Wastewater Characteristics and Flow

☞**Wastewater Flow**

☞**Wastewater Characteristics**

In this presentation, we will discuss wastewater design flow rates, how to calculated a design flow rate for an application, and the different types of wastewater characteristics.

Wastewater Flow

- ☞ **Rule .1949 – Sewage Flow Rates for Design Units**

- ☞ **.1949(a) – Flows per bedroom for homes**
- ☞ **.1949 (b) – Table No. 1 – Daily Design Flow Rates**
- ☞ **.1949(c) – Flow reductions for design flows**

Rule .1949, Sewage Flow Rates for Design Units, provides the basis for determining the design flow rate for homes and businesses. .1949(a) describes the design flow per bedroom, including a minimum design flow for a home. .1949(b) provides a table listing various different businesses/establishments and what the design flow rate is based on, for example offices are sized on the number of people per shift and school design flows are based on the number of students and the facilities available at the school. .1949(c) specifies the information required to request a flow reduction from the flow rates listed in Table No. 1. Flow reductions are never given for homes.

.1949 (a)

- ☞Flow rate shall be 120 gpd/ bedroom
- ☞Minimum design flow from any dwelling unit shall be 240 gpd
- ☞Number of bedrooms is determined by looking at the number of rooms that can reasonable be expected to function as a bedroom

When determining the flow rate of a house, it is based on 120 gpd/bedroom. So, for a 2 bedroom home the design flow would be 240 gpd (2 bedrooms x 120 gpd/bedroom). However, the design flow for a dwelling unit (or home) can not be less than 240 gpd.

To determine the number of bedrooms in a home, each bedroom and any other room that can reasonably be expected to function as a bedroom shall be considered a bedroom for design flow purposes. If there is a question about the number of bedrooms in a home, ask to see plans for the home (if they have not already been submitted). If you have questions about if a room could be classified as a bedroom, contact the Section for help.

.1949 (a)

- ☞ **When the occupancy of a dwelling unit exceeds two persons/ bedroom, the volume of sewage shall be determined by maximum occupancy at 60 gpd/person**

When the occupancy of a bedroom for a home exceeds two people per bedroom, than the design flow is based upon the total number of people that can sleep in the house at 60 gpd/person. The most common place you will see designs of homes for more than two people per bedroom is in rental properties, both at the beach and in the mountains.

☞For a three bedroom house, design flow is

~~3 bedrooms~~ x 120 gpd/~~bedroom~~ =

360 gpd

Let's determine the design flow for a three bedroom home. Multiply the number of bedrooms, three, by 120 gpd/bedroom. Always write out your units, so that you can make sure you have not forgotten something or used the incorrect design flow. In our above example, bedrooms cancels out and we are just left with gallons per day. Our design flow for a three bedroom home is 360 gpd.

☞For a 4 bedroom rental house, that sleeps 4 people per bedroom, the design flow is

4 ~~bedrooms~~ x 4 people / ~~bedroom~~ =

16 people

16 ~~people~~ x 60 gpd / ~~person~~ =

960 gpd

Now, lets look at a different example. A four bedroom rental house will be able to sleep 4 people per bedroom. In this case, the design flow is based on the total number of people that the house can sleep. The house has four bedrooms and each bedroom can sleep four people, so multiply 4 bedrooms times four people per bedroom. The number of bedrooms will cancel out, and the final answer will be the number of people the house can sleep, which is 16 people.

Now, the rules require when more than two people can sleep in a bedroom that the design flow is based on the total number of people that can sleep in the house. In this situation, the number of people, which is 16, needs to be multiplied by 60 gpd/person. People will cancel out and the final answer left will be in gallons per day. The final design flow for the four bedroom rental house is 960 gpd.

☞ **For a one bedroom home, the design flow is**

1 ~~bedroom~~ x 120 gpd / ~~bedroom~~ =

120 gpd

WRONG

.1949 (a) – Minimum design flow from any dwelling unit is 240 gpd

For a one bedroom home, the design flow is one bedroom times 120 gpd/bedroom. The bedrooms cancel out and the final answer is in gpd. The design flow is 120 gpd for a one bedroom home.

Wrong. Rule .1949(a) requires that the minimum design flow from any dwelling unit is 240 gpd. So even for a one bedroom home, the minimum design flow is 240 gpd.

.1949 (b)

- ☞Table No. 1 provides design daily flows for a number of different establishments
- ☞Read the table carefully for what the design flow is based on

Rule .1949(b) provides the daily design flow for various establishments. The table is set-up with the type of establishment on the left hand side, and the design flow per unit on the right hand side. When using the table, make sure to carefully read what the design flow is based on (the unit). When determining a design flow, this will help you determine what information is required.

☞ **For a 50 child day care with 10 employees, the design flow is**

50 children + 10 employees =

60 people

60 ~~persons~~ x 15 gal / ~~person~~ =

900 gpd

For a 50 child day care with ten employees, what is the design flow? When reading the table for day care, the design flow unit is based on per person. So, the first thing to do is determine how many people total are at the day care. Fifty children plus 10 employees is equal to 60 people total at the day care.

Next multiply the 60 people by 15 gal/person (taken from Table No. 1), the people units cancel out, and the final design flow is 900 gpd.

☞A Church has a 500 seat sanctuary with no kitchen, food service, day care, or camp. The design flow is

500 seats x 3 gal/seat =

1500 gpd

A church with 500 seats in the sanctuary has applied for an on-site wastewater system. The church does not have a kitchen, any food service, a day care, or a summer camp. So, the design flow is 500 seats times 3 gal/seat. Three gallons/seat is based on no kitchen, food service, day care, or camp. In the equation, the seats cancel each other out, and the final design flow is 1500 gpd.

☞A 50-seat restaurant, which has 800 sq ft of dining area, has a design flow of

50 seats x 40 gpd/seat =

2000 gpd

Not finished with calculation

What is the design flow based on dining area square footage?

A 50-seat restaurant, with an 800 square foot dining area, will have a design flow of 50 seats times 40 gpd/seat, the seats cancel out, leaving a final design flow of 2000 gpd.

You are not finished with this calculation yet. The rule requires the design flow be based on either the number of seats or square footage of dining area, whichever is greater. So, we now need to calculate the design flow based on the dining area square footage.

☞ **A 50-seat restaurant, which has 800 sq ft of dining area has a design flow of**

800 sq ft of ~~dining area~~ x
40 gal/15 sq ft of ~~dining area~~ =

2134 gpd

So, a 50-seat restaurant with 800 square feet of dining area has a design flow of 800 square feet of dining area times 40 gpd/15 square feet of dining area. The square feet of dining area cancel out, and we are left with a final design flow of 2,134 gpd.

☞Compare the two design flows

☞By number of seats – 2,000 gpd

☞By dining area square footage – 2,134 gpd

☞Final design flow – 2,134 gpd

Comparing the two design flows, by the number of seats the proposed design flow is 2,000 gpd. Looking at the dining area square footage, the proposed design flow is 2,134 gpd. So, the final design flow is 2,134 gpd for a 50-seat restaurant with 800 square feet of dining area.

☞Determine the design flow for the following strip mall

☞Strip mall

- 20 seat restaurant (200 sq ft dining area)
- Bank – 8 employees
- Store - 2000 sq foot retail area

We are now going to determine the design flow for a strip mall. The mall has three tenants: a 20-seat restaurant which has 200 sq ft of dining area, a bank with eight employees, and a store with 2000 square feet of retail area.

20 seat restaurant (200 sq ft dining area)

20 seats x 40 gpd/seat = 800 gpd

200 sq ft x 40 gpd/15 sq ft = 534 gpd

Design flow = 800 gpd

So, the design flow for the restaurant should be calculated for both the number of seats and the square footage of the dining area. Based on number of seats, the proposed design flow is 20 seats times 40 gpd/seat, which is a design flow of 800 gpd. Using the square footage of the dining area, 200 square feet times 40 gpd/15 sq feet gives a proposed design flow of 534 gpd. The greater of these two numbers is 800 gpd, so our final design flow for the restaurant is 800 gpd.

☞**Bank – 8 employees**

8 ~~employees~~ x 25 gpd / ~~employee~~ =

200 gpd

The design flow for a bank is based on the number of employees. Bathrooms at banks are not available to the general public, so we know the employees will be the only ones to use the bathroom.

The bank has eight employees multiplied by 25 gpd/employee, gives a final design flow of 200 gpd.

☞**Store - 2000 sq foot retail area**

2000 ~~sq~~ ft x 120 gpd / 1000 ~~sq~~ ft =

240 gpd

The retail store in the strip mall has 2000 square feet of retail area. So, the proposed design flow is 2000 square feet of retail area times 120 gpd/1000 square feet of retail area. The final answer is 240 gpd.

☞ **Total design flow for strip mall**

20 seat restaurant – 800 gpd
Bank with 8 employees – 200 gpd
2000 sq ft retail area – 240 gpd

800 gpd + 200 gpd + 240 gpd =

1240 gpd

To get a final design flow for our proposed strip mall we need to add the flows for each individual tenant together. Adding together the 800 gpd for the 20-seat restaurant, the 200 gpd for the bank, and the 240 gpd for the store, provides a final design flow of 1,240 gpd.

.1949(c)

☞ **A flow reduction can be obtained two different ways**
- **Low-flow fixtures**
  - **1.6 gallons/flush toilets**
  - **Spring-loaded faucets with flows of 1.0 gpm or less**
  - **Showerheads with flow rates of 2.0 gpm or less**
- **Data from a similar facility**
  - **12 monthly readings**
  - **30 days daily readings**

☞ **Regional Engineer can help with review of flow reduction requests**

Rule .1949(c) specifies the information required to request a flow reduction for a site. There are two different types of flow reductions that can be applied for. One type is based on the use of low-flow fixtures in the facility. The type of low-flow fixtures include toilets that use 1.6 gallons/flush or less, spring-loaded faucets with flows of less than 1.0 gpm, and showerheads with flows of less than 2.0 gpm. Generally, a certain percentage will be given of off the unreduced design flow when using low-flow fixtures. The applicant also must provide cut sheets of the low-flow fixtures that will be proposed to be used in the facility.

To get a larger flow reduction that just that provided by low-flow fixtures,the applicant can supply actual water use data information. This includes 12 monthly readings and 30 daily readings. The facility has to be similar to the proposed facility. For example, a store in Dare County on the beach is not the same as a store in Stokes County.

Any questions about flow reductions should be directed to your regional engineer.

Wastewater Flows

- ☞Design flows over 3,000 gpd must go to the On-Site Water Protection Section for review and approval
- ☞Under 3,000 gpd the Local Health Dept can review and approve plans

For any project with a design flow over 3,000 gallons per day, the On-Site Water Protection Section must review and approve the plans. Design flows under 3,000 gpd can be reviewed and approved by the local health department.

Wastewater Characteristics

- ☞ **Domestic**
  - **Single family home wastewater strength**
- ☞ **High Strength**
  - **Restaurants**
  - **Schools**
  - **Grocery stores**
- ☞ **Industrial**

Wastewater types/characteristics can be broken down into three different categories: domestic, high strength, and industrial.

Domestic strength is the wastewater generated by a home. It generally is not considered a very strong or high strength wastewater.

High strength wastewater is wastewater that has characteristics much stronger that that of domestic. Restaurant wastewater is generally high in BOD, TSS, and fats, oils, and greases. Schools can have very high levels of nitrogen in their wastewater.

Industrial is the last type of wastewater. This category covers everything not covered by the above two groups.

Wastewater Characteristics

☞Domestic

- Single family home wastewater strength
- Also includes
  - Offices
  - Retail stores
  - Banks
  - Churches

Domestic strength wastewater is generated by single family homes, offices, retail stores (not including grocery stores or food stands), banks, churches, or any other facility that does not create a high-strength wastewater.

Wastewater Characteristics

☞ **High Strength – higher than domestic strength wastewater**
- **Restaurants**
- **Schools**
- **Grocery stores**
- **Food stands**
- **Meat markets**

High strength wastewater is just that, wastewater with a higher strength than domestic wastewater. Some typical examples include restaurants, schools, grocery stores, food stands, and meat markets. These strength wastewaters are not treated differently, but we need to be able to understand the impact that high strength wastewater can have on the subsurface system and the environment.

To give a few examples, grease may not cool and congeal in the grease tank. If the wastewater coming from the dishwasher is extremely hot, the grease may be in the pump tank or pretreatment unit before it has cooled down enough to congeal out of the wastewater. At some sites, we have congealed grease in the pressure manifolds.

Some schools discharge wastewater that has a high nitrogen level. This can be of concern in areas that already have high background levels of nitrogen and where all the houses are on individual private wells, as is the school.

Wastewater Characteristics

☞ **Industrial**

- **Any wastewater generated from any process of industry, manufacture, trade, or business**
- **If product is going to be sold, classified as industrial wastewater**
- **If product made is a hobby (such as pottery) not classified as industrial**

Industrial wastewater is defined as any wastewater that is generated from any process of industry, manufacture, trade, or business. If a product is going to be sold, the waste stream is classified as industrial wastewater. If the product is made as a hobby, such as pottery, the waste stream is generally not classified as industrial, but dealt with on a case by case basis.

Wastewater Characteristics

☞ **Industrial**
- X-ray wastewater
- Funeral homes
- Slaughterhouses
- Car washes
- Chicken hatcheries
- Laboratories

Some examples of industrial process wastewater include: wastewater generated from taking X-rays, funeral homes (the embalming rooms), slaughterhouses, car washes, chicken hatcheries, and laboratories.

Wastewater Characteristics

☞ **Industrial**

- **Must be submitted to the On-Site Water Protection Section for review and approval**
- **System must be designed by a Professional Engineer**
- **Each project evaluated on a case-by-case basis**
- **Wastewater characteristics can vary from project to project**

For industrial wastewater projects, the plans must be submitted to the On-Site Water Protection Section for review, irregardless of size. All industrial wastewater projects must be reviewed and approved by the Section. The system must be designed by a Professional Engineer. Each project is evaluated on a case by case basis. Wastewater characteristics are not expected to be the same at all similar projects.

Wastewater Characteristics

☞ **Industrial**

- **If you have a question about whether or not a project would be classified as industrial wastewater, call your Regional Engineer**

If you have a question as to whether or not the wastewater generated from a specific facility would be classified as industrial wastewater, contact your regional engineer for help.