QUALITY CONTROL PLAN

UPPER RIO GRANDE WATER OPERATIONS MODEL

1. Introduction.

Name of Project: Upper Rio Grande Water Operations Model (URGWOM)

Location: Upper Rio Grande basin, from the headwaters of the Rio Grande downstream to American Dam at El Paso, TX.

Cooperators:
Bureau of Reclamation, Albuquerque Area Office;
U.S. Fish and Wildlife Service, New Mexico Ecological Field Office;
U.S. Geological Survey, New Mexico District Office;
Bureau of Indian Affairs, Albuquerque Area Office;
International Boundary and Water Commission (U.S. Section);
U.S. Army Corps of Engineers, Albuquerque District Office;
City of Albuquerque, New Mexico;
City of Santa Fe, New Mexico;
Rio Grande Restoration, Taos, New Mexico;
Sandia National Laboratory, Albuquerque, New Mexico;
Los Alamos National Laboratories, Los Alamos, New Mexico;
Paso del Norte Watershed Council; and
Desert Research Institute.

Project Description: URGWOM is a daily time-step water operations model for the Upper Rio Grande basin utilizing a numerical computer modeling software (RiverWare) capable of simulating the hydrology, water storage and delivery operations in the Rio Grande from its headwaters in Colorado to Elephant Butte Reservoir in New Mexico and for flood control modeling from Elephant Butte Dam to American Dam. The model will be used in flood control operations, water accounting and in the evaluation of water operation alternatives. An URGWOM database will also be developed to store the vast amount of data necessary to develop and maintain the model.

Project Authorization: The plan to develop a unified water operations model for the Upper Rio Grande basin originated in the fall of 1995 when the Federal agencies initiated discussions regarding the need for a water operations model. In late 1995 and early 1996, the federal agencies met with stakeholders in the basin to discuss the program. As a result of these discussions, the six federal agencies signed the *Memorandum of Understanding for the Development of an Upper Rio Grande Water Operations Model for Enhanced System Management* (MOU). Five of the federal agencies signed the MOU in January 1996; the International Boundary and Water

Commission signed an amendment to the MOU in May 1996. Additional cooperators sign the MOU through a second amendment.

2. Quality Control Plan Objective

The objective of this Plan is to ensure that URGWOM is capable of reliably simulating the hydrology of the Rio Grande stream system, the operation of reservoirs and the accounting of water using existing, data. The development and implementation of a reliable computer model will provide for more efficient and effective management of water in the upper Rio Grande basin.

3. Roster of URGWOM Steering Committee Members

The Steering Committee is responsible for overall project management and is composed of one official representative from each of the six federal agencies. Steering Committee responsibilities include attending regular meetings of the Committee, approving plans of study, supporting funding and allocating resources to assure completion of component tasks, tracking task accomplishment and expenditure of funds, preparing progress reports, interagency coordination, and public information.

The current members of the Steering Committee and the agencies they represent are:

Steven Bowser, Bureau of Reclamation,
Dave Wilkins, U. S. Geological Survey (also member of Technical Team),
Cynthia Abeyta, U. S. Fish and Wildlife Service,
John Cawley or Charles Braden, Bureau of Indian Affairs,
Gail Stockton, U. S. Army Corps of Engineers,
Rong Kuo, International Boundary and Water Commission, (U. S. Section).

4. Roster of URGWOM Technical Team Members and their Relevant Experience

The Steering Committee supports a core modeling team to develop the model. Members of this team have expertise in computer hardware and software, knowledge of water operations within the upper Rio Grande basin, knowledge of the data collected on the river, or proficiency in surface water analysis.

The past and present members of the Technical Team, and their relevant experience, are as follows:

April Fitzner, U. S. Army Corps of Engineers; B. S. in Agricultural Engineering and M. S. in Water Resources with thirteen years of experience in surface water hydrology, hydraulics and reservoir operations. Former Technical Team leader.

Ed Kandl, Bureau of Reclamation; B. S. and M. S. in Geology, with fifteen years of experience in hydrology.

Mike Roark, U. S. Geological Survey; B. S. in Geology and graduate studies in geology and hydrology. Seventeen years of experience in the areas of surface and groundwater modeling and groundwater-surface water interaction. Former Technical Team leader and steering committee member.

Dennis Romero, NM Interstate Stream Commission; B. S. in Civil Engineering, and M. S. in Geochemistry with eight years of experience in the areas of surface water quality modeling and monitoring and river and reservoir operations and accounting.

Garret Ross, Bureau of Reclamation; B.S. in Geological Engineering, M.S. in Mineral Engineering, Registered Professional Engineer with four years of experience in water distribution, river and reservoir operations, and water accounting, and seven years of experience in the energy and minerals industry.

Marc Sidlow, U. S. Army Corps of Engineers; B. S. in Civil Engineering. Registered Professional Engineer with twenty years of experience in the areas of surface water hydrology, hydraulics and modeling and river and reservoir operations and accounting.

Carole Thomas, U. S. Geological Survey (retired); B. A. in Mathematics and M. A. in Marine Science. Registered Professional Engineer and Registered Professional Hydrologist with thirty-one years of experience in the areas of surface and groundwater modeling, water use investigations and applied hydrology.

Dave Wilkins, U. S. Geological Survey; B. S. in Agricultural Economics and M. S. in Civil Engineering, with thirty years of experience in the areas of applied surface water and groundwater hydrology. Current Technical Team leader.

Mark Yuska, U.S. Army Corps of Engineers; B. S. in Mechanical Engineering. Registered Professional Engineer with seventeen years of experience in the areas of design and construction of water resource facilities and river and reservoir accounting and operations. Former Technical Team leader.

In addition to the core Technical Team members, other individuals provide specialized support to the Technical Team and their efforts. These individuals and their relevant experience are as follows:

Harriet Allen, U. S. Geological Survey; B. A. in English with sixteen years of experience editing technical documents.

Roberta Ball, U. S. Army Corps of Engineers; B. S. in Civil Engineering and M. S. in Computer Information Systems, with eighteen years of experience in river and reservoir operations and accounting, construction and computer modeling.

Charles Braden, Bureau of Indian Affairs; B. S. in Civil Engineering and M. S. in Environmental Engineering. Registered Professional Engineer with eighteen years of experience in the areas of water rights administration, water quality investigations and surface water and groundwater modeling.

5. Roster of URGWOM Technical Review Committee and Their Relevant Experience

The Steering Committee has established an independent Technical Review Committee. This group is composed of representatives of about 15 governmental entities and other basin interests and groups that have pertinent interest in the development of the model, associated activities (such as data collection, companion model development, etc.), or model applications. The Technical Review Committee conducts periodic independent technical reviews of the modeling program to provide objective feedback during the process to assure that program objectives are being met.

The Technical Review Committee will also review the development and management of an URGWOM database. A Database and Model Testing Quality Assurance/Quality Control Plan was adopted by the Steering Committee in August 2002.

Current and former participants in the Technical Review Committee and their relevant experience are as follows:

Brian Ahrens, Colorado Division of Water Resources; B. S. in Civil Engineering. Registered Professional Engineer with twenty-one years of experience in water resource engineering and groundwater modeling.

Bobby J. Creel, New Mexico Water Resources Research Institute; Ph.D. in Resource Economics with thirty-three years of experience in the areas of water resources planning and development.

John D'Antonio, State Engineer, New Mexico Office of the State Engineer; B. S. in Civil Engineering. Registered Professional Engineer with twenty years of experience in the areas of water resource engineering design, planning and administration.

Rhea Graham, New Mexico Interstate Stream Commission,; B. A. in Geology and M. A. in Oceanography. Registered geologist and engineering geologist with twenty-six years of experience in various aspects of water and natural resource investigations.

Brian Hanson, U. S. Fish and Wildlife Service; B. S. in Wildlife Biology with twenty-eight years of experience in the areas of monitoring and evaluating federal water resources development projects.

Steve Harris, Rio Grande Restoration; private guide and outfitter with twenty-eight years of experience in river conservation and protection activities.

Walter Hines, CH_2M Hill (consultant to the City of Albuquerque); B. S. and M. S. in Civil Engineering. Registered Professional Engineer with thirty-three years of experience in water resource and environmental engineering, hydrology and surface water investigations.

Amy Lewis, Consultant to the City of Santa Fe; B. S. in Geology, M. S. in Hydrology, with twenty years of experience in the areas of groundwater hydrology and hydrologic modeling.

Dan Murray, USDA Natural Resources Conservation Service; B. S. in Agricultural Engineering. Registered Professional Engineer with fifteen years of experience in hydrology, hydraulics and snowmelt runoff forecasting.

Ed Polasko, National Weather Service; B. S. in Meteorology, with thirty years of experience in the areas of hydrology and meteorology.

Herman Settemeyer, Consultant to the Texas Natural Resource Conservation Commission; B. S. and M. S. in Agricultural Engineering. Registered Professional Engineer with twenty -eight years experience in water resource engineering.

Mark Schmidt, City of Albuquerque; B. S. and M. S. in Civil Engineering. Registered Professional Engineer with fourteen years of experience in the areas of environmental and water resources engineering, water resource development and construction management.

Zhuping Sheng, Texas A&M University; Ph.D. in Hydrogeology with thirteen years experience in the areas of groundwater and surface water modeling, well design, wellfield operations, and aquifer storage and recovery.

Paul Tashjian, U. S. Fish and Wildlife Service; M. S. in Geology and two years of post-graduate studies in geology with fourteen years of experience in the areas of climatology and surface water investigations.

John Whipple, New Mexico Interstate Stream Commission; B. S. in Civil Engineering and M. S. in Water Resource Engineering with twenty-one years of experience in water resource investigations, surface water and groundwater modeling.

Steve Vandiver, Colorado Division of Water Resources; B. S. in Civil Engineering. Registered Professional Engineer with thirty years of experience in the areas of water resources planning, development and administration.

Jack Veenhuis, U. S. Geological Survey; B. S. in Hydrology and M. S. in Water Resources, with twenty-seven years experience in the areas of surface and groundwater hydrology and hydrologic modeling.

Timothy James Ward, University of New Mexico; B. S. and M. S. in Geological Engineering, Ph.D. in Civil Engineering. Registered Professional Engineer with twenty-eight years of experience in the areas of hydrology, hydraulics, water resources engineering and education.

In addition to the individuals and the entities they represent listed above, representatives of the Rio Grande basin Pueblos have been regular observers in attendance at meetings of the Technical Review Committee.

6. Quality Control Procedures

Hydrologic Modeling Quality Assurance. Eleven reservoir and river simulation models were evaluated based on general criteria for their use as the URGWOM simulation model. Based on the results of the technical evaluation and the goals and needs defined in the MOU, the Steering Committee unanimously agreed that RiverWare had the greatest likelihood of successfully being developed for the Upper Rio Grande Water Operation Model.

The physical features of the river and reservoirs in the Rio Chama basin, including operation and accounting, were the subject of a test case to determine if RiverWare was capable of adequately representing the physical, accounting and operational complexities that exist on the Rio Chama, which served as a prototype for the Rio Grande basin. Testing was completed in April 1998, and based on the recommendation of the Technical Team that RiverWare was capable and suitable for modeling the Rio Grande basin, the Steering Committee acted to adopt the recommendation of the Technical Team to apply RiverWare for modeling the remainder of the Rio Grande basin.

RiverWare is supported, maintained and continually enhanced by the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) at the University of Colorado at Boulder. CADSWES ensures that professional software standards are applied to maintain a reliable, robust, version-controlled software product. CADSWES also provides technical support, training and documentation to members of the Technical Team. The CADSWES effort is funded in part by the Bureau of Reclamation and URGWOM provides some direct funding for specific development and support needs.

Technical Review Procedures

Technical Team products. Individual Technical Team products will be developed using consistent methods and documented in standardized formats and will

be the subject of Peer Review before the product is released for review by the Technical Review Committee.

Peer Review. Each Technical Team work product, including a check on the data as well as the method and procedures, will be accomplished by competent engineers under contract with one of the federal agencies prior to documentation and submittal for review by the Technical Review Committee. Peer review is provided by Conrad G. Keyes Jr. and William J. Miller.

Conrad G. Keyes Jr., consulting engineer and Past President of ASCE Environmental and Water Resources Institute and Past Chair of the Paso del Norte Watershed Council; B. S., M. S. and Sc. D in Civil Engineering. Registered Professional Engineer with forty-four years of experience in the areas of water resource planning, design, administration and education.

William J. Miller, consulting engineer; Bachelor of Civil Engineering and M. S. in Civil Engineering. Registered Professional Engineer with twenty-six years experience in the areas of water resource engineering, planning, development and administration.

Technical Review Committee. Documentation of model data, methods and results is prepared and made available to members of the Technical Review Team at least one month prior to a meeting of the Committee. Committee meetings are scheduled on an as-needed basis. At meetings of the Technical Review Committee, the results of the URGWOM efforts to date described in the documentation are presented and discussed; questions are addressed to the extent that time allows.

Written comments from Technical Review Committee members on the URGWOM modeling efforts to date are submitted within one-month after the Technical Review Committee meeting. Memoranda summarizing the comments and the responses to the comments are prepared to ensure that the document and/or model are properly modified or clarified to address the comments.

7. Review Documents and Schedule

The following URGWOM Documents prepared by the Technical Team were or will be the subject of peer review and Technical Review Committee review.

Document	Date of Technical Review Committee Review
Conceptualization of the Test Case Reach of the Upper Rio Grande Water Operations Model, Part I – Physical Model	December 11, 1997
Conceptualization of the Test Case Reach of the Upper Rio Grande Water Operations Model, Part II – Water Accounting and	January 22, 1998

Ownership	
Technical Review – Physical Calibration	April 29, 1999
Physical Model Documentation – First Technical Review Committee Draft	February 22, 2000
Physical Model Documentation – Second Technical Review Committee Draft	April 26, 2001
Water Accounting Documentation – Technical Review Committee 1st Draft	April 26, 2001
Technical Review Meeting 3rd Draft – Physical Model Documentation	August 22, 2002
Technical Review - Development of Planning Model	November 13, 2003

8. Discussion of Proposed Deviation from Approved Quality Control Plan.

Any deviation from this approved quality control plan would be subject to the review and approval of the Steering Committee, and in the case of significant deviations, subject to approval of some or all of the agencies represented on the Steering Committee. Deviations from this approved quality management plan must be consistent with the purpose of the MOU for the Development of an Upper Rio Grande Water Operations Model for Enhanced System Management.

Submitted by: William J. Miller — Date: 9/9/03
William J. Miller

Reviewed by: Gail Stockton — Date: 9/9/03
Gail Stockton
U. S. Army Corps of Engineers

Approved by: Steven Bowser — Date: 9/11/03
Steven Bowser
Bureau of Reclamation

Cynthia Abeyta — Date: 9/25/03
Cynthia Abeyta
U. S. Fish and Wildlife Service

David Wilkins — Date: 9/9/03
David Wilkins
U. S. Geological Survey

Charles Braden

Date: 9-10-03

John Cawley/ Charles Braden
Bureau of Indian Affairs

Rong Kuo

Date: 10/9/03

Rong Kuo
International Boundary and Water
Commission (U. S. Section)