

What Is Water Pollution?

* **Monty C. Dozier**

Assistant Professor and Extension Water Resources Specialist

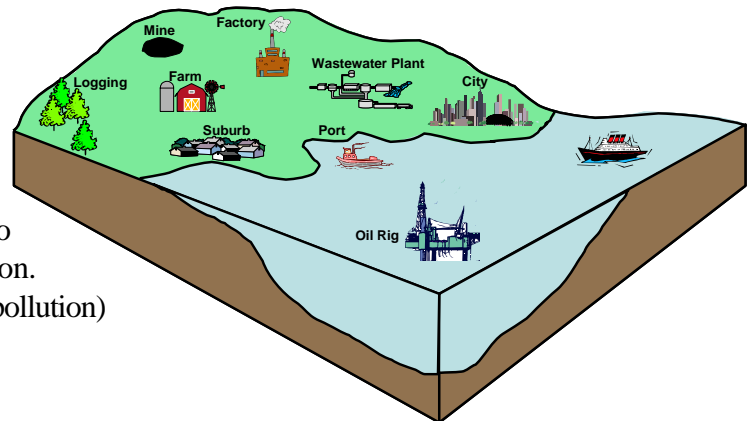
Pollution is a word that you hear almost every day in the news, at school and in day-to-day conversations. Our society has produced many kinds of pollution, some are more dangerous than others. Scientists are constantly studying how the different types of pollution affect the environment and how it can be controlled. Much has been done to reduce and control pollution, but there is still more that needs to be done.

What is your definition of pollution. _____

When something is added to the environment that makes it unclean or unsafe it is called pollution. **Water**

Pollution occurs when the water becomes overloaded with too much of one thing and the aquatic organisms cannot keep up with their cleaning responsibilities. Some organisms may die and others may grow too fast. There are many types and sources of water pollution.

Using the picture, list sources of pollution (such as sewage pollution) that can pollute surface water or groundwater.





Visit our website for additional information:

<http://waterandme.tamu.edu>

<http://water.tamu.edu>

<http://twri.tamu.edu>

Types and Sources of Water Pollution

There are several major types of water pollution. One of the most destructive types is **Petroleum Pollution**. Petroleum products, such as oil and gasoline, enter the water from ships and marine terminals, offshore oil rigs, runoff from parking lots, factories, oil dumping, and other sources. Many of the worst pollution disasters have been due to accidents involving oil rigs, pipelines, or oil tankers.



Sewage Pollution comes from both urban (city) and rural (country) areas. Although many cities and towns have sewage treatment plants, at times, such as during a flood event some may be unable to handle the amount of sewage produced. Treatment plant failures and overflows may result in untreated sewage entering rivers and coastal waters. Some coastal cities may still be using the open ocean as a sewage dumping site. Small pleasure boats, as well as larger ships, can pollute waters by illegally dumping.



Pollution from **Solid Wastes** is a major problem for many communities. Most solid wastes are handled by taking them to landfills, but some illegal dumping of garbage, old tires and other solid wastes occurs. A hazard to both humans and wildlife, solid wastes are unsightly, slow to degrade and, in some cases, non-degradable.

Nuclear-powered ships, power plants and other users of **Nuclear Energy** are possible sources of **Radiation Pollution**, not so much from accidents, but from disposal of nuclear materials such as spent nuclear fuel cells.



Many factories and nuclear power plants use water cooling during manufacturing processes or reactor cooling. Water taken from rivers, bays or lakes is heated and, if returned directly to the environment, can lead to what is called **Heat** or **Thermal Pollution**.

Chemical and industrial plants produce thousands of different types of **Toxic Chemicals** and **Wastes**. Chemicals such as **PCB's** (polychlorinated biphenyls) and **TCE** (trichloroethene) have been highly publicized due to being found in the environment and their harmful effects on living things.



The use of **Fertilizers** and **Pesticides** on cropland, gardens and yards helps farms and homeowners but can also be damaging to aquatic and marine life when not properly applied or managed in rural and urban areas. Poorly managed **Animal Wastes** from farms can also add excess nutrients to rivers and lakes. In addition, runoff from farm lands and urban areas carries large amounts of sediment into waterways making the water cloudy or murky. Sediment is the number one pollutant by volume of surface water in the United States.



Make a list of the ways that you may add to pollution.

Nonpoint Source Pollution (NPS)

Nonpoint source pollution (NPS) can be defined as pollution that comes from many miscellaneous or diffuse sources rather than from an identifiable, specific point.

Nonpoint source pollution can originate from urban environments such as yards in neighborhoods or from agricultural production areas such as crop fields.



Chemicals, waste products and soil that are carried by rain into streams or rivers become a part of NPS. Common examples are fertilizers, herbicides, pesticides, spilled motor oil and wastes from pets, wildlife and livestock. Other significant sources of NPS include:

1. Litter
2. Hazardous waste improperly stored or discarded
3. Erosion from construction sites, farms or homesites
4. Pollution from roadways and road salting activities
5. Discharge of sewage and garbage from ships and boats
6. Cleansers and other compounds used on ships and boats to prevent barnacles and algae from accumulating
7. Disposal of wastes in catch basins
8. Improperly operating septic systems
9. Acid deposition including acid rain and fog
10. Leaking sewer lines
11. Improper use of fertilizers and pesticides in the urban or agriculture environment
12. Animal feeding operations

Point Source Pollution (PS)

Point source pollution (PS) comes directly from a known source like an industrial or sewage outfall pipe. Point sources are typically associated with manufacturing processes. However, point sources also include discharges from water treatment plants and large animal feeding operations.

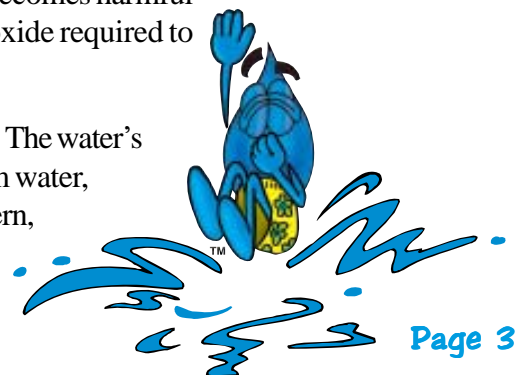
Thermal Water Pollution

Surface water that is heated can lead to what is called thermal water pollution. Heat is sometimes considered point source pollution. Main contributors to thermal pollution are the companies that process our food and generate our electricity. Electrical generating plants can create thermal water pollution when they use surface water to condense steam, which is used to turn turbines, back to the liquid state where water can be used again.



When water is heated, oxygen and carbon dioxide levels drop. Heated water becomes harmful to many aquatic organisms because it deprives them of oxygen or carbon dioxide required to live.

When the source of thermal pollution is discontinued, another problem can arise. The water's temperature returns to normal and the organisms that have adapted to the warm water, or have remained in the warm area rather than follow their usual migration pattern, are then in jeopardy.



Pollution which enters the water from a specific, easy-to-identify site is called **Point Source Pollution**. Factory and sewage discharge pipes are examples of point source pollution. Pollution that does not come from a specific site; but instead come from several different and diffuse sources, is called **Nonpoint Source Pollution**. Runoff from urban lawns and farmlands are examples of nonpoint source pollution.

Classify each of the potential pollution sources listed below as point source (PS) or nonpoint source (NPS).

- _____ 1. FACTORY DISCHARGE PIPE
- _____ 2. CITY SEWAGE PLANT
- _____ 3. FARM RUNOFF ENTERING STREAMS
- _____ 4. OIL SPILL FROM A SHIP
- _____ 5. NUCLEAR POWER PLANT WATER CANAL
- _____ 6. AIR POLLUTION SETTLING ON WATER
- _____ 7. RUNOFF FROM CITY PARKING LOTS ENTERING CREEKS
- _____ 8. GARBAGE DUMP LOCATED NEAR A STREAM
- _____ 9. RUNOFF FROM A LARGE HOUSING PROJECT
- _____ 10. OFFSHORE HAZARDOUS WASTE DUMP SITE

Which do you think is easier to locate and control, point source or nonpoint source pollution? Why?

List additional point and nonpoint sources of pollution.

1. PS 2. PS 3. NPS 4. PS 5. PS 6. NPS 7. NPS 8. PS 9. NPS 10. PS
Point sources of pollution are easier to locate because they are centered in one area and the pollution trail can be easily followed.

Point Source: residential sewage ditch, runoff from a mining site, uncontrolled erosion site, offshore oil rig, boat harbor, marine terminal. **NonPoint Source:** shoreline erosion, seepage from near shore septic tanks, exhaust, gas and oil from ship and boat traffic, soil erosion.



How Does Pollution Affect the Environment?



You have seen news reports showing an oil covered beach or scenes of polluted water near factories and urban areas. There may be other visible examples of water pollution near your home. Some types of pollution are easily seen and identified. Other types may go completely unnoticed until they cause major problems. Water in a lake, creek or river may look clean, but it may contain a number of pollutants.

The effects of different types of water pollution are complex and, in many cases, not well understood. Different organisms may respond differently to the same type of pollution. Some forms of pollution are long lasting while others are short-lived. Other factors such

as temperature, rainfall and water flow may influence effects of pollution. One thing is certain, different types of pollution can affect the environment in many ways.

How Does Water Pollution Affect You?

Most population centers are located near major waterways. These areas were first settled because of their access to water, but there is a continuing nationwide trend for people to move to areas near the coast or major rivers. This movement places more stress on aquatic environments as more people use water resources for recreation, food, water sources, energy and transportation.



Pollution of water resources can interfere with swimming and fishing activities, make boating unsafe, affect wildlife and food resources and even contaminate water supplies. Lakes, rivers and coastal areas are much more enjoyable and safe when they are pollution free. Not only do you benefit from a pollution free environment, but organisms that live there do as well. It is every person's responsibility to clean up after themselves. Throw away their trash and to pick up any other litter they see.

Controlling Pollution



Pollution can be compared to sweet foods; if you eat too much of them, you may get a toothache. But just as toothaches can be prevented and treated, pollution can be monitored, controlled and cleaned up. Preventing or controlling pollution is easier and cheaper than cleaning it up later.

However, the task of controlling pollution today is not easy. The tremendous amount of types and sources of water pollution, in addition to its complex nature, calls for conducting much study and research into pollution problems. The most effective means of controlling pollution results from cooperation between scientists, legislators, citizens and industry.



Pollution Control Framework

Scientists

1. Identify sources and types of pollution
2. Determine amount and concentration of pollution
3. Study the effects of pollution
4. Recommend safe pollution levels
5. Study and design pollution control methods
6. Develop pollution remediation and clean-up plans
7. Monitor effectiveness of clean-up efforts
8. Research new treatment technologies

Legislators/State Agencies

1. Support research/education
2. Enact laws that limit pollution levels
3. Levy fines and penalties against polluters
4. Coordinate state pollution control efforts
5. Create environmental protection plans
6. Provide mechanism to monitor pollution control programs

Citizen Groups

1. Lobby for beneficial laws
2. Educate public of pollution dangers
3. Identify sources of pollution and notify authorities and public
4. Encourage consumer conservation and recycling
5. Volunteer to cleanup polluted areas
6. Participate in citizen volunteer water quality monitoring programs
7. Provide public information

Industries

1. Support education programs, wildlife preserves, etc.
2. Establish quality control to limit pollution
3. Develop recycling programs
4. Find commercial uses for wastes and byproducts
5. Research and use better production methods
6. Monitor water quality of discharges
7. Work with the general public to protect natural resources



Why do legislators and agencies need to be informed about the sources and possible effects of pollution?

Legislators need research - based data to make sound judgements concerning pollution laws. Agencies use the information to set pollution limits, levy penalties and fines against polluters, and determine the best methods for pollution control.

Why do many industries fund research and programs to control pollution?

Many industries fund research and programs to control pollution to meet state and federal pollution control guidelines, improve their production methods and profit margins, and maintain a good public image.

Who should bear the cost of pollution cleanup and control?

The cost of cleanup and controlling pollution can be excessive. In many cases, identified polluters are fined and ordered to clean up the pollution. In severe pollution cases, state and federal agencies may be called in to assist in the cleanup efforts. Most of the time these costs are passed on to the consumers that buy products from the polluters. Therefore, it is important for citizens to stay alert to potential pollution problems and work with the polluters before a problem begins.

Why are strict laws and heavy fines needed for frequent or severe pollution offenders?

Strict laws and heavy fines for frequent or severe pollution offenders are needed as a strong deterrent against pollution. This deterrent in turns helps to protect our environment from the damages resulting from pollution.

Across: 1) sewage 2) NOAA 3) pesticide 4) toxic 5) nonpoint source 6) fertilizer 7) thermal 8) oil 9) NSF 10) herbicide
Down: 1) petroleum 2) radiation 3) point source 4) solid waste 5) EPA 6) water 7) sediment 8) pollution



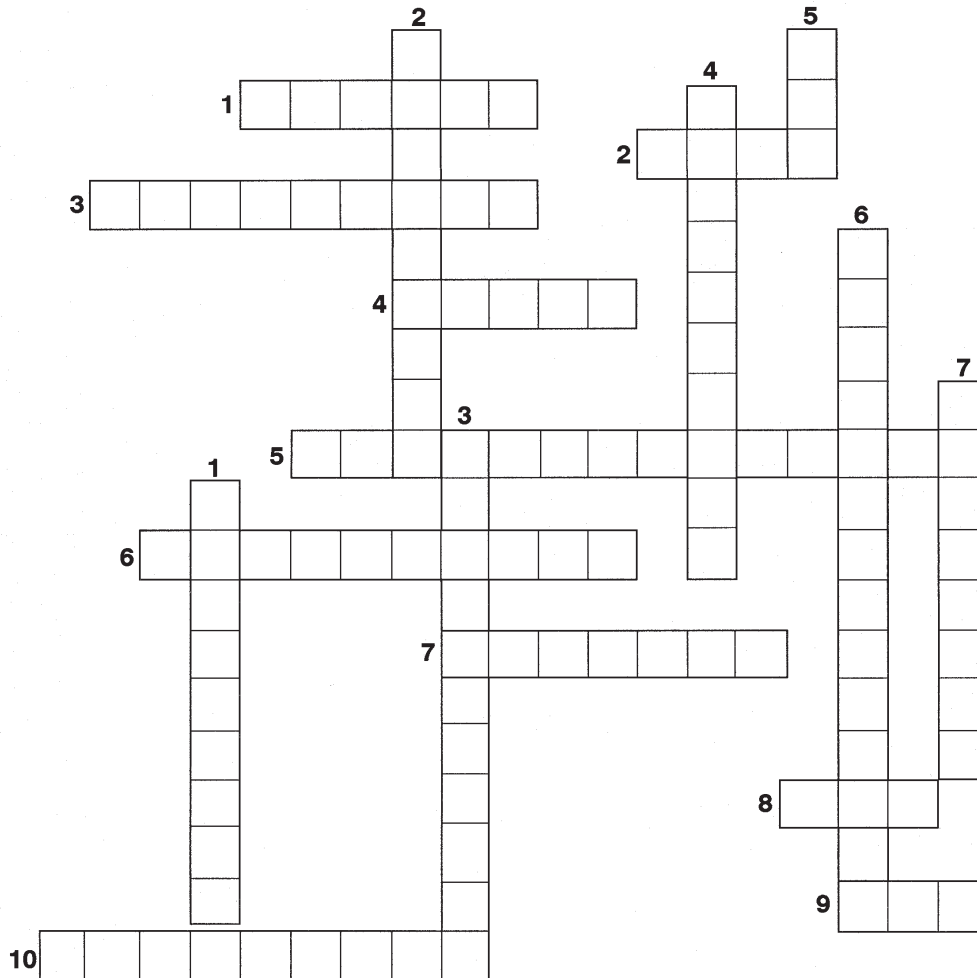
Across

- _____treatment plant
- National Oceanic & Atmospheric Administration
- pest poison
- poisonous
- pollution from a wide area or diffuse source
- plant food
- heat or _____ pollution
- petroleum product
- National Science Foundation abbreviation
- plant poison

Down

- pollution from ships, oil rigs, factories, etc.
- pollution from nuclear waste
- pollution from a small area or single source
- type of waste stored in land fills
- Environmental Protection Agency abbreviation
- topic of this project
- pollution from erosion and runoff

(Answers on page 7)



Cleaning Up Dirty Water

Water Pollution Can Cause Disease

1. Water has been one of man's most precious commodities throughout history. Water, although essential for life, is frequently squandered. Misuse of water became a problem during the Industrial Revolution when populated cities developed. Wastes from the homes and factories were discharged directly into rivers and streams near cities. Contaminated rivers became a major threat to public health because they transmitted disease. For example, 50,000 people died from **cholera** — in London in 1831. **Dysentery** and **typhoid fever** rampaged urban areas late in the 19th century.
2. Microorganisms are found in all natural waterways. They will multiply if there is enough food available and proper environmental conditions are maintained for organism growth. In a polluted stream, microorganisms multiply very fast to consume all of the organic pollution that is available. Unfortunately, microorganisms also need oxygen. Oxygen in the stream is rapidly depleted because microorganisms use oxygen while consuming their food. Dissolved oxygen is essential to microorganisms, fish and plants in a healthy stream. When there is no oxygen in the stream, fish, aquatic plants and microorganisms die and fall to the bottom of the stream and decay. This degradation process causes the bottom of the stream to become black and mucky. It produces odorous gases and makes the stream unacceptable for many uses. This decay also adds to the depleted oxygen problem.

Levels of Wastewater Treatment

1. In today's modern treatment plants, first wastewater receives primary treatment. During **primary treatment** solids found in raw wastewater are either screened out or allowed to settle to the bottom of the tank. Solids removed from the bottom of the tank are called **primary sludge** (see drawing on following page).
2. **Secondary treatment** started on a large scale in the United States in the early 1970s when wastewater flows from primary treatment tanks to larger secondary treatment tanks, a number of processes occur.
 - large amounts of bacteria and other microorganisms, similar to those found in streams, are mixed with the wastewater. Microorganisms use pollutants in wastewater as food and multiply very quickly.
 - After pollutants in wastewater are converted to microscopic organisms (through eating), wastewater is held for several hours in settling tanks.
 - Organisms settle to the bottom of the tank, and clean water flows from the top. It is then disinfected and released to the receiving body of water (stream, river, ocean).
3. During wastewater treatment, there are two places where solids are removed. During **primary treatment**, solids settle to the bottom of the tank and are called **primary sludge**. After **secondary treatment**, the microorganisms are removed from the bottom of the settling tank and are called **secondary sludge**. Usually the two sludges are mixed together and termed **sanitary sludge**.

Results of Treatment

Sludge handling is the most difficult part of wastewater treatment. It is very difficult to find a way to manage sludge.

- **Sludges can be burned.** Unfortunately, any burning process generates some air pollutants. There are already many contaminants in the air, so any additional sources of air pollution, even if they are very small, are usually not allowed.

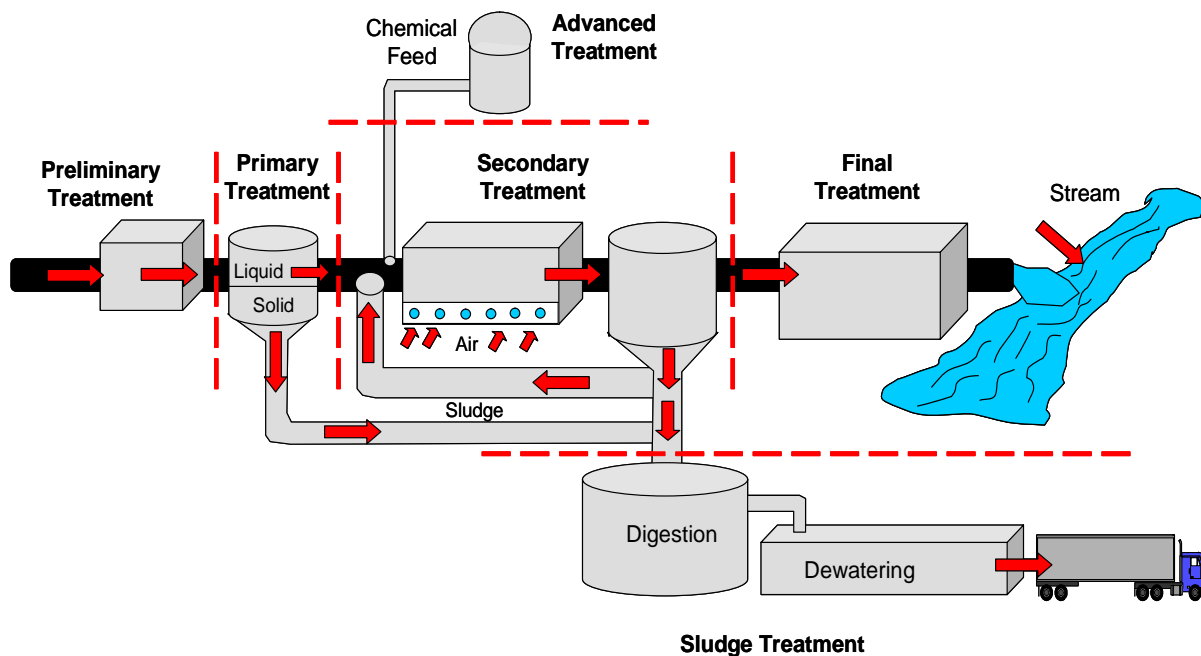


- **Sludge can be spread on the land as a soil conditioner.** Sod and other farmers in Texas have successfully applied sludge to their land. Unfortunately, the amount of farm land is diminishing rapidly. Also, many farms now have housing subdivisions with neighbors and don't like the idea of sludge being brought into their neighborhoods. People neighboring the farm are afraid sludge will cause underground water pollution, disease outbreaks or odor problems after it is spread on the land. Issues of heavy metals in the sludge are also a concern when applying sanitary sludge to lands.
- **Ocean disposal of sludge.** Sometimes sludge is taken to the ocean for disposal. This method continues because there is more sludge produced than the land based sludge disposal alternatives can economically handle.

Biological Pretreatment of Wastewater

The wastewater treatment process at most wastewater treatment plants depends on pollutants in the sewage being **biodegradable**. A pollutant is **biodegradable** if there is a naturally occurring organism that can use it for food.

- Many chemicals manufactured by industries are not biodegradable. Therefore, they are difficult to treat at a biological wastewater treatment plant.
- Industries that discharge non-biodegradable wastewater to a public wastewater treatment plant must **pretreat** their wastes. Pretreatment is usually a chemical process that changes the industrial wastewater to a form that is amenable to biological treatment by the public wastewater treatment plant.

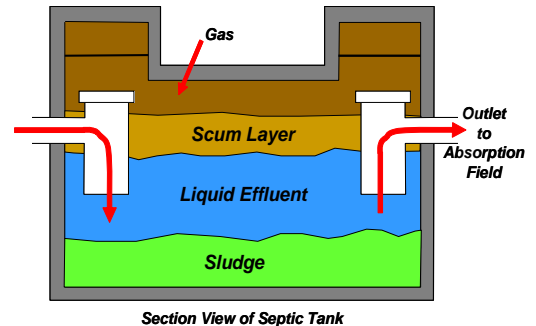


Septic Systems

Some towns and houses located in the country do not have a public sanitary sewerage collection system and treatment plant. In this situation, every house has its own septic system to treat its wastewater.

- a standard septic system has two components, a septic tank and a disposal field usually on the property.
- the solids in the wastewater settle to the bottom of the septic tank (sludge) or float to the top (scum).
- the liquid flows into the underground distribution system where the soil filters pollutants from the wastewater.
- occasionally the septic tank must be cleaned out and the sludge and scum disposed of at an approved facility.

Some septic systems now available add more treatment (such as disinfectant) to the liquid effluent in order that the liquid can be reused as irrigation water in the home landscape.



Personal Responsibility

Water pollution control is everyone's responsibility. Frequently, people make the mistake of thinking that the "government" will take care of problems like water pollution. These people forget we, as citizens, are the ones that should eliminate water pollution. Here are some ideas about what you can do:

- Check to see if your yard is a source of erosion. Plant grass or trees anywhere there is a bare patch in the yard.
- Don't disturb the banks of streams or brooks. The grass and trees on the stream banks keep the soil near the stream from washing into the water. Excessive running, walking, or driving on the sides of the stream will loosen the vegetation so that it can wash away when a storm causes the water in the stream to rise.
- Be sure that you pick up your pet's droppings. Remember that anything that is on the street before a rain storm will be washed into the streams and rivers of your community through storm drains by the rainfall runoff.
- Limit the amount of household chemicals you buy. Pesticides, fertilizers, strong cleaners and oils create serious water pollution problems when they are misused or thrown away carelessly.
- Do not feed the storm drain. Storm drains are not disposal bins. Things such as yard clippings, driveway sweepings or oil should not be disposed of in storm drains. Storm drains channel water from neighborhood streets into rivers, streams, and lakes. These serve as water for many Texans to drink. So remember if you dump it, you drink it.



If you would like to complete a checklist of your school or home to see if you are at risk for pollution problems around your home or school go to <http://www.environment.nsw.gov.au/stormwater/hsieteachguide/stg5activity5a.htm>.





This publication was funded by the Rio Grande Basin Initiative administered by the Texas Water Resources Institute of Texas Cooperative Extension, with funds provided through a grant from the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 2001-45049-01149.

This material adapted from "What is Water Pollution," Virginia Cooperative Extension Service, 4-H Marine Project, December 1987 and from "Water, Our Most Valuable Resource Keeping It Clean", Alabama Cooperative Extension Service, Auburn University.

For additional information visit: <http://soilcrop.tamu.edu> or <http://water.tamu.edu> or <http://waterandme.tamu.edu>

Produced by Soil and Crop Sciences Communications • The Texas A&M University System • 979.862.3796

Educational programs of Texas Cooperative Extension are open to all people without regard to race, color, sex, disability, religion, age or national origin.

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Edward G. Smith, Interim Director, Texas Cooperative Extension Service, The Texas A&M University System.

