

**State of flood related modeling along the Middle Rio Grande
(identification of issues/needs)**

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This report submitted by the University of New Mexico represents the beginning of a collaborative effort between ERDC, DRI, SNL, and UNM to research urban flood reduction and ecologic enhancement issues along the Middle Rio Grande. This particular project is aimed at collaboration initiation and data collection. Collaboration initiation and data collection go hand in hand as both items require contacting agencies and stakeholders involved in modeling the Middle Rio Grande.

Data Collection

A number of federal, state, and local governmental agencies are actively participating in studies related to sediment transport and flood control along the Middle Rio Grande. Some of these studies may be highlighted at a local meeting; however, many of these studies result in reports that are not well circulated. For example, the FLO-2D model was used to model the entire Middle Rio Grande from Cochiti Dam to Elephant Butte. The results of this model have been presented at Bosque Initiative meetings. FLO-2D was applied to the river again to assist the Save Our Bosque Task Force in their restoration planning through the Socorro reach. Results of FLO-2D through the Albuquerque stretch were presented at a February 10, 2006 meeting at the Corps office in Albuquerque. This model used updated cross sections and additional high-flow calibration data. Each of these studies had different objectives; nonetheless, the river was modeled and flood surface elevations were calculated for different flow rates.

One purpose of this project is to determine the current state of knowledge of flooding issues associated with the Middle Rio Grande. Thus, an inventory of hydrologic, hydraulic, sediment transport, and water operation models that have been used for the Middle Rio Grande is being conducted. In order to gain access to studies/reports prepared for different agencies, a number of contacts have been made. Copies of reports are being obtained and summarized. Cooperation from governmental agencies (at all levels) is needed for the work to be as comprehensive as possible.

The following reports have been obtained from the US Bureau of Reclamation in pdf format. The reports are listed by the name of the pdf file.

Development of MRG FLO-2D Flood Routing Model.pdf
Hyd Modeling MRG Rio Puerco Reach 2001.pdf
RG Silvery Minnow Sanctuary 1-D HEC RAS Model.pdf
2002 Cross Section Geometry Generation Apr2006.pdf
Sediment Plug Model Study Oct2005.pdf
Bendway Weir Report Vol I – 2004.pdf
Bernalillo Bridge Reach 1962-2001.pdf
EB Temp Channel 2005 Sediment Transport Model May2006.pdf
Prediction of River Bed Armoring and Sorting Jan2006.pdf
Sed Erosion Analysis San Acacia Div Dam Removal.pdf
Aquatic Habitat and Hydraulic Modeling Study 092004.pdf
Sediment Transport Modeling San Antonio to EB Sep2003.pdf
Bendway Weir Report Vol II – 2004.pdf

The following summaries of some of these reports were provided by Vincent Benoit of the Bureau of Reclamation:

Bernalillo Bridge Reach Highway 44 Bridge to Corrales Flood Channel Outfall Hydraulic Modeling Analysis 1962-2001 (June 1, 2003)

The Bernalillo Bridge reach spans 5.10 miles downstream from Highway 44 at Bernalillo to cross-section CO-33. This reach is included in the habitat designation for two federally-listed endangered species, the Rio Grande silvery minnow and the southwestern willow flycatcher. Restoration efforts for these species require the understanding of historic, current and potential future geomorphic characteristics of the channel. Analysis of water and suspended sediment data at the USGS gaging stations, aerial photos, cross-section surveys and bed material size, reveal the temporal and spatial changes in the processes acting on the channel.

Development of the Middle Rio Grande FLO-2D Flood Routing Model

The FLO-2D flood routing model for the Middle Rio Grande has been evolving since the first application of the model to the Isleta reach in 1997. The model development has involved the cooperation, support and funding from a number of agencies including the U.S. Fish and Wildlife Service, the Albuquerque District of the Corps of Engineers, the Bureau of Reclamation and the New Mexico Interstate Stream Commission (ISC). Initial applications of the model focused on specific reaches of the Rio Grande including the San Acacia to San Marcial reach, the Isleta Reach from the Isleta diversion to Belen, and the Corps' FLO-2D application to the Rio Bravo bridge reach. As these applications were reviewed, the benefits to having a complete Middle Rio Grande flood routing model became more apparent. The current model

predicts discharge hydrographs for approximately every 500 ft of channel and computes overbank flood inundation. These results support the Upper Rio Grande Water Operations Review and EIS (URGWOPs), the analyses of restoration projects and the design of flood mitigation projects.

Middle Rio Grande Ecosystem Bosque Biological Management Plan (June 1, 2005)

In the first years of the 1990s, United States Senator Pete Domenici's Rio Grande Bosque Conservation Committee brought federal dollars, political attention, citizen input, and academic resources to bear on the unique riparian corridor of the central Rio Grande from Cochiti to Elephant Butte. During those same years, an ad hoc gathering of federal, state, and local water managers, academics and technical experts known as Rio Grande Joint Initiatives began exploring a blueprint for agency cooperation and information sharing that acknowledged for the first time the interrelatedness of their various missions. Both endeavors represented a trend toward coordinated management of the river system and a more holistic view of its physiology. For a maze of reasons, however, attainment of those goals would be easier said than done.

Rio Grande Silvery Minnow Sanctuary Proposed Site 1-D HEC-RAS Model of Area of Interest (January 1, 2005)

There is a plan to develop a Rio Grande minnow sanctuary in the Albuquerque area. The specific area spans a reach of the river covered by the surveyed Albuquerque (A)-lines. A 1-D HECRAS model was developed to assist with the planning of this sanctuary.

Tiffany Junction Sediment Plug Computer Modeling Study-DRAFT (February 23, 2004)

There are several documented cases of sediment plug development in alluvial rivers, but little is known about the specific processes affecting the formation of plugs. General qualitative conclusions have been drawn that pertain to such factors as a sudden decline in sediment transport capacity, the effects of debris in a channel, or human factors such as watershed management. These conclusions are pertinent, but they do not contribute to the understanding of the specific processes occurring at the location where plugs develop. This study is being completed to identify the processes affecting sediment plug development along the Tiffany Junction Reach of the Middle Rio Grande. Understanding the formation of sediment plugs is important for addressing endangered species issues, planning river maintenance activities, and managing water deliveries to water users. Several theories have been offered about the cause of the sediment plugs along the Tiffany Junction Reach. Some

of these theories associate the cause to overbank flows and the subsequent effect of overbank flows on sediment transport through the reach. There are several questions related to these theories such as the following: What portion of the sediment load is lost with overbank flows (as a function of the vertical distribution in sediment load) and how does the loss of water and sediment affect deposition or erosion in the main channel? Are there seasonal variations in sediment load or variations with the rising versus falling limb of a hydrograph? How does deposition vary laterally with overbank flows and how does that variability affect sediment transport in the channel?

In addition to these Bureau of Reclamation reports, we are in the process of obtaining reports from the Corps of Engineers, the Interstate Stream Commission, and the Endangered Species Act Collaborative Program. A preliminary database is being developed with the following information from the reports.

- Model used
- Assumptions inherent to model
- Governing equations
- Variables used for calibration
- Data used for validation
- Ranges of input data
- Spatial extent (River miles of application)

As this database is created, it will be circulated to the different agencies that have created the reports for feedback. It is anticipated that the database matrix will be utilized to help determine the most pressing needs for additional modeling and the issues that need to be most quickly addressed. Furthermore, the pdf files will be placed on a website so that all researchers and stakeholders have easy access to the reports.

The following table summarizes reports obtained to date.

Title	Prepared for:	prepared by:	date
Development of the Middle Rio Grande FLO-2D Flood Routing Model Cochiti Dam to Elephant Butte Reservoir	Bosque Initiative Group U.S. Fish and Wildlife Service U.S. Army Corps of Engineers	Tetra Tech, Inc. Surface Water Group Albuquerque, New Mexico	3-Feb-02
Hydraulic Modeling on the Middle Rio Grande, NM Rio Puerco Reach	Bureau of Reclamation Albuquerque Area Office	Gigi Richard Claudia Leon Dr. Pierre Julien Colorado State University Engineering Research Center Department of Civil Engineering Fort Collins, Colorado 80523	Feb-01
Rio Grande Silvery Minnow Sanctuary Proposed Site 1-D HEC-RAS Model of Area of Interest	Bureau of Reclamation Albuquerque Area Office Technical Services Division	Jonathan AuBuchon with Kristi Smith Bureau of Reclamation Albuquerque Area Office Technical Services Division	Jan-05
2002 Cross Section Geometry Generation and Validation Middle Rio Grande Project, NM Upper Colorado Region	Bureau of Reclamation	Christopher L. Holmquist-Johnson, Hydraulic Engineer Sedimentation and River Hydraulics Group, D-8540 Paula Makar, P.E., Hydraulic Engineer Sedimentation and River Hydraulics Group, D-8540	Apr-06
Sediment Plug Computer Modeling Study Tiffany Junction Reach Middle Rio Grande Project Upper Colorado Region	Bureau of Reclamation Albuquerque Area Office Technical Services Division River Analysis Group Robert Padilla, Project Manager	Craig B. Boroughts, Ph.D., P.E. Contractor to the Technical Services Division	Oct-05

Effects of Bendway Weir Characteristics on Resulting Flow Conditions Volume I Technical Report	Bureau of Reclamation Albuquerque Area Office	Colorado State University Engineering Research Center Fort Collins, CO 80523 Jamis D. Darrow, Christopher I. Thornton, Steven R. Abt, Chad M. Lipscomb, Chester C. Watson, Michael D. Robeson	Apr-04
Effects of Bendway Weir Characteristics on Resulting Flow Conditions Volume II Appendices	Bureau of Reclamation Albuquerque Area Office	Colorado State University Engineering Research Center Fort Collins, CO 80523 Jamis D. Darrow, Christopher I. Thornton, Steven R. Abt, Chad M. Lipscomb, Chester C. Watson, Michael D. Robeson	Apr-04
Bernalillo Bridge Reach Highway 44 Bridge to Corrales Flood Channel Outfall Hydraulic Modeling Analysis 1962-2001	Bureau of Reclamation Albuquerque Area Office	Mike Sixta Jason Albert Dr. Claudia Leon Dr. Pierre Y. Julien Colorado State University Engineering Research Center Department of Civil Engineering Fort Collins, Colorado 80523	Jun-03
Elephant Butte Temporary Channel 2005 Sediment Transport Modeling	Bureau of Reclamation Albuquerque Area Office	Kent L. Collins, P.E. Hydraulic Engineer Sedimentation & River Hydraulics	May-06
Prediction of River Bed Armoring and Sorting	Bureau of Reclamation Albuquerque Area Office	Blair Greimann, P.E., Ph.D. Hydraulic Engineer Sedimentation & River Hydraulics Travis Bauer, P.E. Hydraulic Engineer Sedimentation & River Hydraulics	Jan-06

Sediment Erosion Analysis of San
Acacia Diversion Dam Removal
Alternative – Final Report

Bureau of Reclamation
Albuquerque Area Office

Blair Greimann, Ph.D., P.E., Hydraulic Engineer
Sedimentation & River Hydraulics

Aquatic Habitat and Hydraulic Modeling Study
for the Upper Rio Grande Water Operations Model

US Army Corps of Engineering
Albuquerque District

Bohannon Huston
Mussetter Engineering, Inc.
Miller Ecological Consultants, Inc.

29-Sep-04

Sediment Transport Modeling of the Rio Grande
From San Antonio to Elephant Butte Reservoir to
Evaluate Various Temporary Channel Design
Configurations

Bureau of Reclamation
Sedimentation & River Hydraulics
Technical Service Center

Sep-03

Collaboration Initiation

To help determine the current state of knowledge of flooding issues associated with the Middle Rio Grande, we held a seminar class during the fall, 2006, semester which focused on the Rio Grande. The seminar afforded us the opportunity to invite outside speakers as well as provided a collaborative forum for the different Rio Grande projects taking place at UNM.

The Rio Grande Seminar was cross-listed in the Departments of Civil Engineering and Biology and held once-a-week on Tuesdays at 12:30. Twenty students registered for the course. Additional faculty, students, and stakeholders attended the seminar on a regular basis such that attendance was typically about 30 people. Fifteen speakers participated in the seminar including Urban Flood Demonstration Program collaborators Aaron Byrd (Engineering Research Development Center) and Jesse Roberts (Sandia National Laboratory). A website was established to help keep stakeholders informed of the speakers. In most instances, the slides presented by the speakers have been posted on the website. (<http://www.unm.edu/~jcoonrod/rgseminar/>)

In addition to the weekly speakers, we had one week where each student registered for the course was asked to make a brief presentation of their graduate research. The purpose of having each student present their research was to spur more collaboration where appropriate and to educate each other on the Rio Grande related research taking place on campus.

Rio Grande Seminar Schedule, Fall, 2006

1. Aug 22	Julie Coonrod, UNM Civil Engineering	An introduction to the Middle Rio Grande and the Urban Flood Demonstration Program
2. Aug 29	James Cleverly, UNM Biology	Evapotranspiration: long-term studies of ecohydrology and biometeorology along the Middle Rio Grande
3. Sept 5	Dianne McDonnell, UNM and ReSpec	Scaling Riparian Evapotranspiration to Canopies along the Middle Rio Grande Corridor in Central New Mexico
4. Sept 12	Aaron Byrd, ERDC	A system-wide approach to watershed management
5. Sept 19	Rolf Schmidt-Peterson, ISC	River System Overview and Role of Interstate System Commission
6. Sept 26	Paul Tashjian, USF&WS	Physical Habitat of the Middle Rio Grande (historic vs. current)
7. Oct 3	Nabil Shafike, ISC	Modeling Framework for the Middle Rio Grande Basin

8. Oct 10	Mike Harvey, Mussetter Engineering, Inc.	Alluvial Bar Morphology and Dynamics in the Middle Rio Grande: Application to Habitat Restoration for the Rio Grande Silvery Minnow
9. Oct 17	Susan Kelly, UNM Utton Center	Legal / Transboundary Issues
10. Oct 24	Stuart Bunn, Griffith University, Brisbane, Australia	Making the connection between healthy waterways and healthy catchments, Southeast Queensland, Australia
Please note the Fall 2006 UNM Water Forum will meet in the Student Union Building (Lobo A & B) on October 31.		
11. Oct 31	Water Forum at SUB April Sanders, COE	Middle Rio Grande Endangered Species Act Collaborative Program
12. Nov 7	Fred Phillips, NMT	Salt of the Earth: Salinization of the Rio Grande
13. Nov 14	Brief student presentations	Graduate Research Topic
14. Nov 21	Scott Collins, Sevilleta LTER	Sevilleta LTER: Presses and pulses in aridland ecosystems
15. Nov 28	Janie Chermak, UNM Economics	Economics & Water in the Middle Rio Grande
16. Dec 5	Jesse Roberts, SNL	Sediment Transport Modeling in the Albuquerque Reach
17. Dec 12	Finals week	

Some of the slides contained in these presentations provide additional information on the state of modeling in the Middle Rio Grande. In some instances, this is information that is not yet available in report format.