Land Uses & Water Pollution Presentation Script

Slide 1, Land Uses and Water Pollution: In this lesson, we will discover what “land use” means both generally and in The Bahamas specifically. We will also learn major pollutants of our freshwater sources in The Bahamas and where they come from. Can anyone guess what “land use” is? What do you think our major sources of water pollution are (for our freshwater sources)?.

Slide 2, What is “Land Use”?: Land use is the characterization of the function of land, how it is used. People can adapt certain areas of land to suit their needs, but the natural land determines what it can be used for (i.e., if it is suitable for a community, a development, an environment or otherwise). According to IndexMundi, a comprehensive data portal, The Bahamas’ land use is divided into three different categories of use based on the terrain on the land. These categories are 1. Agricultural Land, 2. Forest and 3. Other.

Slide 3, Land Use in The Bahamas: Agricultural land is broken down into “arable land”, which is land that is defined by the Food and Agriculture Organization of the United Nations (FAO) as land under temporary crops, temporary meadows (for mowing/pasture), land under market/kitchen gardens and land that is temporarily fallow (left for too long of a period to be restored). Arable land is cultivated for crops such as wheat, maize and rice, which all can be replanted in the same land after harvest.

Land used for permanent crops are cultivated for crops that are not replanted at the end of harvesting season (fruit trees, vines, flowering shrubs etc.)

Permanent pastures is considered land used for at least 5 years, or more. This land can be land that was cultivated or that is natural.

Forests are considered land that spans more than 0.5 hectare (~1 acre), with trees higher than 5 meters (~16 ft) and a canopy cover of more than 10%. There are three types of forests in The Bahamas: Coppice Forests, Pine Forests and Mangrove Forests.

“Other” land use is classified as developed areas, roads/other transportation features, barren land (less than 1/3 of the area has vegetation), or wasteland.

Slide 4, How does land use affect water quality?: All types of land uses have some sort of effect on the quality of water, whether positive or negative. In The Bahamas where groundwater is our primary source of freshwater, it is especially important to monitor negative effects from certain categories of land use. Land use can effect both groundwater and surface water.

Inorganic contaminants can be found in groundwater either because they are naturally occurring in the geology (in this case, our limestone bedrock), or have been caused by activities such as mining, industry or agriculture. Aluminum is naturally found in some rocks. Chloride on the other hand usually enters groundwater from saltwater intrusion or industrial waste. Copper and mercury can also enter from industrial waste or mining. Fossil-fuel combustion can also emit mercury. Nitrate in the form of nitrogen enters mainly from sewage and fertilizer, but is also found naturally in the ocean, in freshwater systems and other ecosystems.

Even naturally occurring minerals (organic contaminants) within our limestone bedrock can pollute our groundwater source as well. Products such as plastics, rubbers, dyes, inks etc. contain what is known as volatile organic compounds (VOCs) which can be absorbed into the land upon production, affecting our groundwater source. Pesticides can enter the ground as herbicides, insecticides etc. and plasticizers (used as sealants/linings) usually enter from improper waste disposal.

Slide 5, What is Water Pollution?: Pollution is defined as the contamination of air, water or land by pollutants that effect both environmental and biological health. When pollutants enter our fresh water sources, usually by human activities, it degrades our freshwater quality which can be detrimental to our health and the health of our ecosystems.

There are some common groundwater pollutants that have an affect on our freshwater resources.

Slide 6, FOUR common groundwater pollutants: These pollutants are most important to focus on, since the majority of The Bahamas' freshwater source is groundwater.

4 groundwater contaminants that we will highlight are nitrogen, bacteria, pesticides and volatile organic compounds.

Both the types and amounts of these contaminants are based on land use in each particular area.

Slide 7, NITRATE: Nitrate is a form of nitrogen, and is an inorganic compound that can contaminate groundwater if there is an overabundance of it.

Nitrate originates from domestic land use ("other"), such as sewage tanks and lawn fertilizers as well as from agricultural land use from crop fertilizers and manure. If we have heavy rainfall, or during irrigation (watering of crop fields / lawns), nitrate from fertilizers or nitrate that seeps out of sewage tanks can effect both surface and groundwater systems.

Slide 8, BACTERIA: Pathogens are microorganisms that cause disease. The main pathogen in water pollution is bacteria, which sources mostly from animals in the form of fecal waste. Malfunctioning septic systems in residential areas as well as manure from livestock on farmlands can be sources of pollution.

Bacteria originates from mainly agricultural land use as well as domestic land use ("other"). If this land use is properly taken care of with proper waste management systems, pathogens are less likely to enter our ground and surface water resources.

Slide 9, PESTICIDES: Pesticides are used in both agricultural land use as well as developed land use ("other") to kill unwanted pests, which can include insects, rodents, ants, etc. The types of pesticides used is based on the land use and can differ between agricultural and developed land. For example, in residential areas it's more likely to observe pesticides being used for rodent control, and in agricultural areas it's more likely to see pesticides used to control insects and fungi in crops.

Slide 10, VOLATILE ORGANIC COMPOUNDS: Volatile organic compounds (VOC's) are chemicals that are emitted into the atmosphere as gases, but mainly enter groundwater systems through industrial and commercial land use. Their physical and chemical properties allow them to be emitted as all of the states of matter. One of the major sources of VOC's entering groundwater sources are oil or fuel spills. There is a direct relationship between VOC's being detected in groundwater and developmental areas.

Slide 11, Point/Nonpoint Source Pollution: We can determine how land use is affecting our water pollution by identifying which pollutants are from point sources or nonpoint sources. Point source pollution are pollutants that can be traced back clearly to where they originated from - from a specific location. These pollutants enter the freshwater source directly. The major point source pollution is from sewage treatment plants and industrial sites. Whereas nonpoint source pollution is a combination of pollutants from multiple sources that can not be clearly identified. The major nonpoint source pollution is typically from runoff, which can accumulate pollutants from multiple sources such as golf courses, farmlands, parking

lots etc. This makes it difficult to identify the source of these pollutants, since they are all combined.

Point source pollutants are easier to regulate, which makes them less of a culprit to contributing to water pollution due to the regulations put in place at these sources (such as at sewage treatment plants).

Slide 12, Power Plant: This is an example of a power plant that was once proposed for East Grand Bahama back in 2013. Would a power plant be considered point source or nonpoint source pollution? ANS: Point source. We can identify where the pollutants come from.

Slide 13, Oil Refinery: This is a photo of the Bahamas Oil Refining Company International Limited (BORCO) at Freeport Industrial Port. It is the largest oil storage facility in the Caribbean. Would an oil refinery be considered point source or nonpoint source pollution? ANS: Point source. We can identify where the pollutants come from if there is an oil spill.

Slide 14, Runoff: This is showing runoff from multiple areas (roads, parking lots, forests) entering a freshwater stream. Would this be considered point source or nonpoint source pollution? ANS: Nonpoint source. There is no way to trace the pollutants that have entered this stream back to its original source because there are too many different pollutants and origins combined.

Slide 15, Water Pollution from Land Use effects both groundwater and saltwater: These pollutants that we have discussed effect both our groundwater and our saltwater. On major areas of developed land use (such as roads, resorts, stadiums etc), runoff is likely one of the main causes of pollution from land use in saltwater, although this has not yet been analyzed in The Bahamas. In addition, we can see how saltwater intrusion effects our groundwater table in our country. Contaminants from our saltwater from processes like runoff can enter our groundwater table through our porous limestone bedrock.

This is important to understand as The Bahamas is evolving to use saltwater as a major source of freshwater in our country, which we will discuss further shortly.

Slide 16, Wastewater Treatment Plants: The Bahamas Water and Sewage Corporation (WSC) is responsible for monitoring water quality that is pumped throughout the island to its customers. Their two main methods of ensuring clean, healthy water quality are their wastewater treatment plants as well as their reverse osmosis systems.
With proper sites (like this one pictured above) and regulations, wastewater can be disposed of properly and water pumping stations are at less risk of pollution/contamination.

Slide 17, How is this pollution treated?: Reverse osmosis a.k.a. "desalination" is a common method used to treat water pollution. In this method of water treatment, water is taken from the ocean, and pressure forces this water through a "semi-permeable" membrane, which means certain substances can easily pass through the membrane, but others can't. Usually the solvent (liquid) is most easily passed through the membrane, leaving behind pollutants (the solutes), which filters the water. The solvent flows from the more concentrated side (left) to the less concentrated side (right), leaving clean water on the right side after being passed through the membrane.
While most of our freshwater in The Bahamas comes from groundwater, we also have a large reverse osmosis system that not only filters the saltwater itself but pollutants that can also be found in it from runoff and other sources of pollution.

Slide 18, Reverse Osmosis in The Bahamas: Reverse osmosis (RO) requires a large amount of energy in order to be successful. However, there is a need for high-cost processes such as this due to the scarcity of freshwater in The Bahamas. The three major islands that have significant amounts of freshwater resources (from groundwater) are Andros, Great

Abaco Island and Grand Bahama. Rainfall is variable across the archipelago and is very seasonal, therefore considered an unreliable source. RO systems are becoming very popular in The Bahamas as a major source of reliable freshwater.

Slide 19, Reverse Osmosis in The Bahamas cont'd…: The Bahamas faced its greatest natural disaster to date on September 1st, 2019 - Hurricane Dorian. The extent of the damage was very obvious above ground, but also greatly affected our groundwater systems on Abaco and Grand Bahama islands for reliable, clean, and safe freshwater. After such a major disaster, one of the immediate resources needed is clean water. From the destruction of local water resource companies (WSC Bahamas), nonprofits from the U.S. stepped in and helped our country tremendously. Water Mission (WM) is one of them.

Water Mission provides an amazing example of an RO system like the ones we use on other islands in The Bahamas such as New Providence and most recently, Eleuthera. Water Mission has become a major source of freshwater for many residents in Abaco and Grand Bahama after the destruction of Dorian, and many rely on them daily for freshwater for cleaning, cooking, and drinking.

In Marsh Harbour, Abaco, WM has a large osmosis system producing more than 30,000 gallons of safe water daily. There are also four smaller RO systems collectively producing an additional 2,000 gallons of safe water daily.

Slide 20, How WE can help Water Pollution from our Land Use: The main land use that we have a direct relationship with is our residential area, where we live. There are a number of ways we can do our part, the most obvious being using the 5 R's: Reduce, Reuse, Repurpose, Refuse and Recycle. By following these 5 R's, we produce less waste, therefore reducing our demand of purchasing products that are manufactured on

major sites that contribute to water pollution. It also helps to raise awareness to others on why this is important.

In following these 5 R's, we can learn the difference between biodegradable and non-biodegradable items as well. Choosing biodegradable items typically means that we are choosing products made from plant and animal products that can easily be decomposed if they end up in nature. This helps us to avoid water pollution that may be beyond our control (for example, improper disposal of household garbage).

Using environmentally friendly products (such as environmentally friendly pesticides, paints, etc.) can help with the amount and type of pollutants that enter our water sources. Following sustainable building practices would mean that builders are increasing efficiency in water and energy under contract, using eco-friendly building materials and well as reducing the amount of waste and emissions in the atmosphere. Finally, following proper waste management and disposal guidelines are both necessary to ensure we are abiding by laws set out by our government and the WSC of The Bahamas for a cleaner water supply, and a pristine country. This means no practices such as illegal dumping, or unsupervised shallow-dug wells that can compromise our water table.

Slide 21, Questions? : Let your teacher know if you have any questions about this presentation.