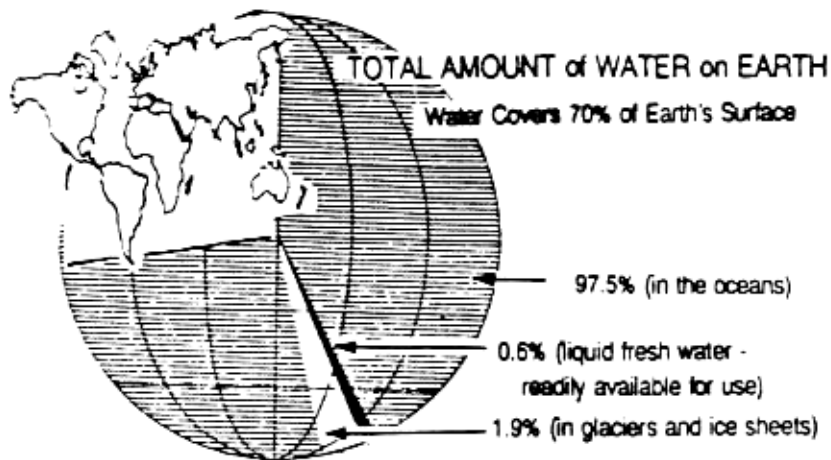


## HANDOUT: Science Background Information

### “Flooding You with Facts”

#### 1. THE EARTH’S SUPPLY OF FRESH WATER

The world’s supply of **fresh water** is estimated to be 325 trillion gallons. Sounds like a lot of water, doesn't it? But is it? Of the total amount of water on earth, about 97.5% is found in the oceans. Around 1.9% is frozen in ice sheets and glaciers. That means only 0.6% is **liquid fresh water**. Fresh water in liquid form is the most easily usable by humans as well as fresh water plants and animals. Water frozen in ice sheets and glaciers or salt water from oceans is expensive to make usable for human consumption.



Of the 0.6% liquid fresh water readily available, 0.58% is found in **ground water** or water below the surface. The other 0.02% of the entire earth's water supply is found in rivers, streams and lakes called **surface water**. Ground water is rain or melted snow that has sunk into the ground.

Some ground water is naturally stored in **aquifers** (auk' wi fur) where water fills the gaps between soil particles. When rain falls or snow melts, the water seeps into the soil. There it can recharge (refill) shallow ground water aquifers. Water from these aquifers may eventually be released into rivers and streams

Some water may slowly seep deep into the earth or it may have been there for hundreds or even thousands of years forming **fossil aquifers**. We can use water from these shallow or fossil aquifers by drilling wells. The difference is shallow aquifers are considered to be rechargeable; fossil aquifers are not because of the length of time.

## 2. THE HYDROLOGIC (hy' dro log ic) CYCLE: HOW WATER RECYCLES

Study the drawing above. Think of yourself as a drop of **precipitation** (pre cip i ta'tion) - rain or a snowflake. On another piece of paper, trace the path that you might follow, and where you might go. Use arrows and drawings to describe how your drop of water or snowflake (precipitation) might recycle through this environment.

**Evapo-transpiration** (e' va po-trans pir a' tion) means that water or moisture is exhaled or sent out of plants through their tissue. This is similar to how we exhale or breathe out from our lungs through our noses. This moisture then **evaporates** (e'va por ates') meaning it becomes vapor or water in the form of a gas.

**Irrigation Diversion** (ir ri ga tion di ver' sion) is water that is shifted from the river into channels that flow into the fields.

**Water Table** refers to the upper 'dividing' line' or point. This upper point separates the ground below that is totally soaked with water from the ground above that is not. **Aquifer** refers to the saturated area below where water naturally collects because of the structure of the rock. It is refilled through channels that allow water to seep back into the aquifer. The water can be pumped and used. At the bottom left is a **fossil aquifer**, water that has gradually seeped or trickled far down through lots of rock over hundreds of years. It is considered 'depleted' or used up once the pumping has drained most of it.

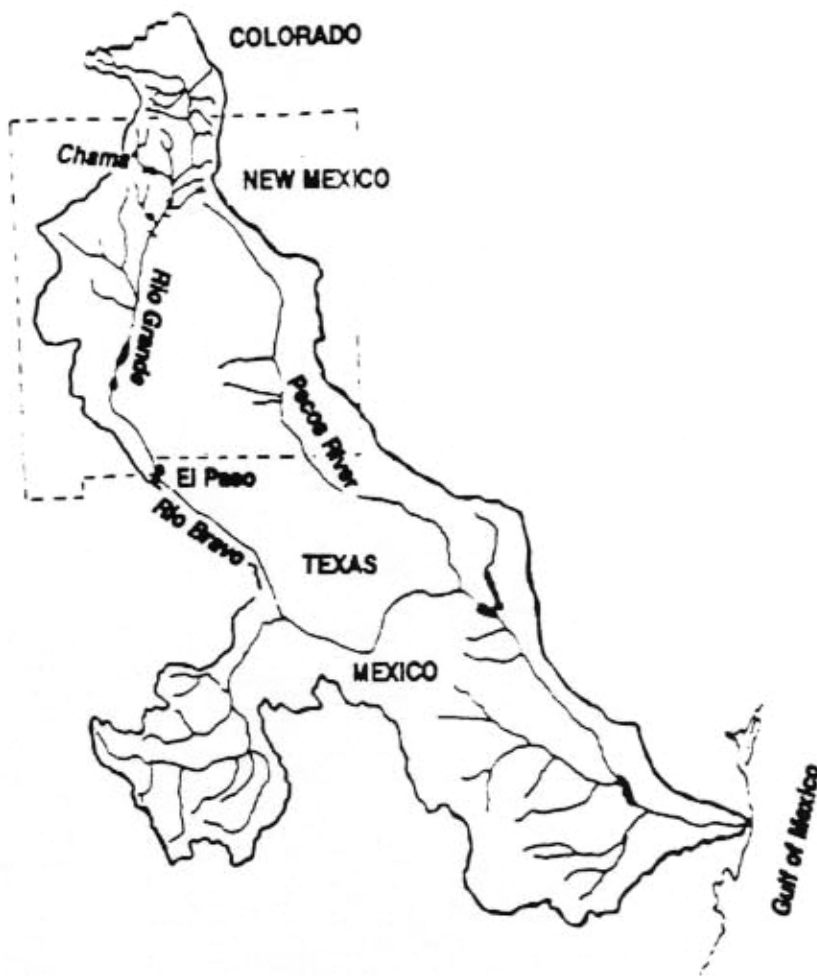
## 3. THE RIO GRANDE SYSTEM

A **river system** is defined by where surface and ground water exists and contributes to the flow of a main river. It includes the plants and animals that live there because of the water from that river system. The Rio Grande System includes **the Rio Grande Basin, watersheds of rivers** that flow into the Rio Grande, as well as many different **ecosystems**. All of the natural living and non-living things exist together in some kind of balance and depend in some way on each other.

### **The Rio Grande Basin**

A **basin**, as used in this lesson, defines where water exists. In dry climates such as found in New Mexico, Texas and northern Mexico, it has been necessary to determine exactly where water is present. So the entire basin has been studied and 'mapped'. The basin includes all of the surface waters - streams, rivers and lakes, as well as their watersheds - that flow into the Rio Grande. It also includes ground water and aquifers that are interconnected with these surface waters.

The Rio Grande Basin begins at an elevation of 12,000' in the San Juan Mountains in southern Colorado. The Rio Grande mainstem or main part goes into New Mexico and is joined by rivers such as the Rio Chama. Seasonal rivers also increase the flow of the Rio Grande during seasonal runoff and rainstorms.



By El Paso the river has dropped 8,000' from its source in Colorado and has completed one-third of its journey to the Gulf of Mexico. The remaining two-thirds of the Rio Grande then defines the boundary between Texas and Mexico.

The Pecos, a large tributary of the Rio Grande, flows through eastern New Mexico and joins the Rio Grande further into Texas.

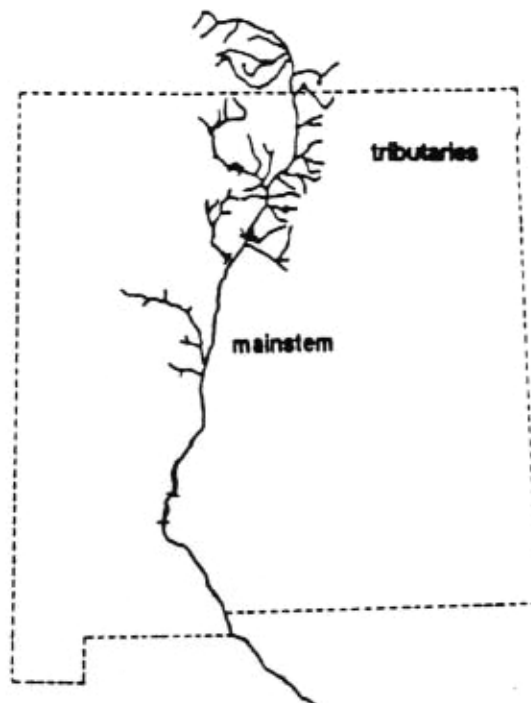
In Mexico the Rio Grande is called the Rio Bravo. More rivers join the Rio Bravo until it finally reaches

the Gulf of Mexico. This vast Rio Grande Basin contains some 49,755 square miles and drains 8% of United States territory. From its headwaters in Colorado to its end waters at the Gulf of Mexico, the basin is made up of many separate watersheds.

## The Watershed

A **watershed** is an entire region in which the precipitation (rain and melted snow) collects or flows into various tributaries (streams and rivers). Each tributary eventually drains into the **mainstem** or main part of the Rio.

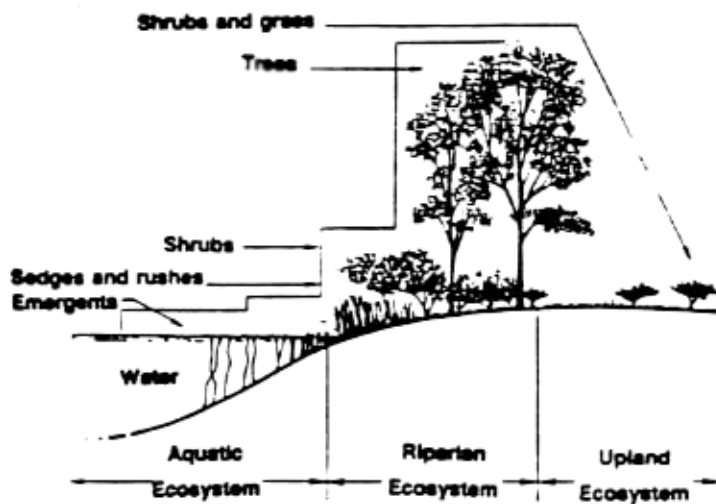
Watersheds with their many tributaries can be thought of as a series of branches of a tree. The large and small streams drain the water from the higher elevations into the tributaries or main branches of the tree. The Rio Grande mainstem is the trunk of this vast tree.



## Riparian Areas and River Ecosystems

Riparian (ri par'i an) areas are the rich, green zones along the banks of streams and rivers. They may also border springs, bogs, wet meadows, lakes and ponds. Some riparian areas have deciduous trees (de cid' u ous) and shrubs, plants that shed their leaves after the growing season. Other riparian areas have meadow grasses along the water. In dry, arid climates such as in New Mexico one can easily recognize some of our riparian areas because of the thickets of trees and woody shrubs growing along rivers and streams in otherwise dry areas.

Riparian areas in New Mexico, known as **bosque**, are easily spotted from the upland drier rangelands. Bosque have groves of deciduous trees such as cottonwoods, willows and thick, woody shrubs. But, non-native species such as Russian olive and salt cedars are beginning to crowd out the native trees.



Riparian areas are very important for maintaining healthy water systems. They are **recharge zones** for ground water as you saw in an earlier drawing; Riparian areas act as filters and cleansing systems for contaminants in the water. The vegetation absorbs and removes certain chemicals which are harmful to animals and humans but useful to riparian plants. For example, nitrates from

septic systems, livestock and fertilizers that could get into the streams are taken up by the plants and used in their growth.

If pesticides and herbicides are present in the water, they can destroy the vegetation in this natural filtering system. Too much of any one contaminant could also harm or even destroy the vegetation.

Vegetation along the river banks forms webs of roots that hold soil in place and prevent erosion. Erosion causes silting which can harm fish and other aquatic life. It blocks sunlight from reaching down into the water. This reduces the sunlight reaching the algae and under water vegetation necessary for plant growth. Since water insects depend on algae for food, their decline hurts the fish that feed on the insects.

Much of the riparian areas and bosque have been destroyed because of too much grazing, road-building and over use. But it still exists along about half of the Rio Grande's length through New Mexico. It makes up just 1% of the state's land mass and provides habitat for much of our wildlife.

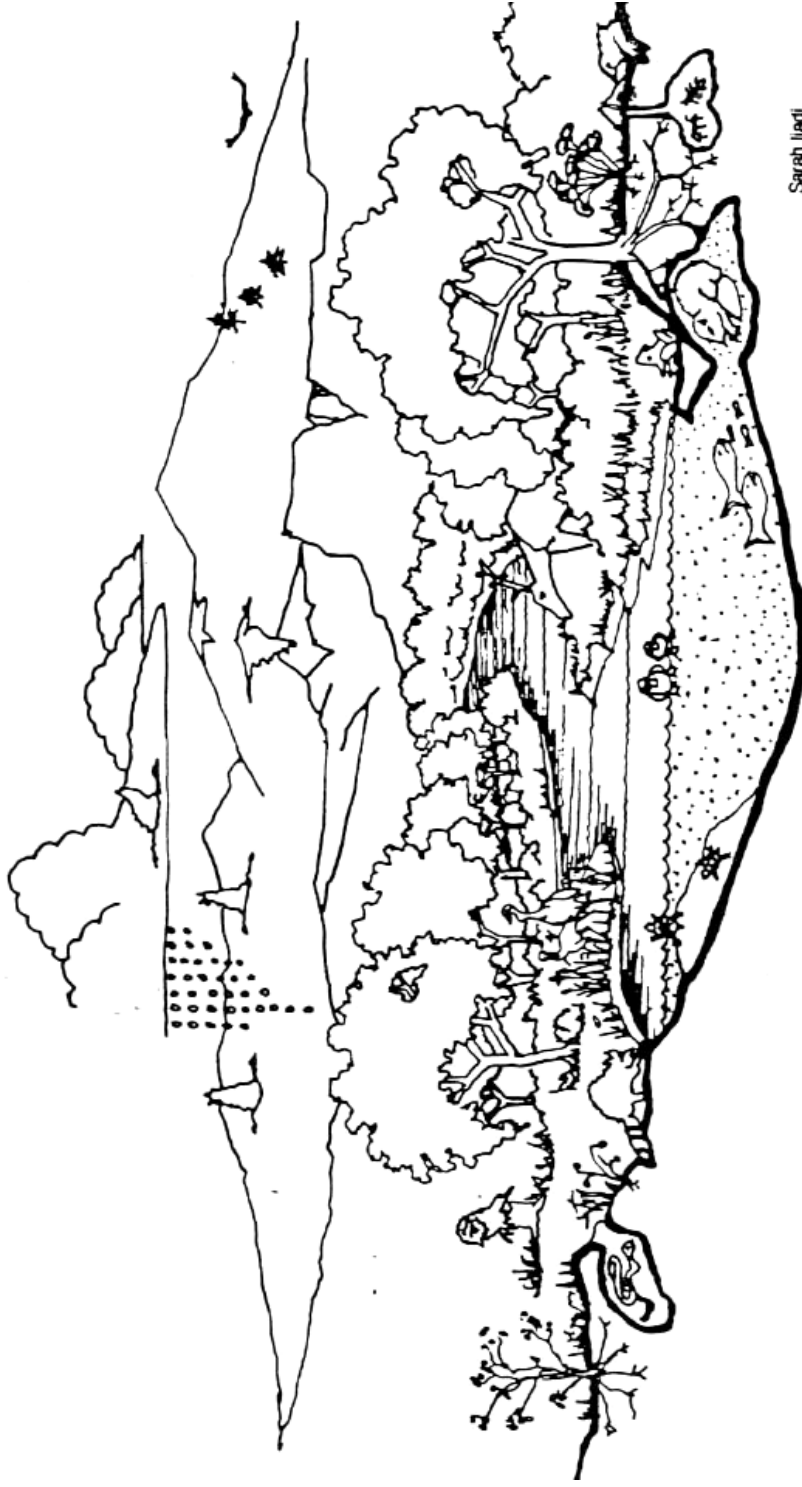
## **Wildlife Habitat**

The richly vegetated areas of riparian and stream ecosystems provide habitat for a majority of fish and wildlife species, it is believed. According to the U.S. Fish and Wildlife Service, nearly 80% of the breeding birds of the Southwest are in some manner dependent upon riparian vegetation for survival.

Here in New Mexico the bosque is where we find concentrations of plant and animal life. The water, of course, is a necessity. The vegetation provides food as well as shade and escape cover for wildlife and fish such as trout. It lowers the summer temperatures both along the banks and in the water. We find 38% of all the North American bird species here. More than 250 bird species use the middle Rio Grande bosque at some time during their life cycles. There are also 30 species of amphibians (frogs and toads, etc.) and reptiles (snakes and lizards, etc.) and over 44 species of mammals listed in the Rio Grande Valley by the U.S. Fish and Wildlife Service.

Riparian habitat upon which the wildlife depend is threatened by the river users. Fluctuations (fluctuations) or changes up and down in the river flow kill some of the seedlings of shade trees such as the Rio Grande cottonwood and willow. Habitat is cleared for development and farming. There is much disagreement about using or preserving these very special areas.

**RIPARIAN HABITAT and WILDLIFE - the BOSQUE in NEW MEXICO**



How many animals can you identify in this drawing? Can you find all of these birds? two Whooping Cranes? four Sandhill Cranes? an owl? ducks? How about turtles and frogs (*amphibians*)? a snake (*reptile*)? trout? Mammals such as beaver? deer? racoon? Any others? Can you name some of the plants found in this riparian zone? In New Mexico what do we call this woodland riparian area?

#### 4. PROTECTING OUR WATER SYSTEMS

Because water is such an important resource there are many special interests wishing to use water for their own economic and leisure time needs. How many of the users below can you identify.

##### **Sustainability**

This use is not always done in ways that protect the river or its sustainability. **Sustainability** (sustain' a bil' i ty) means that the river system is used wisely so that it can support life (has the **ability** to **sustain** life) not only for users now but **for future generations of users**.

Some of the special interests or users of the river dispose of all kinds of garbage or waste material called contaminants (con tam' i nants) into the river system. This has caused the water to become **degraded** or less able to clean itself or support life as it once did. This is dangerous for the long-term health of the river so laws have been passed to protect the river systems.

##### **Setting Water Quality Standards**

Water quality standards in New Mexico are a result of a law called the New Mexico Water Quality Act. It provides for a Commission to set water quality standard which are enforced by the New Mexico Environment Department as well as other agencies.

Standards have been set for water quality to prevent pollution. Standards are like 'measuring sticks'. Based on scientific studies, these 'measuring sticks' or standards tell us how much waste can be present in a water system without harming it. Some **contaminants** (waste material) can be discharged (released) into water systems without doing long-term harm.

Contaminants do, however, change the chemistry, biology, or physical properties of water. The standards also tell us the critical point at which more contaminants can cause the water source to become **polluted**. Pollution means there is contamination in amounts that may cause harm or death to humans, animals, or plants. The water may then be unusable for some purposes.

##### **Controlling Contaminants**

Standards are set for the amount and kinds of **contaminants** that can be released into our surface waters. For example, a factory may use lots of water in making its product and then put the water back into the river after use. It would be extremely costly to return the water to the system as clean as it was when they got it, so factories are permitted to return it containing some contamination. In order to do this the factory must have a **permit to discharge**. The New Mexico Environment Division monitors the amount and type of contaminants discharged into the river. Since these sources have been identified and are regulated, they are called '**point sources**'.

But most contamination comes from sources that are difficult to regulate. **These 'non-point sources'** come from many sources - septic tanks, engine oil leaked onto roads or drained into streets, garbage and livestock manure, fertilizers and pesticides. When rainfall or snowmelt flows over land or through the streets, it picks up and carries away these natural and manmade contaminants and pollutants. Ultimately, it all goes into our river systems.

Non-point sources have been identified as the cause for 87% of the contamination to New Mexico rivers. Some of the contaminants seep into our ground water. More than one-half of all the identified cases of ground water contamination have been caused by non-point sources, mostly household septic tanks or cesspools.

Household septic tanks are most often found in rural areas where there is no community sewer system. In larger towns and cities there are community sewer systems with underground sewer pipes. The sewer pipes run throughout the various neighborhoods and business districts and carry away the wastewater. All of the sewer pipes are hooked together and run into a larger main system which goes into a central sewage treatment plant. Here the waste material is treated and released into the ground or into river systems. These sewage treatment systems are point sources because they are regulated by the state. Household septic tanks are not.

Septic tanks are the most widely used on-site (placed on the homeowner's property) liquid waste disposal system. The idea is that the wastewater is treated naturally. The wastewater filters down through the soil. As it seeps down it comes in contact with natural chemicals in the rocks and soil as well as biological organisms. These biological and chemical processes break down and change the liquid waste into harmless liquids. These liquids may ultimately seep far enough down until they reach the water table.

It all works fine as long as the conditions are right. There has to be a large enough sized lot where the home is, the right kind of soil, and sufficient depth to the water table (groundwater) and bedrock. There has to be a lot of filtering before it can be made safe enough to enter the water table!! The following drawing shows how a standard septic system works.\*

Many septic tanks cause problems for many reasons. Some septic tanks are placed where the water table is too close to the surface. Here the liquid wastes reach the ground water before being properly filtered. The wastes then contaminate the ground water.

This non-point source of contamination comes from 160,000 household septic tanks leaking around 32 million gallons of waste per day.

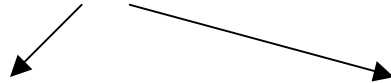
### **Guardians of the Water Resources**

State and federal (national) agencies have dedicated, well trained people who are responsible for making the decisions about water resource management. These people are the 'guardians of our water resources.'

At the national level, the Environmental Protection Agency is the main 'guardian'. Other national agencies also have special responsibilities and have offices here in New Mexico; Bureau of Reclamation, Bureau of Land Management, Bureau of Indian Affairs and the Geological Survey. But in the lessons that follow we will examine more closely the roles of the Fish and Wildlife Service and the Army Corps of Engineers.

Within New Mexico there are several state agencies that manage water resources in New Mexico. We will be closely examining only two ~ the Environment Department and the State Engineer Office. But it is important to know that the New Mexico Game and Fish Department is also concerned about water because it works to preserve our wildlife and habitat.

## FEDERAL (NATIONAL) AGENCIES



### **Environmental Protection Agency**

Responsible for states obeying the Clean Water laws and regulations. Provides technical and financial assistance.

### **Bureau of Reclamation**

Responsible for water development for irrigation and cities. Operates:  
Caballo Reservoir  
Elephant Butte Reservoir  
El Vado Reservoir  
Heron Reservoir  
Platoro Reservoir

### **Army Corps of Engineers**

Controls flooding and operates:  
Cochiti Dam and Reservoir  
Abiquiu Dam and Reservoir  
Galisteo Dam and Reservoir  
Jemez Reservoir

### **Bureau of Land Management**

Responsible for wild and scenic Parts of Rio Grande, regulates recreation use of the river and water for grazing. Manages:  
Rio Grande Wild River

### **Fish and Wildlife Service**

Protects wildlife, endangered Species and habitat. Manages Bosque del Apache Wildlife Refuge.

### **Bureau of Indian Affairs**

Protects water on Indian land.

### **Geological Survey**

Produces water studies and operates gauges that measure river flow

## STATE AGENCIES



### **State Engineer Office**

Concerned with NM water quantity- balances water supply with demand for and use of water.  
Approves 'water rights' Or the legal right to use water and supervises How the water is used.

### **Environment Department**

Concerned with water quality. Oversees protection of ground water and surface water.

### **Game and Fish Dept.**

Responsible for protecting wildlife and endangered species.

*Throughout this unit, we need to keep two things in mind. First, fresh water is vital to life itself: humans are 65% water and need 1-1/2 quarts of water a day to survive. Second, this vital resource is easily polluted.*