

COURSE TITLE

Water Industry Effective Groundwater Supply Management

COURSE DURATION

1 hour

OVERVIEW

Effective Groundwater Supply Management is essential if groundwater resources are to remain viable for the foreseeable future. Groundwater Management is a rapidly evolving discipline that is incorporating ever more factors into the evaluation of principles that will ensure that no harmful effects arise from the utilization of this resource while ensuring that all potential resources that can be maintained are used to satisfy an ever-increasing demand. This interactive online course will present a history of Groundwater Management from its beginnings in the middle of the last century through the present day. Current parameters and environmental factors of concern will be outlined.

This training course has 9 learning modules with a 10-question exam.

PREREQUISITES

No prior knowledge is required.

BEHAVIORAL OBJECTIVES

After successfully completing this course, you will be able to:

- Identify the basics of groundwater management techniques
- Describe the concept of "safe groundwater yield"
- Compare and contrast the "safe yield concept" and the "sustainability concept"
- Identify the environmental factors that determine groundwater withdrawal rates
- Identify basic components of groundwater flow
- Recognize basic groundwater flow equations
- Identify types of aquifer material
- Identify aquifer parameters such as porosity, yield, storage, and hydraulic conductivity

COURSE OUTLINE

- Introduction 4 minutes
- Groundwater Management 10 minutes
- Basics of Groundwater Hydrology 14 minutes
- Groundwater Movement 13 minutes
- General Flow Equations 6 minutes
- Conclusion 1 minute

AVAILABILITY

This course is offered online and is available 24 hours a day, 7 days a week, 365 days a year.

TRAINING METHODOLOGY & EVALUATION

This course is self-paced online training. Review exercises and case studies reinforce the content, and students are evaluated with a multiple choice exam. Upon completion, students are prompted to submit a course evaluation.

REFERENCES

Alley, W. M., T. E. Reilly, and O. E. Franke. (1999). <u>Sustainability of groundwater resources.</u> U.S. Geological Survey Circular 1186, Denver, Colorado, 79 p.

Alley, W. M., and S. A. Leake. (2004). The journey from safe yield to sustainability. *Ground Water*, Vol. 42, No.1, January-February, 12-16.

Freeze and Cherry. (1979). "Groundwater." Prentice-Hall, Inc. Englewood Cliffs, NJ.

Fair and Hatch (1933). Fair, G.M., and Hatch, L.P. 1933. "Fundamental Factors Governing the Streamline Flow of Water through Sand." *Journal of American Water Resources Assoc* 25, pp 1551-1565.

Kazmann, R. G. (1956). "Safe yield" in ground water development: Reality or illusion? *Journal of the Irrigation and Drainage Division*, American Society of Civil Engineers, Vol. 82, No. IR3, November, Paper 1103.

Kendy, E. (2003). The false promise of sustainable pumping rates. *Ground Water*, Vol. 41, No.1, January-February, 2-4.

Krumbein (1943). Krumbein, W. 1943. "Manual of Sedimentary Petrography," Appleton-Century, New York.

Lee, C. H. (1915). The determination of safe yield of underground reservoirs of the closed-basin type. *Transactions*, American Society of Civil Engineers, Vol. LXXVIII, Paper No. 1315, 148-218.

Loucks, D. P. (2000). Sustainable water resources management. *Water International*, Vol. 25, No. 1, 3-10.

L'vovich, M. I. (1979). *World water resources and their future.* Translation of the original Russian edition (1974), American Geophysical Union, Washington, D.C.

Maimone, M. (2004). Defining and managing sustainable yield. *Ground Water*, Vol. 42, No.6, November-December, 809-814.

Miles, J. C., and P. D. Chambet. (1995). Safe yield of aquifers. *Journal of Water Resources Planning and Management*, American Society of Civil Engineers, Vol. 121, No. 1, January/February, Paper No. 5381, 1-8.

Nace, R. L.. (1960). Water management, agriculture, and groundwater supplies. *U.S. Geological Survey Circular 415*, Denver, Colorado, 12 p.

National Research Council. (1994). *Ground water recharge using waters of impaired quality.* National Academy Press, Washington, D.C.

Ponce, V. M. (2006). Groundwater utilization and sustainability. http://groundwater.sdsu.edu

Prudic, D. E., and M. E. Herman. (1996). Ground-water flow and simulated effects of development in Paradise Valley, a basin tributary to the Humboldt River, in Humboldt County, Nevada. *U.S. Geological Survey Professional Paper 1409-F*.

Seward, P., Y. Xu, and L. Brendock. (2006). Sustainable groundwater use, the capture principle, and adaptive management. Water SA, Vol. 32, No. 4, October, 473-482.

Soil Conservation Service. (1967). <u>Ground-water recharge.</u> *Technical Release No. 36,* U. S. Department of Agriculture, Soil Conservation Service, Engineering Division, Geology, Washington, D.C.

Solley, W. B., R. R. Pierce, and H. A. Perlman. (1998). <u>Estimated use of water in the United States in 1995.</u> *U.S. Geological Survey Circular 1200,* Denver, Colorado, 71 p.

Sophocleous, M. (1997). Managing water resources systems: Why "safe yield" is not sustainable. *Ground Water*, Vol. 35, No.4, July-August, 561.

Sophocleous, M. (2000a). From safe yield to sustainable development of water resources - The Kansas experience. *Journal of Hydrology*, Volume 235, Issues 1-2, August, 27-43.

Sophocleous, M. (2000b). The origin and evolution of safe-yield policies in the Kansas Groundwater Management Districts. *Natural Resources Research*, Vol. 9, No. 2, 99-110.

Theis, C. V. (1940). <u>The source of water derived from wells: Essential factors controlling the response of an aquifer to development. *Civil Engineering*, Vol 10, No. 5, May, 277-280.</u>

Todd, D. K. (1959). Ground Water Hydrology. John Wiley and Sons.

US Army Corps of Engineers (1999). Groundwater Hydrology. Washington, DC.