

BOD

Bio  
Chemical  
Oxygen  
Demand

TSS

Total Suspended Solids

# Wastewater Treatment

Fecal  
Coliform

pH

NH<sub>3</sub>

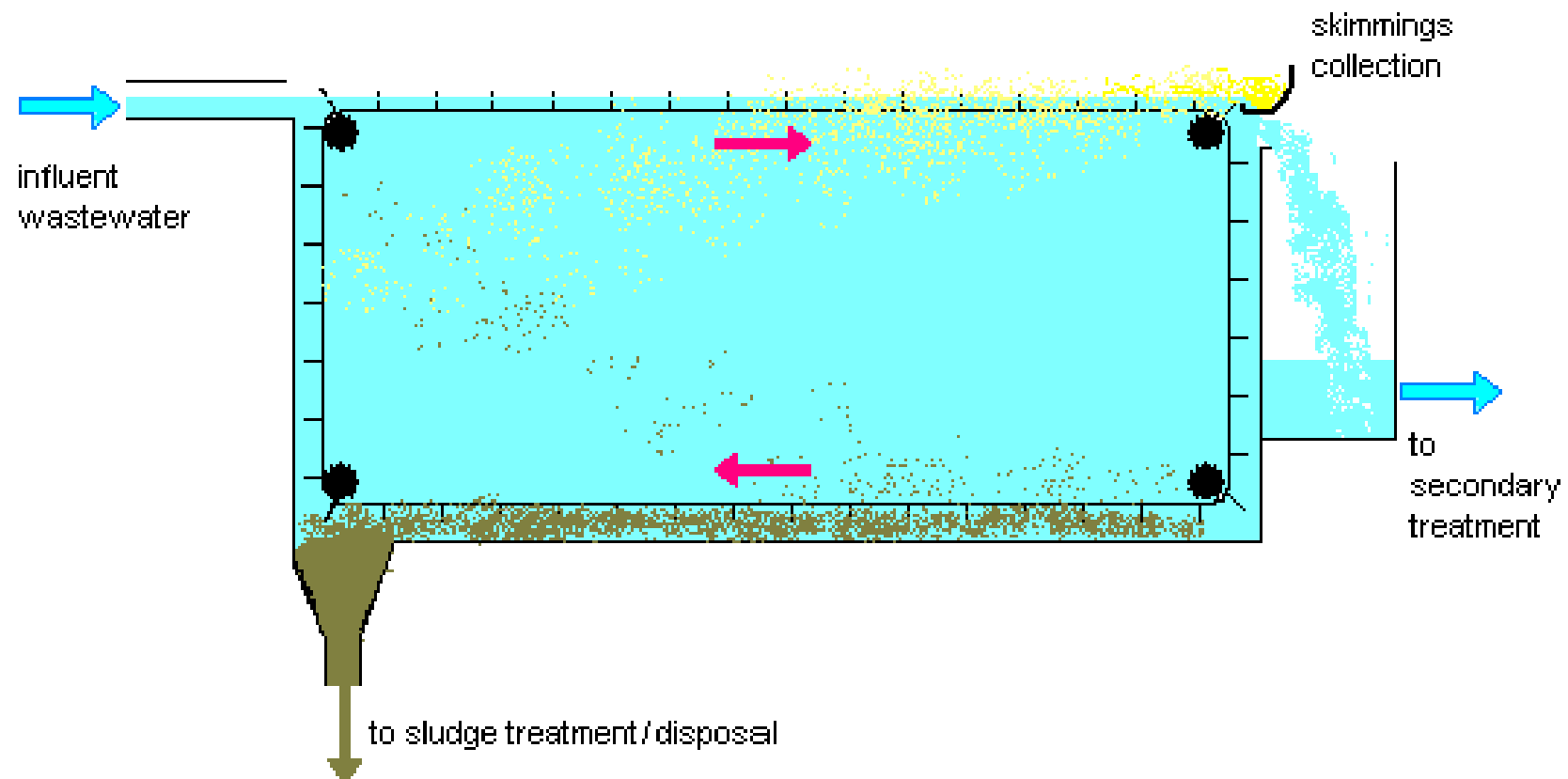
Nitrogen Ammonia

## ■ What is Sewage

- Pathogens or disease-causing organisms are present in sewage.
- Sewage is the wastewater released by residences, businesses and industries in a community. It is 99.94 percent water, with only 0.06 percent of the wastewater dissolved and suspended solid material. The cloudiness of sewage is caused by suspended particles which in untreated sewage ranges from 100 to 350 mg/l. Pathogens or disease-causing organisms are present in sewage. Coliform bacteria are used as an indicator of disease-causing organisms. Sewage also contains nutrients (such as ammonia and phosphorus), minerals, and metals. Ammonia can range from 12 to 50 mg/l and phosphorus can range from 6 to 20 mg/l in untreated sewage.

- Sewage treatment is a multi-stage process .

## Primary Settling Basin



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# Facultative Lagoons





- Like most natural environments, conditions inside facultative lagoons are always changing. Lagoons experience cycles due to variations in the weather, the composition of the wastewater, and other factors. In general, the wastewater in facultative lagoons naturally settles into three fairly distinct layers or zones. Different conditions exist in each zone, and wastewater treatment takes place in all three
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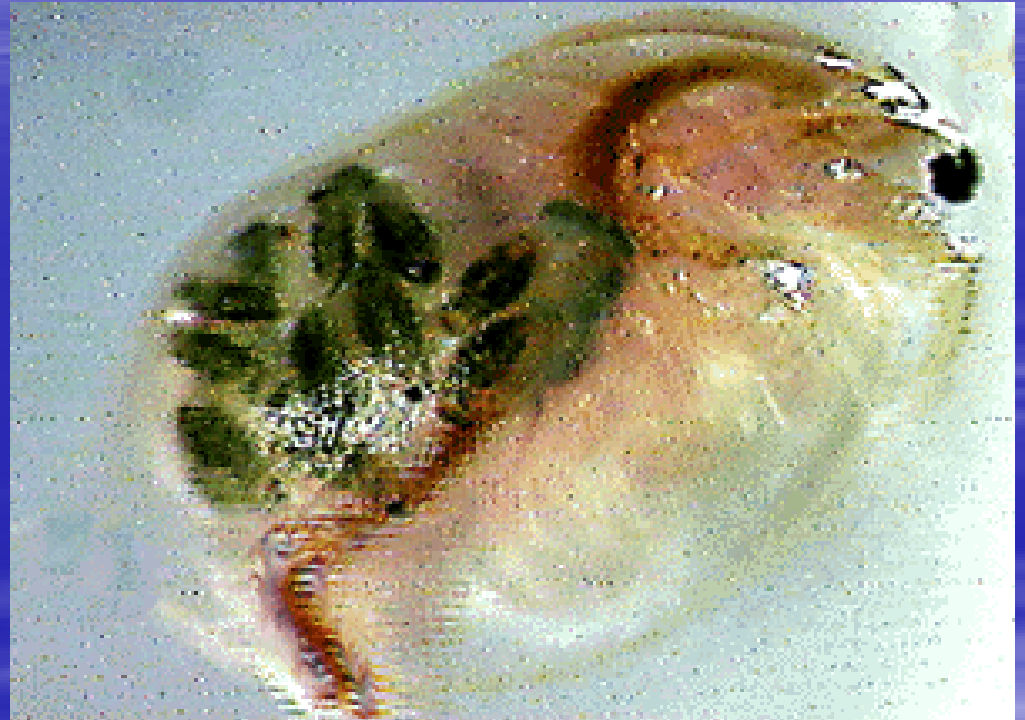
# Facultative Lagoons





- The top layer in a facultative lagoon is called the aerobic zone, because the majority of oxygen is present there. How deep the aerobic zone is depends on loading, climate, amount of sunlight and wind, and how much algae is in the water. The wastewater in this part of the lagoon receives oxygen from air, from algae, and from the agitation of the water surface (from wind and rain, for example). This zone also serves as a barrier for the odors from gases produced by the treatment processes occurring in the lower layers.





- Names for the middle layer include the facultative, intermediate, or aerobic-anaerobic zone. Both aerobic and anaerobic conditions exist in this layer in varying degrees. Depending on the specific conditions in any given part of this zone, different types of bacteria and other organisms are present that contribute to wastewater treatment

# Facultative Lagoons

The anaerobic zone .





# The anaerobic zone .



- The anaerobic zone is the layer at the very bottom of the lagoon where no oxygen is present. This area includes a layer of sludge, which forms from the solids that settle out of the wastewater. Here, wastewater is treated by anaerobic bacteria, microscopic organisms, such as certain protozoa, and sludge worms, all of which thrive in anaerobic conditions.

- Time is another important factor in treatment.





- Facultative lagoons are designed to hold the wastewater long enough for much of the solids in the wastewater to settle and for many disease-causing bacteria, parasites, and viruses to either die off or settle out. Time also allows treatment to reduce the overall organic strength of the wastewater, or its biochemical oxygen demand (BOD). In addition, some of the wastewater eventually evaporates.

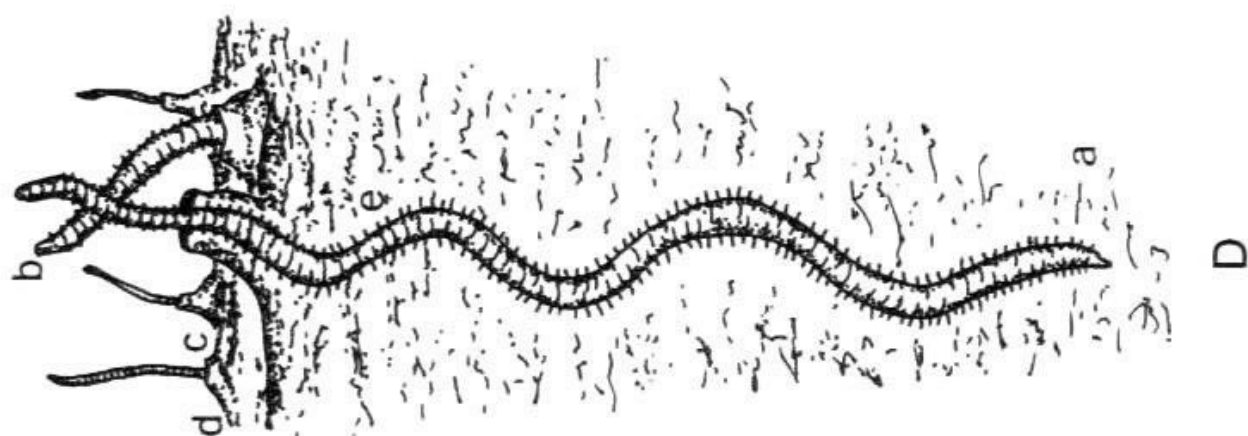
- Sunlight is also extremely important to facultative lagoons .



- Sunlight is also extremely important to facultative lagoons because it contributes to the growth of green algae on the water surface. Because algae are plants, they require sunlight for photosynthesis. Oxygen is a byproduct of photosynthesis, and the presence of green algae contributes significantly to the amount of oxygen in the aerobic zone. The more warmth and light the sun provides, the more green algae and oxygen there is likely to be in the lagoon.



- The oxygen in the aerobic zone makes conditions favorable for aerobic bacteria. Both aerobic and anaerobic bacteria are very important to the wastewater treatment process and to each other.
- Bacteria treat wastewater by converting it into other substances. Aerobic bacteria convert wastes into carbon dioxide, ammonia, and phosphates, which, in turn, are used by the algae as food. Anaerobic bacteria convert substances in wastewater to gases, such as hydrogen sulfide, ammonia, and methane. Many of these by-products are then used as food by both the aerobic bacteria and algae in the layers above.



- In addition, the sludge layer at the bottom of the lagoon is full of anaerobic bacteria, sludge worms, and other organisms, which provide treatment through digestion and prevent the sludge from quickly accumulating to the point where it needs to be removed. How often sludge must be removed from facultative lagoons varies depending on the climate, the individual lagoon design, and how well it is maintained. Sludge in all lagoons accumulates more quickly in cold than in warm temperatures.



# Design criteria

- Normal design flow 2.85 MGD
- Maximum design flow 5.7 MGD
- Peak on Maximum day 9.1 MGD
- Current Flow 1.45 MGD



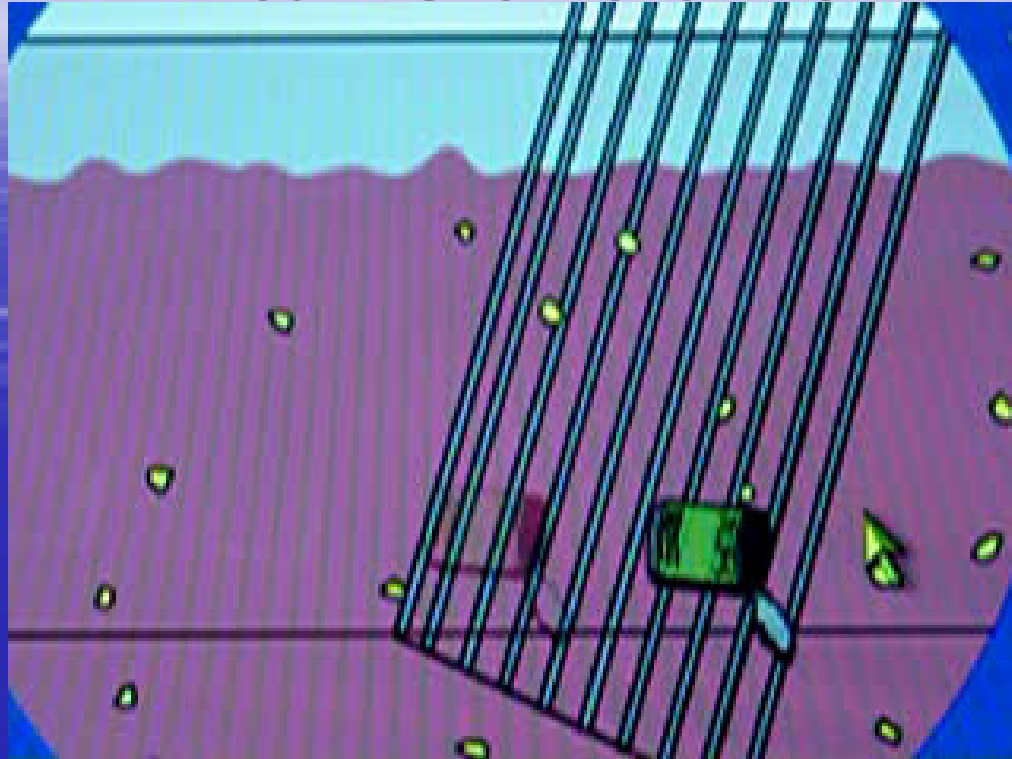
•Pretreatment



# PRELIMINARY TREATMENT

- There is a lot debris which comes through our waste stream. Things like rags, sand, gravel and larger pieces of organic matter must be removed before it enters our Treatment System.

# Bar Screens



- A bar screen with evenly spaced vertical bars is placed at the beginning of a Wastewater Treatment Plant to remove large trash, sticks, plastic material, rags, ect. It is important to remove these materials because they could cause damage to equipment and decrease the capacity of the treatment plant. The captured material is then removed and properly disposed of.

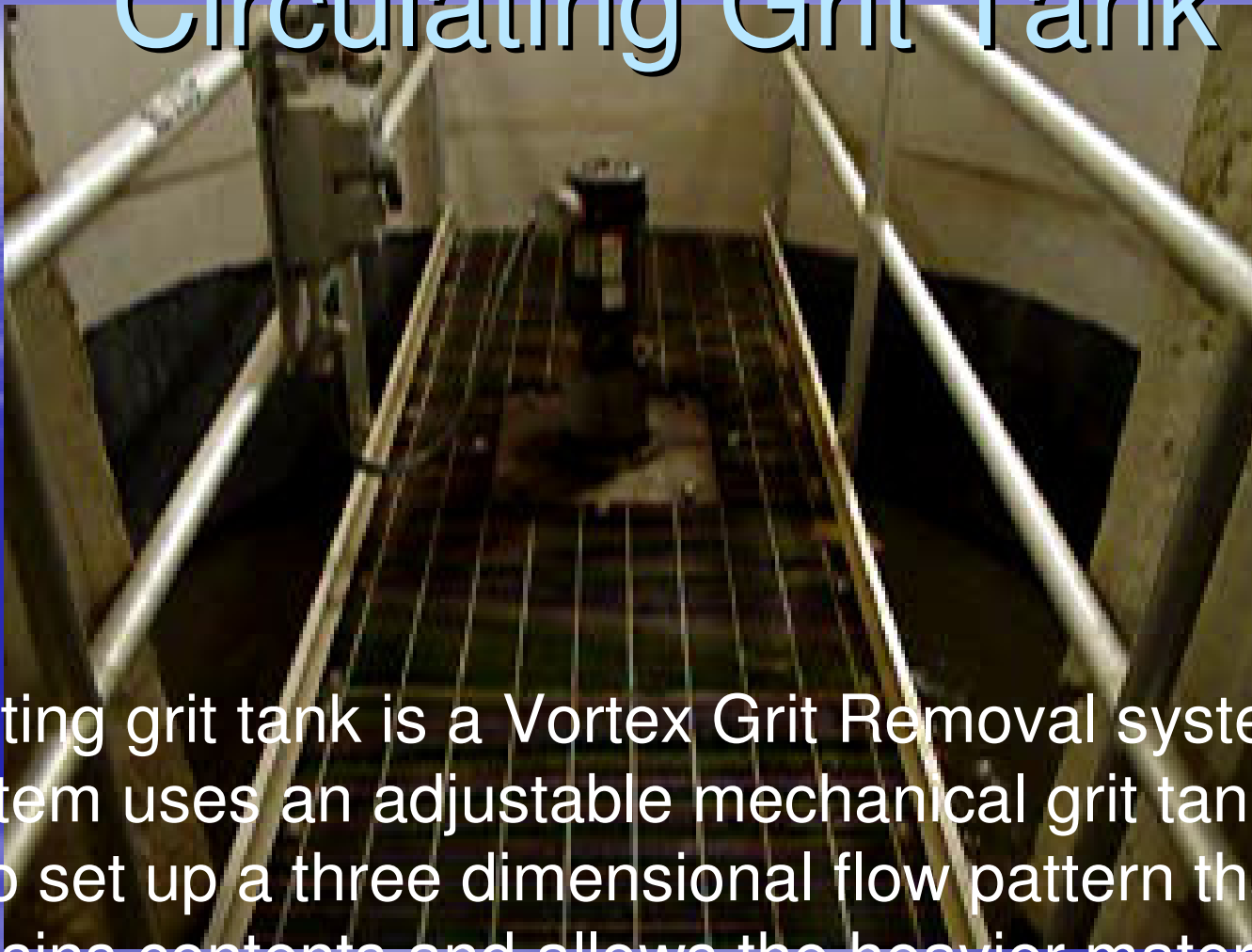


# Climber Screen



Removes material larger than  $\frac{3}{4}$  inch

# Circulating Grit Tank



The circulating grit tank is a Vortex Grit Removal system. This type of system uses an adjustable mechanical grit tank circulator to set up a three dimensional flow pattern that gently rolls the basins contents and allows the heavier material to settle into the sump. Once the grit has been settled in the sump, it is removed by a grit pump which pumps the material to the main floor where it is dewatered using a static dewatering screen.

# Static Dewatering Screen



# Aeration





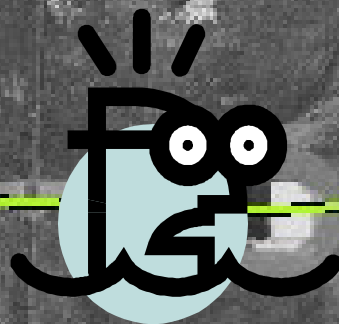
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# Mechanical Aeration

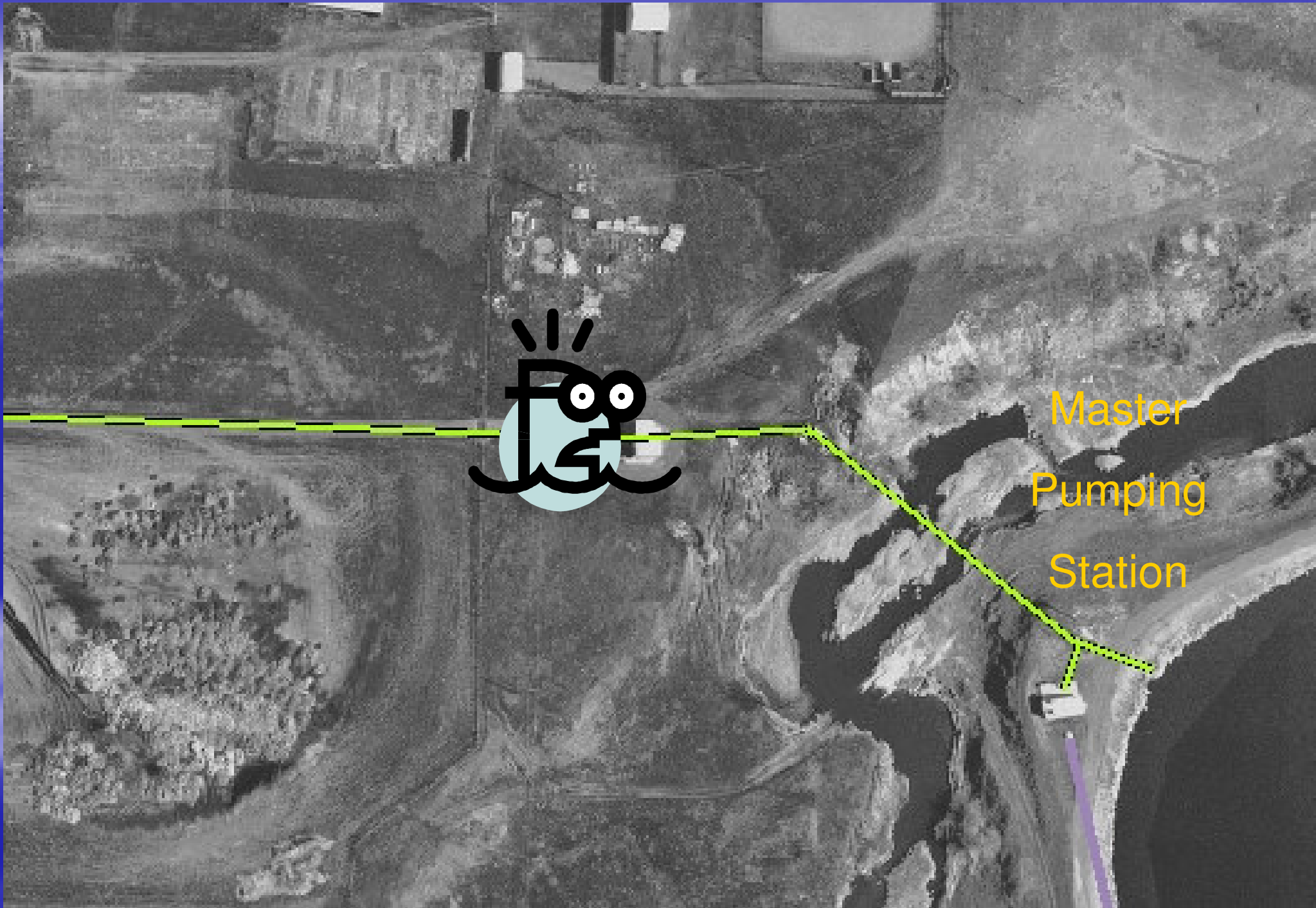








Master  
Pumping  
Station















# Pre-discharge Requirements

- No discharge shall occur from the lagoon until permission has been granted by the North Dakota Department of Health
- Permission to discharge shall be based on best professional judgment after a review of all applicable information and data.
- If permission is granted, the permittee shall comply with the following limitations.

# NPDES Permit

- BOD
  - 25 mg/l (30 day average)
  - 45 mg/l (7 day average)
- TSS
  - 30 mg/l (30 day average)
  - 45 mg/l (7 day average)
- Fecal Coliform
  - 200 /100 ml (30 day average)
  - 400 /100 ml (7 day average)
- pH shall remain between 6.0 and 9.0
- In addition, there shall be no visible solids and/or visible oil or greases in the discharge

# Monitoring requirements

Parameter	Frequency	Type of Measurements
■ Total flow	Continuous	Recorder
■ pH	Daily	Instantaneous
■ TSS	Weekly	Grab
■ BOD	Weekly	Grab
■ Fecal	Weekly	Grab
■ Temp	Daily	Instantaneous
■ Ammonia	Weekly	Grab
■ Oil & Grease	Daily	Visual

# Monitoring requirements

- The Permittee shall sample and analyze the effluent for the parameters listed in 40 CFR 122 Appendix D, Table III
- **Whole Effluent Toxicity Testing**
  - There shall be no acute toxicity in any discharge.
  - Acute toxicity occurs when 50% or more mortality is observed for either species at any effluent concentration.
  - At least one test shall be performed for each calendar quarter in which there is a discharge.





