Handbook of Applied Hydrology

Second Edition

Vijay P. Singh
Editor-in-Chief

Mc Graw Hill Education

Handbook of Applied Hydrology

Editor-in-Chief

Vijay P. Singh, Ph.D., D.Sc., D. Eng. (Hon.), Ph.D. (Hon.), D. Sc. (Hon.), P.E., P.H., Hon. D. WRE, Academician (GFA), is a Distinguished Professor and Caroline & William N. Lehrer Distinguished Chair in Water Engineering in the Department of Biological and Agricultural Engineering and Zachry Department of Civil Engineering at Texas A&M University. He holds a B.Tech degree from U.P. University of Agriculture and Technology, a Master's Degree from the University of Guelph, a Ph.D. from Colorado State University, and a D.Sc. from the University of the Witwatersrand. One of today's leading experts in the field of hydrology, Dr. Singh specializes in surface water hydrology, groundwater hydrology, hydraulics, irrigation engineering, environmental quality, and water resources. He has published 25 books and has edited over 58 books, and has published hundreds of journal articles. He has been the Editor-in-Chief of the Journal of Hydrologic Engineering, ASCE; is currently serving as Editor-in-Chief of Open Agriculture, and Journal of Agricultural research, and Journal of Groundwater Research and is on the editorial boards of numerous journals. He is also serving as Editor-in-Chief of Water Science and Technology Book Series as well as World Water Resources Book series. He has received more than 75 national and international awards.

Handbook of Applied Hydrology

EDITED BY VIJAY P. SINGH

Second Edition to replace the classic 1963 edition edited by Ven Te Chow

New York Chicago San Francisco Athens London
Madrid Mexico City Milan New Delhi
Singapore Sydney Toronto

Cataloging-in-Publication Data is on file with the Library of Congress.
McGraw-Hill Education books are available at special quantity discounts to use as premiums and sales promotions, or for use in corporate training programs. To contact a representative please visit the Contact Us page at www.mhprofessional.com.

Handbook of Applied Hydrology, Second Edition

1 2 3 4 5 6 7 8 9 DOW 21 20 19 18 17 16

ISBN 978-0-07-183509-1
MHID 0-07-183509-1

The pages within this book were printed on acid-free paper.

Sponsoring Editor
Lauren Poplawski

Editorial Supervisor
Donna M. Martone

Acquisitions Coordinator
Lauren Rogers

Project Manager
Raghavi Khullar, Cenveo® Publisher Services

Copy Editor
Cenveo® Publisher Services

Proofreader
Cenveo® Publisher Services

Indexer
Ariel O. Tuplano

Production Supervisor
Pamela A. Pelton

Composition Art Director, Cover
Jeff Weeks

Dedicated to

Hydrologists and Water Scientists

Contents in Brief

For online supplements and color versions of images, please go to www.mhprofessional.com/handbookofappliedhydrology

Contents