

Hydrology and Floodplain Analysis (3rd Edition)

By Philip B. Bedient, Wayne C. Huber

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For undergraduate and graduate courses in Hydrology. This text offers a clear and up-to-date presentation of fundamental concepts and design methods required to understand hydrology and floodplain analysis. It addresses the computational emphasis of modern hydrology and provides a balanced approach to important applications in watershed analysis, floodplain computation, flood control, urban hydrology, stormwater design, and computer modeling. Includes HEC-HMS, HEC-RAS, and SWMM models plus GIS and radar rainfall.

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Editorial Review

From the Back Cover

Now in its third edition, *Hydrology and Floodplain Analysis* continues to offer a clear and up-to-date presentation of the fundamental concepts and design methods required to understand hydrology and floodplain analysis. It addresses the computational emphasis of modern hydrology and provides a balanced approach to important applications in watershed analysis, floodplain computation, flood control, urban hydrology, stormwater design, and computer modeling. Includes HEC-HMS, HEC-RAS, and SWMM models plus GIS and radar rainfall. The text is ideal for students taking an undergraduate or graduate course on hydrology, while the practicing engineer should value the book as a modern reference for hydrologic principles, flood frequency analysis, floodplain analysis, computer simulation, and hydrologic storm water design.

Updated coverage in the third edition includes:

- *Three New Chapters*
  - Chapter 1: Geographic Information Systems (GIS)
  - Chapter 2: Use of NEXRAD Radar Data
  - Chapter 3: Floodplain Management Issues in Hydrology
- A new, detailed case study of a complex watershed using GIS linked with radar technology.
- New tools and technologies used for watershed analysis, hydrologic modeling, and modern floodplain delineation.
- New examples and homework problems in each chapter.

About the Author

Philip B. Bedient is the Herman Brown Professor of Engineering, with the Department of Civil and Environmental Engineering, Rice University, Houston, TX. He received the Ph.D. degree in environmental engineering sciences from the University of Florida, Gainesville. He is a registered professional engineer and teaches and performs research in surface and ground water hydrology and flood prediction systems. He has directed 45 research projects over the past 26 years, and has written over 120 journal articles and conference proceedings over the past 25 years. He has also written four textbooks in the area of surface and groundwater hydrology.

Dr. Bedient has worked on a variety of hydrologic problems, including river basin analyses, major floodplain, studies, groundwater contamination models, and hydrologic/GIS models in water resources. He has been actively involved in developing computer systems for flood prediction and warning, and recently directed the development of a real-time flood alert system (FAS) funded by the Texas Medical Center in Houston. The FAS is based on converting NEXRAD radar data directly to rainfall in a GIS framework, which is then used to predict peak channel flows.

Dr. Bedient has overseen the monitoring, modeling, and remediation at numerous hazardous waste sites, including six Superfund sites, and U.S. Air Force bases in five states. He has extensive experience in contaminant transport at sites impacted with chlorinated solvents and fuels. He has served on two National Academy of Science committees relating to environmental remediation and technology, and has received

research funding from the EPA, the U.S. Department of Defense, the State of Texas, the U.S. Army Corps of Engineers, and the City of Houston.

Wayne C. Huber is Professor of Civil, Construction, and Environmental Engineering at Oregon State University, Corvallis. His doctoral work at the Massachusetts Institute of Technology dealt with thermal stratification in reservoirs, for which he received the Lorenz G. Straub Award from the University of Minnesota and the Hilgard Hydraulic Prize from the American Society of Civil Engineers (ASCE). He is a member of several technical societies and has served several administrative functions within the ASCE. He is the author of over 120 reports and technical papers, is a registered professional engineer, and has served as a consultant on numerous studies done by public agencies and private engineering firms.

Beginning at the University of Florida and continuing at Oregon State University, Dr. Huber's research has included studies of urban hydrology, stormwater management, nonpoint source runoff, river basin hydrology, lake eutrophication, rainfall statistics, and hydrologic and water quality modeling. He is one of the original authors of the EPA Storm Water Management Model and has helped to maintain and improve the model continuously since 1971. Dr. Huber is an internationally recognized authority on runoff quantity and quality processes in urban areas.

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The field of hydrology is of fundamental importance to civil and environmental engineers, hydrogeologists, and other earth scientists because of the environmental significance of water supply, major floods and droughts and their management, drainage and urban stormwater issues, flooplain management, and water quality impacts. This text was written to address the computational emphasis of modern hydrology at an undergraduate or graduate level and to provide a balanced approach to important applications in hydrologic engineering and science.

THE EVOLUTION OF HYDROLOGY

In the 1970s, a large number of sophisticated computer models were created by government agencies and university groups to address hydrologic prediction, flood control, hydraulic design, water resources engineering, contaminant transport, water quality management, and water supply. During the 1980s, several of the most comprehensive and best-documented computer programs became routine operating procedures for the detailed hydrologic analysis of watersheds. Many state and federal water programs rely heavily on the application of hydrologic models for planning and decision-making.

Increasing use and sophistication of personal computers in the 1990s further revolutionized the daily practice of hydrology. Hundreds of small programs have been written to ease the computational burden on the hydrologist or engineer, and many of the earlier hydrologic models have newer versions designed to run on new and powerful personal computers. The availability of Internet access worldwide (since approximately 1994) has revolutionized the usefulness and accessibility of hydrologic data and models. The impact of transferring online data from governmental and scientific sources to the practicing hydrologist or student has been amazing. The evolving interactions of hydrologic data, digital terrain models, and mapping software with hydrologic modeling have been phenomenal. A list of important web sites and links currently used routinely in hydrology is contained in Appendix E.

ORGANIZATION OF THE TEXT

The text is divided into three main sections. The first section, consisting of the first four chapters, covers traditional topics in hydrology such as: (1) weather, precipitation, evaporation, infiltration, hydrologic

measurement, (2) rainfall-runoff analysis, (3) frequency analysis, and (4) flood routing methods. These topics provide the student with a comprehensive view of the overall hydrologic cycle in nature as well as the problem of engineering design within certain flood limits. Numerous worked examples are used to highlight theory, problem definition, solution methods, and computational approaches. Spreadsheets are used throughout. The third edition of the text includes expanded coverage and new examples in Chapters 1 through 4.

The second section, Chapters 5 through 9, is designed to apply hydrologic theory and available hydrologic modeling techniques to several areas of engineering hydrology and design—watershed analysis, floodplain delineation, and urban stormwater. The latest methods and computer models are emphasized in enough detail for practical use, and detailed examples and case studies are provided. The third edition of the text updates earlier hydrologic models with new versions as of 2001, such as HEC-HMS and HEC-RAS from the U.S. Army Hydrologic Engineering Center, and the latest improvements to the EPA model SWMM.

Chapter 5, Hydrologic Simulation Models, presents modern methods for simulating rainfall and runoff, flood hydrograph prediction, and flood control options in a watershed. The HEC-1 and HEC-HMS models are highlighted with detailed examples. Chapter 6, Urban Hydrology, presents standard methods and reviews available computer models for pipe and open channel storm drainage systems. The Storm Water Management Model (SWMM) is highlighted as the most comprehensive urban runoff model available today. Chapter 7, Floodplain Hydraulics, first reviews concepts from open channel flow required to understand water surface profile computations. Next, the HEC-2 and HEC-RAS models are described in detail with a case study for practicing engineers.

Chapter 8 presents ground water hydrology as a stand-alone chapter, including flow in porous media, aquifer properties, well mechanics, and computer applications. Governing equations of flow are derived and applied to a number of ground water problems, including both steady-state and transient analyses. A detailed case study on the application of a regional ground water flow model is included for the third edition.

Chapter 9 addresses some of the hydrologic issues relating to design, rainfall, small watershed design, detention pond design, and large watershed floodplain design.

In the final section, the text includes three new chapters (10, 11, and 12) that guide the user to the next generation of hydrologic computation and watershed evaluation. Chapter 10 presents the use of geographic information systems (GIS) and digital elevation models (DEMs) as important tools for watershed analysis, hydrologic modeling, and modern floodplain delineation. For the first time, useful hydrologic information is now widely available in high-resolution digital form on the Web. Chapter 11 presents some of the latest technology on the use of NEXRAD radar data to estimate rainfall intensities over watershed areas. Radar rainfall (available since 1994) has greatly improved our ability to predict rainfall patterns over a watershed and offers real advantages for hydrologic flood alert systems. Chapter 12 reviews some of the emerging trends in floodplain management, an important topic given the enormous flood damages that have occurred in recent decades in the United States. A detailed case study of a complex watershed study using GIS linked with radar technology is highlighted in Chapter 12.

The third edition of the text should provide the engineering or science student with all the necessary theory to understand hydrology, hydrologic modeling, and floodplain analysis in the modern world. The practicing engineer should find the book a useful reference for hydrologic principles, current models, examples, and case studies. In addition, simple calculations and spreadsheet examples from earlier editions are utilized and highlighted i.p numerous places in the third edition, which contains over 80 worked examples, over 220 homework problems, and six major case studies.

IMPORTANCE OF DATA AND LOCAL EXAMPLES

We often tell our students that the most difficult part of the application of hydrologic principles to engineering practice is not the routine execution of well-defined mathematical procedures or a model, but rather the assembly of data and parameters specific-to a given problem and location. What are suitable values for infiltration rates, Manning's roughness, hydraulic conductivity, etc.? What are the cross section and slope of the channel for flow routing? How do we determine Muskingum parameters K and x? What is an appropriate runoff coefficient and time of concentration? We urge instructors to emphasize the importance of the task of data collection and parameter selection. Although several homework problems have been designed with this in mind, e.g., "select a value from a table," we urge instructors to supplement the text with their own regional data and examples whenever possible. Such examples will likely be more relevant to students than some of the Texas, Florida, and Oregon examples found in the text.

The World Wide Web offers many opportunities for access to regional data with minimal cost and effort (see Appendix E), but the U.S. Geological Survey, National Weather Service, National Resources Conservation Service, U.S. Army Corps of Engineers, and other state and local agencies should be emphasized for students as likely sources of regional hydrologic data. Instructors and students should note, incidentally, that all National Oceanic and Atmospheric Administration, National Climatic Data Center meteorological data may be downloaded at no charge for receipt by e-mail addresses ending in .edu.

SUPPLEMENTS FOR THE THIRD EDITION

Hydrology and Floodplain Analysis includes a companion web site **www.prenhall.com/bedient** where updates and information can be found regarding the third edition. Selected problem and example datasets and figures will also be available along with simple programs that can be downloaded. A detailed solutions manual with updated problems is available for the third edition.

Users Review

From reader reviews:

Michael Brown:

Reading a reserve tends to be new life style with this era globalization. With looking at you can get a lot of information that may give you benefit in your life. Together with book everyone in this world can certainly share their idea. Textbooks can also inspire a lot of people. A great deal of author can inspire their very own reader with their story or maybe their experience. Not only situation that share in the textbooks. But also they write about the data about something that you need example. How to get the good score toefl, or how to teach your sons or daughters, there are many kinds of book which exist now. The authors nowadays always try to improve their skill in writing, they also doing some research before they write for their book. One of them is this Hydrology and Floodplain Analysis (3rd Edition).

Clarence Riley:

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Joan Rogers:

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