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## Session 13

# NATURAL Vs MAN-MADE LAKES

# Natural Lake

- Natural lakes are naturally formed, usually “**bowl-shaped**” depressions in the land surface that became filled with water over time.
- These depressions (also called basins) were typically produced as a result of the catastrophic events of glaciers, volcanic activity, or tectonic movements.
- The age of most permanent lakes usually is of a geological time frame, but with most not much older than 10,000 years. A few are much older, and some ancient lakes may be millions of years old.



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- Other natural processes that produced lake basins include
  - ▣ (i) seepage of water down through layers of soluble rock
  - ▣ (ii) erosion of the land surface by wind action
  - ▣ (iii) plant growth or animal activity that resulted in damming of the outlet channels from shallow depressions in the land surface.
  
- There are literally millions of small lakes around the world, concentrated largely in the temperate and sub-arctic regions. These regions are also characterized by a relative abundance of fresh water. Many more millions of temporary lakes occur in semi-arid and arid regions.

# Man-Made Lakes

- Man-made lakes are water impoundments or water accumulated in reservoirs that do not occur naturally in the landscape.
- These lakes are most commonly created by constructing dams in river or stream valleys. Water released downstream from large man-made lakes, or reservoirs, is regulated according to water use.
- Reservoirs are typically constructed for purposes of power generation, flood control, navigation, water supply, and recreation. Smaller man-made lakes may be constructed for agricultural irrigation, recreation, or aesthetic purposes.



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- Since the reservoirs have both river-like and lake-like characteristics, reservoirs constitute an intermediate type of water-body between rivers and natural lakes. Their flushing rate and the degree of river influence ultimately determines the specific characteristics and potential uses of reservoirs.
- A man-made lake can be designed and constructed to incorporate the desired features including, size, depth, shoreline slope, vegetation, nutrient levels, water residency time, water elevation, and water levels. A man-made lake goes through a period of equilibrium establishment (accelerated ageing) over the first few years. After that time the differences are minimal.

# Difference between Man-made and Natural lakes

- The drainage basins of **reservoirs** are typically much larger in relation to the lake surface area than the drainage basins of natural lakes. Reservoir basins tend to be narrow, elongated, and dendritic (branching) because they are most commonly formed in river valleys.
- Reservoirs receive runoff from large streams and rivers, and are not typically intercepted by wetlands or shallow interface regions. The result is that runoff inputs are larger, are more closely linked to rainfall, and affect a larger portion of the lake than is the case in most natural lakes. These characteristics lead to high inputs of nutrients and sediments in rainy weather.



- **Natural lakes** tend to be located at the headwaters of rivers or streams, whereas man-made lakes tend to be closer to the mouth of the river or stream. Natural lakes therefore tend to have lower nutrient and sediment concentrations than those in man-made systems.
- The water levels in natural lakes are fairly constant, while those in reservoirs are typically managed for flood control, hydropower production, and/or navigation. Reservoirs frequently release water from the bottom of the dam pool, which contains little dissolved oxygen; this may cause problems with water quality downstream. Natural lakes, in contrast, typically release well-aerated surface DEW waters.

- Management of reservoir water levels result in large areas of sediments that are alternately flooded and exposed; frequent manipulation of water levels prevents the establishment of stabilizing wetlands and shoreline vegetation, and increases shoreline erosion and sediment loading.
- The frequent alternation between flooding and exposure may encourage sediments to release more nutrients than are found in natural lakes. The higher nutrient load encourages the growth of algae and other organisms that sink to the sediments upon death. The sediments gradually fill in the reservoir, so that the life span of the reservoir is shorter than that of natural lake systems.

- Man-made lakes formed by river impoundment typically have hydrodynamic characteristics that are very different from natural lakes, consisting of riverine (river like), transitional, and lacustrine (lake like) zones in the reservoir.
- Lakes created for hydropower generation may have additional variations in hydrodynamic characteristics caused by the flow created by the power-generating turbines, or by the pumping system for hydropower generation.

- Smaller man-made lakes and ponds also have characteristics different from natural lakes. The creation of these impoundments can alter the shape of the basin to inhibit the establishment of emergent and shoreline vegetation necessary to prevent bank erosion.
- Small man-made lakes frequently have no outflow point, and hence accumulate sediments and nutrients at a faster rate than natural lakes. The result is that small man-made lakes support different flora and fauna than natural lakes.

- The **biota (animal and plant life)** of man-made lakes may be very different from natural systems. Reservoirs are stocked with fish to develop sport fisheries for recreation. Small man-made lakes and ponds are also frequently stocked with fish for recreation, and to control the growth of submerged vegetation.
- The stocking of fish develops a different food web from what would naturally occur. The impoundment of rivers also may inhibit the growth of native fish species by preventing movement of the fishes at critical times, and by removing native habitat (flowing water) necessary for reproduction.

- In addition, the reduced flow velocity and increased sediment loading can suffocate native mussels and other bottom-dwelling species. The differences in flow and sediment also alter the base of the food web to one of suspended algae (phytoplankton), rather than the attached algae (periphyton) and detrital material that form the food base in rivers and streams.

# Differences between lakes and reservoirs on a global scale

Lakes	Reservoirs
<ul style="list-style-type: none"><li>•Especially abundant in glaciated areas; orogenic areas are characterized by deep, ancient lakes; riverine and coastal plains are characterized by shallow lakes and lagoons</li></ul>	<ul style="list-style-type: none"><li>•Located worldwide in most landscapes, including tropical forests, tundra and arid plains; often abundant in areas with a scarcity of natural lakes</li></ul>
<ul style="list-style-type: none"><li>•Generally circular water basin</li></ul>	<ul style="list-style-type: none"><li>•Elongated and dendritic water basin</li></ul>
<ul style="list-style-type: none"><li>•Drainage: surface area ratio usually &lt;10:1</li></ul>	<ul style="list-style-type: none"><li>•Drainage: surface area ratio usually &gt;10:1</li></ul>
<ul style="list-style-type: none"><li>•Stable shoreline (except for shallow, lakes in semi-arid zones)</li></ul>	<ul style="list-style-type: none"><li>•Shoreline can change because of ability to artificially regulate water level</li></ul>
<ul style="list-style-type: none"><li>•Water level fluctuation generally small (except for shallow lakes in semi-arid zones)</li></ul>	<ul style="list-style-type: none"><li>•Water level fluctuation can be great</li></ul>

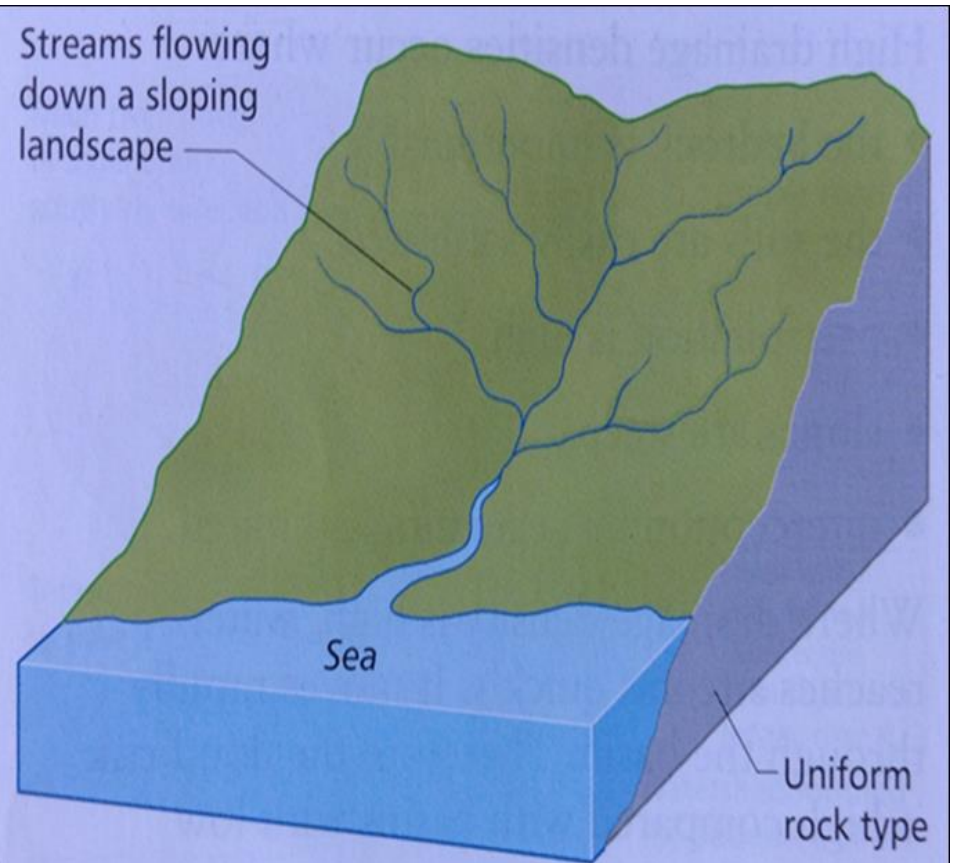
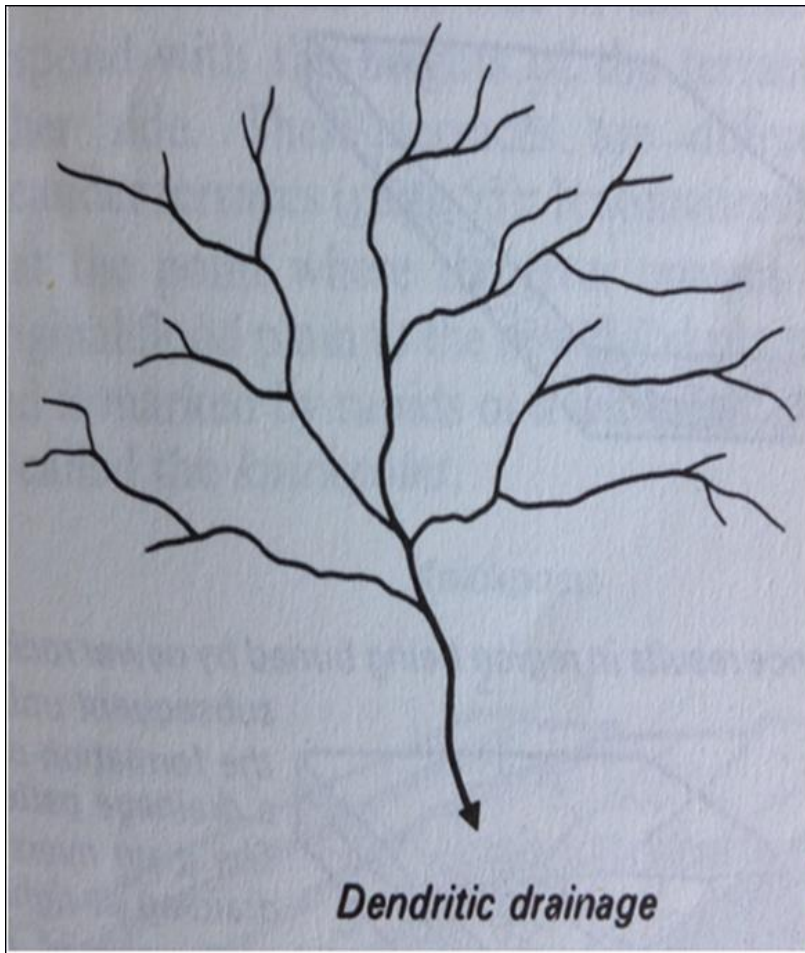


Figure 3.9 A dendritic drainage pattern



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Lakes	Reservoirs
•Long water flushing time in deeper lakes	•Water flushing time often short for their depth
•Rate of sediment deposition in water basin is usually slow under natural conditions	•Rate of sediment deposition often rapid
•Variable nutrient loading	•Usually large nutrient loading their depth
•Slow ecosystem succession	•Ecosystem succession often rapid
•Stable flora and fauna (often includes endemic species under undisturbed conditions)	•Variable flora and fauna
•Water outlet is at surface	•Water outlet is variable, but often at some depth in water column
•Water inflow typically from multiple, small tributaries	•Water inflow typically from one or more large rivers