MUSCATINE

Water Pollution Control Plant

Process and Flow Map

1. **Headworks Building**- All flow comes in at this point to have any large material separated from the raw influent wastewater. Mechanically cleaned bar screens remove the biggest material like leaves, wood, rocks, baseball caps, bowling balls, etc. Vortex Grit Chambers, or "Tea Cups" remove finer particles like sand, coffee grounds, egg shells, or "grit". All this removed material is taken to the landfill for final disposal.

2. **Primary Clarifiers-** The screened wastewater is sent to large tanks, called clarifiers, to slow the flow to allow most of the remaining material to settle out. When flows are higher, more clarifiers are used to keep the flow at a slow enough speed to allow material to sink to the bottom of the clarifiers. The settled material has a strong organic content that is sent to the digesters for further treatment (see #6). The lighter material such as oil, grease or anything else that floats is skimmed off the top of the clarifiers and is called "scum". Scum is also collected and sent to the digesters for further treatment (see #6).

3. **Aeration Basins-** The activated sludge process is the most common biological process for reducing the concentration of organic and inorganic pollutants in municipal wastewater. The wastewater is mixed with Return Activated Sludge (RAS) (see #4) in the splitter box and air is added to it in these large basins. This "biomass" is referred to as mixed liquor and is the most important process in the plant. The mixed liquor is aerated and mixed as it moves through the basin where living and actively metabolizing organisms biodegrade the pollutants in the water. The mixed liquor contains a mixture of bacteria, fungi, protozoa and rotifers. Identifying how many and what kind of organisms are in the mixed liquor is one of the most important aspects to how clean the water will be when put back into the environment (like rivers, streams and lakes).

An activated sludge plant can be compared to a huge bug farm, or an enormous biological factory. Biochemistry is the term used to describe how the various "good" biological organisms react with the organic pollutants in wastewater. When trying to determine how dirty or clean the water is, Biochemical Oxygen Demand (BOD) is the unit of measure used. BOD tells the operator of treatment plants how much or how little organic material is in the water. For example: a low number of 3 mg/L (milligrams per liter) of BOD in the water indicates relatively clean water. The treatment plant is not permitted to discharge water with over 25 mg/L of BOD by the Iowa Department of Natural Resources (IDNR). Raw influent wastewater before treatment can be as high as 500 mg/L of BOD, with some industrial and agricultural wastewater being in the thousands to 10's of thousands. The higher the influent BOD, the more bugs you need to treat the water.

4. **Final Clarifier-** The mixed liquor has reached the end of the aeration basin and is now sent to the secondary or final clarifiers. It must travel from the middle of the clarifier to the outer ring, allowing the heavier material to sink and the clarified water to proceed to the next step. The heavy settled material becomes RAS that is sent to the beginning of the aeration basin to be mixed with more incoming wastewater. It contains all the "good" bugs that will biologically clean the continuous flow of incoming wastewater. The clarified water is sent to be disinfected before being sent back out into the environment. Any material that did not settle in the final clarifiers is measured as Total Suspended Solids (TSS). Cleaner and clearer water will have a lower TSS. The Muscatine WPCP is not permitted to discharge over 30 mg/L of TSS.

5. **Disinfection-** The Muscatine WPCP uses UV disinfection for the effluent water sent to the Mississippi River. After final clarification, the water passes through the UV array where 254 nanometer wavelengths of UV attack the vital DNA of bacteria left in the water, making bacterial reproduction impossible. Bacteria have a short life span and must reproduce often, so the bacterial colonies quickly die. The Muscatine WPCP has used chlorine for disinfection in the past, but the chemicals are hazardous, dangerous to handle and require more hazardous chemicals to de-chlorinate. UV has no by product and is effective in seconds as opposed to 30 minutes of contact required by chlorine.

6. **Thickener Building-** A portion of the RAS is taken away to maintain a balance of "good" bugs being sent to the aeration basins. This is called Waste Activated Sludge (WAS). Since the main goal is to clean and return as much water as possible, the solid material in the water is removed by a solids separation device. There are many different kinds of

devices used for the efficient removal of solids from water and more are being invented all the time. The Muscatine WPCP uses a Dissolved Air Flotation (DAF) process that floats the solid material to the top of a large tank using small bubbles and skimming the thick material off the top. The water that is separated from the solids is then sent back to the beginning of the plant to be cleaned again. The thickened material is sent to the anaerobic digesters (See #7).

7. **Anaerobic Digesters-** Anaerobic means "without oxygen" (digesters can be aerobic as well where oxygen is added to promote digestion). The WAS from the thickener building along with the settled primary material and primary scum are all sent to the anaerobic digesters. Here the total mass of organic waste is reduced by biologically destroying volatile waste solids. These volatile solids carry the odor and disease causing agents most undesirable at a wastewater plant and in the environment. The anaerobic bacteria in the digester and incoming material mixture is heated to 95° Fahrenheit (35° Celsius) and maintained at a steady pH of 7.0. This creates the environment best suited for methanogenisis, which is a scientific term for "creating methane gas".

    - Methane gas (CH_4) has been identified as being 21 times more potent than carbon dioxide (CO_2) as a greenhouse gas. Principal sources of CH_4 are organic-rich sediments, ruminant animals and rice paddies. It has also been found to come from dental plaque of primates, termites, the Dead Sea, hot springs, black smoker vents at the ocean floor and most recently discovered from living plants under normal aerobic conditions (it has been shown that living plants emit some 10 to 1000 times more CH_4 than dead plant material. Investigation is on-going).

   When the anaerobic digesters are functioning properly, methane gas is produced that "raises the roof" quite literally. The covers on the digesters float on a pocket of methane gas, which is why they are called "floating covers". The roof levels will go up and down with CH_4 production. CH_4 gas burns and is also highly explosive. Great care is taken to release this gas and ensure that it is properly removed. A portion of this gas will be used to fire the boilers that heats the system to 95° F. The rest will be burned off and released to the atmosphere. Plans are currently in place to use this excess gas to power generators that can run other equipment at the plant.

8. **Digested Sludge Storage Tanks-** When sludge goes into the digesters, the same amount must be taken out. The sludge that is removed has been stabilized, meaning most of the

BOD has been removed. Since the highest concentration of BOD is fed to the digesters, they are the main source of BOD reduction in the plant and a vital process for returning material into the environment. This digested and stabilized sludge is tested for harmful pathogens (disease causing organisms), metals, volatile acids and other parameters. Once it has been determined that the sludge is acceptable according to strict state and federal rules, it is classified as a Class A, B or C (or I, II, III) biosolid. The Muscatine WPCP produces a Class B(II) biosolid, which is classified as safe for specific agricultural applications. This biosolid material is then pumped to two large lagoons across the Hwy 61 bypass. Here it is stored until the fall when fields have been harvested. It is then pumped to a tractor that injects the biosolid material 8 inches into the subsurface of the ground. Biosolids, the by-product of the wastewater treatment system, is a safe, organic and economical alternative to chemical fertilizers. It is highly sought after by farmers and is often sold commercially in other areas.

9. **Laboratory-** The laboratory supports the WPCP by testing plant and industrial samples. The WPCP needs to meet the limits of its NPDES Permit, which is mandated by the U. S. EPA and implemented by the Iowa DNR. The Laboratory is also certified by the Iowa DNR and has a Clean Water Certification. The plant performs testing for the NPDES Permit. These tests are BOD (biochemical oxygen demand), Total Suspended Solids (TSS), E. coli, Settleable Solids, Alkalinity and Volatile Organic Acids. The plant sends a sample out called a WETT Test, which determines the toxicity of the plants effluent by determining if small water animals, Daphnia, can survive in the effluent.

   The laboratory also performs testing for metals, Cyanide and Oil/Grease for the FOG program. We also support the Biosolids program for testing soils for metals, TKN, Ammonia, and Total Phosphorus. The Iowa DNR currently does not require our WPCP to test the effluent for the nutrients that discharge to the Mississippi River. In the future the nutrient testing will be required for our plant permit.

What **NOT** to Put Down the Drain

It is easy to forget that what we drain down our toilets, sinks, showers, washing machines, or dishwashers drains to a community sanitary sewer and on to the wastewater treatment plant. It may not seem like a big deal until raw sewage is filling up your basement or yard with all of your neighbor's odor and disease causing wastewater. Below is a list of items that should *not* be flushed or put down the drain:

- ✓ Personal Products- All of these items can clog pipes and cause raw sewage to overflow in your home or yard. Anything collected by the treatment process is sent to the landfill anyway, so flushing them simply creates problems at your house, neighborhood or local collection system.
  - Diapers and baby wipes
  - Flushable wipes- Most anything named "flushable" is not appropriate for the system.
  - Toilet bowl scrub pads
  - Dental floss
  - Hair- capture hair in the shower and sinks and dispose of in the trash
  - Mini/Maxi pads, tampons, tampon applicators, other feminine hygiene products
  - Condoms
  - Facial Tissues
  - Band-aids and bandages
  - Needles and sharps
  - Cotton balls, swabs and pads
  - Nail polish and polish remover
- ✓ ***Toilet paper and bodily waste is the only acceptable component that is safe to flush.***
- ✓ Fats, Oils and Grease- This alone causes most clogged sewer lines than anything else.
  - Meat Fats - Household grease should be poured into a non-recyclable container (if possible) and disposed of in the trash.
  - Cooking oil, butter, margarine, shortening.
  - Dairy products, creams and sauces.
  - Wipe grease and food from cookware and plates into the trash before washing.
  - Do *not* use the garbage disposal for large amounts of food or grease.
- ✓ **Medicine**- Prescription medications should not be flushed down the drain. Check with your pharmacy to see if they will take old prescriptions, or place in a zip lock bag and dispose of in the trash. The wastewater treatment plant will not degrade the medication and it will go to the local waterways.
- ✓ Motor Oil, Anti-freeze and other automotive products – It diminishes the effectiveness of the treatment process and contaminants can be discharged to the local waterways.
- ✓ Fertilizers, Pesticides and Chemicals
  - Fungicides, mothballs, bug sprays, weed killers and rat poison.
  - It is always best to buy household chemicals in the smallest size. If you do not use it, then pass it to a friend, neighbor or relative that can use the chemical.
- ✓ Paint
  - Latex paint is not considered hazardous. The paint can be dried out, or have an absorbent added to it, such as kitty litter and thrown into the trashcan.
  - Oil Based paint- These items include varnish, turpentine, paint thinner, primers, and auto or model paints. Take these to a local recycling center for proper disposal.
- ✓ Other household items
  - Swiffers
  - Paper Towels, facial tissue and napkins
  - Kitty litter
  - Cigarette butts
  - Gum
  - Any plastic material

Form 30 Part A (13a)(13d)(14 a-e)

Influent metering with Parshall Flume

Primary sludge pumped to Anaerobic Digesters

Roughing/Trickling Filter

Blue arrows indicates path of flow through the plant

Digested sludge pumped to Biosolid Lagoons 1.75 miles off site (see attached).

Primary Effluent composite sampling.

5 Blowers for aeration basins.

Digester sludge recirculation, heating and pumping to Digested Sludge Storage Tanks.

Effluent pumping and effluent composite sampling.

Aeration Basin Splitter Box and RAS return

Influent Head-box, (see attachments) and influent composite sampling.

RAS to Thickener Building

UV Disinfection

Effluent to Mississippi Outfall (see attached)

RAS pumped to Aeration Splitter Box

Diffused Air Flotation thickened WAS pumped to Anaerobic Digesters

Influent from Industrial Park and Stewart/Sampson (see attached Head Box identification)

Influent from Papoose and Sunset (see attached Head Box indentification)