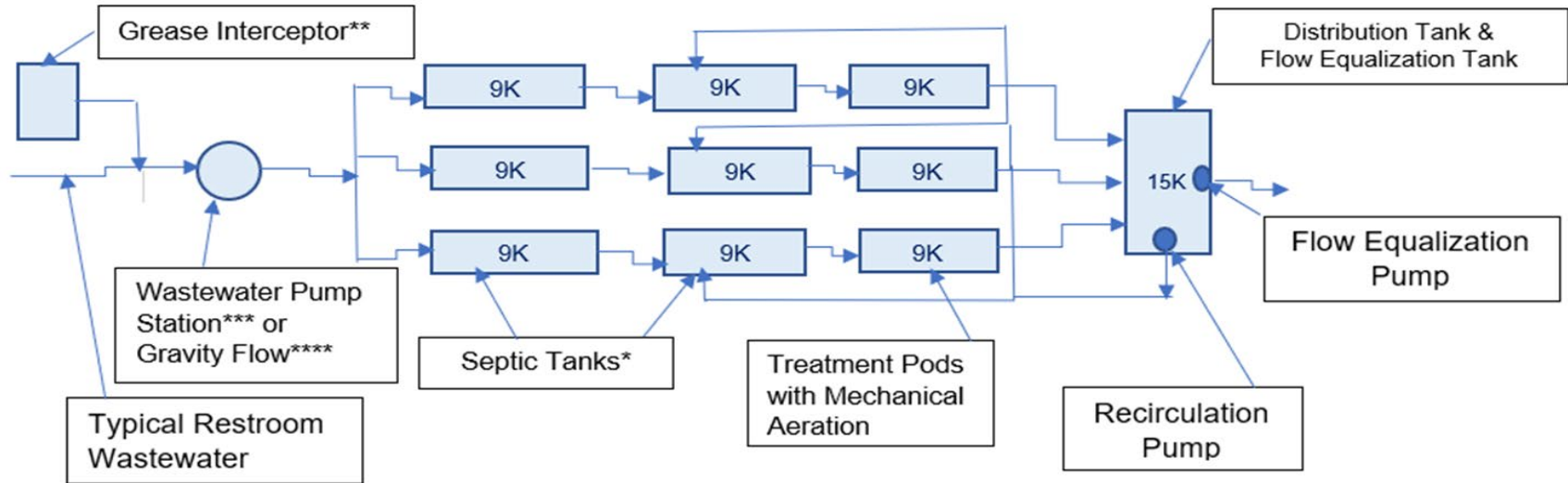




Design Summary – Pretreatment Flow Chart



Design Summary – Pretreatment Flow Chart



*Septic Tanks with a baffle and a septic tank filter. A water spigot located next to each septic tank is preferred to make it easier to periodically clean the septic tank filter.

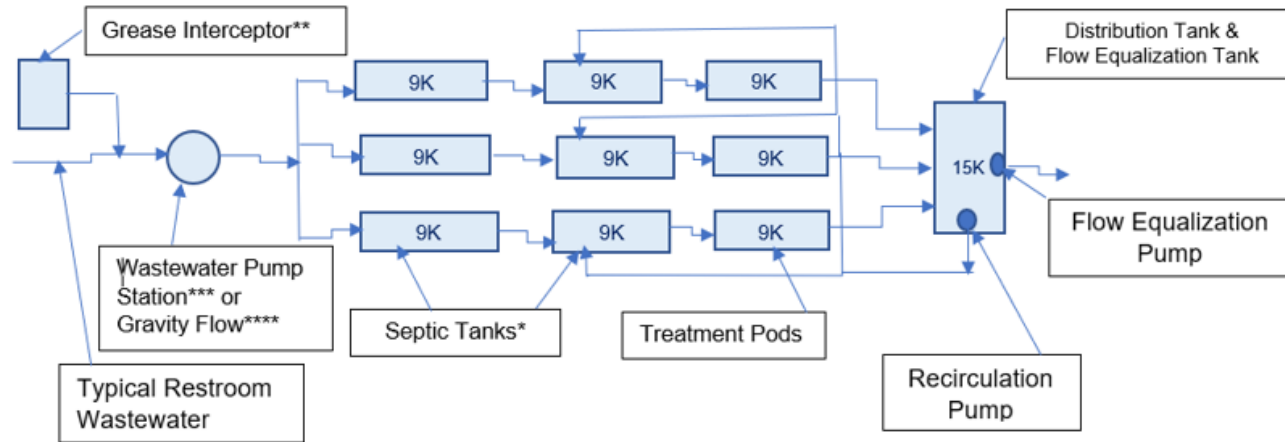
**Grease Interceptor with a grease trap filter

***If a Wastewater Pumping Station is used, a grinder pump should be avoided, if possible, to improve the treatment performance of the downstream septic tanks.

****For Gravity Flow to work, the downstream tanks will probably have to be buried deeper.

Pretreatment Flow Chart

– Key Wastewater Values



Influent:
BOD5 = 876 mg/l at $Q_d = 24,370$ gpd
BOD5 = 178#
TN = 74 mg/l
TN = 15#
Alkalinity = 350 mg/l
Alkalinity = 71#

Septic Tank effluent:
BOD5 = 125# (with 30% Removal of 178 #)
Total Carbon Ratio = 21 > 5

Effluent:
BOD5 = 128 mg/l at $Q_d = 24,370$ gpd
BOD5 = 26#
TN = 30 mg/l
TN = 6#
Alkalinity = 206 mg/l > 70 to 80 mg/l
Alkalinity = 42#



Pretreatment Process – Key Considerations

- The septic tank sizes are 9,000 gallons each instead of the first one being 12,000 gallons and the second one 6,000 gallons which would put the detention volume in the first tank to at least $\frac{2}{3}$ of the design flow or a $\frac{2}{3}$ – $\frac{1}{3}$ split between the two septic tanks.
- The goal in this case (with a 50% – 50% split) is to carry over more solids to the second septic tank to make sure there is enough carbon in this tank to accomplish denitrification successfully. The detention time is still 2.1 days using both tanks. A two day detention time is considered optimum for removing BOD₅.





Key Considerations (continued)

- The inlet pipe into the second septic tank should end at about 12” from the floor of the septic tank. The return pipe for the effluent from the secondary treatment process should terminate near the inlet to the second septic tank and at a point where it is 12” from the floor of the septic tank. This will facilitate mixing of the returning nitrate with the anaerobic bacteria and carbon coming from the first septic tank. The end result should be improved denitrification.
- Mechanical aeration is used to supply a lot of oxygen during the secondary treatment process. The more carbon you have, the greater the oxygen demand.





Wastewater Strength Calculations

– Method 1

- Restaurant wastewater BOD5 concentration – 2,137 mg/l (Fast Food Restaurant)
- Service station wastewater BOD5 concentration – 380 mg/l (maximum strength for typical sewage according to the Arizona Administrative Code (AAC))
- Combined wastewater strength calculations (Method 1 using BOD5 Pound Calculations)
- Total # of BOD5 = Average Daily Wastewater Flow in MGD x 8.34 x Wastewater Strength (mg/l) x Peaking Factor
- # of BOD5 = (0.0140 mgd x 8.34 x 380 mg/l * 1.25 P.F.) + (.005496 mgd) x 8.34 x 2,137mg/l * 1.25 P.F.)
 - Total # of BOD5 = 56 # + 122 # = 178 #
 - BOD5 (mg/l) = # of BOD5 / (Average Daily Flow (mgd) * 8.34 * 1.25 P.F.)
 - BOD5 (mg/l) = 178 # / (.019496 * 8.34 * 1.25 P.F.) = 876 mg/l



Wastewater Strength Calculations

– Method 2

- Combined wastewater strength calculations (Method 2 using Ratio & Proportion)
 - $\text{BOD5 Avg (mg/l)} = (\text{Average Daily Flow (ADWF1)} / \text{Total ADWF in } \text{mgd} \times \text{Wastewater Strength1 (mg/l)} + (\text{ADWF2} / \text{Total ADWF in } \text{mgd} \times \text{Wastewater Strength2 (mg/l)})$
 - $\text{BOD5 Avg (mg/l)} = (14,000 \text{ gpd} / 19,496 \text{ gpd}) * (380 \text{ mg/l}) + (5,496 \text{ gpd} / 19,496 \text{ gpd}) * (2,137 \text{ mg/l})$
 - $\text{BOD5 Avg (mg/l)} = 273 \text{ mg/l} + 603 \text{ mg/l} = 876 \text{ mg/l (178\# @ 24,370 gpd)}$



Design Guidance for Treatment Calculations

- If the wastewater strength exceeds that of typical sewage, then the wastewater must be pretreated to produce a wastewater that meets the definition of typical sewage. There is no specific permit or design guidelines that must be followed other than some general rules given in the Arizona Administrative Code.
- In general, the designer must design “the on -site wastewater treatment facility project using good design judgment and [*rely*] on appropriate design methods and calculations” as per R18-9-A312.A.2.





Design Guidance for Treatment Calculations

The following language is put in all proprietary product listing (PPL) approval certificates:

- “When wastewater does not meet the definition of typical sewage as defined in R18 -9-101(48), a Manufacturer’s Design Review Report shall be submitted for review and approval along with the Notice of Intent to Discharge. This Design Review Report shall specify component capacities, control settings, and supplemental installation and operational practices.”
- It should also be noted that supporting calculations for the design report details are needed.





Pretreatment Calculations for Wastewater

- Pretreatment Equipment
 - Size of treatment modules – 9000 gpd
 - BOD5 Removal – 676 mg/l (152 # at 27,000 gpd)
 - Total Nitrogen Removal – 41 mg/l (9 # at 27,000 gpd)
- Pretreatment - BOD5 reduction Process
 - Pretreatment reduction (#) = [(High Strength Wastewater (mg/l)) x Peak Daily Wastewater Flow (mgd) x 8.34] – [Treatment BOD5 Reduction in #]
 - Pretreatment reduction (#) = [(876 mg/l) x .02437 mgd x 8.34] – [152 #]
 - Pretreatment BOD5 Effluent (#) = 178 # - 152 # = 26 #
 - Pretreated Effluent BOD5 = 128 mg/l

Pretreatment Calculations for Wastewater

- Pretreatment - Total Nitrogen Reduction Process
 - Pretreated Effluent TN (#) = (High Strength Wastewater TN (mg/l) – Pretreatment Equipment Reduction (#))
 - Pretreated Effluent TN (#) = (74 mg/l * 8.34 * 0.02437 mgd) - (9 #)
 - Pretreated Effluent TN = 15 # - 9 # = 6 #
 - Pretreated Effluent TN = 30 mg/l





Interceptor Requirements as per the A.A.C.

R18-9-A315. Interceptor Design, Manufacturing, and Installation for On-site Wastewater Treatment Facilities

- Interceptor requirement. An applicant shall ensure that an interceptor as required by R18-9-A309(A)(7)(c) or necessary due to excessive amounts of grease, garbage, sand, or other wastes in the sewage is installed between the sewage source and the on-site wastewater treatment facility.
- Interceptor design. An applicant shall ensure that:
 - An interceptor has not less than two compartments with fittings designed for grease retention and capable of removing excessive amounts of grease, garbage, sand, or other similar wastes.
 - An interceptor may not accept human excreta or toilet wastewater. Applicable structural and materials requirements prescribed in R18-9-A314 apply



Interceptor Calculations

1. Interceptor Size (I.S.) = $M \times F \times T \times S$
 - a) M = # of meals served per peak hour
 - b) F = unit wastewater flow rate from Table 1
 - c) T = estimated retention time
Commercial = 2.5 hours
 - d) S = estimated storage factor
(1) Full Service 16 hours of operation – 2.0
2. $I.S. = 48 \times 7 \times 2.5 \times 2.0 = 1680$ gallons
3. Detention Time (D.T.) = $I.S. / ADWF$ or $I.S. / PDWF$
 - a) $D.T. = (1680 \text{ gal} / 5496 \text{ gpd}) \times 24 \text{ hours} = 7.3 \text{ hours ADWF}$
 - b) $D.T. = (1680 \text{ gal} / 6870 \text{ gpd}) \times 24 \text{ hours} = 5.9 \text{ hours PDWF}$



Thank you. Questions?

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