

**TRANSPORTATION RESEARCH BOARD  
2000 EXECUTIVE COMMITTEE\***

---

**Chairman:** **Martin Wachs**, Director, Institute of Transportation Studies, University of California, Berkeley  
**Vice Chairman:** **John M. Samuels**, Senior Vice President—Operations Planning and Support (Operations Division), Norfolk Southern Corporation, Norfolk, Virginia  
**Executive Director:** **Robert E. Skinner, Jr.**, Transportation Research Board

---

**Thomas F. Barry, Jr.**, Secretary of Transportation, Florida Department of Transportation, Tallahassee  
**Jack E. Buffington**, Associate Director and Research Professor, Mack-Blackwell National Rural Transportation Study Center, University of Arkansas, Fayetteville  
**Sarah C. Campbell**, President, TransManagement, Inc., Washington, D.C.  
**Anne P. Canby**, Secretary of Transportation, Delaware Department of Transportation, Dover  
**E. Dean Carlson**, Secretary of Transportation, Kansas Department of Transportation, Topeka  
**Joanne F. Casey**, President, Intermodal Association of North America, Greenbelt, Maryland  
**John L. Craig**, Director, Nebraska Department of Roads, Lincoln  
**Robert A. Frosch**, Senior Research Fellow, Belfer Center for Science & International Affairs, John F. Kennedy School of Government, Harvard University, Cambridge, Massachusetts  
**Gorman Gilbert**, Director, Oklahoma Transportation Center, Oklahoma State University, Stillwater  
**Genevieve Giuliano**, Professor, School of Policy, Planning, and Development, University of Southern California, Los Angeles  
**Lester A. Hoel, L.A.** Lacy Distinguished Professor, Department of Civil Engineering, University of Virginia, Charlottesville  
**H. Thomas Kornegay**, Executive Director, Port of Houston Authority, Houston, Texas  
**Thomas F. Larwin**, General Manager, San Diego Metropolitan Transit Development Board, San Diego, California  
**Bradley L. Mallory**, Secretary of Transportation, Pennsylvania Department of Transportation, Harrisburg  
**Jeffrey R. Moreland**, Senior Vice President—Law and Chief of Staff, Burlington Northern Santa Fe Corporation, Fort Worth, Texas  
**Sid Morrison**, Secretary of Transportation, Washington State Department of Transportation, Olympia  
**John P. Poorman**, Staff Director, Capital District Transportation Committee, Albany, New York  
**Wayne Shackelford**, Senior Vice President, Gresham Smith & Partners, Alpharetta, Georgia (Past Chairman, 1999)  
**Michael S. Townes**, Executive Director, Transportation District Commission of Hampton Roads, Hampton, Virginia  
**Thomas R. Warne**, Executive Director, Utah Department of Transportation, Salt Lake City  
**Arnold F. Wellman, Jr.**, Vice President, Corporate Public Affairs, United Parcel Service, Washington, D.C.  
**James A. Wilding**, President and CEO, Metropolitan Washington Airports Authority, Alexandria, Virginia  
**M. Gordon Wolman**, Professor of Geography and Environmental Engineering, The Johns Hopkins University, Baltimore, Maryland  
**David N. Wormley**, Dean of Engineering, Pennsylvania State University, University Park (Past Chairman, 1997)

**Mike Acott**, President, National Asphalt Pavement Association, Lanham, Maryland (ex officio)  
**Sue Bailey**, Administrator, National Highway Traffic Safety Administration, U.S. Department of Transportation (ex officio)  
**Kelley S. Coyner**, Administrator, Research and Special Programs Administration, U.S. Department of Transportation (ex officio)  
**Mortimer L. Downey**, Deputy Secretary of Transportation, U.S. Department of Transportation (ex officio)  
**Nuria I. Fernandez**, Acting Administrator, Federal Transit Administration, U.S. Department of Transportation (ex officio)  
**Russell L. Fuhrman**, (Maj. Gen., U.S. Army), Acting Commander, U.S. Army Corps of Engineers, Washington, D.C. (ex officio)  
**Jane F. Garvey**, Administrator, Federal Aviation Administration, U.S. Department of Transportation (ex officio)  
**John Graykowski**, Acting Administrator, Maritime Administration, U.S. Department of Transportation (ex officio)  
**Edward R. Hamberger**, President and CEO, Association of American Railroads, Washington, D.C. (ex officio)  
**Clyde J. Hart, Jr.**, Acting Deputy Administrator, Federal Motor Carrier Safety Administration, U.S. Department of Transportation (ex officio)  
**John C. Horsley**, Executive Director, American Association of State Highway and Transportation Officials, Washington, D.C. (ex officio)  
**James M. Loy** (Adm., U.S. Coast Guard), Commandant, U.S. Coast Guard, Washington, D.C. (ex officio)  
**William W. Millar**, President, American Public Transportation Association, Washington, D.C. (ex officio)  
**Jolene M. Molitoris**, Administrator, Federal Railroad Administration, U.S. Department of Transportation (ex officio)  
**Margo Oge**, Director, Office of Transportation and Air Quality, U.S. Environmental Protection Agency, Washington, D.C. (ex officio)  
**Valentin J. Riva**, President and CEO, American Concrete Pavement Association, Skokie, Illinois (ex officio)  
**Ashish K. Sen**, Director, Bureau of Transportation Statistics, U.S. Department of Transportation (ex officio)  
**Kenneth R. Wykle**, Administrator, Federal Highway Administration, U.S. Department of Transportation (ex officio)

**Transportation Research Board publications** may be ordered directly from the TRB Business Office, through the Internet at [nationalacademies.org/trb](http://nationalacademies.org/trb), or by annual subscription through organization or individual affiliation with TRB. Affiliates and library subscribers are eligible for substantial discounts. For further information, contact the Transportation Research Board Business Office, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418 (telephone 202-334-3214; fax 202-334-2519; or e-mail [TRBsales@nas.edu](mailto:TRBsales@nas.edu)).

© 2000 by the National Academy of Sciences.  
All rights reserved.  
Printed in the United States of America.

**Library of Congress Cataloging in Publication Data**  
Highway capacity manual.  
p. cm.  
"HCM 2000."  
Includes bibliographic references.  
ISBN 0-309-06681-6  
1. Highway capacity—Handbooks, manuals, etc.  
HE336.H48 H54 2000  
388.3'14—dc21

00-061507

---

\* Membership as of October 2000.

# THE NATIONAL ACADEMIES

*Advisers to the Nation on Science, Engineering, and Medicine*

National Academy of Sciences  
National Academy of Engineering  
Institute of Medicine  
National Research Council

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. William A. Wulf is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council had become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. William A. Wulf are chairman and vice chairman, respectively, of the National Research Council.

The **Transportation Research Board** is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's mission is to promote innovation and progress in transportation by stimulating and conducting research, facilitating the dissemination of information, and encouraging the implementation of research results. The Board's varied activities annually engage more than 2,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academies, all of whom contribute their expertise in the public interest. The program is supported by the state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

# CONTENTS

PREFACE.....	vii
CONTRIBUTORS AND ACKNOWLEDGMENTS.....	ix
<b>PART I: OVERVIEW</b>	
1. INTRODUCTION .....	1-1
2. CAPACITY AND LEVEL-OF-SERVICE CONCEPTS.....	2-1
3. APPLICATIONS.....	3-1
4. DECISION MAKING .....	4-1
5. GLOSSARY .....	5-1
6. SYMBOLS.....	6-1
<b>PART II: CONCEPTS</b>	
7. TRAFFIC FLOW PARAMETERS .....	7-1
8. TRAFFIC CHARACTERISTICS.....	8-1
9. ANALYTICAL PROCEDURES OVERVIEW .....	9-1
10. URBAN STREET CONCEPTS .....	10-1
11. PEDESTRIAN AND BICYCLE CONCEPTS.....	11-1
12. HIGHWAY CONCEPTS.....	12-1
13. FREEWAY CONCEPTS .....	13-1
14. TRANSIT CONCEPTS .....	14-1
<b>PART III: METHODOLOGIES</b>	
15. URBAN STREETS.....	15-1
16. SIGNALIZED INTERSECTIONS .....	16-1
17. UNSIGNALIZED INTERSECTIONS .....	17-1
18. PEDESTRIANS.....	18-1
19. BICYCLES .....	19-1
20. TWO-LANE HIGHWAYS .....	20-1
21. MULTILANE HIGHWAYS .....	21-1
22. FREEWAY FACILITIES.....	22-1
23. BASIC FREEWAY SEGMENTS .....	23-1
24. FREEWAY WEAVING .....	24-1
25. RAMPS AND RAMP JUNCTIONS .....	25-1
26. INTERCHANGE RAMP TERMINALS.....	26-1
27. TRANSIT.....	27-1
<b>PART IV: CORRIDOR AND AREAWIDE ANALYSES</b>	
28. ASSESSMENT OF MULTIPLE FACILITIES.....	28-1
29. CORRIDOR ANALYSIS.....	29-1
30. AREAWIDE ANALYSIS .....	30-1
<b>PART V: SIMULATION AND OTHER MODELS</b>	
31. SIMULATION AND OTHER MODELS .....	31-1

## PREFACE

The Transportation Research Board's (TRB's) *Highway Capacity Manual* (HCM) provides a collection of state-of-the-art techniques for estimating the capacity and determining the level of service for transportation facilities, including intersections and roadways as well as facilities for transit, bicycles, and pedestrians. For more than 50 years, the HCM has fulfilled this goal, earning a unique place in the esteem of the transportation community.

Developed and revised under the direction of the TRB Committee on Highway Capacity and Quality of Service, this newest edition, HCM 2000, presents the best available techniques for determining capacity and level of service for transportation facilities at the start of the new millennium. However, this comprehensive manual does not establish a legal standard for highway design or construction.

### HISTORICAL PERSPECTIVE

Originally published in 1950, the HCM was the first document to quantify the concept of capacity for transportation facilities. The 1965 edition in turn was the first to define the concept of level of service, which has become the foundation for determining the adequacy of transportation facilities from the perspectives of planning, design, and operations. The 1985 edition, along with its 1994 and 1997 updates, is TRB's most widely used document. Translated into several languages, it has become the standard reference on capacity and level-of-service procedures, relied on by transportation analysts around the world.

### DEVELOPMENT OF HCM 2000

To produce HCM 2000, TRB's Committee on Highway Capacity and Quality of Service developed a comprehensive program of research. The research was implemented through the funding efforts of the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program. In addition, the Federal Highway Administration supported TRB with a variety of research endeavors. These combined efforts produced the basic research reviewed by the committee and incorporated into HCM 2000.

All of the research results contributing to HCM 2000 underwent an iterative and interactive review. When a funded research project was completed, the group that guided its development—for example, an NCHRP panel—reviewed the findings first. If accepted by the group, the research was then presented for consideration by one of the 12 working subcommittees of the Highway Capacity and Quality of Service Committee. The subcommittee, including several committee members as well as other active professionals, then provided its recommendations to the full committee. The final approval for each chapter of HCM 2000 rested with the Highway Capacity and Quality of Service Committee, composed of 30 members representing the research community, government agencies, and private industry.

### CONTENTS OF HCM 2000

The *Highway Capacity Manual* 2000 represents a significant revision and expansion of the material provided in previous editions. The manual has grown from 14 to 31 chapters. These chapters are divided into five parts:

- I. Overview,
- II. Concepts,
- III. Methodologies,
- IV. Corridor and Areawide Analyses, and
- V. Simulation and Other Models.

Parts I and III contain information that corresponds to the contents of previous editions. Part II provides concepts and estimated default values for use in planning-level

analytical work. Part IV presents computational techniques and general analysis guidelines for corridor and areawide analyses. Part V offers background and information on alternative models that may be appropriate for systemwide or more complex analyses.

A companion version of the manual is available in CD-ROM, including tutorials and video clips to enhance the communication of the concepts. In addition, there are links between the text and the glossary to facilitate understanding of the manual by less-experienced users.

### **SPECIAL ACKNOWLEDGMENTS**

HCM 2000 incorporates significant advances in the state of knowledge in determining capacity and quality-of-service values for all modes of surface transportation.

Hundreds of professionals have volunteered their time and energy to the work of the Committee on Highway Capacity and Quality of Service. Twice every year, the committee meets to perform a major review of relevant research and to identify new research needs in response to changes in roadway design standards, driver behavior, and vehicle operating characteristics.

Members of the committee and its subcommittees are listed on pages ii–vii. Special recognition is extended to those who have chaired the committee: O.K. Normann, Carl C. Saal, Robert C. Blumenthal, James H. Kell, Carlton C. Robinson, and Adolf D. May. In acknowledgment of their sustained contributions to the committee and to the development of HCM 2000, Robinson and May have been designated members emeritus of the committee.

Complementing the volunteer efforts vital to the work of the committee, TRB staff has provided outstanding support. Special thanks are given to Richard Cunard, Engineer of Traffic and Operations, and to B. Ray Derr, NCHRP Senior Program Officer, for their contributions.

The Committee on Highway Capacity and Quality of Service invites comments and suggestions on HCM 2000 while continuing its mission of enhancing and improving the design, operation, and planning of transportation facilities.

#### **John D. Zegeer**

Chairman, TRB Committee on Highway Capacity and Quality of Service

## CONTRIBUTORS AND ACKNOWLEDGMENTS

HCM 2000 is the result of the coordinated efforts of many individuals, groups, research organizations, and government agencies. The TRB Committee on Highway Capacity and Quality of Service is responsible for the content of the *Highway Capacity Manual*; preparation of the volume was accomplished through the efforts of the following groups and individuals:

### TRB COMMITTEE ON HIGHWAY CAPACITY AND QUALITY OF SERVICE

(Members as of January 31, 2000)

John Zegeer, *Kittelson & Associates, Inc.*—Chairman  
 Richard Dowling, *Dowling Associates, Inc.*—Secretary  
 James Bonneson, *Texas A & M University*  
 Werner Brilon, *Ruhr University, Bochum, Germany*  
 Robert Bryson, *City of Milwaukee*  
 Kenneth Courage, *University of Florida*  
 Alan Danaher, *Kittelson & Associates, Inc.*  
 Rafael DeAraza, *Florida Department of Transportation*  
 Lily Elefteriadou, *Pennsylvania State University*  
 Dan Fambro, *Texas A & M University (deceased)*  
 Ronald Giguere, *Federal Highway Administration*  
 Albert Grover, *Albert Grover & Associates*  
 Mariano Gullón Löw, *Centro de Estudios de Carreteras (deceased)*  
 Fred L. Hall, *McMaster University, Canada*  
 Douglas Harwood, *Midwest Research Institute*  
 Chris Hoban, *The World Bank*  
 Wayne Kittelson, *Kittelson & Associates, Inc.*  
 Michael Kyte, *University of Idaho*  
 Adolf D. May, *University of California at Berkeley*  
 Douglas McLeod, *Florida Department of Transportation*  
 Barbara Ostrom, *LAW PCS*  
 James Powell, *Parsons Transportation Group*  
 Nagui Roupail, *North Carolina State University*  
 Erik Ruehr, *Valley Research and Planning Associates*  
 Rikke Rysgaard, *Danish Road Directorate*  
 James Schoen, *Catalina Engineering, Inc.*  
 Alex Sorton, *Northwestern University*  
 Dennis Strong, *Strong Concepts*  
 Stan Teply, *University of Alberta, Canada*  
 Rod Troutbeck, *Queensland University of Technology, Australia*  
 Richard Cunard, *Transportation Research Board Staff Representative*

### Emeritus Members

(As of February 1, 2000)

Adolf D. May, *University of California at Berkeley*  
 Carlton C. Robinson, *Consultant*

### Subcommittee on Arterials

James Bonneson, *Texas A & M University*—Chair  
 Janice Daniel, *New Jersey Institute of Technology*  
 Ronald Giguere, *Federal Highway Administration*  
 Joel Marcuson, *Sverdrup Civil, Inc.*  
 Doug McLeod, *Florida Department of Transportation*

(continued)

**Subcommittee on Arterials (continued)**

Dennis Strong, *Strong Concepts*  
Andrzej Tarko, *Purdue University*  
Mark Vandehey, *Kittelson & Associates, Inc.*

**Subcommittee on Concepts and Definitions**

Barbara Ostrom, *LAW PCS—Chair*  
Fred L. Hall, *McMaster University, Canada*  
Doug McLeod, *Florida Department of Transportation*  
Stan Teply, *University of Alberta, Canada*

**Subcommittee on Freeways and Multilane Highways**

Adolf D. May, *University of California at Berkeley—Group Leader, Uninterrupted Flow*  
Nagui Rouphail, *North Carolina State University—Group Leader, Uninterrupted Flow*  
Lily Elefteriadou, *Pennsylvania State University—Leader, Ramp and Weaving Junctions*  
James Schoen, *Catalina Engineering, Inc.—Leader, Basic Freeway Segments and Multilane Highways*  
Michael Cassidy, *University of California at Berkeley*  
Michael Church, *California Department of Transportation*  
Brian Eads, *Crawford, Murphy & Tilly, Inc.*  
Lily Elefteriadou, *Pennsylvania State University*  
Joseph Fazio, *Illinois Institute of Technology*  
Fred L. Hall, *McMaster University, Canada*  
Abdul-Rahman Hamad, *H.W. Lochner, Inc.*  
Lee Han, *University of Tennessee*  
Joel Leisch, *Consultant*  
John Leonard, *Georgia Institute of Technology*  
Barbara Ostrom, *LAW PCS*  
Thomas Parlante, *Arizona Department of Transportation*  
Ronald Pfefer, *Northwestern University*  
William Prosser, *Federal Highway Administration*  
William Reilly, *Catalina Engineering, Inc.*  
Bruce Robinson, *Kittelson & Associates, Inc.*  
Roger Roess, *Polytechnic University*  
Fred Rooney, *California Department of Transportation*  
Rikke Rysgaard, *Danish Road Directorate*  
James Schoen, *Catalina Engineering, Inc.*  
Ronald Sonntag, *Marquette University*  
Andrzej Tarko, *Purdue University*  
Michelle Thomas, *Federal Highway Administration*  
Jose Ulerio, *Polytechnic University*  
Tom Urbanik, *Texas A & M University*

**Subcommittee on Interchange Ramp Terminals**

James Powell, *Parsons Transportation Group—Chair*  
James Bonneson, *Texas A & M University*  
Robert Bryson, *City of Milwaukee*  
Michael Church, *California Department of Transportation*  
Thomas Creasey, *Jordan, Jones & Goulding, Inc.*  
Janice Daniel, *New Jersey Institute of Technology*

(continued)

**Subcommittee on Interchange Ramp Terminals** *(continued)*

Michael Holling, *Transcore*  
B. Kent Lall, *Portland State University*  
Joel Leisch, *Consultant*  
Joel Marcuson, *Sverdrup Civil, Inc.*  
Scott Parker, *Edwards & Kelcey, Inc.*  
Fred Rooney, *California Department of Transportation*

**Subcommittee on Pedestrians and Bicycles**

Alex Sorton, *Northwestern University—Chair*  
Patrick Allen, *California Department of Transportation*  
Hein Botma, *Delft University, The Netherlands*  
Jeff Davis, *The Citadel*  
Joseph Fazio, *Illinois Institute of Technology*  
Chris Hoban, *The World Bank*  
Bruce Landis, *Sprinkler Associates*  
John LaPlante, *TYLin-Bascor*  
Joe Milazzo, *North Carolina State University*  
John Morrall, *University of Calgary, Canada*  
Virginia Sisiopiku, *Michigan State University*  
Mark Virkler, *University of Missouri at Columbia*  
Thomas Walsh, *Madison Department of Transportation*

**Subcommittee on Planning Applications**

Douglas McLeod, *Florida Department of Transportation—Chair*  
Jim Altenstadter, *Arizona Department of Transportation*  
Robert Bryson, *City of Milwaukee*  
Thomas Creasey, *Jordan, Jones & Goulding, Inc.*  
Richard Dowling, *Dowling Associates, Inc.*  
Kurt Eichin, *Florida Department of Transportation*  
Abdul-Rahman Hamad, *H.W. Lochner, Inc.*  
John Karachepone, *Kittelson & Associates, Inc.*  
Wayne Kittelson, *Kittelson & Associates, Inc.*  
William McShane, *Polytechnic University*  
Barbara Ostrom, *LAW PCS*  
Elena Prassas, *Polytechnic University*  
Erik Ruehr, *VRPA Technologies*  
Paul Ryus, *Kittelson & Associates, Inc.*  
Terrel Shaw, *Reynolds, Smith & Hills, Inc.*  
Stan Teply, *University of Alberta, Canada*

**Subcommittee on Research**

Fred L. Hall, *McMaster University, Canada—Chair*  
Alan Danaher, *Kittelson & Associates, Inc.*  
Richard Dowling, *Dowling Associates, Inc.*  
Lily Elefteriadou, *Pennsylvania State University*  
John Leonard, *Georgia Institute of Technology*  
George List, *Rensselaer Polytechnic University*  
Pawan Maini, *University of Colorado at Denver*  
James Powell, *DeLeuw Cather & Company*  
Larry Sutherland, *Ohio Department of Transportation*  
Rod Troutbeck, *Queensland University of Technology*  
Davey Warren, *Federal Highway Administration*

### **Subcommittee on Signalized Intersections**

Dennis Strong, *Strong Concepts—Chair*  
Rahmi Akcelik, *Akcelik & Associates*  
Rahim Benekohal, *University of Illinois*  
Robert Bryson, *City of Milwaukee*  
Kenneth Courage, *University of Florida*  
Glenn Grigg  
Albert Grover, *Albert Grover & Associates*  
David Hook, *Hook Engineering*  
John Leonard, *Georgia Institute of Technology*  
Feng-Bor Lin, *Clarkson University*  
Pawan Maini, *University of Colorado at Denver*  
Carroll Messer, *Texas A & M University*  
Elena Prassas, *Polytechnic University*  
Bruce Robinson, *Kittelson & Associates, Inc.*  
Roger Roess, *Polytechnic University*  
Nagui Rouphail, *North Carolina State University*  
Stan Teply, *University of Alberta, Canada*  
Robert Wortman, *University of Arizona*

### **Subcommittee on Transit Systems**

Alan Danaher, *Kittelson & Associates, Inc.—Chair*  
Tara Barte, *Florida Department of Transportation*  
Howard Benn, *Montgomery County, MD Transit*  
Joseph Goodman, *Federal Transit Administration*  
William Hoey, *Consultant*  
Michael Kyte, *University of Idaho*  
Herbert Levinson, *Consultant*  
David Miller, *Parsons Brinckerhoff*  
Rikke Rysgaard, *Danish Road Directorate*  
Paul Ryus, *Kittelson & Associates, Inc.*  
Kevin St. Jacques, *Wilbur Smith and Associates*  
Joel Volinski, *Center for Urban Transportation Research—University of South Florida*

### **Subcommittee on Two-Lane Roads**

Douglas Harwood, *Midwest Research Institute—Chair*  
Jan Botha, *San Jose State University*  
Hein Botma, *Delft University, The Netherlands*  
Albert Grover, *Albert Grover & Associates*  
Mariano Gullón Löw, *Centro de Estudios de Carreteras (deceased)*  
Christopher Hoban, *The World Bank*  
Greg Laragan, *Idaho Department of Transportation*  
David Lovell, *University of Maryland*  
Adolf D. May, *University of California at Berkeley*  
Carroll Messer, *Texas A & M University*  
John Morrall, *University of Calgary, Canada*  
William Prosser, *Federal Highway Administration*  
Guido Radelat  
Alex Sorton, *Northwestern University Traffic Institute*  
Davey Warren, *Federal Highway Administration*  
Alexander Werner, *Reid Crowther Consultants, Ltd.*

**Subcommittee on Unsignalized Intersections**

Rod Troutbeck, *Queensland University of Technology, Australia—Chair*  
 Werner Brilon, *Ruhr University, Bochum, Germany*  
 Robert Bryson, *City of Milwaukee*  
 Joon Byun, *Federal Highway Administration*  
 Mitzi M. Dobersek, *Wisconsin Department of Transportation*  
 Aimee Flannery, *Mitretek Systems*  
 Glenn Grigg  
 Mariano Gullón Löw, *Centro de Estudios de Carreteras (deceased)*  
 Wayne Haussler, *Goodkind & O’Dea, Inc.*  
 Dane Ismart, *Federal Highway Administration*  
 R. Ian Kingham, *GMK Transportation, Ltd., Canada*  
 Wayne Kittelson, *Kittelson & Associates, Inc.*  
 Michael Kyte, *University of Idaho*  
 B. Kent Lall, *Portland State University*  
 George List, *Rensselaer Polytechnic Institute*  
 Charles Manning, *Creighton Manning, Inc.*  
 Joseph Marek, *Clackamas County*  
 Michael O’Rourke, *Eng-Wong-Taub & Associates*  
 Bruce Robinson, *Kittelson & Associates, Inc.*  
 Lee Rodegerdts, *Kittelson & Associates, Inc.*  
 Erik Ruehr, *VRPA Technologies*  
 John Sampson, *Jeffares & Green, Inc.*  
 Zong Tian, *Kittelson & Associates, Inc.*  
 Marian Tracz, *Cracow Technical University, Poland*  
 Kenneth Voigt, *HNTB Corporation*  
 Andrew Wolfe, *Union College*

**Subcommittee on User Liaison**

Wayne Kittelson, *Kittelson & Associates, Inc.—Chair*  
 Robert Foyle, *ITRE*  
 Ronald Giguere, *Federal Highway Administration*  
 Joel Leisch, *Consultant*  
 John Leonard, *Georgia Institute of Technology*  
 William Prosser, *Federal Highway Administration*  
 Dennis Strong, *Strong Concepts*  
 Charles Wallace, *University of Florida*

**NCHRP 3-55 PANEL**

Carlton C. Robinson, *Consultant—Chair*  
 Rafael DeArazoza, *Florida Department of Transportation*  
 Richard Dowling, *Dowling Associates, Inc.*  
 Ronald Giguere, *Federal Highway Administration*  
 Wayne Kittelson, *Kittelson & Associates, Inc.*  
 Barbara Ostrom, *LAW PCS*  
 William Prosser, *Federal Highway Administration*  
 Nagui Rouphail, *North Carolina State University*  
 Ronald Sonntag, *Marquette University*  
 Stan Teply, *University of Alberta, Canada*  
 Edward Thomas, *Federal Transit Administration*  
 John Zegeer, *Kittelson & Associates, Inc.*  
 B. Ray Derr, *Transportation Research Board Staff Representative*

**RESEARCH TEAM**

William Reilly, Principal Investigator, *Catalina Engineering, Inc.*  
Susan Donahue, *Catalina Engineering, Inc.*  
Michael Ereti, *Catalina Engineering, Inc.*  
Wei Lien Liang, *Catalina Engineering, Inc.*  
Khang Nguyen, *Catalina Engineering, Inc.*  
Andrea Reilly, *Catalina Engineering, Inc.*  
James Schoen, *Catalina Engineering, Inc.*

Roger Roess, *Polytechnic University*  
Elena Prassas, *Polytechnic University*  
Jose Ulerio, *Polytechnic University*  
Rahmi Akcelik, *Akcelik & Associates*  
Ronald Pfefer, *Maron Engineering, Ltd.*

HCM 2000 was edited and produced under the supervision of Nancy A. Ackerman, director of the TRB Office of Reports and Editorial Services; Javy Awan and Norman Solomon edited the manual.