DEFINITION(S) OF HYDROLOGY

FROM PG 227 [redacted] of Mays, Water Resources Engineering 2008

The U.S. National Research Council (1991) presented the following definition of hydrology:

> *Hydrology is the science that treats the waters of the Earth, their occurrence, circulation, and distribution, their chemical and physical properties, and their reaction with the environment, including the relation to living things. The domain of hydrology embraces the full life history of water on Earth.*

For purposes of this book we are interested in the engineering aspects of hydrology, or what we might call *engineering hydrology*. From this point of view we are mainly concerned with quantifying amounts of water at various locations (spatially) as a function of time (temporally) for surface water applications. In other words, we are concerned with solving engineering problems using hydrologic principles. This chapter is not concerned with the chemical properties of water and their relation to living things.

Books on hydrology include: Bedient and Huber (1992); Bras (1990); Chow (1964); Chow, Maidment, and Mays (1988); Gupta (1989); Maidment (1993); McCuen (1998); Ponce (1989); Singh (1992); Viessman and Lewis (1996); and Wanielista, Kersten, and Eaglin (1997).

FROM PREFACE OF WANIELISTA ET. AL.

Why are hydrology and water controls important? Hydrology provides a basic understanding of the occurrences and distribution of waters above, on, and below the earth. As development occurs, the quantity and quality of water may not be sufficient to provide for all intended economical uses. Thus, we must be able to control waters within their intended risk and for beneficial uses. Major disasters are caused by below normal or excessive rainfall and snowfall. Droughts cause populations to be displaced and human suffering. Or at the other extreme, streams and rivers overflow into populated areas. Wildlife is displaced or destroyed. Damage to transportation systems occurs. And, unfortunately there is a long list of human sufferings resulting in excessive government expenditures when we do not understand hydrology and the management of waters. We should be able to design structures to control water related events at a risk that is acceptable to the peoples of an area and within budget expenditures.

Hydrology is the major discipline used to understand and design water management systems. Principles and concepts related to basic hydrologic processes and their use in analysis and design form a major part of this

[illegible]ek to identify are processes tha[illegible]

From pg 3, McCuen

The word *hydrology* combines the Greek and word *hudōr*, which means "water," and the term *-logy*, which designates "a study of." It also has origins in the New Latin word *hydrologia*. More specifically, the general word *hydrology* refers to the scientific study of water and its properties, distribution, and effects on Earth's surface, soil, and atmosphere. The study of water can mean different things to different professions. To a chemist, a water molecule is a stable chemical bond of two atoms of hydrogen and one atom of oxygen; the chemist will be interested in the properties of water and its role in chemical reactions. The climatologist will be interested in the effect of the water stored [illegible] climatic processes. To [illegible] will [illegible] operations require a consistent [illegible] time for a variety of purposes, such as to provide cooling water and to assimilate waste. Thus although Earth's total volume of water may be adequate to meet all needs, problems are created by variations in both the spatial and temporal distributions of water availability. Extreme problems, including life-threatening situations, can result from extreme variations in either the spatial or temporal distribution of water, or both.

SPATIAL & TEMPORAL AVAILIABILITY ARE THE ENGINEERING & SCIENTIFIC CHALLENGE!

From pg 1, Bedient & Huber

Hydrology is a multidisciplinary subject that deals with the occurrence, circulation, storage, and distribution of surface and ground water on the earth. The domain of hydrology includes the physical, chemical, and biological reactions of water in natural and man-made environments. Because of the complex nature of the hydrologic cycle and its relation to weather inputs and climatic patterns, soil types, topography, geomorphology, and other related factors, the boundary between hydrology and other earth sciences (i.e., meteorology, geology, oceanography, and ecology) is not distinct. The study of hydrology [illegible]

Common "THEMES"

- OCCURANCE
- DISTRIBUTION OF WATER ON EARTH
- CIRCULATION

"BRANCHES" OF HYDROLOGY

- METEOROLOGY (ATMOSPHERIC WATER)
- SURFACE HYDROLOGY (SURFACE WATER)
- SUBSURFACE HYDROLOGY (GROUNDWATER)

From deMarsily 1986

Meteorology or climatology comes first in the study of the water cycle. It has several aspects: (1) composition and general circulation of the atmosphere; (2) energy balance of the atmosphere; (3) precipitation, rainfall and snow, snowmelt, artificial rain; and (4) evaporation and evapotranspiration.

The random nature of the climate results in a great variability, on different levels of time and space, of the precipitation, which is the first link in the chain of the hydrologic cycle. This precipitation is consequently studied from a statistical viewpoint, which is also used in the following links in the chain.

Surface hydrology is concerned with flow in the hydrographic network. It may be studied with several aims in mind:

(1) Evaluation of available resources, either in their natural state or after development (dam), and the calculation of the reservoir volume necessary to ensure a given flow.

(2) Forecasting of flood risks and the works required to control them (drainage network, retarding basin). Very often the works (dams) have to fulfill several simultaneous and often contradictory needs: a reservoir to control floods must be emptied as fast as possible, and this is directly antagonistic to the objective of a reservoir meant to increase flow at low water. Hence the difficult management problems attached to multipurpose installations.

DRAINAGE ENGINEERING

In hydrology, two methods are commonly used:

(1) The stochastic method: because of the variability of rainfall, stream-flow is studied as a random variable.

(2) The deterministic method: the process of runoff and infiltration is studied from a physical deterministic viewpoint (flow equations) based on an impulse assumed to be known, rainfall, on which the entire variability is concentrated.

PROBABILITY & STATISTICS

PHYSICS

The basin may be represented as a black box in which its components are lumped together, which one studies according to the theory of systems analysis (Fig. 1.6).

On the other hand, one may study the watershed from a physical point of view by considering all the physiographic parameters of the medium. *Groundwater hydrology* or *hydrogeology* ~~is our main concern in this book.~~

→ WATER BELOW SURFACE; AQUIFERS, SOIL WATER

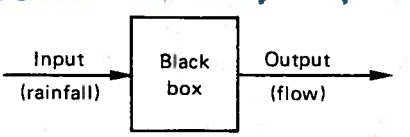

Fig. 1.6. Black box system.