**ROMBLON STATE UNIVERSITY**

**College of Engineering and Technology**

**Main Campus, Odiongan, Province of Romblon**

**HANDOUT #5**

**CE4113 ENVIRONMENTAL ENGINEERING MW: 10-11:30; TTH: 10-11:30AM**

**Engr. Reynaldo P Ramos, PhD MF: 4-5:30; TTH: 4-5:30PM**

**INTRODUCTION**

* Importance of Water
* Water is essential for life. The use of water by man, plants, and animals is universal. Without water can be no life.
* Man can live nearly two months without food, but can live only three or four days without water. Man himself is 80 percent water.
* Water is essential for the maintenance and improvement of health and sanitation of the community.
* Water is a principal raw material for food production and metabolic processes.
* Water provides man with some means of recreation, such as boating, hunting, swimming and fishing.
* Water protects life and property against fire.
* Water is employed in various industrial processes, power generation and also for navigation and transportation of goods and people.
* Water plays an important role in balancing the ecological system - the relationship between living things and the environment in which they live.
* Water conservation and sanitation are important.

The use of water is rapidly increasing due to growing population and urbanization. Shortage of both surface and groundwater is some areas in the country. Illegal and unregulated construction of deep wells also contributed in land sinking, consequently caused the lowering of water table. The lowering of fresh water (lakes, rivers) levels cause salt intrusion or salt water in the some coastal areas which ruined wells. In addition, uncontrolled pollution and contamination of the river systems and underground sources have greatly impaired the water quality. Thus, depletion of water supply is inevitable which requires better means of replenishing its supply to meet the increasing demand.

* Major Purposes/Uses of Water
* Domestic/residential: for household needs such as drinking, food preparation, bathing, washing clothes and dishes, flushing of toilets, watering of plants (gardens and lawns).
* Commercial: for hotels/motels, restaurants, office buildings, other commercial facilities and institutions.
* Irrigation: artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth in recreational lands such as parks and golf courses.
* Industrial: for industrial purposes such as fabrication, processing, washing, and cooling.
* Livestock: for livestock watering, feed lots, dairy operations, fish farming, and other on-farm feeds.
* Mining: for extraction of minerals occurring naturally and associated with quarrying, well operation, milling, and other preparations at the mine site.
* Public: for the public purposes such as fire fighting, street washing, municipal/town parks, and swimming pools.
* Rural: for suburban or farm areas for domestic and livestock needs and this is generally self-supplied type.
* Thermoelectric power: for the process of the generation of power.

**HYDROLOGIC CYCLE**

* Water is available in the atmosphere, the oceans, on land and within the soil and rocks of the earth’s crust. Water molecules from one location to another are driven by the solar energy. Moisture circulates from the earth into the atmosphere through evaporation and then back into the earth as precipitation (rainfall/rainwater).
* Hydrologic or water cycle describes the continuous movement of water on, above and below the earth surface. This cycles involves the following key processes:
1. *Precipitation (P)*: condensed water vapour that falls to the earth surface. Some precipitations forms are rain, snow, hail, sleet, drizzle, etc.
2. *Runoff or Surface runoff (Q)*: variety of ways by which water moves across the land which includes both surface and channel runoff.
3. *Infiltration or subsurface runoff/flow (Qc)*: the flow of water from the ground surface into the ground, consequently becomes soil moisture or ground water. Subsurface runoff when the flow of water underground, in the vadoze zone and aquifers which returns to the surface as springs or seep into the oceans and seas, or land surface at lower elevation due to gravity.
4. *Evaporation and transpiration:*

(e.1) *Evaporation* is the process of liquid converting into water vapour (gas), through wind action and solar radiation and returning to the atmosphere.

(e.2) *Transpiration* is the process by which water molecules leaves the body of a living pant and escapes to the atmosphere.

(e.3) *Evapo-transpiration* includes all evaporation from water and land surfaces, as well as transpiration from plants.

* The estimated volumes of water held at the earth’s surface as shown below. It can be observed that most of the earth’s water is in the oceans and fresh water is only a small proportion of the total water (2.5%) mainly stored in the ice.

***Volume (*×*103 km3) % of total % of fresh water***

Oceans and seas 1,338,000 96.54 -

Ice caps and glaciers 24,064 1.74 69.6

Groundwater 23,400 1.69 30.1

Permafrost 300 0.022 -

Lakes 176 0.013 0.3

Soil 16.5 0.001 0.05

Atmosphere 12.9 0.0009 0.04

Marsh/wetlands 11.5 0.0008 0.03

Rivers/Streams 2.12 0.00015 0.006

Biota 1.12 0.00008 0.003

**Total 1,385,984 100.00**

**Freshwater 35,029 2.5 100.00**

*Source: Dawei Han (2010), Concise Hydrology; Tim Davie (2002), Fundamentals of Hydrology*

**CLASSIFICATION OF FRESH SURFACE WATER (RIVERS, LAKES, RESERVOIRS, PONDS, GROUNDWATER)**

**Fresh Waters – refer to waters containing less than 500 parts per million (ppm) dissolved common salt, sodium chloride.**

 **Classification Beneficial Use**

Class AA Public water supply class I. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines

Class A Public Water Supply Class II. For sources of water supply that will require conventional treatment (coagulation, sedimentation, filtration, and disinfection) in order to meet the NSDW.

Class B Recreational Water Class I. For primary contact recreation such as bathing, swimming, etc.

Class C (1) Fishery Water for the propagation and growth of fish and other aquatic resources; (2) Recreational Water Class II (boating, fishing etc.); and (3) For agriculture, irrigation, and livestock fishing or similar activities

Class D Navigable Waters

**CLASSIFICATION OF MARINE WATERS**

**Marine Waters – refer to waters with salinity levels not less than 30 parts per thousands (ppt), at least 95% of the time.**

 **Classification Beneficial Use**

Class SA (1) Protected waters – waters designate as national or local marine parks, reserves, sanctuaries, and other areas established by law (Presidential Proclamation 1801), and/or declared as such by appropriate govt agencies. (2) Fishery Water Class I – suitable for shellfish harvesting for direct human consumption

Class SB (1) Fishery Water class II – waters suitable for commercial propagation of shellfish and intended as spawning areas for milkfish and similar species, (2) Tourist zones – for ecotourism and recreational activities, (3) Recreational Water Class I – intended for primary contact recreation (bathing, swimming, skin diving, etc.), (3) Recreational Water Class I – intended for primary contact recreation (bathing, skin diving, etc.)

Class SC (1) Fishery Water Class III – for the propagation and growth of fish and other aquatic resources and intended for commercial and sustenance fishing, (2) Recreational Water Class II – for boating, fishing, or similar activities, (3) Marshy and/or mangrove areas declared as fish and wildlife sanctuaries.

Class SD Navigable waters

***Note: The Rules and Regulations of the National Pollution Control Commission (1978), 1982 Effluent Regulations, and DENR Administrative Orders (DAO) 1990-34 and 1997-23 are hereby repealed; while DENR Administrative Order (DAO) 1990-35 is modified accordingly. Effluent used for irrigation and other agricultural purposes shall conform to the Department of Agriculture Order 2007-26.***

**REFERENCES:**

Davie, Tim (2008). *Fundamentals of Hydrology*, Taylor & Francis e-Library, Retrieved from <http://www.univpgri-palembang.ac.id/perpus-fkip/Perpustakaan/Geography/Hidrologi/Hidrologi%20Dasar.pdf>

Department of Environment and Natural Resources (2016). *DENR Administrative Order N. 2016-08*, May 24, 2016.

Han, Dawei (2010). *Concise Hydrology*, Dawei Han and Ventus Publishing Aps, Retrieved from [www.bookboon.com](http://www.bookboon.com).

Vesilind P.A, Morgan, S.M., and Heine, L.G. (2013*). Introduction to Environmental Engineering*, 1st Philippine reprint, Singapore: Cengage Learning Asia Pte Ltd.