

HIGHWAY DRAINAGE guidelines



fourth edition **2006**



American Association of State Highway and Transportation Officials
444 North Capitol Street, NW • Suite 249 • Washington, DC • 20001

This is a preview. [Click here to purchase the full publication.](#)

HIGHWAY DRAINAGE GUIDELINES



2007

**American Association of State
Highway and Transportation Officials
444 North Capitol Street, N.W., Suite 249
Washington, DC 20001
(202) 624-5800
www.transportation.org**

© 2007, by American Association of State Highway and Transportation Officials. *All rights reserved.* This book, or parts thereof, may not be reproduced in any form without written permission of the publisher. Printed in the United States of America.

ISBN 978-1-56051-292-9

**AMERICAN ASSOCIATION OF STATE HIGHWAY
AND TRANSPORTATION OFFICIALS**

**EXECUTIVE COMMITTEE
2006–2007**

OFFICERS:

PRESIDENT: Victor Mendez, Arizona

VICE PRESIDENT: Pete Rahn, Missouri

SECRETARY-TREASURER: Larry M. King, Pennsylvania

REGIONAL REPRESENTATIVES:

REGION I: Allen Biehler, Pennsylvania, One-Year Term
David Cole, Maine, Two-Year Term

REGION II: Joe McInnes, Alabama , One-Year Term
Denver Stutler, Florida, Two-Year Term

REGION III: Carol Molnau, Minnesota, One-Year Term
Debra Miller Kansas, Two-Year Term

REGION IV: Victor Mendez, Arizona, One-Year Term
To Be Determined, Two-Year Term

IMMEDIATE PAST PRESIDENT: Harold Linnenkohl, Georgia

EXECUTIVE DIRECTOR: John Horsley, Washington, D.C.

AASHTO HIGHWAY SUBCOMMITTEE ON DESIGN

September 2002–2003

Chairman: Dr. Kam K. Movassaghi, Louisiana

Vice-Chairman: Susan Martinovich, Nevada

Secretary: Dwight A. Horne, FHWA

Staff Liaison: Jim McDonnell, AASHTO

Alabama:	Walker, Steven E Arkle, Don T.	Louisiana:	Kalivoda, Nicholas Porta, Lloyd E.
Alaska:	Hogins, Gary		Israel, N. Kent
Arizona:	Louis, John L.	Maine:	Casey, Jerry A.
Arkansas:	Loe, Dale F. McConnell, Phillip L.	Maryland:	McClelland, Kirk G. Douglass, Robert D.
California:	Sutliff, Karla	Massachusetts:	Wood, Stanley Blundo, John
Colorado:	Van De Wege, Dean	Michigan:	Miller, Paul F.
Connecticut:	Bard, Carl F. Smith, Bradley J. Byrnes, James F.	Minnesota:	Elasky, Richard Gerdes, Delbert
Delaware:	Canning, Kevin Simmons, Michael H. Angelo, Michael A.	Mississippi:	Pickering, John B. Ruff, Wendel T.
District of Columbia:	Sandhu, Harbhajan S.	Missouri:	Heckemeyer, Diane Nichols, David B.
Florida:	Blanchard, Brian Mills, Jim Hattaway, Billy L.	Montana:	Peil, Carl S. Williams, Ron
Georgia:	Buchan, Ben Palladi, Joseph Kennerly, James	Nebraska:	Poppe, Eldon D. Allyn, Dawn Turek, Don
Hawaii:	Fronza, Julius Abe, Casey	Nevada:	Kinder, Wayne
Idaho:	Hutchinson, Steven C. Thomas, Loren D.	New Hampshire:	Green, Craig A.
Illinois:	Hine, Michael	New Jersey:	Eisdorfer, Arthur J. Miller, Charles Dunne, Richard W.
Indiana:	Klika, Phelps Halsey	New Mexico:	Trujillo, Charlie V. Maestas, Roy Valerio, Max
Iowa:	Little, David Stein, Will Dillavou, Mitch	New York:	Bellair, Peter J. D'Angelo, Daniel Clark, Phillip J.
Kansas:	Adams, Richard G. Brewer, James O. Armstrong, LaMonte "Corky"	North Carolina:	Barbour, Deborah M. Hill, Len Alford, John E.
Kentucky:	Sperry, Kenneth R. Kratt, David Sharpe, Gary	North Dakota:	Birst, Kenneth E.
		Ohio:	Sutherland, Larry F. Misel, Cash

Oklahoma:	Taylor, Bruce E. Senkowski, Christine M.	Texas:	Marek, Mark A. Wilson, Robert L.
Oregon:	Greenberg, Dave Nelson, Catherine	Utah:	Mohanty, P. K.
Pennsylvania:	Schreiber, Dean A.	Vermont:	Shattuck, Robert F. Lathrop, Donald H.
Puerto Rico:	Ramos Hernandez, Javier E.	Virginia:	Mirshahi, Mohammad
Rhode Island:	Bennett, J. Michael	Washington:	Mansfield, Cliff Albin, Richard
South Carolina:	Kneece, Rocque L. Walsh, John V. Pratt, Robert I.	West Virginia:	Clevenger, David E. Epperly, Randolph T. Roush, Norman H.
South Dakota:	Feller, Joe Bjorneberg, Timothy	Wisconsin:	Pfeiffer, Robert F. Haverberg, John E.
Tennessee:	Zeigler, James Jones, Jeff C.	Wyoming:	Bercich, Paul P.

Affiliates and Others

BRITISH COLUMBIA:	Voyer, Richard	(250) 387-7761	richard.voyer@gems9.gov.bc.ca
ONTARIO:	Bucik, Joseph A.	(905) 704-2284	joe.bucik@mto.gov.on.ca
U.S. DOT:	Rice, John	(202) 267-3826	john.l.rice@faa.dot.gov

TASK FORCE ON HYDROLOGY AND HYDRAULICS 2003

Chairman: Merrill E. Dougherty, Indiana

Vice Chairman: James R. Richardson, Kansas

Secretary: Philip L. Thompson, FHWA

Participant	Represents	Year Joined	Task Force Chair	Chair of Chapters	Participated in Preparing Chapters	Editions
Bill Bailey	Wyoming	1994		9	12–14	1999, 2006
Brooks Booher	Arkansas	2002		6		2006
John Boynton	Minnesota	1998		2, 8	14	1999, 2006
Saeed Choudhary	Ontario	1998			14	2006
Glenn DeCou	California	1994		14	12–14	1999, 2006
Merril E. Dougherty	Indiana	1994	2001–2003	12	12–14	1999, 2006
Michael Fazio	Utah	2001		1		2006
Preston Helms	South Carolina	2001				2006
David R. Henderson	North Carolina	2000		3	10–11	2006
Mark D. Miles	Alaska	2000		10		2006
Roy T. Mills	Virginia	1999		7		2006
Barry A. Newman	Pennsylvania	1997		14		1999, 2006
Te Anh Ngo	Oklahoma	1991	1997–1999	9–14		1992, 1999, 2006
Francis H. Nishioka	Hawaii	1991		9–14		1992, 1999, 2006
Matt O'Connor	Illinois	2001	2003			
Richard Phillips	South Dakota	2002		13		2006
Lotwick I. Reese	Idaho	1996		12–14		1999, 2006
Rick Renna	Florida	2001		11		2006
James R. Richardson	Kansas	1996		5	12–14	1999, 2006
Norman P. Schips	New York	2002		Glossary		2006
David Stolpa	Texas	2001				2006
Philip L. Thompson	FHWA	1989	Secretary	4	9–14	1992, 1999, 2006
Duc minh Tran	Quebec	1999		14		2006
Raja Veeramachaneni	Maryland	1997		15	14	1999, 2006

TASK FORCE ON HYDROLOGY AND HYDRAULICS PAST PARTICIPANTS

Participant	Represents	Years	Task Force Chair	Chair of Chapters	Participated in Preparing Chapters	Editions
Tony Abyad	Oklahoma	1988–1990		9–11		1992
Richard G. Adams	Kansas	1987–1991		9–11		1992
Floyd Ball	Oklahoma	1970–1971		1–3		
Henry J. Barousse	Louisiana	1985–1988				1992
Calvin F. Boles, III	Virginia	1984–2000	1995–1997	7, 11	9–14	1992, 1999, 2006
Roy W. Caspe	Pt. Auth. NY&NJ	1997–1999		14		1999
Fred Boucher	California	1984–1990		8–10		1992
David W. Bryson	Oregon	1994–2001		6	12–14	1999, 2006
Roy Chalmers	California	1974–1981		5, 8	4–7	
Earl Cochran	Virginia	1972–1983	1977–1979	6	4–8	
Bruce Cole	Kentucky	1970–1974		4, 5	1–6	
Stanley R. Davis	FHWA	1980–1988	Secretary	7–10		1992
Winston S. Dean	Connecticut	1987–1991		9–10		1992
Ron Dehlin	Idaho	1992–1993		9–13		1992
Jay Devashrayee	Utah	1983–1995	1993–1995	5	9–13	1992, 1999
Abby Fallahi	Utah	1997–2000			14	1999, 2006
Stephen F. Drumm	Maryland	1987–1990				1992
Gene R. Fiala	FHWA	1976–1987	Glossary	5–10		1992
Samuel V. Fox	Texas	1970–1983	1970–1971	3, 4	1–8	
Eric R. Friedrich	Texas	1986–1990		9		1992
Daniel G. Ghere	Illinois	1975–2001	1979–1981	9	5–14	1992, 1999, 2006
David V. Halvorson	Minnesota	1975–1995	1981–1983	9	5–13	1992, 1999
Archie L. Hankins, Jr.	North Carolina	1976–2000	1983–1985	3	5–14	1992, 1999, 2006
Lester A. Herr	FHWA	1970–1973	Secretary	1, 2, 4	1–6	
William H. Hulbert	South Carolina	1992–2001	1999–2001	9	9–14	1992, 1999, 2006
William T. Jack	Louisiana	1976–1985		9	5–9	
Todd Jensen	Utah	1996–1997				1999
Frank L. Johnson	FHWA	1973–1979	Secretary	4, 6, 7	4–7	
Danny Landry	Vermont	1997–2001		14		1999, 2006
Mark F. Looschen	Iowa	1970–1988	1975–1977	7, 8	1–10	1992
George Lopez-Cepero	Arizona	1985–1990			9–10	1992
Kirk McClelland	Maryland	1990–1997		12	9–13	1992, 1999
Shawn McLemore	Florida	1992–2001		11	9–14	1992, 1999, 2006
Jack L. McIntosh	Washington	1972–1979			4–6	
John Pangallo	Indiana	1989–1993			9–13	1992
James L. Pierce	Georgia	1972–1974		9	1–6	
Arthur L. Pond	Virginia	1970–1972		6	1–6	
Don L. Potter	Arkansas	1983–1996	1991–1993		9–13	1992, 1999
Edward G. Ringe	Florida	1986–1991			9–11	1992
Wilford T. Robertson	Washington	1970–1972			1–4	
John E. Sandahl	Minnesota	1974–1975			5, 6	
Anthony J. Schneider	Texas	1998–2000			14	2006
Keith Shannon	Minnesota	1996–1998		12–14	1999	
Robert F. Shattuck	Vermont	1979–1997	1989–1991	1	6–13	1992, 1999
Peter Smith	Texas	1991–1997		13	9–13	1992
H. R. Solano	Arizona	1979–1981		7–8	1992	

Participant	Represents	Years	Task Force Chair	Chair of Chapters	Participated in Preparing Chapters	Editions
James L. Spencer	Connecticut	1975–1975		4		
D. W. Stehmeyer	Florida	1970–1972		1–4		
Ming C. Tsai	Pennsylvania	1976–1995	1987–1989	2	5–13	1992, 1999
George T. Tucker	Vermont	1970–1973		1–4		
Adrianus VanKampen	Michigan	1970–1974		1–4		
A. Mainard Wacker	Wyoming	1970–1993	1973–1975	7, 10	1–13	1992 (Glossary)
W. A. Whitnack	California	1970–1973		4	1–3	
Charles Whittle	Oklahoma	1980–1987	1985–1987		6–10	1992
Wan Wong	Ontario	1991–1997		6	9–13	1992, 1999
John Wright	California	1991–1993			9–13	1992
Jerome Younger	Kansas	1991–1995	8		9–13	1992

ACKNOWLEDGMENTS

2007 EDITION

The Task Force on Hydrology and Hydraulics gratefully acknowledges the contributions made by the many persons and agencies involved in the preparation of this dual unit version of the *Highway Drainage Guidelines*. The 2003 *Highway Drainage Guidelines* project was funded by NCHRP Project 15-23 that was directed by NCHRP Program Manager, Tim Hess. The Principal Investigator for the NCHRP contract was Mr. Ken Shearin of Roy Jorgensen Associates, Inc. (RJA). Mr. Don Potter, former member of the Task Force, assisted him by checking and updating the guidelines. This 2003 Microsoft Word electronic edition of the guidelines was prepared by a joint effort of the contractor and the Task Force. The Task Force wishes to give special thanks to the RJA reviewers Mr. Don Potter, Mr. Dave Halvorson, and Mr. Peter Smith for their substantial recommendations for improving and enhancing the 2007 *Highway Drainage Guidelines*, to Mr. Ken Shearin for his efficient management of the project, to Ms. Noreen Arvin for her accurate and fast production of the final documents, and to Ms. Dareya Cohen for the professionally enhanced graphics. The Task Force also wishes to give special thanks to the FHWA Reviewers: Mr. Joe Krolak for Chapter 2, Dr. Mark Browning for Chapter 6, Dr. Larry Arneson for Chapter 7, Mr. Sterling Jones and Mr. Dan Ghery (former Task Force member) for Chapter 9. The Task Force wishes to give special thanks to the SCDOT for funding the rewriting of Chapter 11 by Dr. Billy Edge and Dr. Lyle Zevenbergen of Ayres Associates.

ACKNOWLEDGMENTS

1999 EDITION

The 1999 *Highway Drainage Guidelines* metrication project was funded by NCHRP Project 20-40, Conversion of AASHTO Publications and Software to Metric Units, which was directed by NCHRP program manager, Dr. Ed Harrigan. The Principal Investigator for the NCHRP contract was Mr. Byron Blaschke of the Texas Transportation Institute (TTI). The 1999 metric, electronic edition of the manual was prepared by a joint effort of the contractors and the Task Force. The Task Force wishes to give special thanks to Dr. Ed Harrigan and Mr. Byron Blaschke for their assistance in developing, reviewing, and finalizing the 1999 *Highway Drainage Guidelines*.