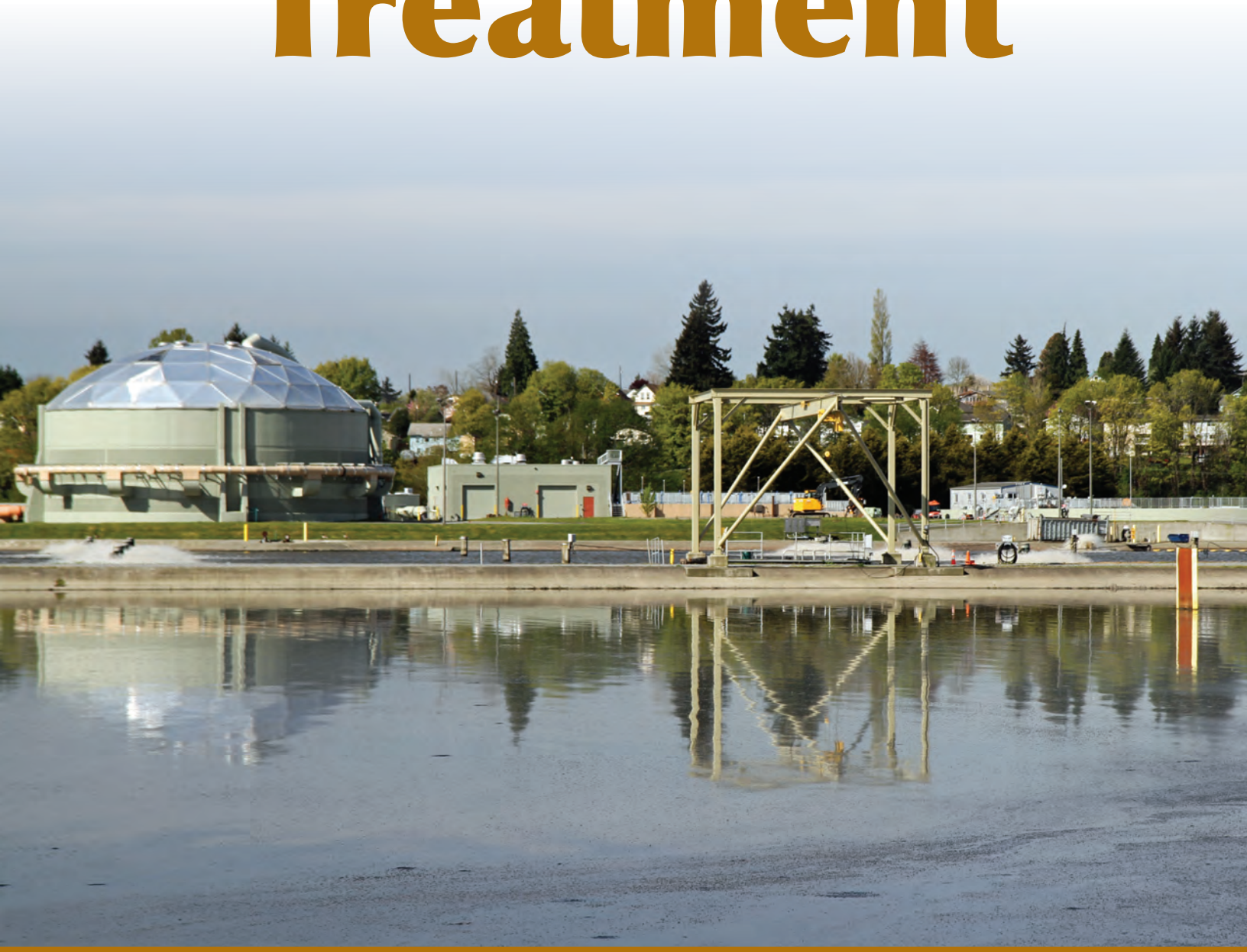
Learning About Water:

# Wastewater Treatment



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# Introduction

Have you ever wondered what happens when you flush the toilet or when soapy bathwater goes down the drain? This booklet is designed to answer those questions and more.

***When you have finished the booklet you will have learned:***

- How individual actions affect wastewater
- How wastewater is treated
- What substances cause problems for the wastewater treatment process or the collection system
- What substances are not entirely removed by wastewater treatment
- Where biosolids come from and how they are reused
- Key vocabulary words related to wastewater

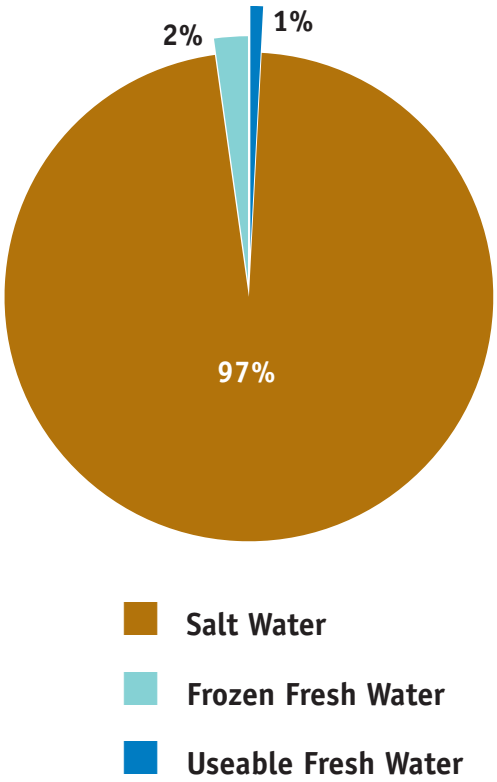
# Wastewater – Part of the Water Cycle

About 70 percent of the Earth's surface is covered with water, most of which is salt water in the oceans and seas.

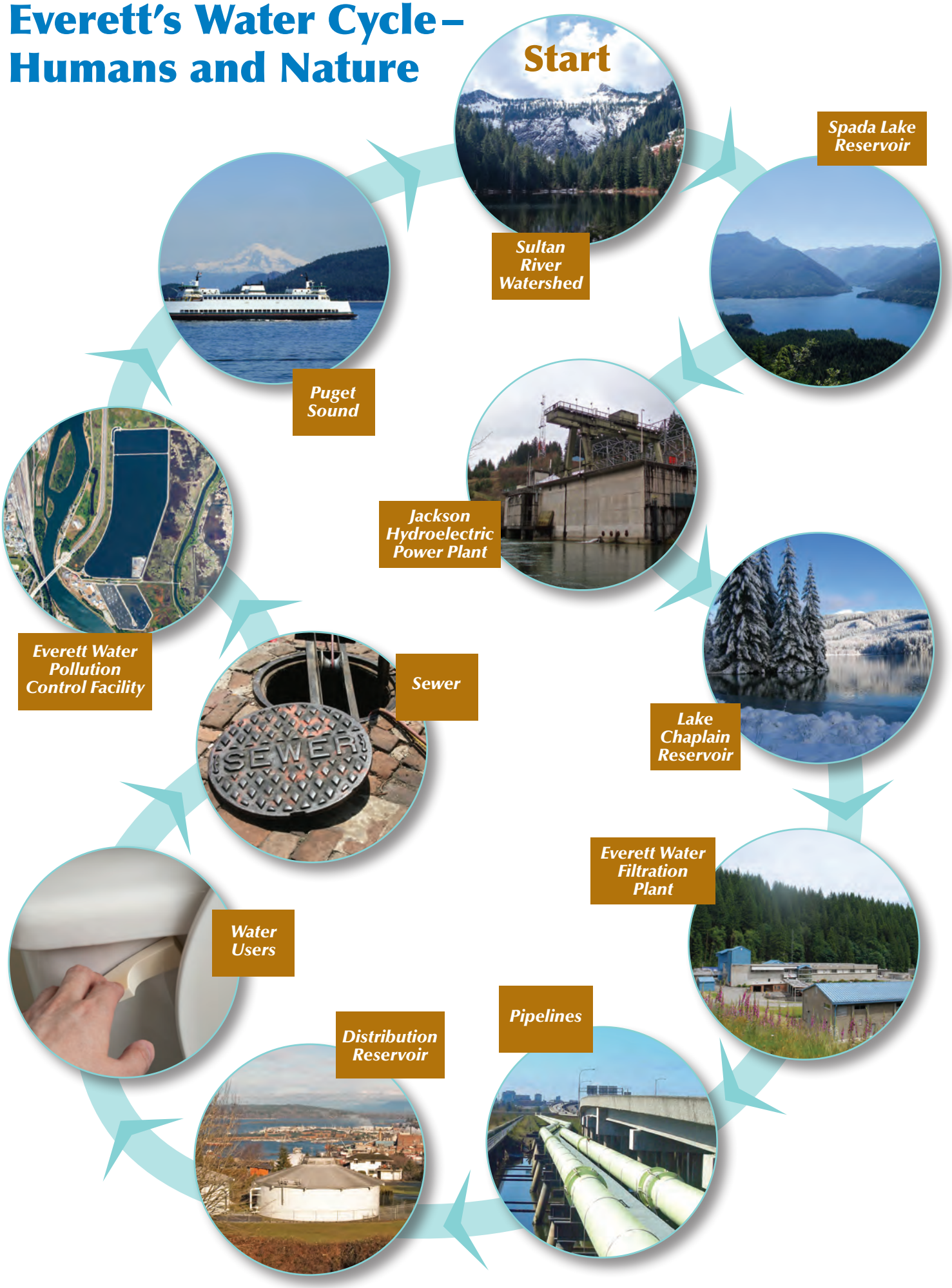
Only about one percent of all the water on the Earth is fresh water that is available for human use.

Water repeatedly flows through the water cycle. As it flows it picks up sediments and natural wastes. Nature can easily handle the job of removing these natural pollutants. However, nature isn't able to remove all of the pollutants contributed by humans.

Manmade facilities such as the Everett Water Filtration Plant, where drinking water is treated, and the Everett Water Pollution Control Facility, where wastewater is treated, are an important part of the water cycle in our area.

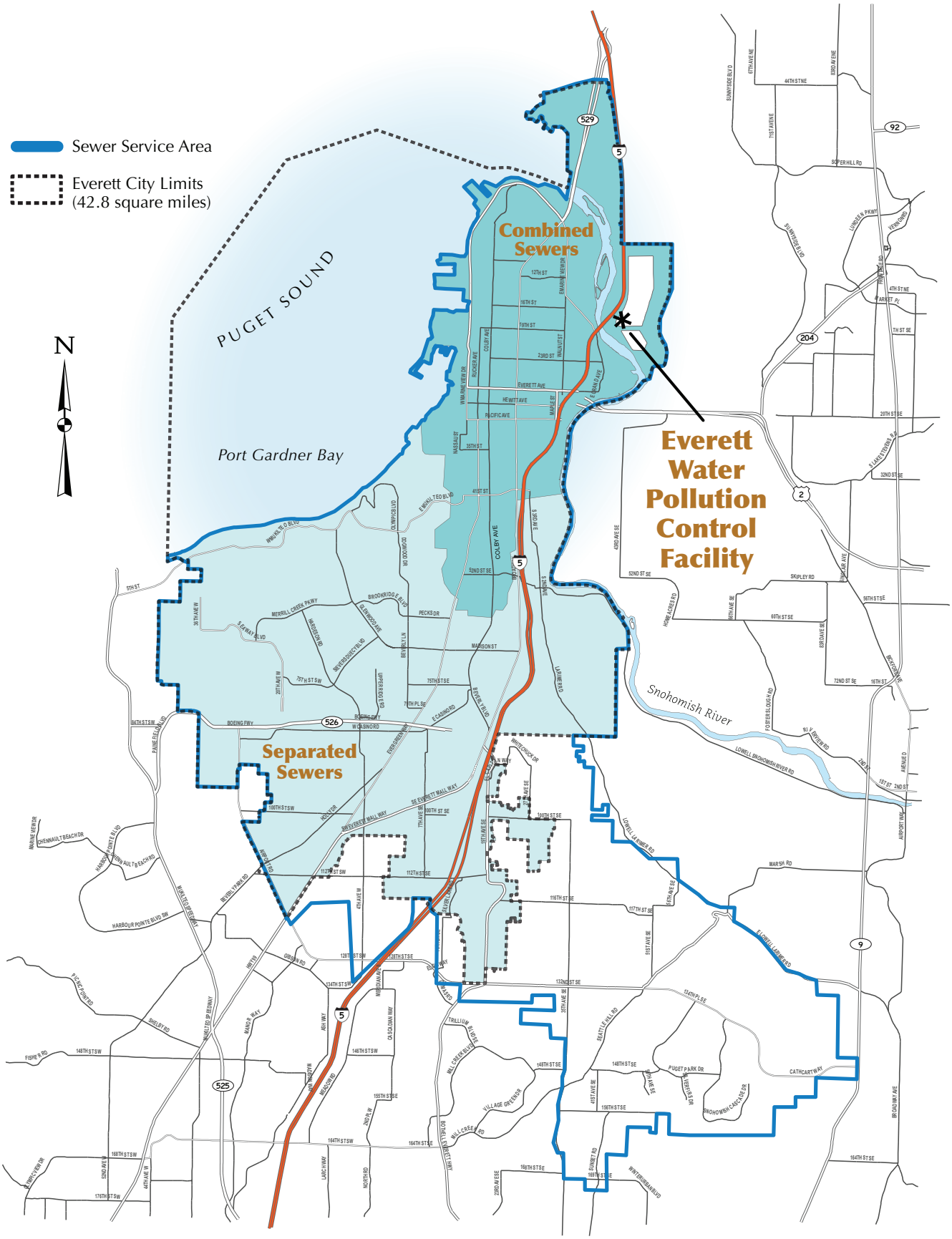


# Everett's Water Cycle – Humans and Nature



# Sewer System Service Area

The Everett Water Pollution Control Facility (EWPCF) is located on Smith Island in north Everett. It serves all of the city of Everett, and parts of Alderwood Water and Wastewater District, Mukilteo Water and Wastewater District and Silver Lake Water and Sewer District.



# Wastewater System Highlights

In 1890, the first clay sewer pipes were installed along Broadway Avenue. The city incorporated in 1893 and a few years later construction began of the first citywide sewer system. The original system was a combined sewer system that collected wastewater and stormwater and discharged the combined wastewater into the Snohomish River.

As the city grew an improved wastewater treatment system was needed. Major construction highlights of Everett's wastewater treatment system include:

- **1959** Oxidation and polishing ponds 2 3
  Effluent discharge – north river outfall 6
- **1972** North contact channel – disinfection 4
  Aeration pond 1
- **1984** Headworks – bar screens and grit collectors 1
- **1991** Biological trickling filters, aeration tanks and secondary clarifiers 1 3 4
  South contact channel – disinfection 5
  Trickling filter bar screen 4
- **1994** North effluent pump station 5
- **1998** Headworks biofilter – odor control 2
- **2002** South effluent pump station 6
  Effluent discharge – pipeline to Port Gardner Bay outfall 7
- **2005** Primary settling tanks and skimmers 3
  Primary biofilter – odor control 5
  Secondary biofilter – odor control 2

Everett continues to upgrade and expand the Everett Water Pollution Control Facility to meet the needs of the growing population.

## True or False?

**DIRECTIONS:** Circle **T for true** by the true statements and **F for false** by the false statements.

| | | |
|---|---|---|
| 1. The preliminary treatment – headworks facility was constructed in 1970. | T | F |
| 2. The pond system provides secondary treatment. | T | F |
| 3. The south contact channel provides disinfection for the pond system. | T | F |
| 4. The first sewer pipes were made of clay. | T | F |
| 5. The secondary treatment – mechanical system uses biological trickling filters, aeration tanks and secondary clarifiers. | T | F |

# The Everett Water Pollution Control Facility (EWPCF)

All of the wastewater arriving at the EWPCF flows through preliminary and primary treatment.

### *Preliminary treatment*

1. Headworks – bar screens and grit collectors
2. Headworks biofilter – odor control

### *Primary treatment*

3. Primary settling tanks and skimmers
4. Trickling filter barscreen
5. Primary biofilter – odor control

Then some of the wastewater flows through the pond system.

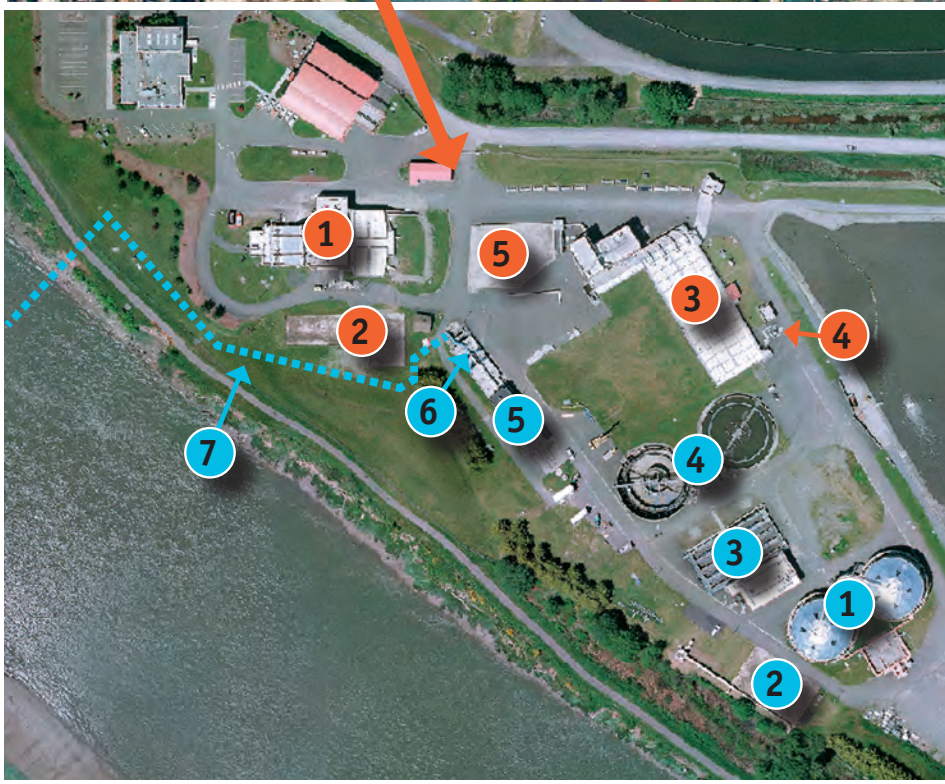
### *Secondary treatment: the pond system*

1. Aeration pond
2. Oxidation pond
3. Polishing pond
4. North contact channel – disinfection
5. North effluent pump station
6. Effluent discharge – north river outfall

And some of the wastewater flows through the mechanical system.

### *Secondary treatment: the mechanical system*

1. Biological trickling filters
2. Secondary biofilter – odor control
3. Aeration tanks
4. Secondary clarifiers
5. South contact channel – disinfection
6. South effluent pump station
7. Effluent discharge – pipeline to Port Gardner Bay outfall



# About Wastewater

## What is wastewater?

Wastewater is water that contains pollutants produced by humans. Sewage is part of wastewater and refers to wastewater that carries human waste.

## Where does wastewater come from?

Wastewater comes from homes, schools, businesses and industries. It is used water that comes from sinks, showers, bathtubs, toilets, dishwashers, clothes washers and floor drains. Wastewater is about 99 percent water and 1 percent solids and dissolved materials.

## Where does wastewater go?

When wastewater goes down a drain or toilet it enters a system of pipelines that carry it to the wastewater treatment plant for cleaning. Everett's wastewater treatment plant is called the Everett Water Pollution Control Facility (EWPCF).

## How does wastewater get to the EWPCF?

Wastewater travels to the EWPCF through about 334 miles of sewer pipes, some up to six feet in diameter. There are 33 lift stations located throughout the system that push the wastewater to help keep the flow moving to the plant.

## How much wastewater are we producing?

Each person produces an average of 75 to 100 gallons per day of used water. The rest of the wastewater flow comes from businesses, industries and stormwater. The EWPCF serves more than 160,000 customers and treats an average of 20 million gallons of wastewater per day. On rainy days the influent volume can increase to more than 100 million gallons.

## Why do we mention stormwater?

In Everett's combined sewer area, water that flows down the storm drains mixes with wastewater in a combined pipeline and is carried to the EWPCF for treatment. In the rest of Everett, water that flows down storm drains is not treated and flows directly into creeks, ponds, streams, lakes and Puget Sound.

**Did you know?**

The treatment processes described in this booklet are for normal or lower wastewater flows. When flows are high there are overflows and bypasses that route the wastewater to the pond system for storage and treatment.

# Making the Connection to Source Control

Water pollution control begins at homes, schools, businesses and industries when sinks, showers, bath tubs, toilets, dish washers, clothes washers and floor drains are used. Controlling what does and does not go down the drain is called source control.

When hair and fats, oils and grease (FOG) go down the drain they can cause problems for wastewater systems in homes, the collection system and at the wastewater treatment plant. Other items such as feminine hygiene products, paper towels, flushable wipes, dental floss and cotton swabs don't breakdown or dissolve quickly. Once down the drain, these items can wrap around a moving part of the system and cause the part to slow down or stop moving.

Cleaning out items that cause clogs or sewer backups can be expensive.

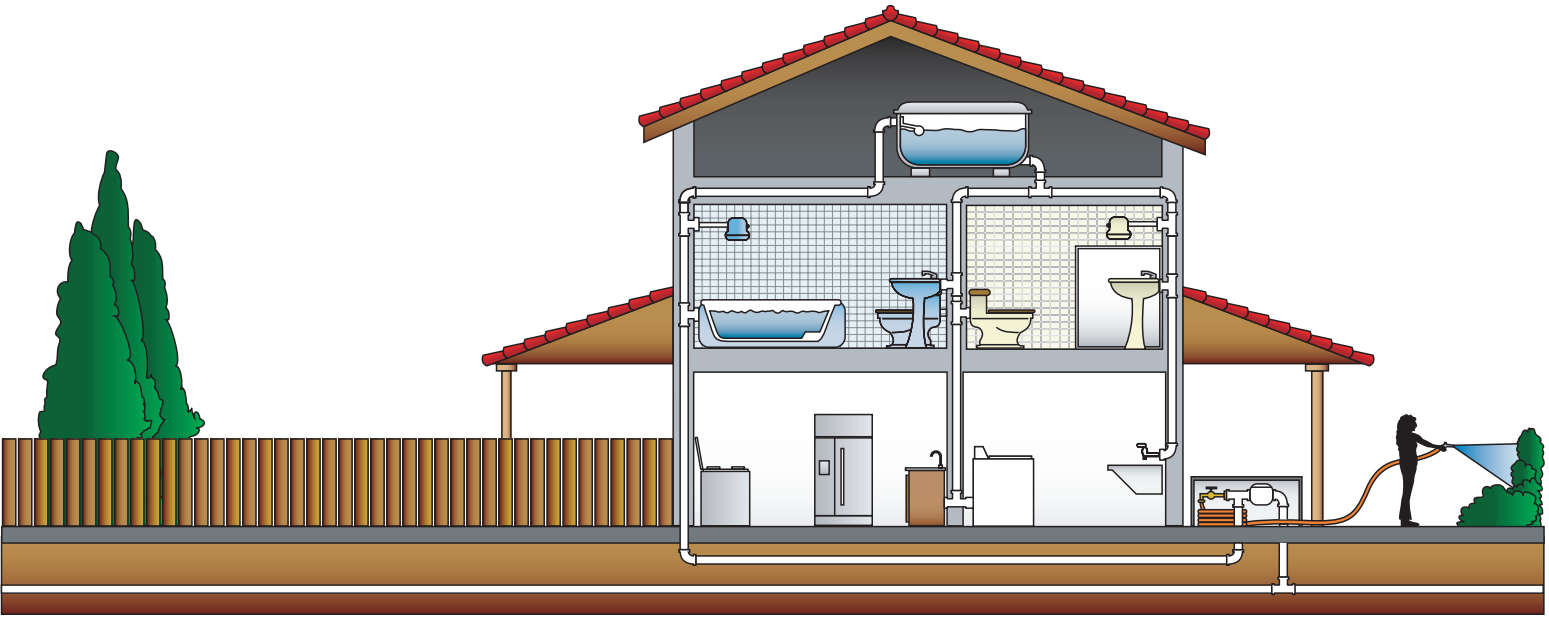
Some chemicals from personal care products, home and yard products, and unused medicines and vitamins are not entirely removed during wastewater treatment. What isn't removed eventually ends up in Puget Sound.

## *What can you do to help?*

You can control what items enter the wastewater system at the source. Before you put something down a drain or the toilet, ask yourself if there is a better way to dispose of the item. You can also decide to use products that are safer for the environment whenever possible.

**DIRECTIONS:** List seven things that can clog the pipes in your home and in the city's sewer system.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____



# Preliminary Treatment: Headworks – Bar Screens and Grit Collectors

Preliminary treatment takes place at the headworks, the first stop in the wastewater treatment process. Preliminary treatment is a physical process that uses bar screens and grit collectors to remove debris and heavy solids.

**Bar screens** remove organic and man-made debris such as trash, sticks, rocks, leaves, toys, feminine hygiene products, cloth and paper products (informally called rags) and even dead animals. The screenings are collected and sent to a landfill.

After the large debris is removed by bar screens, small materials such as sand and coffee grounds settle to the bottom of the **grit collectors**. They are then removed and sent to a landfill.

**DIRECTIONS:** Complete each sentence by filling in the blanks.
***Hint:*** Look for the answers above.

1. Three things that bar screens remove are _____ , _____ , and_____ .

2. Small materials such as _____ and _____ _____ settle to the bottom of the grit collectors.

3. Items collected by the bar screens and grit collectors are removed and sent to a _____ .

# Primary Treatment: Primary Settling Tanks and Skimmers

Primary treatment is a physical process that uses primary settling tanks and skimmers to remove 40 to 60 percent of pollutants.

In the **primary settling tanks** wastewater flows are slowed down. This allows solids that weren't removed during preliminary treatment to sink to the bottom of the primary settling tanks.

These settled solids are then pumped to the aeration pond for secondary treatment. Once in the aeration pond they are digested by microorganisms and later removed to become biosolids.

**Skimmers**, located inside the primary settling tanks, remove fats, oils and grease (FOG) that float to the surface where they are skimmed off and sent to a landfill.

**DIRECTIONS:** Solve the message puzzle by using the message puzzle decoder to learn what you can do to help. Locate each brown letter on the decoder, then write the corresponding black letter on the space provided.

*Message Puzzle Decoder*

| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | G | L | U | N | W | O | B | T | P | I | M | Q |

| N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | R | E | H | S | V | X | D | Z | F | K | J | Y |

| _ _ _ _ | _ _ _ _ | _ _ _ | _ _ _ _ _ _ _ | _ _ _ | _ _ | _ _ _ | _ _ _ _ _ _ _. |
|---|---|---|---|---|---|---|---|
| X P P J | Q A K O | A E U | B O P A R P | G D I | G W | I Q P | U O A K E R |

# Secondary Treatment: The Pond System

Secondary treatment is a biological process that uses oxygen, bacteria and other microorganisms (informally called tiny bugs) to remove dissolved and suspended pollutants from wastewater. The Everett Water Pollution Control Facility uses a pond system and a mechanical system to perform secondary treatment.

In Everett's pond system the wastewater flows through aeration, oxidation and polishing ponds, before flowing into the north contact channel for disinfection.

## *The pond system treats wastewater in a few weeks.*

The **aeration pond** is the first stop for wastewater in the pond system. Here aerators mix the water and add oxygen for the microorganisms that consume the pollutants. When their job is done the microorganisms settle to the bottom with digested waste while the wastewater flows to the oxidation pond. The sediment removed from the aeration pond becomes biosolids that are safe for reuse as fertilizer.

The **oxidation pond** is the next stop for the wastewater flowing through the pond system. It allows for more biological activity and settling.

The **polishing pond** provides even more biological treatment for the wastewater and is the last stop before it enters the north contact channel for disinfection.

**DIRECTIONS:** Write the answer in the blank. ***Hint:*** Unscramble the clue to find the answer.

1. _____ treatment is a biological process. **CODRASNEY**

2. _____ are used as fertilizer. **BISILOSDO**

3. _____ consume pollutants. **NRROSGOCIMMSIA**

# Secondary Treatment: The Mechanical System

Biological Trickling Filter

Aeration Tanks

Secondary Clarifiers

In Everett's mechanical system wastewater flows through biological trickling filters, aeration tanks and secondary clarifiers before flowing into the south contact channel for disinfection. The biological trickling filters are flushed daily to maintain their effectiveness.

## *The mechanical system treats wastewater in a few hours.*

In the **biological trickling filters** wastewater is sprayed onto plastic media designed to provide surface area and air flow. Microorganisms (informally called tiny bugs) grow on the media and consume pollutants as the water trickles down through the media. As the microorganisms grow and get full, they are washed into the aeration tanks.

Microorganisms continue feeding on pollutants in the **aeration tanks**. Blowers inject oxygen to help keep the microorganisms as active as possible.

In the **secondary clarifiers** slow moving water allows floc, microorganisms and suspended solids that have formed into clumps, to settle to the bottom of the tank. Most of the microorganisms are recycled back to the aeration tanks, however some of them are sent to the aeration pond.

Primary and secondary treatment remove up to 99 percent of most pollutants. Some of the pollutants that can't entirely be removed come from chemicals in personal care products, home and yard care products, and unused medicines and vitamins.

**DIRECTIONS:** Write the answer in the blank. ***Hint:*** Unscramble the clue to find the answer.

1. In the _____ tanks, blowers inject oxygen to help the bugs stay active. **AAREONIT**

2. Microorganisms feed on _____ . **TOAPLNULTS**

3. In the biological trickling filter, wastewater trickles down _____ _____. **MADCASPLTIEI**

# Disinfection

The disinfection process is a chemical process that uses sodium hypochlorite, similar to chlorine bleach, to eliminate any remaining disease-causing microorganisms, called pathogens.

In the pond system wastewater travels through the **north contact channel** where sodium hypochlorite is added. Next, treated wastewater, called effluent, is dechlorinated by adding a very small amount of sodium bisulfite, a chemical that neutralizes the sodium hypochlorite. Then it is discharged to the Snohomish River through a set of 12 diffusing pipes buried in the riverbed. The effluent mixes with the Snohomish River water and is eventually carried to Puget Sound.

*North Contact Channel*

*South Contact Channel*

In the mechanical system, sodium hypochlorite is added to the wastewater in the **south contact channel**. As the effluent travels through pipes the sodium hypochlorite dissipates before the effluent is discharged to Puget Sound.

**DIRECTIONS:** Unscramble each of the clue words. Copy the letters in the numbered cells to other cells with the same number to reveal the water quality message.

1. **CIIFIENSDNTO**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| 9 | | 5 | | | | | | 11 | | | |

2. **SEWRATEWTA**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | 15 | | | | | | 3 | 13 |

3. **IUMODS REYCOPHILTHO**

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | |
| 10 | | | | 7 | | | | 1 | 6 | | 16 | | | 18 | | | |

4. **SISTEIPAD**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | 12 | 4 | 17 |

5. **LEFNUTFE**

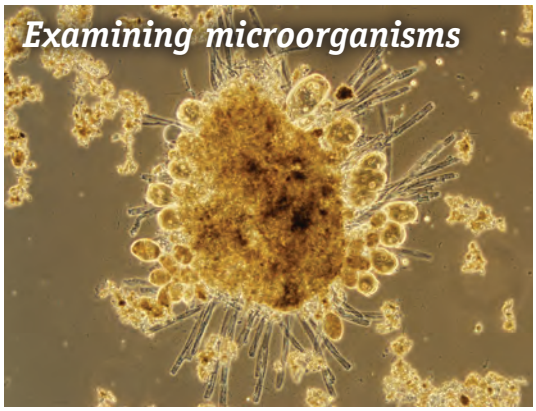
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | 2 | 19 | 8 | 14 |

*Water Quality Message:*

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | G | | | | | | | | | | | | | | | | | |
| 1 | 2 | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

# Quality Control

*Testing suspended solids*


*Examining microorganisms*

*Preparing to test bacteria*

Quality Control is an important part of the wastewater treatment process. Wastewater flowing through the Everett Water Pollution Control Facility (EWPCF) is monitored daily at every stage of this cleaning process at the Environmental Laboratory. Since wastewater never stops flowing to the EWPCF, operations, maintenance, testing and analysis occur around the clock, 365 days a year.

Because the quality of the wastewater has to meet standards and regulations administered by the Washington Department of Ecology and the Washington Department of Health, the laboratory is accredited by these agencies.

The volume and chemical makeup of the wastewater arriving at the plant is always changing. The laboratory analysts conduct a wide range of sampling and testing on the wastewater and the solids. Some of the instruments they use can detect traces of substances down to less than one part of pollutant per a billion parts of water. The information from this testing and analysis is used by wastewater treatment plant operators to make adjustments throughout the treatment process to make sure the wastewater is treated effectively.

**DIRECTIONS:** Complete the sentence. Draw a line to connect the sentence beginning in the left column with the correct ending in the right column.

| | |
|---|---|
| 1. Everett's Environmental Laboratory is accredited by the | a. changing. |
| 2. Wastewater is monitored at every stage of the | b. adjustments. |
| 3. The chemical makeup of wastewater arriving at the plant is always | c. Washington Department of Ecology and the Washington Department of Health. |
| 4. Treatment plant operators must be able to make | d. cleaning process. |

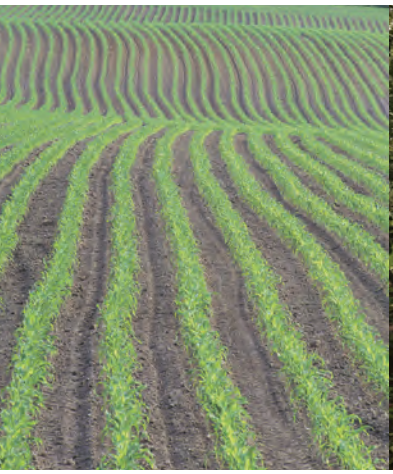
# Biosolids

Biosolids are the nutrient-rich product of the wastewater treatment process and are recycled and reused to enhance soil conditions. Biosolids are made up of bacteria and microorganisms plus digested wastes that settle to the bottom of the aeration pond during secondary treatment. Biosolids contain essential plant macronutrients including nitrogen, phosphorus and sulfur. They also include plant micronutrients such as zinc and copper.

Long-term scientific studies repeatedly demonstrate that it is safe to recycle and reuse biosolids. Monitoring of biosolids, soils, water resources and plants grown using biosolids, continues to show benefits from recycling. This monitoring is the basis for federal and local biosolids regulations designed to protect public and environmental health.

Biosolids from the Everett Water Pollution Control Facility are used to improve the soil in areas depleted by mining or construction. They help reclaim the land by rebuilding topsoil, increasing the growth of vegetation and reducing erosion. They are also used in forestry and agriculture. In the Pacific Northwest, they are used on a variety of crops including wheat, barley, canola, hops, silage corn, hay and orchards.

The dewatered biosolids generated in Everett's wastewater treatment process are a semi-solid form called cake that is similar in consistency to firm Jell-O. Farmers typically apply them with a calibrated manure spreader pulled behind a tractor and till them into the soil. Application rates are carefully designed to meet the needs of individual crops. When farmers use biosolids, they are able to reduce or eliminate the need to use higher cost chemical fertilizers.



**The three Rs of waste management are reduce, reuse and recycle. Practicing the three Rs every day is a great way to keep our environment healthy.**

**DIRECTIONS:** Fill in the blanks to list the three Rs of waste management.

1. R ___ ___ ___ ___ ___
2. R ___ ___ ___ ___
3. R ___ ___ ___ ___ ___ ___

# A Word about Wildlife

The Everett Water Pollution Control Facility (EWPCF) is situated on the Snohomish River and surrounded on three sides by wetlands. Canada geese and other waterfowl, including some birds rarely seen in Washington, nest or stopover on the grounds. Large birds of prey such as red-tailed hawks, falcons and bald eagles are frequently seen circling the skies above the facility or perched on trees around the ponds. Deer and smaller animals can also be seen in the area.

The Snohomish River provides a habitat for migrating salmon and steelhead as well as smaller fish such as cutthroat and Dolly Varden trout. Otters and great blue herons can often be seen searching for a meal along the river banks or in the Snohomish estuary's sloughs and wetlands as the river empties into Port Gardner Bay.

The City of Everett takes pride in protecting the habitat of fish and other wildlife. The EWPCF is really a man-made component of the water cycle in the water environment of the Snohomish estuary.

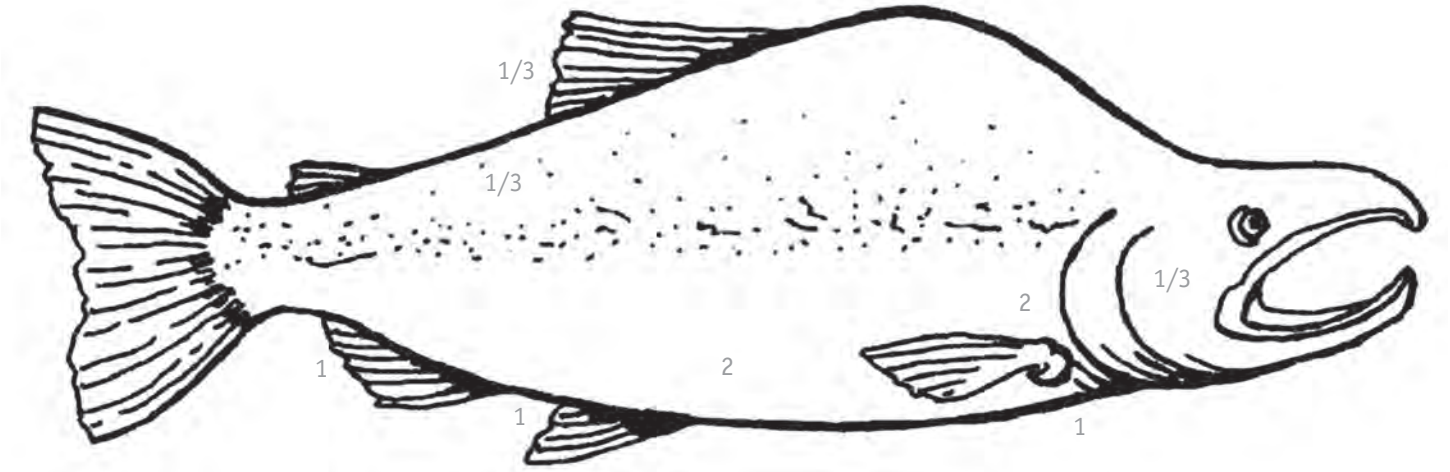
## Did you know?

There are five species of native salmon that live in the Snohomish River system, which includes the Skykomish and Snoqualmie River watersheds. They are commonly called Chinook, coho, pink, chum and sockeye. Chinook are listed as "threatened" under the Endangered Species Act.

The salmon below is a pink salmon.

**DIRECTIONS:** Color the salmon using the color key.

1. **Olive Green**
2. **Salmon Pink**
3. **Turquoise Blue**



# Industrial Pretreatment

Most of the pollutants found in wastewater that comes from homes, schools, businesses and industries can be removed by the Everett Water Pollution Control Facility (EWPCF). However, some industries produce wastes that cannot be completely removed by the city's treatment processes. They are required to "pre-treat" their wastewater to remove these contaminants before they send the wastewater to the EWPCF.

In 1987, the Everett Industrial Pretreatment (IPT) Program was started to help industries find ways to remove pollutants from their wastewater. The IPT program monitors them to help keep pollutants such as acids, solvents and heavy metals from entering the city's sewer pipes.

IPT also inspects restaurants and other food services to help them reduce the amount of fats, oils and grease (FOG) that go down kitchen drains. FOG allowed to enter sewer lines are common causes of the overflow of those sewer lines. Buildups increase maintenance costs for both businesses and the city. The best way to control FOG is by removing fats, oils and grease before washing dishes.

**DIRECTIONS:** Fill in the blanks to list common causes of sewer overflows.

1. F _ _ _
2. O _ _ _
3. G _ _ _ _ _

# What Choices Are You Making?

**DIRECTIONS:**

Circle **"YES"** next to each sentence if the action HELPS or is a GOOD use of the wastewater system.

Circle **"NO"** next to each sentence if the action DOES NOT HELP or is NOT A GOOD use of the wastewater system.

| | | |
|---|---|---|
| 1. Hair removed from a hair brush is flushed down the toilet. | **YES** | **NO** |
| 2. Hair is cleaned out of a hair brush and placed in a trash can. | **YES** | **NO** |
| 3. After grease in a fry pan has cooled, it is wiped out of the pan with a paper towel or other paper and placed in a trash can. | **YES** | **NO** |
| 4. Hot water is used to rinse grease in a fry pan down the sink drain. | **YES** | **NO** |
| 5. Used dental floss and cotton swabs are flushed down the toilet. | **YES** | **NO** |
| 6. Used dental floss and cotton swabs are placed in a trash can. | **YES** | **NO** |
| 7. Leftover medicine is flushed down the toilet. | **YES** | **NO** |
| 8. Used paper products such as paper towels, tissues and wet wipes are flushed down the toilet. | **YES** | **NO** |
| 9. Toilet paper and human wastes are flushed down the toilet. | **YES** | **NO** |
| 10. Hair is trapped in a shower drain strainer that prevents it from going down the drain. | **YES** | **NO** |

# Household Hazardous Waste and Unused Medicines

Some products that are used in home and yard care are hazardous and are referred to as household hazardous waste (HHW). The easiest way to tell if a product is hazardous is to look at its label. If it is hazardous one of these signal words will be on the label, DANGER, POISON, CAUTION or WARNING. The label may also describe the way a product is hazardous with one of these words: TOXIC, FLAMMABLE, CORROSIVE or REACTIVE. Examples of HHW products are: drain cleaner, oven cleaner, furniture polish, some leftover paints, stains, varnishes, solvents and pesticides.

Wastewater treatment plants are not designed to handle certain kinds of HHW and it is important that they are disposed of properly. Leftover amounts of these products should never be disposed of down a drain inside or outside of the house. Improper disposal also includes pouring them on the ground and in some cases putting them out with the trash.

The best way to dispose of HHW is to take the items to the Snohomish County Hazardous Waste Drop-off Station located at 3434 McDougall Ave. in Everett. The station is open Wednesday-Saturday from 7:30 a.m. to 4 p.m. The telephone number is: 425-388-6050. To learn more about HHW go to this website: http://snohomishcountywa.gov/477/Hazardous-Waste.

Because unused prescription drugs, over-the-counter medicines and vitamins can't be entirely removed in the treatment process, they should be disposed of at an established prescription drug drop-off location such as a law enforcement site or pharmacy. To learn what items are accepted and where, go to this website: http://snohomishcountywa.gov/541/Pharmaceutical-Medical-Waste.

---

**DIRECTIONS:** List the four signal words that are found on labels of hazardous household products.

1. _____
2. _____
3. _____
4. _____

**DIRECTIONS:** List four words that describe the way a product is hazardous.

1. _____
2. _____
3. _____
4. _____

# Summary

Wastewater treatment begins at a drain or toilet in a home, school, business or industry. When you or someone else decides what does and does not go down a drain, it is referred to as source control.

After wastewater arrives at the Everett Water Pollution Control Facility, the wastewater goes through a system of steps:

1. Preliminary treatment: bar screens and grit collectors
2. Primary treatment: settling tanks and skimming machines
3. Secondary treatment:
   - pond system – aeration, oxidation and polishing ponds
   - mechanical system – biological trickling filters, aeration tanks and secondary clarifiers
4. Disinfection: addition of sodium hypochlorite

There are many items that can cause problems for wastewater systems in homes, the collection system and at the treatment plant. The best way to avoid clogs, which can be expensive to fix, is to keep problem causing items out of the drains.

Wastewater treatment plants can remove up to 99 percent of the pollutants in wastewater. However, the pollutants that can't be removed eventually end up in Puget Sound.

Biosolids are a nutrient-rich product of secondary wastewater treatment that can be recycled and reused to enhance soil conditions.

Your actions can help or harm the system.

## *We need your help.*

- Keep hair, fats, oils and grease (FOG), feminine hygiene products, paper towels, flushable wipes, dental floss and cotton swabs out of the system.
- Keep home and yard care chemicals and unused medicines and vitamins out of the system.
- Reduce, reuse, recycle.

# Word Search

The words listed below are hidden in the puzzle. They are arranged forward, backward, horizontally, vertically and diagonally.

**DIRECTIONS:** Find and circle the words.

1. aeration
2. biological treatment
3. biosolids
4. bugs
5. clarifiers
6. disinfection
7. dissipate
8. dissolved
9. effluent
10. floc
11. grit
12. influent
13. macronutrient
14. microorganism
15. oxidation
16. pathogen
17. primary
18. secondary
19. sediment
20. sewage
21. sodium bisulfite
22. storm drains
23. suspended
24. wastewater
25. wastewater treatment

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | L | S | J | T | Z | S | I | D | N | D | S | F | D | K | A | X | E | F | E | F | X | U | Q |
| M | E | T | E | O | N | N | R | O | S | H | L | M | L | M | D | S | G | D | T | W | L | Q | T |
| C | C | T | A | W | F | E | I | E | T | V | S | W | A | E | R | O | S | R | I | X | X | J | T |
| Q | B | K | A | L | A | T | M | I | T | I | R | U | Q | E | O | P | U | L | F | R | O | K | N |
| D | X | O | U | W | A | G | B | T | N | I | D | Z | I | Z | X | R | S | G | L | D | W | D | E |
| C | Q | E | H | D | E | Y | E | A | A | I | Z | F | V | O | N | N | P | M | U | I | U | J | I |
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| T | W | X | L | K | Z | R | S | I | F | R | R | A | I | O | C | L | N | V | I | S | Y | T | T |
| B | O | L | T | G | O | H | N | A | A | S | X | T | G | A | B | B | D | B | B | I | N | P | U |
| M | F | X | W | O | C | F | P | L | W | R | Y | X | R | E | T | V | E | U | M | P | O | H | N |
| C | E | W | R | E | E | O | C | O | A | Q | J | H | S | E | J | O | D | G | U | A | I | D | O |
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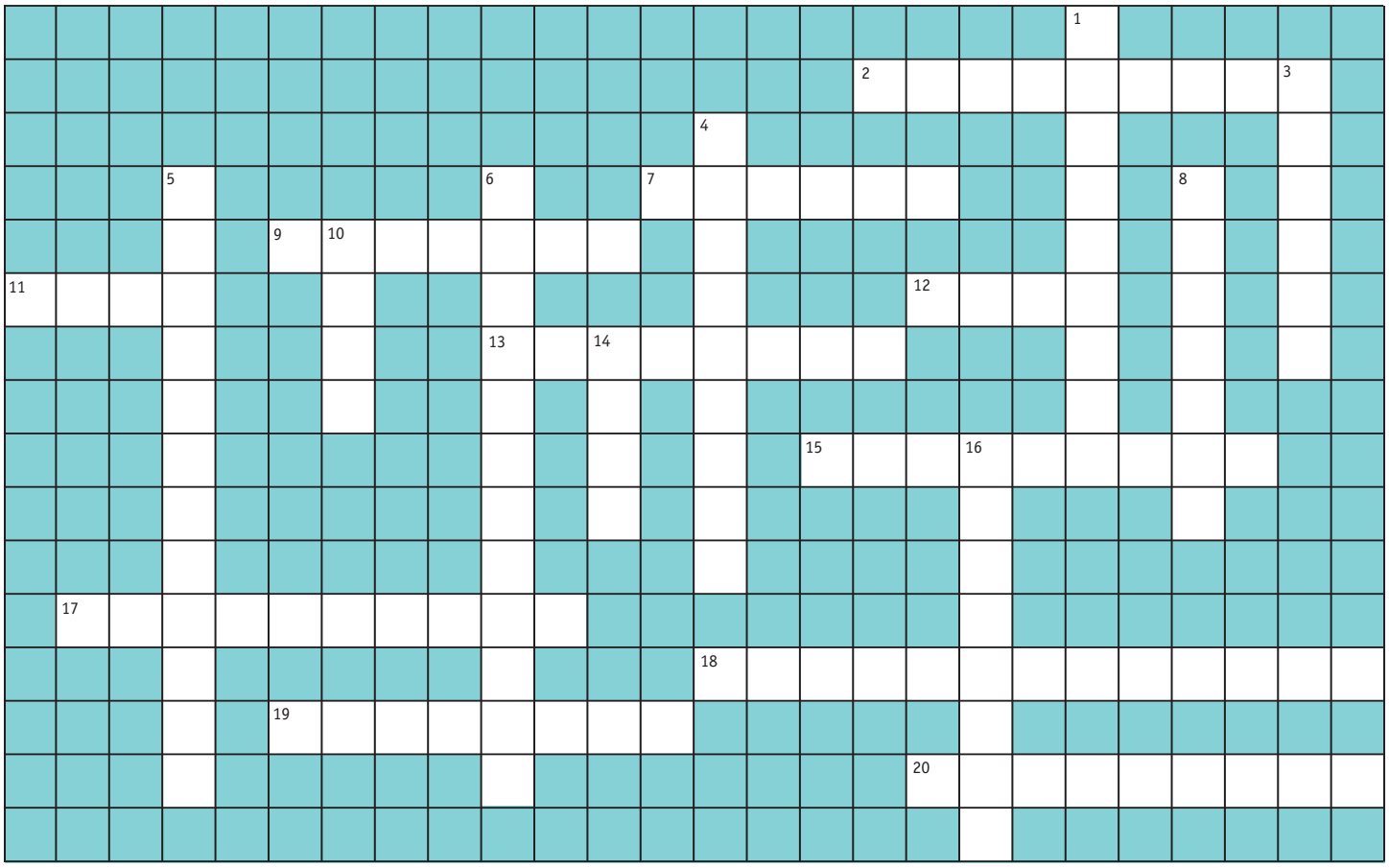
| R | I | X | T | P | R | I | M | A | R | Y | A | R | I | S | M | A | P | N | D | E | A | U | C |
| M | W | I | O | V | H | Y | T | F | M | K | K | I | L | G | E | F | W | Y | O | I | R | X | A |
| O | O | D | U | C | C | L | T | F | G | P | J | E | O | N | F | C | S | E | S | O | E | Q | M |
| N | N | E | I | X | P | D | Y | L | Z | H | U | N | S | E | E | L | O | E | T | N | A | Y | N |
| A | S | N | I | A | R | D | M | R | O | T | S | D | O | K | J | G | D | N | F | S | D | O | M |
| M | Q | G | B | A | R | S | J | G | N | O | W | B | I | P | F | M | O | P | D | B | A | S | O |
| T | I | R | G | V | Z | M | D | Y | M | Q | A | I | B | H | L | U | N | H | Q | A | C | W | F |
| K | P | Z | J | L | T | Q | G | Q | D | Z | A | F | X | J | E | C | N | C | T | I | R | L | T |
| T | N | E | M | T | A | E | R | T | L | A | C | I | G | O | L | O | I | B | L | A | O | Y | U |
| I | X | V | R | W | V | Q | S | E | D | I | M | E | N | T | N | T | O | D | N | C | P | Q | B |
| N | B | Y | K | S | A | V | B | H | X | Q | G | W | W | Z | Z | U | Y | K | Z | F | T | X | W |
| T | N | E | U | L | F | F | E | N | H | J | R | W | Z | F | O | F | B | O | R | L | D | O | K |

# Crossword Puzzle

**DIRECTIONS:** Use your word knowledge to complete the crossword puzzle.
***Hint:*** Review the glossary for clues.



### *ACROSS*

2. nutrient-rich product of the wastewater treatment process used as fertilizer
7. the place where you decide what does and does not go down the drain
9. the stage of wastewater treatment that uses settling tanks and skimmers to remove pollutants
11. a common informal or slang term used for microorganisms
12. sediment such as sand and coffee grounds taken out of wastewater during treatment
13. treated wastewater that is recycled back to the environment after it goes through the treatment process
15. hanging with no visible support in air or liquid, as solids in wastewater.
17. the natural pathway of water from clouds to rain to the earth and back into the clouds, occurs again and again
18. a plant or animal so small it can only be seen through a microscope
19. the addition of air to water, helps microorganisms in the wastewater treatment process
20. the stage of wastewater treatment that uses biological processes to remove pollutants from wastewater

### *DOWN*

1. the presence of harmful materials in water, air or on land
3. subset of wastewater that contains human waste
4. any substance that dirties air, land or water
5. the process of eliminating most microorganisms in wastewater, including most of the bacteria
6. how clean water is for supporting life, the level of water purity
8. a machine used to remove fats, oils and grease that float to the surface during primary treatment
10. an informal term used for cloth and paper products removed by bar screens during preliminary treatment
14. masses of bacteria and suspended particles that clump together and settle in secondary clarifiers
16. disease-causing microorganism

# Scramble Unscramble

**DIRECTIONS:** Unscramble the word at the end of each sentence to complete the sentence.
***Hint:*** Review the glossary for clues.

1. The type of treatment that uses living organisms to remove pollutants from wastewater is called __ __ __ __ __ __ __ __ __ __ or secondary treatment. ***LBOCGAOLII***

2. Materials such as sand and gravel particles removed from wastewater are called __ __ __ __ . ***TIGR***

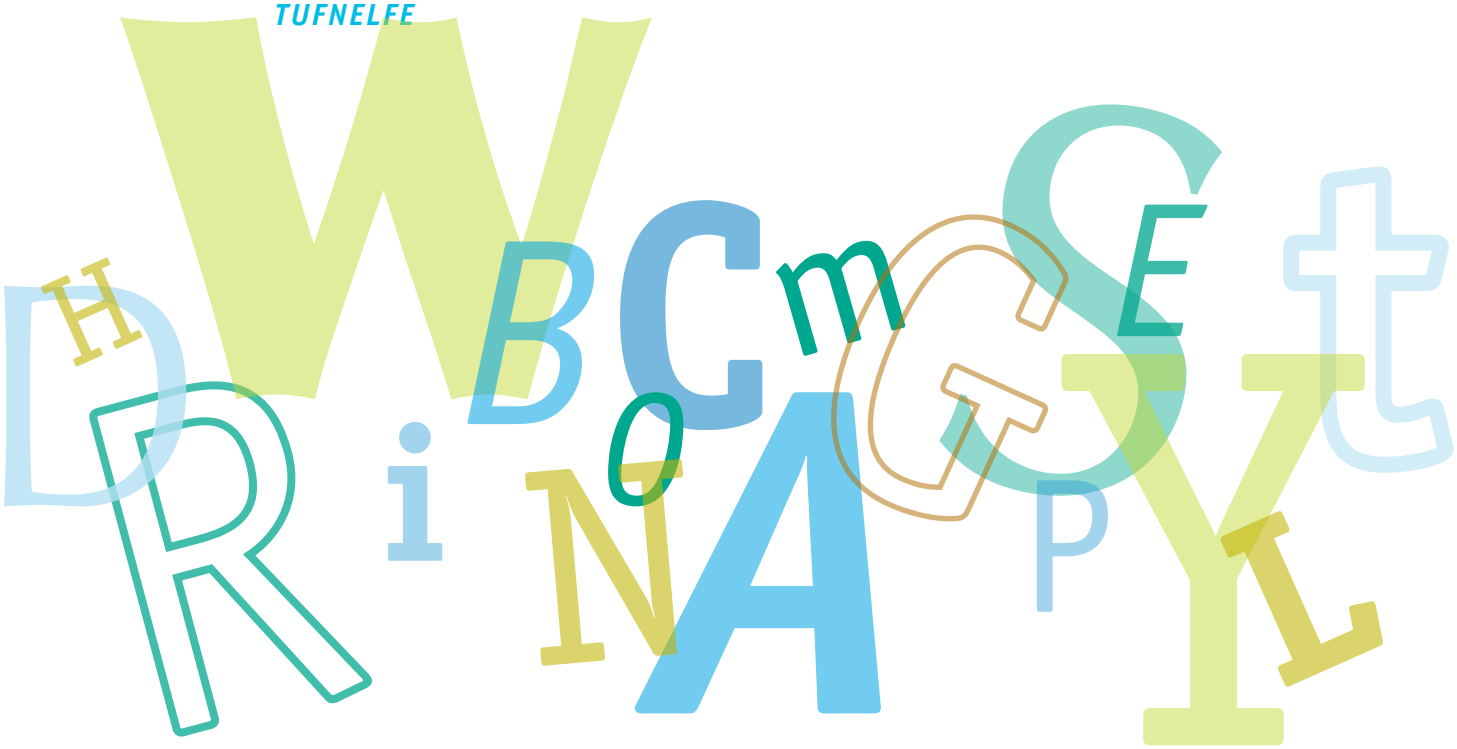
3. Substances used by plants in large amounts such as nitrogen, phosphorus and sulfur are called __ __ __ __ __ __ __ __ __ __ __ __ __ __ . ***MIRNOATURSTECN***

4. __ __ __ __ __ __ __ __ is material that settles to the bottom of a tank or pond. ***NEDESITM***

5. A __ __ __ __ __ __ __ __ is a disease causing microorganism of a tank or pond. ***GOAPENHT***

6. __ __ __ __ __ __ __ treatment uses physical means to remove pollutants that sink or float. ***PIYMRRA***

7. __ __ __ __ __ __ __ __ is treated wastewater that is recycled back into the environment. ***TUFNELFE***



# Glossary

| | |
|---|---|
| **aeration** | The addition of air to wastewater to add oxygen to help the microorganisms. |
| **bacteria** | Organisms so small you need a microscope to see them. Bacteria are everywhere. Some bacteria can cause diseases and others are helpful to animals and humans. |
| **biological treatment** | The use of living organisms to remove pollutants from wastewater, secondary treatment. |
| **biosolids** | Nutrient-rich product of the wastewater treatment process that can be recycled and reused to enhance soil conditions, used as fertilizer. |
| **bugs** | Common informal or slang term in the wastewater industry used for microorganisms. |
| **clarifiers** | Settling tanks in which material sinks to the bottom for removal while the wastewater flows off the top prior to disinfection and discharge. |
| **disinfection** | The process of destroying most microorganisms such as disease causing pathogens in wastewater, including most of the bacteria. |
| **dissipate** | To disperse or go away. Sodium hypochlorite dissipates in the south contact channel. |
| **dissolved** | The state in which materials are in a solution such as oxygen in wastewater. |
| **effluent** | Wastewater that has cycled through a treatment process and then is recycled back to the environment. Some effluent is used for irrigation. |
| **floc** | Microorganisms and suspended solids that clump together and settle to the bottom of the secondary clarifiers. |
| **grit** | Materials such as sand, gravel, small rocks and coffee grounds removed from wastewater during preliminary treatment. |
| **grit collectors** | Tanks in which materials such as sand and coffee grounds are allowed to settle to the bottom so they can be removed from wastewater. |
| **influent** | Wastewater flowing into a wastewater treatment plant. |
| **lift station** | A series of pumps and valves used to move wastewater to a wastewater treatment plant, pump station. |
| **macronutrient** | Substance used by plants in large amounts such as nitrogen, phosphorus and sulfur. |
| **micronutrient** | Substance used by plants in small amounts such as zinc and copper. |
| **microorganism** | A plant or animal so small it can only be seen through a microscope. |
| **oxidation** | In wastewater treatment, a biological process in which oxygen and microorganisms burn-up or consume organic materials. |
| **pathogen** | Disease-causing microorganism. |

*continued on next page*

# Glossary *continued*

| | |
|---|---|
| **pollutant** | Any substance that dirties air, land or water such as the organic and inorganic matter found in wastewater. |
| **pollution** | The presence of harmful material in the air, on land or in water. |
| **preliminary treatment** | Stage of wastewater treatment in which physical methods, using machinery such as bar screens and grit collectors, remove debris and heavy solids. |
| **primary treatment** | Stage of wastewater treatment in which physical processes, such as settling and skimming, remove pollutants that sink or float. |
| **rags** | Informal term used for cloth and paper products removed by bar screens during preliminary treatment. |
| **secondary treatment** | Stage of wastewater treatment in which biological processes, using oxygen, microorganisms and other bacteria, remove dissolved and suspended pollutants from wastewater. |
| **sediment** | Term for material that settles out of wastewater to the bottom of a pond or tank. |
| **sewage** | Wastewater that contains human waste, needs to be treated and cleaned before it is reused. |
| **sodium bisulfite** | A chemical used to help remove sodium hypochlorite from wastewater before it is recycled to a river or body of water such as Puget Sound. |
| **sodium hypochlorite** | A chemical similar to chlorine bleach that is used to remove disease causing pathogens from wastewater. |
| **storm drains** | System of pipes that usually carry stormwater and street runoff directly to a body of surface water such as a stream, river or lake. In the Everett combined sewer area, pipes route stormwater to the wastewater treatment plant. |
| **stormwater** | Rain and melting snow or ice that flows into storm drains. Stormwater picks up and carries pollutants from roofs, yards, parking lots and streets as it flows over these surfaces. |
| **suspended** | Hanging with no visible support in air or liquid, such as solids in wastewater. |
| **wastewater** | Water that contains pollutants produced by humans, collected from homes, schools, businesses and industries. |
| **wastewater treatment** | The process of removing pollutants from wastewater. Everett uses preliminary, primary and secondary treatment and disinfection to remove pollutants from wastewater. |
| **water cycle** | The natural pathway of water from clouds to rain, to the earth and back into the clouds. |
| **water quality** | How clean water is for supporting life, the level of water purity. |

# Answer Key

### Page 4: Wastewater System Highlights

1. F 2. T 3. F 4. T 5. T

### Page 7: Making the Connection to Source Control

(answers can be listed in any order)

1. hair
2. fats, oils and grease (FOG)
3. feminine hygiene products
4. paper towels
5. flushable wipes
6. dental floss
7. cotton swabs

### Page 8: Preliminary Treatment: Headworks – Bar Screens and Grit Collectors

1. (list three in any order) rocks, leaves, toys, feminine hygiene products, cloth and paper products (rags), dead animals
2. sand, coffee grounds
3. landfill

### Page 9: Primary Treatment: Primary Settling Tanks and Skimmers

*What you can do:* Keep hair and grease out of the drains.

### Page 10: Secondary Treatment: The Pond System

1. Secondary 2. Biosolids 3. Microorganisms

### Page 11: Secondary Treatment: The Mechanical System

1. aeration 3. plastic media 2. pollutants

### Page 12: Disinfection

1. disinfection
2. wastewater
3. sodium hypochlorite
4. dissipate
5. effluent

*Water Quality Message:* Puget Sound Starts Here

### Page 13: Quality Control

1. c 2. d 3. a 4. b

### Page 14: Biosolids

1. Reduce 2. Reuse 3. Recycle

### Page 16: Industrial Pretreatment

1. Fats 2. Oils 3. Grease

### Page 17: What Choices Are You Making?

1. N
2. Y
3. Y
4. N :
5. N
6. Y
7. N
8. N
9. Y
10. Y

### Page 18: Household Hazardous Waste and Unused Medicines (answers can be listed in any order)

*Signal Words:*

1. danger
2. poison
3. caution
4. warning

*Ways a Product is Hazardous:*

1. toxic
2. flammable
3. corrosive
4. reactive

### Page 20: Word Search

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | L | S | J | T | Z | S | I | D | N | D | S | F | D | K | A | X | E | F | E | F | X | U | Q |
| M | E | T | E | O | N | N | R | O | S | H | L | M | L | M | D | S | G | D | T | W | L | Q | T |
| C | C | T | A | W | F | E | I | E | T | V | S | W | A | E | R | O | S | R | I | X | X | J | T |
| Q | B | K | A | L | A | T | M | I | T | I | R | U | Q | E | O | P | U | L | F | R | O | K | N |
| D | X | O | U | W | A | G | B | T | N | I | D | Z | I | Z | X | R | S | G | L | D | W | D | E |
| C | Q | E | H | D | E | Y | E | A | A | I | Z | F | V | O | N | N | P | M | U | I | U | J | I |
| M | N | K | I | W | J | T | G | R | S | E | I | I | G | H | I | J | E | R | S | S | W | L | R |
| T | W | X | L | K | Z | R | S | I | F | R | R | A | I | O | C | L | N | V | I | S | Y | T | T |
| B | O | L | T | G | O | H | N | A | A | S | X | T | G | A | B | B | D | B | B | I | N | P | U |
| M | F | X | W | O | C | F | P | L | W | R | Y | X | R | E | T | V | E | U | M | P | O | H | N |
| C | E | W | R | E | E | O | C | O | A | Q | J | H | S | E | J | O | D | G | U | A | I | D | O |
| G | V | C | A | C | D | I | S | S | O | L | V | E | D | L | T | D | I | S | I | T | T | H | R |
| R | I | X | T | P | R | I | M | A | R | Y | A | R | I | S | M | A | P | N | D | E | A | U | C |
| M | W | I | O | V | H | Y | T | F | M | K | K | I | L | G | E | F | W | Y | O | I | R | X | A |
| O | O | D | U | C | C | L | T | F | G | P | J | E | O | N | F | C | S | E | S | O | E | Q | M |
| N | N | E | I | X | P | D | Y | L | Z | H | U | N | S | E | E | L | O | E | T | N | A | Y | N |
| A | S | N | I | A | R | D | M | R | O | T | S | D | O | K | J | G | D | N | F | S | D | O | M |
| M | Q | G | B | A | R | S | J | G | N | O | W | B | I | P | F | M | O | P | D | B | A | S | O |
| T | I | R | G | V | Z | M | D | Y | M | Q | A | I | B | H | L | U | N | H | Q | A | C | W | F |
| K | P | Z | J | L | T | Q | G | Q | D | Z | A | F | X | J | E | C | N | C | T | I | R | L | T |
| T | N | E | M | T | A | E | R | T | L | A | C | I | G | O | L | O | I | B | L | A | O | Y | U |
| I | X | V | R | W | V | Q | S | E | D | I | M | E | N | T | N | T | O | D | N | C | P | Q | B |
| N | B | Y | K | S | A | V | B | H | X | Q | G | W | W | Z | Z | U | Y | K | Z | F | T | X | W |
| T | N | E | U | L | F | F | E | N | H | J | R | W | Z | F | O | F | B | O | R | L | D | O | K |

### Page 21: Crossword Puzzle

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| | | | I | | P | R | I | M | A | R | Y | | L | | | | | | U | | K | | A |
| B | U | G | S | | | A | | | T | | | | L | | | | G | R | I | T | | I | | G |
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| | | | N | | | | | | Y | | | | | | | | S | E | C | O | N | D | A | R | Y |
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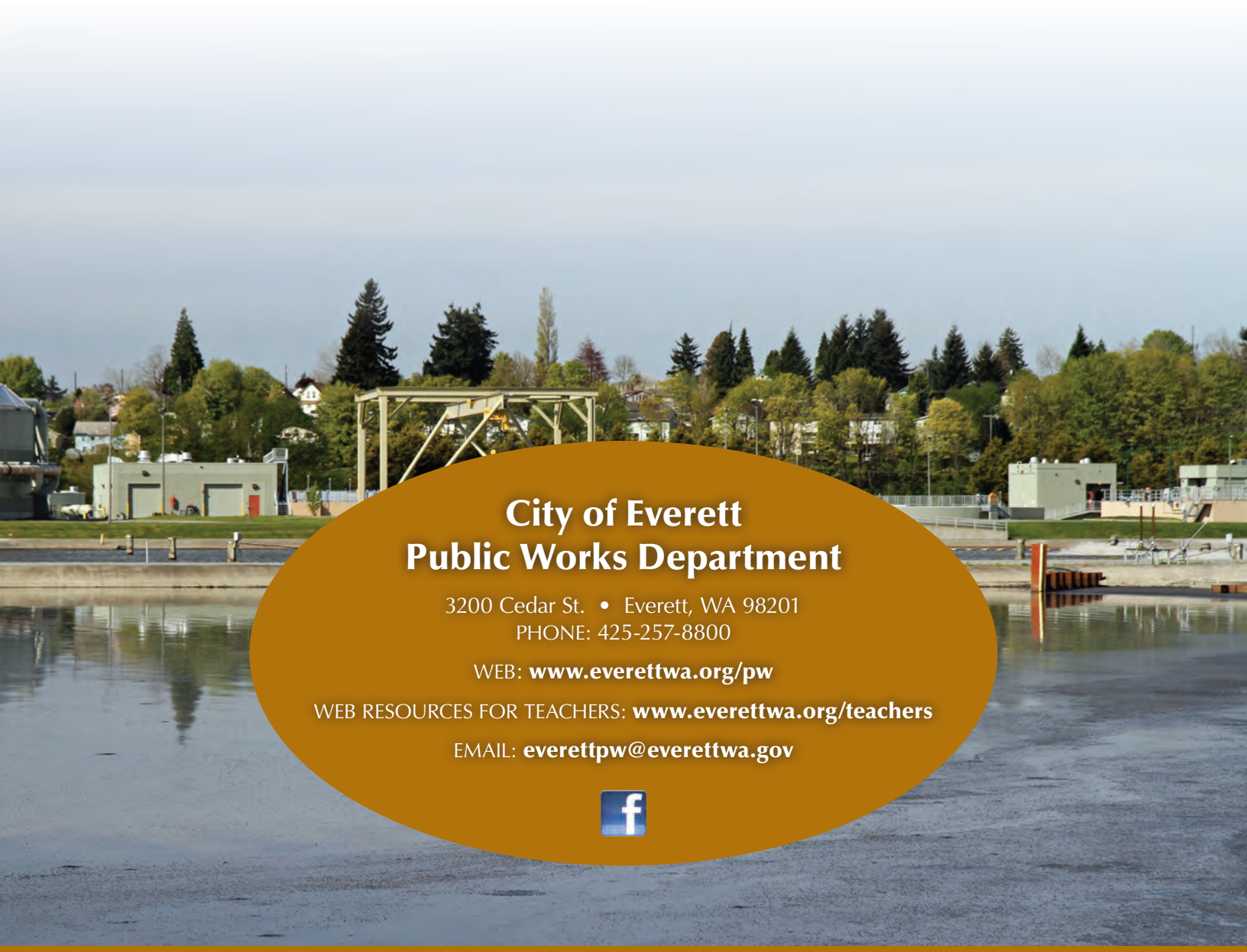
### Page 22: Scramble Unscramble

1. biological
2. grit
3. macronutrients
4. Sediment
5. pathogen
6. Primary
7. Effluent

## Learning About Water:

# Wastewater Treatment

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WEB RESOURCES FOR TEACHERS: **www.everettwa.org/teachers**

EMAIL: **everettpw@everettwa.gov**


EVERETT

**Please recycle!**