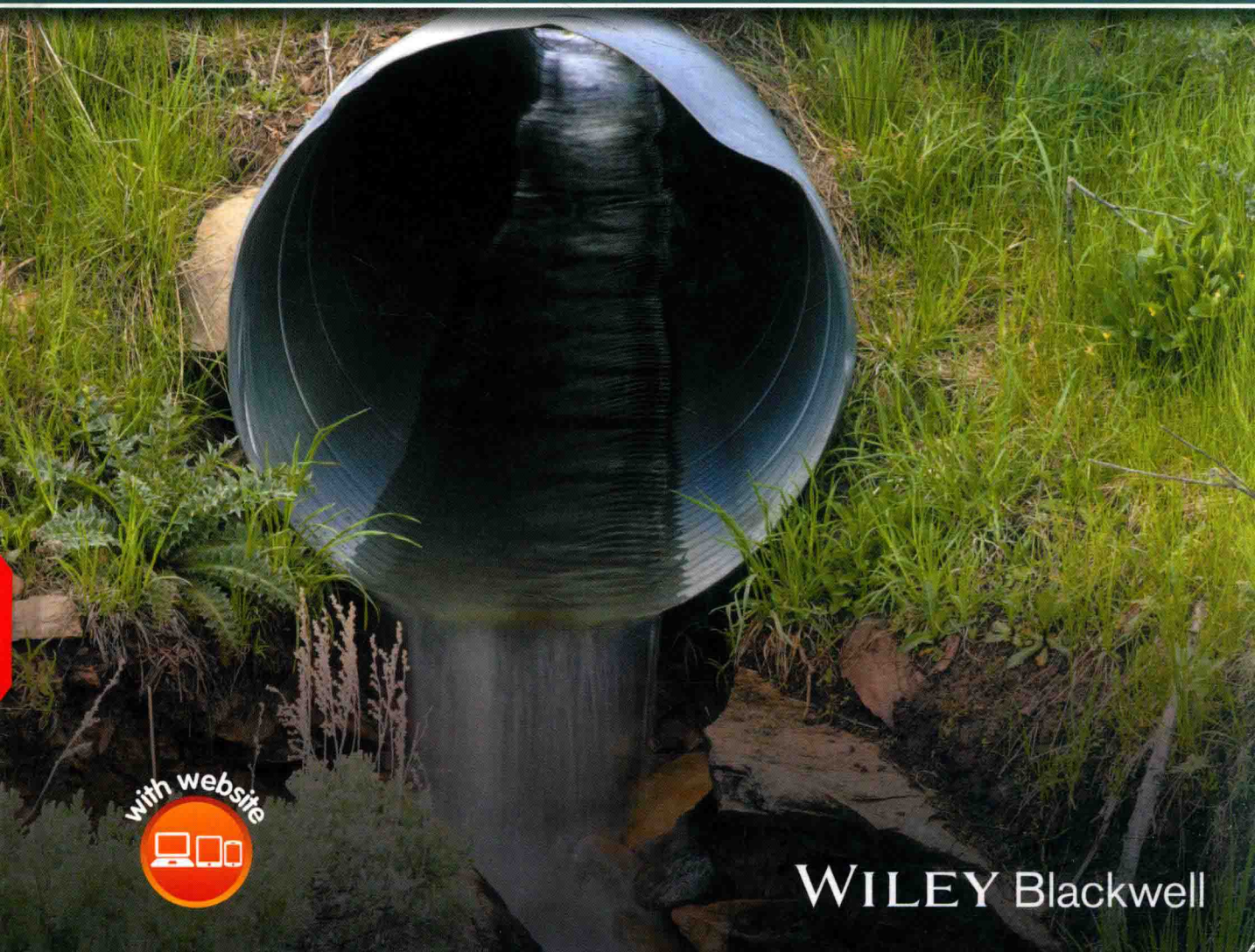


Engineering Hydrology for Natural Resources Engineers

Second Edition

Ernest W. Tollner



WILEY Blackwell

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Preface

The definition of Natural Resource Engineering proposed in the previous edition has become fairly well accepted. One could easily call the Natural Resources Engineer an Ecological Engineer, particularly at the basin scale. The difference between the two designations is mainly one of starting point. Most of those pursuing Natural Resources Engineering began with a physics view of engineering and have since picked up much ecology along the way. Many Ecological Engineers started their careers in ecology and then incorporate necessary physical processes as they practice. The end is often similar for both pathways except that registration as a Professional Engineer (PE) is easier to obtain via the physics-based engineering route.

The goal of this revision is threefold. The text reflects new developments in discipline knowledge and ever-changing regulation. The book now more thoroughly presents the similarity of many agricultural and urban processes. The text introduces up-to-date and accessible software tools. The text includes manual calculation examples for clearly demonstrating solution methods. We have simplified the writing. The revised edition incorporates comments received from instructors and students in programs across the United States and around the world.

As in the first edition, this revision first provides a quantitative overview of the hydrologic processes. We then discuss runoff, erosion, and water-quality implications. The book moves to field-scale water management, including structures, drainage, and some irrigation topics.

At the basin scale the text covers some stream and lake ecology topics for supporting the Ecological Engineering discipline. A summary of Ecological Engineering, as viewed by an ecologist, concludes the book. The goal remains to aid students and practicing professionals help their clients reach rural and urban environmental stewardship objectives. The text is a survey of the field of Natural Resources Engineering. Chapters in the latter half of the book support detailed topical instruction when coupled with indicated web resources.

Online Supplementary Material contains access to Excel spreadsheets and other selected software: Appendix B contains additional details. Internet links are provided relating to the main topics. Users may obtain current information on each subject using the revised Internet links.

It became evident in the revisions that the physics of hydraulics and sedimentation is nearly identical, be it on the farm or in the city. The universal physical principles at work in the farm and urban environments guided the revision of many chapters. There is an increased emphasis on the urban environmental problems. However, traditional agricultural problems remain. The common physics is a potential venue for kindling the urban student's desire to consider agricultural topics. Likewise, the rural student can see how practices applied on the farm can contribute to environmental stewardship in urban environments.

Climate change potentially influences economic well-being and holistic satisfaction. The climate-change phenomenon thereby impacts Natural Resources Engineering practices. Thus, a revisit of the robustness of civil, environmental, and agricultural engineering designs on the landscape is in order. Reflecting on process commonalities should engender stronger, more robust design concepts over the scope of the text.

The desired outcome of this book is to provide the background for using the standard references associated with each subject area of the text. This background includes online resources such as the *National Engineering Manual* of the US Natural Resources Conservation Service (NRCS). A second desired outcome is to develop skills to move the content towards more urban and ecological engineering applications (as the NRCS is now doing incrementally). A third desired outcome is to prepare one for applying sophisticated public domain and commercially available software packages for natural resources engineering design and watershed assessment.

As the author, I am solely responsible for errors and omissions. Please notify me of errors in text or the artwork. I would also welcome input regarding significant omissions.

About the companion website

This book is accompanied by a companion website:

www.wiley.com/go/Ernest/EHNRE

The website includes

- Software
- Excel

Scan this QR code to visit the companion website



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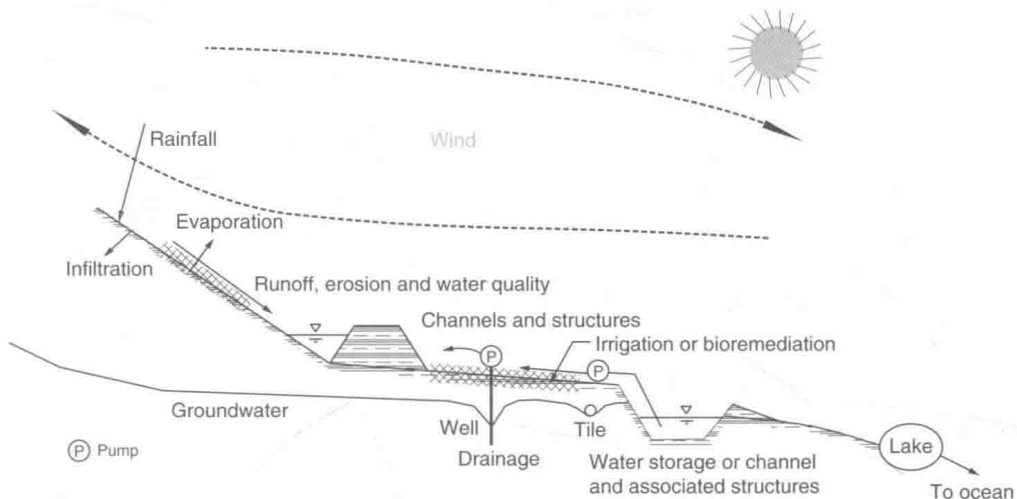
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CHAPTER 1

Natural resources engineering opportunities



Water, soil, air, plants, animals, other people, are each necessary for our existence. They form our collective environment. Since the dawn of history, humankind has been cultivating food and fiber, domesticating animals, and developing resources. Providing tools facilitating “dressing and keeping” the planet while meeting feed, food, and fiber needs is the overarching vision for this text. Since the 2002 edition, bioenergy production, sustainability, and climate-change pressures have stimulated increased realization of the necessity for responsible natural resource engineering.

Where do we begin? The study of natural resources engineering starts primarily with the study of the physical, biological, and chemical modalities operating in the environment. Physical effects are manifest in the **hydrologic cycle** (see NOAA, 2014). In a survey of the holdings of the University of Georgia Libraries under “land use change,” some 8000 articles discuss the hydrologic cycle. The near uniform distribution of books and microfilms dated from 1833 to 2014. There were an additional 500 items going back to 1569. Land-use change has exercised public debates for many years. According to Biswas (1970), philosophers have documented natural forces since the time of Hammurabi (circa 1700 B.C.E.). Solomon (circa 900 B.C.E.) made one of the most elegant statements pointing toward the hydrologic cycle:

A generation goes, and a generation comes, but the earth remains forever. Also, the sun rises and the sun sets; and, hastening to its place, it rises there again. Blowing toward the south, then turning toward the north, the wind continues swirling along. On its circular courses the wind returns. All the rivers flow into the sea yet the sea is not full. To a place where the rivers flow, there they flow again.

Ecclesiastes (1:4-7)

Humankind establishes boundaries in time and space not respected by water, soil, and air. People cannot completely control the biotic or chemical components. We focus mainly on water and soil. Impacts spread across humankind’s