Fall 2010

Water Resources 2010 APR Self-Study & Documents

University of New Mexico

Academic Program Review

Self-Evaluation Report

Water Resources Program

University of New Mexico

Fall, 2010

Table of Contents

Introduction

Summary of the Program

The Water Resources Program (WRP) is an interdisciplinary graduate program at the University of New Mexico that was created to offer the Masters of Water Resources (MWR) degree. The University of New Mexico's location in the Southwestern USA means that there is a natural emphasis on dry-region water issues; however, the MWR degree is designed to provide its students a firm grounding in water resources that is applicable throughout the world. The program is designed to provide a wide breadth of education and professional training in topics related to water resources including the sciences (hydrology, environmental science, chemistry, biology), management (economics, political science, planning), law and policy, and engineering (water resources and environmental engineering).

The MWR degree is generally directed towards students wishing to develop their qualifications and expertise in the practice of water resources management. Therefore, although it does include considerable exposure to research topics and methods in this area, its principal orientation is towards practice rather than research. Entering students are assumed to have a basic proficiency in at least one water-related discipline (defined rather broadly) such as engineering, sociology, management, public administration, environmental studies, economics, law, chemistry, planning, political science, geology, geography, and biology, or professional experience in the water field. The program seeks to expand and deepen students' knowledge of their primary disciplines as well as provide them with an integrated perspective on water in nature and society, improve their capacity to think carefully and comprehensively, and develop their technical and communications skills.

The success of the WRP can be measured in several ways. First, and most importantly is the success of its graduates. The MWR degree is considered a professional degree and its principal purpose is to prepare the students for entering water-related professions rather than joining a Ph.D. program. In this regard it is similar to degrees such as the MBA, Master of Architecture, or Master of Engineering. The WRP graduates have varied employment opportunities available to them. Approximately 100 students have graduated from the program since 2000 and have begun successful careers in federal, state or local government (~32%), consulting firms or private business (~20%), or work with the national laboratories (~9%). Approximately 12% of the students have pursued other opportunities such as additional graduate study, work for non-profits, or have chosen not to seek employment. Contact with the remaining graduates has been lost. An important point to note is that approximately 90% of this cohort has remained in NM. These graduates are making important contributions towards management of water resources in the state and at the same time bringing recognition to the WRP and to UNM.

A second measure of success of the WRP is the contribution its faculty make to academia, to UNM, and to the community. While most of the academic contributions of UNM faculty is associated with their home department, within the state of NM faculty associated with the UNM WRP are increasingly being called upon to serve on state and local committees and task forces, to give presentations and analyses to legislative committees, and to give lectures to civic groups.

These activities bring recognition to UNM and that is hoped will eventually lead to research contracts with state and local resource management agencies.

The WRP curriculum requires 39 credits. Students must take a common core of classes (WR 571 – Contemporary Issues, WR 572 – Modeling, and WR -573 – Field Methods, WR 598 – Professional Project). The rest of each student's curriculum is taken from existing courses. Students must choose to specialize in either the hydroscience area (HS) or policy and management area (PM), and at least five of their classes will be selected accordingly. However, in recognition of high degree of interdisciplinarity of the field, all students must also take at least two courses in the other area.

The student's program at UNM is completed by conducting an independent investigation resulting in preparation of Professional Project (WR 598). The Professional Project is intended to be demonstration of a student's ability to conduct independent high level investigation, analysis, and interpretation on a problem related to water resources. In many respects it is similar to a traditional Masters Thesis, and indeed many Professional Project studies are conducted, written, published, and would satisfy the criteria for a Masters Thesis. However, because the MWR degree is professionally oriented, the Professional Project offers students the opportunity to work on a topic that is more practical and less theoretical than expected for a Masters Thesis. All Professional Projects are added to the collection in UNM's Zimmerman Library. Since 2006, they have also been placed in the library's D-Space (digital space) collection in electronic format so that they can identified and retrieved using database search engines such as Google.

History of the Water Resources Program

The WRP evolved from a series of interdisciplinary brown bag seminars that started in the mid 1980's for the purpose of developing collaboration across campus on research and teaching on issues associated with water resources interpreted in its broadest meaning. Regular seminar participants were principally from the Colleges of Arts and Sciences, Engineering, Architecture and Planning, and Law. The seminars led to recognition of the wide ranging expertise in water issues that existed among the faculty at UNM, as well as recognition that the challenges related to understanding and addressing these issues could only be addressed by teams of participants with representatives from multiple disciplines. It was further recognized that the educational programs provided at UNM did not offer much opportunity for students to step out from their traditional and fairly rigid curricula and develop the breadth of knowledge needed to work on these issues.

In 1988 a core group of faculty began developing plans for an interdisciplinary masters program that would focus on training professionals who would seek employment in water resources and related fields. This effort culminated in a formal proposal titled "A Proposal to Establish A Graduate Program in Water Resources Administration" that was submitted by professors F. Lee Brown (economics) and James Gosz (biology).

In 1991, the Master of Water Resources Administration (MWRA) degree was formally initiated at the University of New Mexico in response to the need for well-educated water resources administrators, who could balance competing economic, social, technological, ecological and

cultural requirements. This 36 semester-credit professional degree helped organize and package the considerable water expertise of the UNM campus in a manner that made it readily available to students and citizens of New Mexico. The interdisciplinary nature of the degree assured that its graduates were exposed to the issues and conflicts facing today's water managers as well as the solutions being proposed. The core of the degree brought diverse faculty together to present their knowledge in an integrated manner. Without the MWRA degree, this integrated view of water management problems and potential solutions was not possible within highly structured, discipline-focused university departments and traditional degree programs.

The first student graduated from the program in 1991. Since its inception the program has graduated more than 120 students.

In 1995, a Professional Project was initiated in place of the Master's comprehensive exam. No semester credits were given for the project.

In 1998, the highly-structured MWRA degree became the current Master of Water Resources (MWR) degree. This included implementation of a more flexible two-track MWR degree that affords students greater options in their coursework program (Policy/Management or Hydroscience). Implementation of the two tracks led to increased interest by faculty in disciplines not directly associated with water resources which led to additional faculty participation in the program. Three semester credits were given for the Professional Project, bringing the total number of semester credits to 39. The Water Resources Program, the graduate unit responsible for administering the degree, was transferred to UNM's University College. On July 1, 2010, the WRP began reporting directly to the Deputy Provost for Academic Affairs.

Since its inception the WRP has had only three directors
1991 – 1996 – Denise Fort, JD – Professor, Law
1996 – 2006 – Michael Campana, Ph.D. – Professor, Earth and Planetary Sciences
2006 – Present – Bruce Thomson, Ph.D. – Professor, Department of Civil Engineering

Purpose of the Academic Program Review

"Academic Program Review (APR) provides an opportunity for all academic programs at the" University of New Mexico to examine their achievements and goals. In addition to preparing a self-study, programs will invite distinguished colleagues to review the program and confer about how it can best move forward. Although some manner of program review has been a part of UNM's culture for most of its history, this comprehensive approach is more relevant to the university's strategic plan. The APR will evaluate the quality of the program and describe how it serves other parts of the university (other academic departments, interdisciplinary programs, centers, service units, etc.), its discipline, the community, and the state.

The results of the comprehensive review process are important for planning, curriculum, professional development, budget and time allocation decisions, and more broadly, for examining how the program presents itself within the university community and to the outside world. The goals of program review are entwined with high aspirations for the University of New Mexico. These go far beyond compliance and accountability issues, although inevitably there are elements of those issues in the operational life of any large organization. Program reviews are a crucial element of university accreditation and are also an important complement to other accreditation processes. For units that undergo professional or other types of accreditation, the APR will precede and provide support for those accreditation efforts.

The APR is structured to help both the unit and the institution make progress in achieving their goals. Looking at past performance is useful insofar as it tells us something about the future prospects for the program. The focus of the APR is solidly on the future."[1]

Issues To Be Considered in Academic Program Review

The APR process directs the unit being reviewed to identify specific issues or questions that are to be considered by the review team. These are summarized here. The context in which they were generated are discussed in subsequent sections of this report. In addition, at the end of each section there is a list of other issues and challenges that the WRP must consider. This is presented to assist the APR team in understanding the issues of concern to the WRP. The APR team is specifically being asked to consider five specific issues.

Future Evolution of the Water Resources Program

Should the WRP Expand Its Mission to Include Sustainability, Environmental Science or Develop a Doctoral Program?

The WRP needs to consider whether there is value, opportunity and need for expanding the scope of the program into areas of sustainability or environmental science. The WRP also should consider whether an interdisciplinary Ph.D. in Water Resources might be worth developing.

[1] from Academic Program Review: Policies, Principles and Procedures, the University of New Mexico, Office of the Provost, Office of Graduate Studies, and Faculty Senate Standing Committees: Curricula, Graduate, and Undergraduate (2005).

Governance & Administration Issues Facing the Water Resources Program

What is the Proper Administrative Home for the WRP?

The current administrative home of the WRP is University College which is principally oriented towards freshman programs and lower division student advising. The WRP is the only graduate program in University College. UNM has asked the WRP for its input in identifying another administrative home.

Curriculum Issues Facing the Water Resources Program

Should the WRP Program Retain the Separate Concentrations in HS and PM?

The separate curriculum concentrations of Hydroscience (HS) and Policy and Management (PM) in the MWR program was implemented in about 1998. Offering the same degree with two very different concentrations allows students to tailor their curriculum to focus in their areas of interest. At least one faculty member has expressed concern that this reduces some of the interdisciplinary characteristics of the program that is in part responsible for its success.

Research Issues Facing the WRP

Can the WRP's Externally Funded Research Program be Increased?

Currently little externally funded research is done through the WRP because: 1) the program does not have a strong research orientation and, 2) participating faculty are strongly encouraged to conduct research through their home departments. This results in few Research Assistant opportunities for WRP students and little overhead return for discretionary use. UNM and the WRP needs to determine if an externally funded research program is a reasonable expectation of the WRP and if so, what institutional arrangements can be implemented to assure support by participating departments and units across campus.

Budget Issues Facing the WRP

Can the WRP Program be Modified to Accommodate Past & Future Budget Cuts?

Perhaps the single greatest threat to the WRP posed by recent budget cuts is reduction of the teaching team in WR 571 from three faculty to two and elimination of the communications component from the three core classes. Further cuts (or increased cost of faculty release time) will have a similar impact on WR 572. The Program must find a way of restoring participation by faculty from multiple disciplines in the teaching mission or possibly change the way the core curriculum is delivered.

Program Mission Statement

The Goal of the Water Resources Program

The UNM Water Resources Program (WRP) will become a regionally prominent center of expertise on water related issues and training for environmental professionals, promoting fair, healthy and sustainable solutions to the challenges of water use in New Mexico and the southwest.

Mission of the Water Resources Program

The mission of the WRP includes the following:

- To train water resource professionals at the graduate and post-graduate degree levels
- To educate the public and the UNM community about water resource issues
- To provide expertise and research to guide water policy and management decisions
- To promote and coordinate research into water-related issues and challenges

Future Vision of the Water Resources Program

The WRP faculty have had two strategic planning retreats in which the current challenges and future vision of the program has been extensively discussed; one was conducted in October 2006 when Prof. Thomson became Director, and a second was done in February 2010. A summary of the 2010 retreat is included in Appendix IV. The results of this discussion can be categorized as near term plans (< 5 years) and long term plans (> 5 years).

Near Term Plans

Plans for the WRP in the immediate future focus on improvements in the existing program. These include:

- Improved qualifications of entering students
- Improved quality and increased rigor in students' Professional Projects
- Increased faculty participation in core classes and service on student Professional Project committees
- Increase externally funded interdisciplinary research
- Increased public engagement through seminars, speakers bureaus, and service on local and state advisory boards and committees
- Improved linkage with the water resource profession resulting in collaboration on local water resource projects, increase internship opportunities, and increased employment opportunities for MWR graduates

Long Term Plans

Although the political and financial climate in NM and at UNM are likely to limit expansion of existing programs and prohibit creation of new ones, for the WRP to remain innovative and energetic it is important to consider opportunities for growth of the program. In early 2010 the WRP Director led a team that prepared a pre-proposal in response to an NSF Request for Proposals to develop professional masters degrees in the sciences. The pre-proposal was

circulated among WRP affiliated faculty and met with favorable response, however, it was not selected by UNM for subsequent preparation of a full proposal. Ideas that were included in the pre-proposal for possible expansion of the WRP an included:

- Coordinate with the existing undergraduate minor in Sustainability Studies to evaluate possibilities for incorporating sustainability topics into the MWR degree. Consider implementing a graduate minor or even a graduate degree in sustainability or a related field.
- Coordinate with the existing undergraduate program in Environmental Science to evaluate a graduate minor or even a graduate degree in this field.

For 10 years faculty within the WRP have discussed creation of a doctoral program. This program might take one of two forms: 1) a Doctor of Water Resources degree that would be oriented towards professional practice, or 2) a research oriented Ph.D. degree in Water Resources. To date the faculty have not come to a resolution as to whether a doctoral program would be successful at UNM. The topic has not been formally addressed by the faculty because: 1) it is not clear that UNM would be able to provide the resources to support a new degree, 2) the WRP does not have a sufficient externally funded research to support doctoral level research activities, and 3) the NM State Department of Higher Education has expressed strong concerns about proliferation of graduate degrees so that new degrees require an extraordinary amount of justification.

Graduate Issue for the WRP – Coordinate A Response to NMSU Proposal for MS and PhD Degrees in Water Science and Management

Related to the discussion of whether to expand the scope of the MWR degree or possibly develop a doctoral program in water resources, faculty at New Mexico State University have developed aproposal to create a new interdisciplinary graduate program leading to M.S. and Ph.D. degrees in Water Science and Management. At the masters level this program is very similar to the MWR degree offered at UNM. The proposed Ph.D. is likely very similar to one that might be proposed by UNM. The UNM Dean of the Office Graduate Studies will have an opportunity to comment on this new degree, probably in AY 2010-2011. The Dean has asked the WRP evaluate this proposal and assist her in developing a response. The issue and UNM's response are loaded with political dynamics that will require careful deliberation.

Issues to be Considered by the APR Team Regarding the Mission of the WRP

Should the WRP Expand Its Mission to Include Sustainability, Environmental Science or Develop a Doctoral Program?

The WRP needs to consider whether there is value, opportunity and need for expanding the scope of the program into areas of sustainability or environmental science. The WRP also should consider whether an interdisciplinary Ph.D. in Water Resources might be worth developing.

Governance and Administration

UNM Administration

The University of New Mexico is governed by a Board of Regents which is responsible for the governance of the University of New Mexico. The Board's power to govern the University includes fiduciary responsibility for the assets and programs of the University, establishment of goals and policies to guide the University and oversight of the functioning of the University.

The Board is comprised of seven members who are appointed by the Governor of New Mexico, with the consent of the Senate, for staggered terms of six years except for the student regent who is appointed for a two-year term. The Governor and the Secretary of Education are designated as ex-officio, non-voting members, and the Presidents of the Faculty Senate, Staff Council, Associated Students of UNM, Graduate and Professional Student Association, Alumni Association, and UNM Foundation are non-voting advisors.

The President of the University is appointed by the Regents and is directly responsible to them. As chief executive officer of the institution, the President directs the administration in carrying out University Policy, and he has the authority to assign and reassign administrative duties. David Schmidly was installed as UNM's 20th President in October 2007 (www.unm.edu/president/).

The six major divisions of the University are headed, respectively, by the Provost/Executive Vice President for Academic Affairs; the Executive Vice President for Administration; the Vice President for Student Affairs; the Vice President for Institutional Advancement; the Vice President for Research; and the Vice President for the Health Sciences.

The Provost/Executive Vice President for Academic Affairs is Suzanne Ortega, a position she has held since August 2008 (www.unm.edu/~acadaffr/OrtegaBio.html). Richard Holder is the Deputy Provost for Academic Affairs (www.unm.edu/~acadaffr/HolderBio.html).

The Water Resources Program also works closely with the office of the Vice President for Research. The Vice President for Research is Julia Fulghum (http://research.unm.edu/).

The Office of Graduate Studies (OGS) is responsible for implementing the policies and procedures governing graduate education at UNM (www.unm.edu/~grad). OGS maintains graduate students' academic records, processes graduate assistantships, approves students' Programs of Studies, and provides final review and approval of students' academic performance prior to graduation. In addition, OGS provides review and the first line of approval of departmental curriculum changes. OGS does not contain any degree granting programs at present. The Dean of OGS is Amy Wohlert. Dr. Wohlert is on sabbatical leave during the fall, 2010 semester.

Administration of the Water Resources Program

The Water Resources Program is administratively located in the University College. However, at present this college does not have a Dean. Therefore, since July 2010 the Water Resources

Program (WRP) has administratively reported to Richard Holder, the Deputy Provost for Academic Affairs.

The WRP is lead by a Director (Bruce Thomson) and Associate Director (Steve Cabaniss). Both positions are half-time. Dr. Thomson is a tenured professor in Civil Engineering and Dr. Cabaniss is a tenured professor in Chemistry. Drs. Thomson and Cabaniss are responsible for day-to-day operations of the program including advising students, supervising the academic program, and preparing and administering program budgets.

The WRP has a full time Administrative Assistant, Annamarie Cordova. Her responsibilities include providing administrative assistance; processing and tracking student paperwork related to admissions, academic requirements, and graduation; tracking WRP finances; conducting basic WRP web site maintenance; and representing the WRP at Office of Graduate Studies staff meetings.

The WRP is governed by a Program Committee that is responsible for setting policy and establishing the rules and regulations governing the Program and its Master of Water Resources degree. The Program Committee also provides counsel to the Program Director and may hear student appeals regarding issues such as admissions and curriculum approvals. The Program Committee consists of six UNM full-time faculty members, a member of the water resource profession, and an alumni member. Program Committee members serve three year terms and are elected by the participating UNM faculty. The Program Committee members, their affiliation and the year in which they first joined the Program Committee are:

Bruce Milne (Biology) - 2010
David Brookshire (Economics) – 2009
Jose Rivera (Community & Regional Planning) - 2000
Mark Stone (Civil Engineering) - 2010
Melinda Benson (Geography) - 2009
Susan Kelly (Utton Center – Law) - 2008
John Shomaker (Consultant & Adjunct Professor)- 2000
Katie Lee (Alumna) – 2010

Summaries of the qualifications of the Program Committee members begin on page 31 and resume's are provided in Appendix V.

Administrative Home for the Water Resources Program

The Water Resources Program (WRP), the academic unit responsible for administering the degree, was originally administratively located in the Division of Public Administration. It was transferred to UNM's University College in 1998 in large part because of concerns about inequitable allocation of resources that was expressed by members of Colleges and Schools at UNM with affiliated faculty. University College is University College is the administrative unit that serves as the academic home for almost every beginning student at UNM. It also houses several interdisciplinary academic programs: University Honors Program, Chicano/Hispano/Mexicano Studies, Native American Studies, Aging Studies, Freshman Academic Choices, Sophomore Seminars in Career Awareness, and the Research Service

Learning Program. Besides the MWR degree, the only degree granting programs in University College are the Bachelor of University Studies and the Bachelor of Native American Studies programs. The interdisciplinary aspect of this College made it an attractive home for the WRP, however, it also presented an administrative inconsistency in that the WRP was the only graduate program in the College. Nevertheless, University College provided an administrative home with unquestioned impartiality with respect to allocation of financial resources.

As the WRP has grown and matured its location in University College was subjected to increasing scrutiny. The issue of an academic home for the WRP briefly surfaced in 2006 when Michael Campana, Director of the WRP from 1997 to 2006, left UNM to accept an academic position at another university. Deans in the School of Engineering and the College of Arts and Sciences both requested that the WRP be transferred to their respective School/College. Participating WRP faculty and the Program Committee strongly objected to these proposed transfers out of concern that location in either School/College would discourage participation by faculty in the other College/School. This would reduce the interdisciplinary nature of the program which has been perceived to be one of its main strengths.

Administrative location of the WRP in University College has had several beneficial attributes including:

- Absolute impartiality from the perspective of faculty and administrators in other Colleges and Schools at UNM
- A high degree of autonomy by virtue of being the only graduate program in the College
- Ability to keep all of indirect F&A costs generated by research projects that has been returned to the College

At the same time, this independence and impartiality has had several negative consequences:

- A heavy College service load (i.e. service on College committees) on the Director by virtue of his being the only Full Professor in the College
- Little understanding of the goals and constraints of the WRP by the University College Dean, faculty, or administrative staff
- A 20% budget reduction in AY 2008-2009
- Weak administrative support in the form of book keeping, research administration, and budgeting
- Weak advocacy for the WRP in the UNM Dean's Council

The issue of a possible new administrative home for the WRP surfaced in the spring of 2010 when a decision was made not to renew the appointment of the Interim Dean of University College, Dr. Finnie Coleman. Since July 2010 the WRP has reported to Richard Holder, the Deputy Provost for Academic Affairs. The UNM Provost has asked the WRP to consider whether it would be appropriate to report to a different college or school that has a graduate mission. This is currently in progress and a final decision on an administrative home for the WRP is expected by the end of 2010.

Identifying a new administrative home for the WRP involves many different considerations. The WRP Program has met to discuss alternatives administrative homes and developed a list of "Positive Aspects"and "Negative Aspects or Questions" for four different scenarios (Table 1). At present there is considerable uncertainty regarding the future of the current home, University College, there has discussion is continuing.

Table 1. Considerations involved in possible future administrative homes for the Water Resources Program.

Positive Aspects	Negative Aspects or Questions
College of A&S, School of Engr., etc.	
• Degree granting colleges	• Strong inter-college rivalry & jealousy
Office of Graduate Studies (OGS)	
• Neutral location • Administered by a Dean	• Can OGS award degrees? • Does OGS have conflict of interest? • Possibility that OGS will be swallowed by VPR • Will Faculty Senate approve move to OGS?
Provost	
• Neutral organization • Presumably would have good Admin. support	• Concern that the Provost's office is subject to intense campus & state politics • It would be difficult to obtain much intellectual attention from Provost
University College	
• Has been good home for ~15 yrs • Neutral location	• WR has little in common with UC programs • Future of UC is very uncertain • UC administration has little understanding of WRP

UNM is in the early stages of developing a management protocol for interdisciplinary graduate programs. At present there are two other such programs at UNM, the Nanoscience and Micro systems (NSMS) and Optical Science and Engineering programs. Both programs offer M.S. and Ph.D. degrees. A notable difference between them and the WRP is that they only involve faculty in two schools/colleges, the School of Engineering and College of Arts and Sciences. This limited participation makes administration more straightforward. The NSMS program has an executive committee consisting of the Deans of Engineering, Arts and Sciences, and Graduate Studies, and the Vice President for Research. A similar model was proposed for the WRP, however, this would committee would likely consist of six Deans (or their appointed representatives) and is considered by the WRP Director to be unwieldy.

Faculty affiliated with the WRP have expressed a preliminary preference for moving to the Office of Graduate Studies (OGS). However, the emphasis of this office is on administrative

aspects of the university and it does not presently grant degrees. Furthermore, a proposal to move the WRP to OGS about 15 years ago was not approved by the UNM Faculty Senate.

The Dean of the Office of Graduate Studies, Dr. Wohlert, is on sabbatical leave for fall, 2010. Her sabbatical project involves assessing other universities' administration of interdisciplinary programs and identifying administrative strategies that might be appropriate for interdisciplinary programs at UNM

Issues to be Considered by the APR Team Regarding Governance & Administration Issues Facing the WRP

What is the Proper Administrative Home for the WRP?

The current administrative home of the WRP is University College which is principally oriented towards freshman programs and lower division student advising. The WRP is the only graduate program in University College and thus may not provide the best administrative structure. UNM has asked the WRP for its input in identifying the proper administrative home. The WRP requests that the APR team consider this issue and if appropriate, offer suggestions regarding the best administrative home for the program.

Master of Water Resources Curriculum

Master of Water Resources Curriculum

The Masters of Water Resources (MWR) degree requires that students identify a concentration either in the area of hydrosciences (HS) or policy and management (PM). This allows the students to focus their curriculum in an area that is most consistent with their academic preparation and their professional interests. Usually students with a background in engineering or the physical and/or biological sciences will select the HS concentration, whereas students with a background in the social sciences, humanities or community and regional planning will select the PM concentration. However, it is possible, indeed not even unusual, for students to choose to study in an area of concentration that is in contrast to their previous academic preparation.

The HS concentration emphasizes course work in physical, chemical, and biological processes and phenomenon related to water resources management in its broadest context. Students select classes primarily offered in the Departments of Civil Engineering, Earth & Planetary Sciences, Biology, and Chemistry. The PM concentration involves study in economics, policy, administration and law. Students select from classes offered in the Departments of Economics, Community and Regional Planning, Public Administration, and the School of Law. The curriculum requirements for the MWR degree are summarized in Table 2.

Table 2. Summary of curriculum requirements of the Master of Water Resources (MWR) degree.

Category of Classes	Description	No. of Credits
Water Resources core – 3 classes	WR 571 – Contemporary Issues WR 572 – Models WR 573 – Field Problems	12
Area of Concentration – 5 classes (HS or PM)	UNM classes in hydroscience (HS) or policy & management (PM)	15
Not In Area of Concentration – 2 classes (PM or HS)	UNM classes in policy & management (PM) or hydroscience (HS)	6
Utilities Class – 1 class	GIS, statistics, modeling	3
Professional Project – 1 class	Independent project with paper & exam	3
	Total	**39**

To insure breadth, classes in the student's area of concentration must be taken from a distribution of courses as described below. A listing of the course numbers and titles is presented at the end of this section.

MWR-HS Concentration: 15 credits from Group I (HS courses) with at least one course from each category, 6 credits from Group II (PM courses) in two categories, and 3 credits from Group III (utilities classes).

or

MWR-PM Concentration: 15 credits from Group II (PM courses) with at least one course in any 3 of the 4 categories, 6 credits from Group I (HS courses) from two different categories, and 3 credits from Group III (utilities classes).

Group I: HS Courses (3 categories)

- Hydrology and Hydraulics (WR 576, E&PS 562, 572, 576, 580, 581L; Civil Engineering 442, 540, 541, 542, 543, 544, 545, 549)
- Ecosystems, Environment, Health, and Water Quality (Biology 502, 507L, 558, 535, 495 or 514; E&PS 515, 558; Civil Engineering 335, 531, 532, 534, 536, or 537L; Environmental Science 530; Public Health 502)
- Climatology (E&PS 522, 536, 570)

Group II: PM Courses (4 categories)

- Law (Law 547, 554)
- Economics (Economics 541, 542, 543, 544)
- Policy, Administration and Management (Geography 514, 561, 562, 563; CRP 527, 524, 564, 577; Public Administration AD 500, 521, 524, 525, 544, 546, 577; Political Science 470, 475; Public Health 501, etc.)
- Sociology, Communication, and Culture (CRP 569, 574; American Studies 523, 524, 525; C&J 554)

Group III: Utilities Courses (3 categories)

These are courses that are generally not classifiable as HS or PM courses but introduce the student to academic tools that are frequently applicable to the water resource management profession.

- GIS (C E 547; Geography 559, 587L, 588L)
- Methods (Statistics 538, 539; Economics 504; E&PS 533; Political Science 581; CRP 515)
- Modeling (E&PS 557L; Economics 540; Modeling the Environment - usually CRP 570)

WR 590 - Internship can substitute for a Group I, II, or III course, depending upon the nature of the internship.

With the approval of the WRP Director, students may substitute new classes or special topics classes as they become available at UNM.

WR Core Classes

The three water resources core classes are WR 571 – Contemporary Issues, WR 572 – Models, and WR 573, Field Problems. The catalog descriptions are:

WR 571 I – Contemporary Issues (4 credits)

Students examine contemporary issues in water resource systems including water quality; ecosystem health; stakeholder concerns; economics; and water supply, policy management and allocation. Emphasis on teamwork, cooperation, and oral, written and graphic communications. (Fall).

WR 572 II – Models (4 credits)
(Also offered as ECON 545) Practical aspects of the different technical models used by water resource professionals: hydrological, economic, ecological, etc. Students use models to solve problems. Emphasis on oral, written and graphic communication.
Prerequisite: WR 571 and (ECON 106 or 300 – Microeconomics) and (EPS 562 or WR 576, or CE 541 or CE 542 – Hydrology).
(Spring).

WR 573 III – Field Problems (4 credits)
Intensive experience with a field-based problem or suite of problems. Students work through problem identification and definition, collect/analyze data, propose solutions and present conclusions and recommendations in an appropriate forum
Restriction: WR majors and permission of instructor.
(Summer).

In recognition of the wide diversity of material covered in these classes, each is taught by a faculty team. In recent years these teams have consisted of:

WR 571 – Bruce Thomson (Civil Engineering and WRP), David Brookshire (Economics)
WR 572 – Bruce Thomson (Civil Engineering and WRP), Janie Chermak (Economics), Vince Tidwell (Sandia National Laboratories)
WR 573 – Bruce Thomson (Civil Engineering and WRP), Abdul-Mehdi Ali (Earth & Planetary Sciences

Brief descriptions of each of these classes is provided here. A course syllabus for the most recent offerings of each of these classes is included in Appendix III.

WR 571 Water Resources I - Contemporary Issues

Course Description & Objectives

WR 571 is the first of three interdisciplinary courses in the Master of Water Resources (MWR) core curriculum. This course, like the next two in the series, emphasizes the development of skills in critical and comparative analysis, and in technical communication.

This course focuses on identifying, analyzing, and reporting on water issues, both individually and in groups. Students in this course will learn how to: 1) Identify a water issue or problem in a particular region, river basin, or ground water system and prepare a review of the technical, policy, and management aspects that create the issue. 2) Prepare a written proposal to address this water issue or problem. 3) Communicate the results of these activities in written and oral presentations.

Generally, students study water resource issues outside of New Mexico to expose them to a breadth of challenges facing the profession and to lean of alternative strategies for addressing these issues.

Course Challenges

Reduced Faculty Participation: Until recently this course was taught by three faculty with additional support provided by an adjunct faculty who provided intensive assistance to the students' written and oral communication skills. Budget cutbacks and increased cost of course buy-outs have resulted in this course being taught by only two faculty and elimination of the communications component.

Student Preparation: Though it is an entrance requirement, few of the students have taken microeconomics. Furthermore, most of the students have not had any formal training in hydrology. This requires that the instructors spend additional time in class covering remedial material, and in some cases limits the level of class discussion.

WR 572 Water Resources II – Models

Course Description & Objectives

WR 572 is the second of three interdisciplinary courses in the core curriculum for the Master of Water Resources (MWR) degree. The principal objectives of this course include:

- Develop an understanding of how a quantitative representation of physical, environmental and socio-economic phenomenon can be derived from a conceptual understanding of these phenomenon
- Introduce basic concepts in modeling water resources systems and related social behavior.
- Lean how analytic and numerical models of water resources phenomenon are developed, calibrated, and used
- Develop an appreciation of the utility and limitations of water resources models
- Provide practice in constructing cross-disciplinary hybrid models.
- Develop students' ability to make good technical presentations and write good technical reports. Desirable attributes of these presentations and reports include clarity, organization, and containing unambiguous, defensible conclusions.
- Learn to work in small groups on complicated technical assignments.

The course involves an intensive quantitative study of a watershed or water challenge in New Mexico. Examples of the topics that have been investigated include: 1) investigate the consequences of a proposed 54 kAF/yr ground water withdrawal and trans-basin transfer from the San Augustin closed basin, 2) model the water resources of the Estancia closed basin, and 3) model the surface and ground water resources, and the economic impacts of the proposed Eastern New Mexico Rural Water Supply project (i.e. the Ute Pipeline). Students work in teams to develop three dynamic simulation models of the region: 1) a model of the surface water resources, 2) a model of the ground water resources, and 3) a model of the economic dependence on the surface and ground water resources. The general purpose dynamic simulation code PowerSim Studio 7 is used.

This course results in collection and analysis of a large amount of data. However, due to time constraints associated with an academic semester, the analysis is generally not complete. The course faculty have recently encouraged two students to take the topics studied in the WR 572 class and complete as their Professional Project. The first such project is expected to be completed Fall, 2010.

Course Challenges

Modeling Software: The PowerSim code is very powerful, however as with all computer codes, involves a steep learning curve. Many students experience a great deal of frustration at learning the code. A complicating factor is that PowerSim is only installed on the WRP's computers and those of a few faculty affiliated with the program. If more than about 15 students enroll in WR 572 availability of computers with the software installed becomes a challenge.

Student Preparation: Approximately half of the WRP students have weak math backgrounds and are challenged by the level of math and the quantitative relationships that are required to develop a computer model.

WR 573 Water Resources III – Field Problems

Course Description & Objectives

WR 573, Field Methods, is the third of three required courses in the UNM Water Resources Program. It is intended to provide a capstone experience for students in the program to allow them to integrate knowledge gained in other classes in the curriculum, and to learn some of the basic skills used in field studies of water resources issues. Past classes have conducted studies in the U.S. (principally New Mexico), and Latin America (Mexico and Honduras).

Prior to 2006 the WR 573 class involved field work in Honduras helping small indigenous communities design and build a water supply system. This was an enormously popular project and a significant attractor to the WRP. However, the program was not able to fund this project. Further, an evaluation of the sustainability of water systems conducted by one of the WRP students[2] found that most systems were not fully functional after just a few years of operation. Accordingly, the class was reoriented towards characterizations of water resources issues in New Mexico and Mexico.

Since 2006 the Field Methods course has been modified to focus on the field methods and the laboratory methods used in measurement and analysis of physical, chemical, and socioeconomic factors associated with watersheds. These methods are used to assess an actual watershed in NM. Each class evaluates the characteristics of a watershed selected by the instructors. The evaluation includes: 1) surface water resources, 2) ground water resources (if relevant), and 3) stream and water quality characteristics. These characteristics are likely to have environmental, economic and cultural impacts as well and are included in the study.

[2] Casey, Christine. Community Management for Improved Sustainability: Case Studies of Three Rural Community Water Supply and Sanitation Projects in Honduras. December 2005. (C. Issac)

Each class prepares a comprehensive report that describes the investigation, the water resource challenges in the basin, and develops possible strategies for addressing these challenges. The reports are published electronically and cataloged in UNM's D-space (http://repository.unm.edu/). This repository is searchable by Google and other search engines. As a point of reference, a Google search using the name of the each watershed returns a reference to each UNM study as one of the top three most relevant references. Recent reports include:

Thomson, B., Fleming, W. (editors) (2007). Water Resources Assessment in the Greater Rio Casas Grandes Watershed, Water Resources Program, University of New Mexico, Albuquerque, NM, 28 p.

Thomson, B., Ali, A. (editors) (2008). Water Resources Assessment of the Sapello River, New Mexico., Water Resources Program, University of New Mexico, Albuquerque, NM, 45 p.

Thomson, B., Ali, A. (editors) (2009). Water Resources Assessment of the Mora Rive, New Mexico, Water Resources Program, University of New Mexico, Albuquerque, NM, 71 p.

Thomson, B., Ali, A. (editors) (2010). Water Resources Assessment of the Cimarron River and Evaluation of Water Quality Characteristics at the Maxwell National Wildlife Refuge, New Mexico, Water Resources Program, University of New Mexico, Albuquerque, NM, 78 p.

The work of the WR 573 class has brought recognition of the WRP from the NM Environment Department (NMED), the NM Office of the State Engineer (OSE), the NM Department of Game and Fish, local soil and watershed conservation districts and local governments. The 2010 study of the Cimarron River was cited as in-kind support by the Cimarron Watershed Alliance for their Section 319 watershed restoration grant. The work conducted by UNM was valued at $56,700. The Table of Contents and Abstract of the 2010 report are included in Appendix II.

WR 573 Course Challenges

Resources: The WRP has no funds available to support this course. Support is needed in the form of travel, food, field equipment and laboratory analyses. Faculty and student vehicles have been used to date because university vehicles are too costly. Field equipment has been borrowed from engineering and science departments. Laboratory analyses have been conducted at no cost by WRP students in the GeoEnvironmental Laboratories in the Department of Earth and Planetary Sciences.

Number of Students: The WR 573 course faculty have discussed limiting the number of students in WRP 572 to 15 each summer as this is felt to be the maximum number that can be supervised by two faculty. However, the faculty recognize that it is a core class that must be taken by all students in the program. This limitation has not been imposed to date, however if the WRP continues to grow it will be an issue requiring consideration.

WR 573 Course Substitution

Every year there are one or two students who have the acquired the field skills and experience taught in this class, usually through professional employment. These include students employed

by the USGS, the NM Environment Department, and various consulting firms. The WRP has developed a procedure that allows these students to substitute other approved classes for WR 573 if they can provide work products and job descriptions that unequivocally demonstrate their skills and experience.

WRP 598 – Professional Project

Description

A formal Professional Project has been a required component of the WRP since 1995. The Professional Project is the culmination of the student's graduate experience and demonstrates the student's ability to perform professional quality independent work on a topic related to water resources management. The topic of the project is selected by the student in an area of his/her choosing, and with guidance of a faculty advisor and graduate committee. The project can be related to a student's employment, however, additional independent work is required for the project to serve as a UNM Professional Project. The end product of the Professional Project is a formal, professional report that is defended before a faculty graduate committee in a public forum.

The Professional Project must be directed by a UNM faculty member who is either tenured or in a tenure track, or holds an appointment as a Research Professor. The committee must have at least three members. Two must be UNM faculty while the third person can be from outside of the university but must be approved by the Office of Graduate Studies (OGS).

All students must take at least 3 credits of WR 598. More than 3 credits can be taken, and usually are, but only 3 count. It should generally not be taken until a student has a committee and an approved Professional Project proposal. Not all the credits must be taken in the same semester. There are many different sections of WR 598 – sign up for the section corresponding to your committee chair. If one does not exist, contact the Director. A student must be registered for at least 1 credit of WR 598 during the semester in which he/she graduates.

Identifying a research topic, performing the appropriate research and writing a Professional Project is one of the most under estimated requirements associated with a graduate degree. This requirement demonstrates the student's ability to independently formulate a research question, develop an appropriate scope of work, generate information to address the question, communicate the ideas and conclusions in a written document and defend the work before a committee of experts.

The question is often asked, what is the difference between a Professional Project and a Master's Thesis? Though the expected level of effort for the two is the same, there is not a clear distinction between the intellectual content. In principle the Professional Project is more applied and less academic than a thesis. However, there are many examples of Professional Projects that would constitute very strong theses.

Guidance for identifying a topic, conducting the research, writing the Professional Project, and defending it are contained in the WRP Program Guidelines (Appendix I). This also includes a list of all Professional Projects completed by students in the Water Resources Program (www.unm.edu/~wrp/ProgramGuidelines2009.pdf).

Quality of the Professional Project

Since its inception WRP faculty have been concerned about the quality of work done by some students. Increasing emphasis has been placed on publication of the student's Professional Projects, however, an honest evaluation recognizes that much of this work is not publishable either because it is too system specific (i.e. an assessment of a local water resource problem of little national interest) or the work is simply not strong enough.

In an effort to provide an incentive to improve the quality of Professional Projects WRP students are strongly encouraged to present their results at local and regional conferences or at local luncheons of professional groups. Until 2007 UNM sponsored an on-campus one-day symposium featuring all of the student and faculty water related research, however, this was discontinued due to lack of funding. Many WRP students participate in the annual New Mexico Symposium on Water Resources sponsored by the NM Water Resources Research Institute.

Further incentive has been provided by posting PDF files of all Professional Projects on the UNM library's D-space (http://repository.unm.edu/). This repository is Google searchable and offers the benefit of making the student's work available for future reference. And most students do work a bit harder as they recognize that their name will be associated with the work.

Nevertheless, less than a quarter of the Professional Projects result in journal publications. The lack of publishable work produced by a WRP student is a disincentive to some faculty who limit their commitment to the WRP accordingly.

Dual Degree Program – Masters of Water Resources and Masters of Community and Regional Planning

In recognition of the close relationship between planning and water resource management a dual degree program leading to the Master of Water Resources and Master in Community and Regional Planning (CRP) was established in 2009. The curriculum requirements include 53 credits of classes and six credits of Professional Project or Thesis. The curriculum is summarized in Table 3. Implicit in this curriculum is the assumption that MWR students who pursue the dual degree will choose the Policy and Management (PM) concentration. Thus, the curriculum has fewer PM classes than the MWR degree but similar material is covered in the CRP classes.

Table 3. Curriculum leading to dual degrees of Master of Water Resources and Master of Community and Regional Planning.

Category of Classes	Description	No. of Credits
Water Resources Classes		
Water Resources core – 3 classes	WR 571 – Contemporary Issues WR 572 – Models WR 573 – Field Problems	12
HS electives – 2 classes	Hydroscience electives	6
PM electives – 1 class	Policy & Management elective	3
Utilities class – 1 class	GIS, statistics, modeling	3
General elective – 1 class	Elective approved by advisor	3
Planning Classes		
CRP 500	Planning Theory & Process	4
CRP 510	Planning Communications Workshop	2
CRP 511	Analytical Methods for Planning	4
CRP 521	Advanced Planning Studio	5
CRP 527	Watershed Management	3
CRP 532	Foundations of Natural Resources Planning	3
CRP 580	Community Growth & Land Use Planning	3
CRP 588	Professional Project & Thesis Preparation	2
CRP 589	Professional Project or Thesis	6
	Total	**59**

At least four students received dual degrees prior to implementation of the formal dual degree program by completing the entire curriculum in Water Resources and in Community Regional Planning (89 credits required). Since its implementation in 2009 three students have completed this curriculum.

Enrollments in WRP Core Classes

Enrollments in the three WRP core classes are shown in Figure 1. There was a substantial decrease in enrollments in the fall semester 2007 that may have been partly associated with discontinuance of the WR 573 Honduras field experience. Enrollments appear to have recovered and may reflect a positive trend.

Enrollments have grown sufficiently that faculty teaching the core classes and the Program Committee have had preliminary discussions about limiting the entering class. Both WRP 572 and WRP 573 are negatively impacted by classes greater than about 15 students. WRP 572 makes extensive use of expensive dynamic simulation software (PowerSim Studio 7). This software is installed on a limited number of publicly accessible computers, four in the WRP computer lab and two each in computer labs in the Departments of Earth and Planetary Sciences and Community and Regional Planning. There are not enough computers running the dynamic

simulation software and, as a practical matter, the course instructors do not have enough time to assist large numbers of students trying to learn a powerful but unfamiliar code.

As discussed above, the WR 573 – Field Problems class also faces limitations with respect to available field equipment and faculty supervision. Furthermore, it is not practical for a large class to study a single watershed as logistical problems of transportation, camping, and field work become overwhelming.

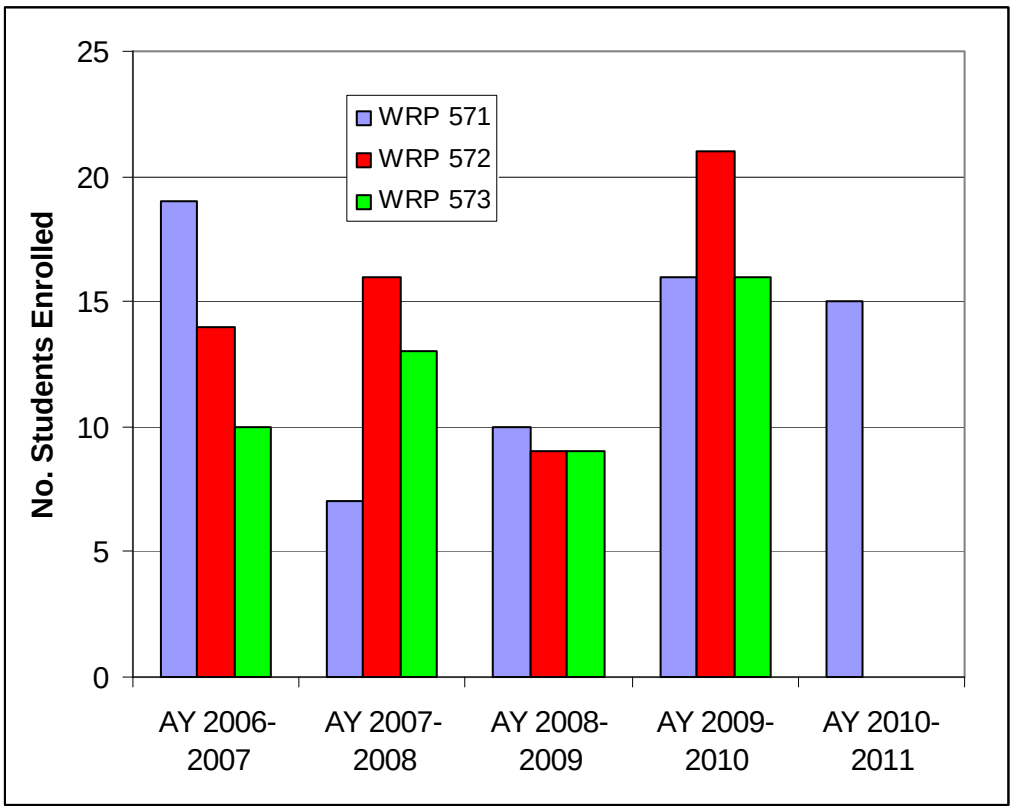


Figure 1. Enrollments in the Water Resources Program core classes.

The number of MWR degrees granted each year is shown in Figure 2. The average number of degrees awarded since 2000 is 9.3. Note that three students have announced their intent to graduate in the fall semester, 2010.

In fall 2009 the WRP implemented an Outcomes Assessment Program for students completing the program. This requires the student's Examination Committee to evaluate the student's overall knowledge and skills in four areas relevant to water resources, not just those demonstrated during the defense of his Professional Project:

- Knowledge of the hydrologic cycle, occurrence & characteristics of water & its administration
- Ability to formulate quantitative relationships of water & its socioeconomic value

- Knowledge of field, laboratory, computational & library methods relevant to water management
- Effective written & oral communication skills

The purpose of the Outcomes Assessment is to provide feedback to the WRP regarding the success of the curriculum. To date, too few students have been evaluated by this rubric to provide meaningful results.

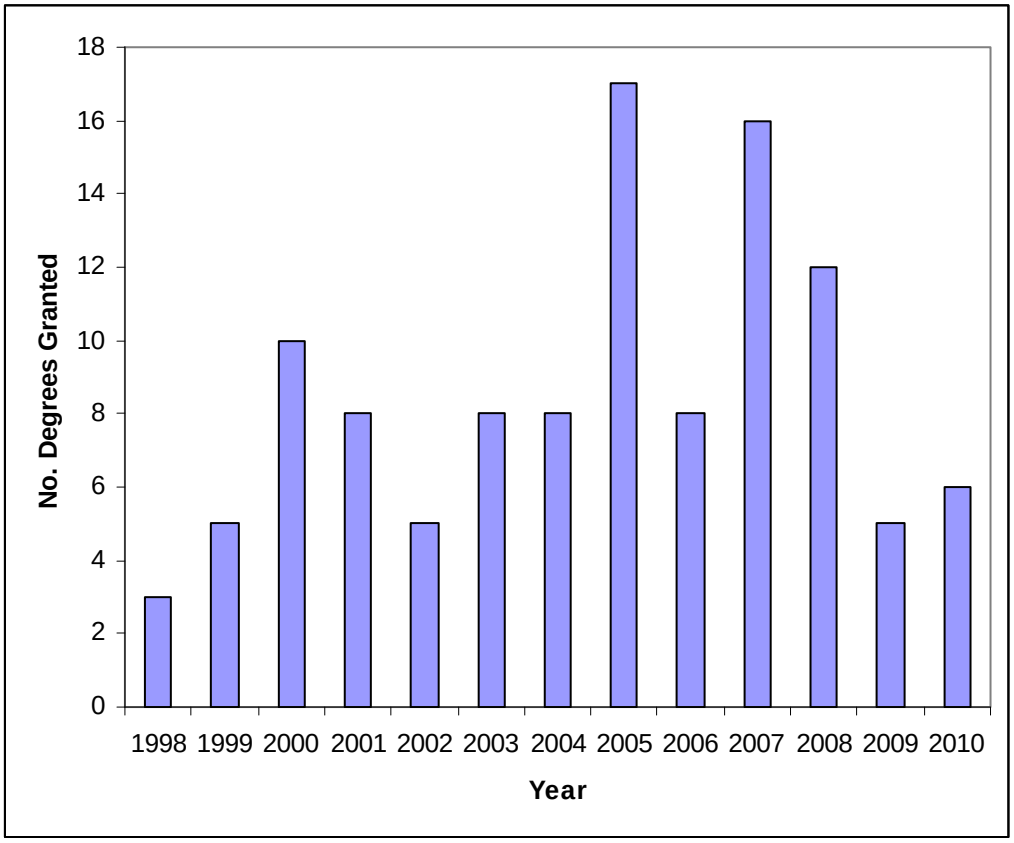


Figure 2. Number of degrees awarded by calendar year (three students have declared their intent to graduate by December 2010).

Outcomes Assessment

UNM has required all academic programs to develop an outcomes assessment program. Each program must develop program goals and learning outcomes for its students. The program goals reflect the Program's overarching mission to promote, develop and improve expertise on water related issues and provide training for environmental professionals, promoting fair, healthy and sustainable solutions to the challenges of water use in New Mexico and the southwest. They are

A. Students will understand the physical, ecological, economic, and socio/cultural aspects of water in the human environment.
B. Students will develop skills related to measurement, modeling, analysis, and assessment of water resources.

C. Students will develop skills in field, laboratory, electronic, and library research methods for generating and acquiring information and data on issues of water resources management.
D. Students will develop written and oral communication skills
E. Students will learn to work in groups.

The student learning outcomes are grouped into five categories. Category A is focused on the student's knowledge of the science, policy, economics, and management aspects of water. Category B addresses the student's ability to clearly formulate a testable relationship between causes and effects related to water resources and its management. Category C deals with the student's knowledge of methods and tools associated with generating and analyzing data and information relevant to water resources management. Category D addresses student's oral and written communication skills. Category E concerns the ability of students to work in groups of their peers.

A.1. Students will be able to explain the hydrologic cycle
A.2. Students will be able to explain the relationship between water characteristics and occurrence and the aquatic environment
A.3. Students will be able to explain the economic consequences of water and its scarcity or abundance
A.4. Students will be able to explain the administration and regulation of water resources in NM and the southwestern US
A.5. Students will be able to describe the social and cultural aspects of water in NM and the southwestern US

B.1. Students will demonstrate the ability to formulate quantitative relationships to explain hydrology and its relation to water resources
B.2. Students will demonstrate the ability to relate water resources to economic and social/cultural values.

C.1. Students will demonstrate familiarity with field, laboratory, electronic and library methods for collecting data relevant to water resources problems
C.2. Students will demonstrate their ability to analyze data and information related to water resources

D.1. Students will demonstrate effective written communication skills
D.2. Students will demonstrate effective oral communication skills

E.1. Students will demonstrate their ability to work in groups of their peers.

Following the student's oral examination of his/her Professional Project, the examination committee will formally evaluate the student's overall preparation and knowledge in these five areas and fill out an assessment rubric. Information gathered from this assessment tool is to be used as one measure of the success of the program. The program began in fall, 2009, and there is insufficient data at present to present a formal assessment at this time..

Curriculum Issues Facing the Water Resources Program

There are four issues regarding the WRP curriculum that have been under discussion by the program's administrators and the Program Committee. Some of these have been described previously.

Should the Number of Students Admitted be Limited?

As discussed above, about 15 students is the maximum that can be managed in the WR 572 Water Resources II – Models class and the WR 573 Water Resources III – Field Problems class. The constraint in WR 572 is primarily the number of computers with the dynamic simulation software and the amount of instructor time it takes to teach a computer intensive course using powerful software. The limitations associated with WR 573 are the amount of available field equipment needed and the logistics of managing a large number of students in a field investigation.

The principal argument in favor of admitting all qualified students is the resources and visibility that large class sizes bring to the program. An alternative strategy under consideration is to use the limitations as justification for increasing the admissions criteria.

Should Other Classes Be Required in the Core Curriculum?

Currently the only required classes are the three core classes. Two additions to this core have been suggested: water law and hydrology.

Water Law: This class is taught once a year by faculty in the law school. WRP students are welcome by the faculty but are required to take it on a Credit/No-Credit basis to avoid having to compete with advanced law students. In recent years about a third of the WRP students take this class. In the fall, 2010 semester, there are 5 WRP students in a class of 25 total students.

Arguments in favor of adding this course to the curriculum are that it is an important topic that is relevant to most jobs related to water resources and their management.

Arguments against this addition are: 1) that the students already receive considerable exposure to water law in the three core classes and many of the PM classes, 2) that the course is taught in the middle of the day which makes attendance difficult for part-time students, and 3) enrollment by all WRP students each year would dilute the legal preparation of the students in the class and would require the instructor to change its content.

Hydrology: Most of the PM students do not take a course in hydrology and therefore have little understanding of the quantitative aspects of surface and ground water hydrology. Furthermore, there is almost no consideration given to water quality in the WRP core. Addition of a hydrology course in either the Department of Civil Engineering (CE) or Earth and Planetary Sciences (EPS) would dramatically strengthen the students' background in these topics.

Argument in favor of adding a hydrology requirement are that it would improve students' knowledge and understanding of this topic which is critical to water resources management.

Argument against this addition are that many of the PM do not have sufficient mathematical skills or a quantitative orientation to allow them to successfully take a graduate CE or EPS course.

Issues to be Considered by the APR Team Regarding Curriculum

Should the WRP Program Retain the Separate Concentrations in HS and PM?

The separate curriculum concentrations of Hydroscience (HS) and Policy and Management (PM) in the MWR program was implemented in 1998 in recognition that the MWR students have a very diverse background and professional interests. Offering the same degree with two very different concentrations allows students to tailor their curriculum to focus in their areas of interest. At least one Program Committee member has expressed concern that this reduces some of the interdisciplinary characteristics of the program that is in part responsible for its success. The issue will be considered by the Program Committee during AY 2010-2011.

Water Related Classes Listed in the UNM Catalog

The following is a relatively complete listing of the water related classes that are listed in the UNM catalog. Many of these classes are included in the list of courses students may select for their program of studies. It should be recognized that this list is dynamic and courses appear and disappear as departments and faculty modify their programs.

Group I: Suggested Hydroscience Courses

Listed by category and, within a category, by department or program. The number of credit hours for each course is shown in parentheses; "AOA" means "also offered as".

Hydrology and Hydraulics
Water Resources
576 Physical Hydrology (AOA E&PS 576) (3)
Earth and Planetary Sciences
562 Hydrogeology (3)
572 Subsurface Fate and Transport Processes (3)
576 Physical Hydrology (AOA WR 576) (3)
580 Advanced Hydrogeology (3)
581L Geomorphology and Surficial Geology (4)
Civil Engineering
442 Hydraulic Engineering and Hydrology (3)
541 Groundwater Engineering (3)
542 Intermediate Hydrology (3)
543 Introduction to Groundwater and Contaminant Transport Modeling (3)
544 Water Resources Engineering (3)
545 Open Channel Hydraulics (3)
549 Vadose Zone Hydrology (3)

Ecosystems, Environment, Health, and Water Quality
Biology
495 Limnology (3)
496L Limnology Laboratory (1)
507L Bosque Biology (3)
514 Ecosystem Studies (3)
535 Freshwater Ecosystems (AOA E&PS 535) (3)
558 Geomicrobiology (AOA E&PS 558) (3)
Civil Engineering
335 Introduction to Water & Wastewater Treatment (3)
531 Physical-Chemical Water and Wastewater Treatment (3)
532 Advanced Physical-Chemical Water and Wastewater Treatment (3)
534 Environmental Engineering Chemistry (3)
536 Biological Wastewater Treatment (3)
537L Aqueous Environmental Chemistry and Analysis (3)
Earth and Planetary Sciences
515 Geochemistry of Natural Waters (3)

535 Freshwater Ecosystems (AOA Biology 535) (3)
558 Geomicrobiology (AOA Biology 558) (3)
Environmental Science
530 Advanced Environmental Science (3)
Public Health
502 Epidemiologic Methods I (3)

Climatology category
Earth and Planetary Sciences
522 Hydrometeorology of the Southwestern USA
536 Climate Dynamics (3)
570 Physical Climatology (AOA Geography 570) (3)
Geography
570 Physical Climatology (AOA E&PS 570) (3)

Group II: Suggested Policy/Management Courses

Listed by category and, within a category, by department or program. The number of credit hours for each course is shown in parentheses; "AOA" means "also offered as".

Law
Law
547 Water Law (3)
554 Indian Water Rights (2-3)

Economics
Economics
541 Sustainable Development (3)
542 Environmental and Natural Resource Economics: Survey (3)
543 Natural Resource Economics (3)
544 Environmental Economics (3)

Policy, Administration, and Management
Community and Regional Planning
524 Environmental Planning Methods (3)
527 Watershed Management (3)
564 Foundations of Natural Resources (3)
577 Practice of Policy Development (AOA Public Administration 577) (3)
Geography
514 Natural Resources Management Seminar(3)
561 Environmental Management (3)
562 Water Resources Management (3)
563 Public Land Management (3)
Political Science
470 Public Policy Analysis (3)
475 Environmental Politics (3)
Public Administration
500 Public Management and Policy (3)

521 Institutional Development and Behavior (3)
524 Intergovernmental Administrative Problems (3)
525 Human Resources Management in the Public Sector (3)
544 Public Budgeting (3)
546 Public Financial Administration (3)
577 Practice of Policy Development (AOA CRP 577) (3)
Public Health
501 Principles of Public Health (3)

Sociology, Communication, and Culture
American Studies
523 Environmental Justice (3)
524 Environmental Conflicts in the U.S. West (3)
525 Environmental Theory and Practice (3)
Communication and Journalism
554 Diffusion of Innovations (3)
Community and Regional Planning
569 Rural Community Development (3)
574 Cultural Aspects of Community Development Planning (3)

Group III: Suggested Utilities Courses

Listed by category and, within a category, by department or program. The number of credit hours for each course is shown in parentheses; "AOA" means "also offered as".

GIS
Civil Engineering
547 GIS in Water Resources Engineering (3)
559 Natural Resources and GIS (3)
587L Intermediate Geographic Information Systems (3)
588L Advanced Geographic Information Systems (3)
Earth and Planetary Sciences
555L Computational and GIS Applications in Geomorphology (3)

Modeling
Community and Regional Planning
570 Seminar - Modeling the Environment (3)
Earth and Planetary Sciences
557L Mathematical Modeling in the Geosciences (3)
Economics
540 Environmental and Natural Resource Modeling (3)
Geography
521 Environmental Modeling and Geographic Information Systems (3-6)

Methods
Community and Regional Planning
515 Natural Resources Field Methods (3)

Earth and Planetary Sciences
533 Statistics and Data Analysis in Earth Science (3)
Economics
504 Mathematical Tools and Economic Models (3)
Statistics
538 Biostatistical Methods I (3)
539 Biostatistical Methods II (3)
Political Science
581 Statistics for Social Research (3)

Faculty Affiliated with the Water Resources Program

There are approximately 60 UNM faculty members who are affiliated with the Water Resources Program. They constitute a diverse group of individuals from six different schools or colleges with expertise in just about every aspect of water resources. The schools or colleges represented by the faculty are Arts and Sciences, Architecture and Planning, Engineering, Law, Medicine and the UNM Libraries. Affiliation with the program is on a voluntary basis and there are no specific selection criteria nor are there any specific responsibilities required.

Core Faculty

Core faculty identified in this report include those who are members of the Program Committee, those who teach the Water Resources core classes (WR 571, WR 572, and WR 573), and those who teach classes that are taken by large numbers of WR students. Brief biographical sketches are included in this section and short resumes are contained in Appendix V.

WRP Administrators

Bruce Thomson, Professor of Civil Engineering
Director, UNM Water Resources Program
Ph.D., Environmental Science and Engineering, Rice University, Houston, TX
505-277-5249, bthomson@unm.edu
Bruce Thomson is Professor of Civil Engineering and Director of UNM's Water Resources Program. He teaches in the areas of water and wastewater treatment, management of radioactive and hazardous wastes, water reuse, and water resources management. His areas of research expertise are in physical-chemical water and wastewater treatment, water chemistry, and biological transformations of inorganic contaminants. He has conducted extensive work on transformations and remediation of arsenic, selenium, and uranium. He has received research funding from federal sources (USEPA, USDOE), state agencies, research foundations (AWWARF, Water Reuse Foundation), local agencies, and private companies. He has served on numerous federal, state, and local advisory boards and commissions. He is a licensed professional engineer in New Mexico.

Stephen Cabaniss, Professor of Chemistry
Associate Director, UNM Water Resources Program
Ph.D., Chemistry, University of North Carolina
505-277-4445, cabaniss@unm.edu
Study of the natural environment raises biogeochemical questions related to naturally-occurring organic compounds: How do organic substances lead to soil formation? How is energy transferred from higher plants to microbes? What controls the bioavailability and movement of metals in surface and subsurface waters? To address these and other questions, we have developed an agent-based model (ABM) of organic chemistry in the environment, employing stochastic kinetic algorithms and quantitative structure reactivity (QSPR) relationships. The ABM is ideally suited to representing the heterogeneous mixtures of compounds found in the environment, while carefully formulated QSPRs permit quantitative predictions of chemical observables. Current work seeks to apply the mode to problems in metal complexation, drinking water disinfection, microbial ecology and sub-surface contaminant transport.

WRP Program Committee

Melinda Benson, Assistant Professor of Geography
J.D. University of Idaho
505-277-1629, mhbenson@unm.edu
Melinda Harm Benson's research and teaching centers on environment and natural resource management challenges, with a particular emphasis on emerging trends in environmental governance. Her work focuses on the complexities associated with many current environmental challenges, including examining the role of law and institutional integration of in emerging concepts including resilience theory and adaptive management. Prior to joining UNM, she worked as an attorney representing conservation groups on environment and natural resources issues in the Intermountain West.

David S. Brookshire, Professor of Economics and Director of the Science Impact Laboratory for Policy and Economics, Department of Economics
Ph.D. Economics, University of New Mexico
505-277-1964, brookshi@unm.edu
David Brookshire is a former Policy Sciences Editor of Water Resources Research. He has been a contributor to the development of the stated preference methods for valuing non-market commodities. Current methodological interested include experimental markets, valuation, benefit transfer and the design of market structures for nonmarket goods. Topical research interests include ecosystems valuation, endangered species, urban water demand, the value of water, western water market leasing structures and urban boundary issues relating to the preservation of open space. He participated in the SAHRA science and technology center at the University of Arizona as a member of the Executive Board and a Theme leader (river systems) and researcher.

Katie Lee, Alumni Representative, Program Manager, RT Hicks Consultants
Master of Water Resources, University of New Mexico
505-266-5004, Katie@rthicks.com
Katie Lee is a Project Manager at RT Hicks Consultants in Albuquerque. She works on due diligence for the commercial real estate industry and on site characterization, remediation and regulatory compliance for the oil and gas industry, municipalities and non-profit organizations. She has a B.A. in Economics and a Masters of Water Resource from the University of New Mexico, completed in 2007.

Bruce Milne, Professor of Biology
505-277-5356, bmilne@sevilleta.unm.edu
Ph.D., Rutgers University. Botany & Plant Physiology.
Bruce Milne has taught botany, ecology, introductory biology, biostatistics, landscape ecology, and seminars in biocomplexity since 1986. Since 2004 he has developed the UNM Sustainability Studies Program where he teaches any of the four SUST courses required for the undergraduate minor degree in Sustainability Studies. His research in landscape ecology most recently involves investigation of Horton laws for riparian vegetation in stream networks.

Susan Kelly, Director, Utton Transboundary Resources Center
UNM Law School
J.D. University of New Mexico

505-277-0514, skelly@unm.edu
Susan Kelly is Interim Director of the Utton Transboundary Resources Center at the UNM School of Law (http://uttoncenter.unm.edu/). In this capacity she directs the activities, programs, and projects of the Center, including research, writing, educational initiatives, policy analysis on water issues, and organization of symposia and workshops; teaches water law as adjunct professor. She has an extensive background as a water planner and previously worked as a Water Rights Manager and Senior Planner, City of Albuquerque, New Mexico. In this capacity she managed the City's water rights portfolio, acquisition of water rights and administration of well permits and water storage contracts.

Jose Rivera, Professor of Community and Regional Planning
505-277-2257, jrivera@unm.edu, http://www.unm.edu/~spagrad
Ph.D., Brandeis University.
José A. Rivera is a Professor of Planning at the School of Architecture and Planning at the University of New Mexico. His teaching fields include rural community development, public policy analysis, and water resources management. He earned a Master of Social Welfare degree from the Florence Heller Graduate School for Advanced Studies in Social Welfare at Brandeis University in 1970 and a doctorate in Social Policy also from Brandeis in 1972. His research interests include water management institutions, comparative irrigation governance systems, social and political organization of irrigation, and mutual aid organizations in traditional cultures. His current fieldwork on these topics includes the southern provinces of Spain, the coastal valleys of Peru, Baja California Sur in Mexico, Ilocos Norte in the Philippines, and the American Southwest. In 1991 he co-authored a book titled *Rural Environmental Planning for Sustainable Communities*, followed by a book titled *Acequia Culture: Water, Land, and Community in the Southwest* (1998). Professor Rivera has also served as an expert witness in a number of water rights transfer applications in the State of New Mexico, qualified to present testimony in the areas of public welfare, economic development, public administration and acequia culture. All his cases have involved applications to transfer water rights from community acequia irrigation systems to municipal, commercial and other uses. His testimony has centered on the social, cultural and ecological impacts of the proposed changes in point of diversion and purpose of use. Similarly, when he is invited to present lectures, his topics include the history, evolution and contemporary values of community-based irrigation systems.

John Shomaker, Adjunct Professor of Earth & Planetary Sciences and Consultant
Ph.D. Hydrogeology
505-345-3407, jshomaker@shomaker.com
John Shomaker is founder and part owner in the hydrogeologic consulting firm John Shomaker and Associates. He has served as a consultant on major water resources investigations throughout the state of NM for over 30 years and is regarded as one of the premier consulting hydrogeologists in the southwest.

Mark Stone, Assistant Professor of Civil Engineering
Ph.D. Civil Engineering, Washington State University
505-277-0115, stone@unm.edu
Mark Stone joined UNM as an Assistant Professor of Civil Engineering in 2009 and teaches and conducts research in surface water hydrology, ecohydraulics, ecohydrology, and sustainable

watershed management. He was previously a research engineer at the Desert Research Institute at the University of Las Vegas.

Instructors of Key WRP Courses (Course Taught)
Abdulmehdi Ali, Research Scientist, Earth & Planetary Sciences (WR 573 Water Resources III – Field Problems)
Ph.D. Chemistry, University of Arizona
505-277-1637, mehdiali@unm.edu

Reed Benson, Professor of Law (Law 547 – Water Law)
J.D. University of Michigan
505-277-1119, benson@law.unm.edu

Janie Chermak, Professor of Economics (WR 572 Water Resources II – Models)
Ph.D. Economics
505-277-4906, jchermak@unm.edu

Julie Coonrod, Associate Professor of Civil Engineering (CE 547 – GIS Applications in Water Resources)
Ph.D. Civil Engineering, University of Texas
505-277-3233, jcoonrod@unm.edu

William Fleming, Associate Professor of Community & Regional Planning (CRP 527 Watershed Management)
Ph.D.
505-277-6455, fleming@unm.edu

David Gutzler, Professor of Earth and Planetary Sciences (EPS 536 Climate Dynamics)
505-277-3328, gutzler@unm.edu

Vince Tidwell,Sandia National Laboratories (WR 572 Water Resources II – Models)
Ph.D. Hydrogeology, University of Arizona
505-844,6025, vctidwe@sandia.gov

Faculty Affiliated with the WRP

A list of current WRP faculty according to their primary departmental affiliation is presented below.

Biology
Rebecca Bixby, Research Assistant Professor
505-277-3411, bbixby@unm.edu

Clifford N. Dahm, Professor
505-277-2850, cdahm@sevilleta.unm.edu, http://biology.unm.edu/fac_list.htm

Marcy Litvak, Assistant Professor
505-277-5580, mlitvak@unm.edu

Kelly Miller, Assistant Professor
505-277-2496, kbmiller@unm.edu

Bruce Milne, Professor
505-277-5356, bmilne@sevilleta.unm.edu

Thomas Turner, Director, Museum of Southwestern Biology
505-277-7541, turnert@unm.edu, http://www.msb.unm.edu/fishes/index.html

Chemistry
Stephen E. Cabaniss, Professor
505-277-4445; cabaniss@unm.edu, http://www.unm.edu/~cabrsrch/index.htm

Civil Engineering
Julia E. Allred Coonrod, P.E., Associate Professor
505-277-3233, jcoonrod@unm.edu, http://www.unm.edu/~civil/faculty.htm

John C. Stormont, P.E., Professor
505-277-6063, jcstorm@unm.edu, http://www.unm.edu/~civil/faculty.htm

Kerry J. Howe, P.E., Assistant Professor
505-277-2702, howe@unm.edu, www.unm.edu/~civil/howe.htm

Andrew Schuler, P.E., Assistant Professor
505-277-4556, aschuler@unm.edu

Mark Stone, P.D., Assistant Professor
505-277-0115, stone@unm.edu

Bruce M. Thomson, P.E., Regents' Professor
505-277-4729, bthomson@unm.edu, http://www.unm.edu/~civil/faculty.htm

Communication and Journalism
Tema Milstein, Assistant Professor
tema@unm.edu, www.unm.edu/~tema

Community and Regional Planning
Claudia B. Isaac, Associate Professor
505-277-5939, cisaac@unm.edu, http://www.unm.edu/~saap/People/Isaac.html

Theodore Jojola, Professor
505-277-6428, tjojola@unm.edu, http://www.unm.edu/~saap/People/Jojola.html

James R. Richardson, Professor
505-277-6460, jrich@unm.edu, http://www.unm.edu/~saap/People/Richardson.html

José A. Rivera, Professor
505-277-2257, jrivera@unm.edu, http://www.unm.edu/~spagrad

David S. Henkel, Jr., Associate Professor and Director of the CRP Program
505-277-1276, cymro@unm.edu, http://www.unm.edu/~saap/People/Henkel.html

William M. Fleming, Associate Professor
505-277-6455, fleming@la.unm.edu, http://www.unm.edu/~saap/People/Fleming.html

Earth and Planetary Sciences
Abdulmehdi Ali, Senior Research Scientist I
505-277-1637, mehdiali@unm.edu

Yemane Asmerom, Associate Professor
505-277-4434, asmerom@unm.edu, http://epswww.unm.edu/faculty.htm

Laura J. Crossey, Professor
505-277-5349, lcrossey@unm.edu, http://epswww.unm.edu/faculty.htm

Peter J. Fawcett, Associate Professor
505-277-3867, fawcett@unm.edu, epswww.unm.edu/faculty.htm

Joseph Galewsky, Assistant Professor
505-277-2361, galewsky@unm.edu, epswww.unm.edu/facstaff/galewsky/home.htm

David S. Gutzler, Professor
505-277-3328, gutzler@unm.edu, epswww.unm.edu/faculty.htm

Grant A. Meyer, Associate Professor
505-277-5384, gmeyer@unm.edu, epswww.unm.edu/faculty.htm

Leslie D. McFadden, Professor
505-277-6121, lmcfadnm@unm.edu, epswww.unm.edu/faculty.htm

Louis A. Scuderi, Associate Professor
505-277-2644, tree@unm.edu, epswww.unm.edu/faculty.htm

Gary A. Smith, Professor
505-277-2348, gsmith@unm.edu, epswww.unm.edu/faculty.htm

Zachary D. Sharp, Professor
505-277-2000, zsharp@unm.edu, http://epswww.unm.edu/facstaff/zsharp/home.htm

Gary Weissmann, Associate Professor
505- 277-3636 weissman@unm.edu, epswww.unm.edu/facstaff/weissman/home.htm

John W. Shomaker, Adjunct Professor
505-345-3407, jshomaker@shomaker.com

Economics
David S. Brookshire, Professor
505-277-1964, brookshi@unm.edu, http://www.unm.edu/~brookshi/

Robert Berrens, Associate Professor
505-277-9004, rberrens@unm.edu, http://www.unm.edu/~econ/faculty/berrens.html

Janie Chermak, Associate Professor
505-277-4906, jchermak@unm.edu, http://www.unm.edu/~econ/faculty/chermak.html

Catherine (Kate) Krause, Associate Professor
505-277-3429, kkrause@unm.edu, http://www.unm.edu/~econ/faculty/krause/krause_home.html

Jennifer Thacher, Associate Professor
505-277-1965, jthacher@unm.edu

Family & Community Medicine (Public Health)
Kristine Tollestrup
505-272-9555, ktollestrup@salud.unm.edu

Geography
O. Paul Matthews, Professor Emeritus
505-277-2607, opmatt@unm.edu, http://www.unm.edu/~geog/MATTHEWS.htm

Melinda Benson, Assistant Professor
505-277-1629, mhbenson@unm.edu

Paul Zandbergen, Associate Professor
505-277-3105, zandberg@unm.edu

Law
G. Emlen Hall, Professor Emeritus
505-277-2866, hall@law.unm.edu, http://lawschool.unm.edu

Reed Benson, Professor
505-277-1119, benson@law.unm.edu

Susan Kelly, Research Professor
Interim Director, Utton Transboundary Resources Center, UNM School of Law

505-277-0514, skelly@law.unm.edu

Political Science
Gregory W. Gleason, Professor
505-277-7391, gleasong@unm.edu, http://www.unm.edu/~polsci/faculty_listing/index.htm

Public Administration
F. Lee Brown, Professor Emeritus Economics, Professor Emeritus Public Administration
505-277-2845, flbrown@unm.edu

Santa Falcone, Associate Professor
505-277-4934, falcone@unm.edu, http://www.unm.edu/~spagrad

T. Zane Reeves, Professor
505-277-3312, tzane@unm.edu, http://www.unm.edu/~spagrad

Mario A. Rivera, Professor
505-277-3312, marivera@unm.edu, http://www.unm.edu/~spagrad

Water Resources
Bruce M. Thomson (Director)
505-277-4729, bthomson@unm.edu, http://www.unm.edu/~civil/faculty.htm

Stephen Cabaniss (Associate Director)
505-277-4445; cabaniss@unm.edu, http://www.unm.edu/~cabrsrch/index.htm

Faculty Issues Facing the WRP

How Can Faculty Participation in the WRP be Rewarded?
With the exception of faculty who co-teach the core classes (WR 571 Water Resources I – Contemporary Issues, WR 572 Water Resources II – Models, and WR 573 Water Resources III – Field Problems) there is no compensation of any form for participation in the WRP. Many of the faculty devote extraordinary amounts of time to advising and mentoring graduate students and serving on the examination committees for their Professional Projects. UNM needs to develop a mechanism to encourage faculty to participate in interdisciplinary programs such as the WRP. This is especially critical for non-tenured junior faculty who are often discouraged by Department Chairs from becoming involved in academic activities outside their home department.

Can Faculty Conduct Sponsored Research Through the WRP?
Except for a few small projects, most specifically developed to provide student support, little research is conducted through the WRP. This is principally because Deans and Department Chairs are concerned that faculty support students in their home department to generate student credit hours and graduate student degree production, and also because a fraction of the research overhead is returned to the generating unit. This results in few Research Assistant opportunities for WRP students. UNM needs to identify mechanisms by which faculty can conduct externally funded research through interdisciplinary programs such as the WRP.

Water Resources Student Population

The Masters of Water Resources (MWR) degree is intended to be a professional degree that provides education and training for students in water resources management. Water resources management is considered in the broadest possible context and includes professions associated with administration of water and its use as well as the protection of the quality and the aquatic environment. Management of this resource requires appreciation and understanding of a diverse set of issues including technical topics as well as social, cultural, legal, and political issues. As such, the Water Resources Program (WRP) is oriented towards students with diverse interests and varied educational backgrounds.

This section discusses the WRP student population including the admissions criteria and the education background of current students, and considers some of the challenges students face in completing the program.

Admissions Criteria

The admission requirements for the MWR degree program are described in the Program Guidelines (Appendix I):

- A Bachelor's degree from an accredited college or university.
- A GPA of at least 3.0 out of 4.0 for the last two years of undergraduate work. A student with a GPA under 3.0 may be admitted if he/she has other exceptional qualifications indicating their likelihood of success in the program.
- Three references from individuals (not friends) qualified to assess the applicant's academic and/or professional qualifications. At least one of these letters must be from a former professor. Letters from friends or personal acquaintances are not acceptable. Letters of reference must be sent to the WRP Office, not OGS.
- A 1-2 page letter of intent describing the student's background, interests in water resources, experience in the field, objectives, desired concentration, and future plans. A resume or *curriculum vitae* is helpful, but does not replace the letter of intent. This letter must be sent to the WRP Office, not OGS. Please put your name and all contact information on your letter.
- Successful completion of the MWR prerequisites in the student's intended area of study (see below).

The Graduate Record Examination (GRE) is not required for admission to the WRP.

Prerequisites

Admission to the program requires completion of the prerequisite courses listed below. Generally students should not apply until all prerequisites have been completed. However, students with a strong academic preparation may, upon occasion, be admitted with only one or two unfulfilled prerequisites.

Hydroscience Concentration

- Calculus I (Math 180 or 162L), Calculus II (Math 181 or 163L), and Statistics (Stat 145). Note: Math 162L and 163L are highly recommended.
- Introductory Microeconomics (Economics 106) or Intermediate Microeconomics I (Economics 300)
- Three semesters of introductory (or higher) science courses (UNM 100-level) in at least *two different* disciplines

Policy/Management Concentration

- Calculus I (Math 180 or 162L) and Statistics (Stat 145)
- Introductory Microeconomics I (Economics 106) or Intermediate Microeconomics I (Economics 300)
- Two semesters of introductory (or higher) science courses (UNM 100-level)
- One introductory or higher course in: sociology (Sociology 101); political science (Political Science 110); or psychology (Psychology 105). Note: a student entering with a degree in one of the above must have taken a course in one of the other two disciplines.

Admission to the WRP is handled by the Director and Associate Director. To date all qualified students have been admitted; there has been no cap on the number of students allowed into the program.

Prerequisite Issues
Generally the students who meet these admissions criteria and enroll in the program become successful graduate students in the sense that they can do well in most graduate classes that are affiliated with the WRP. However, 66% of the current students in the program (33 of 50) had one or more deficiency and 20% of the current students had two deficiencies. With almost no exceptions these deficiencies are the microeconomics course (60% of the students) and the calculus requirement (26%). In the past year as enrollments have grown the program has adopted the policy that students missing two or more prerequisites will be denied admission until this deficiency has been removed.

The microeconomics deficiency is so common because it is required in very few undergraduate programs. The calculus deficiency generally occurs in students with degrees in humanities and social sciences (except economics).

While both deficiencies present a challenge, the microeconomics deficiency presents the greatest challenge because economics constitutes roughly one third of the material covered in two of the three core classes; WR 571 Water Resources I – Contemporary Issues, and WR 572 Water Resources II – Models. A background in calculus is needed in WR 572 and in most of the HS elective classes, however, by the second semester at UNM most grad students have satisfied the calculus deficiency.

Proposed strategies for addressing the problem of deficiencies include:

- Strictly enforce the prerequisite criteria required for admission. This likely would reduce enrollments in the program.
- Require students with deficiencies to satisfy the missing course during the first semester enrolled as a graduate student. It is not clear how this policy could be enforced; if a student did not comply would it be possible to disenroll him?
- Offer an intense evening short course (perhaps 12 hours) in microeconomics early in the fall semester to cover basic principles needed in the core classes. This might be taught by a graduate student. It is not clear how this would be financed.

Resolution of this issue is a topic of current discussion by the Program Committee.

Water Resources Student Characteristics

The WRP currently has 50 students enrolled with a remarkably diverse background of degrees, age, and experience. Their academic preparation is summarized in Table 4. 60% of these students have bachelors degrees (and one masters degree) in environmental science (28%) and biology or a related field (32%). 24% of the students have degrees in the humanities, social sciences or journalism.

Table 4. Academic background of current students in the Water Resources Program.

Degree	Number	Percent
Biology	16	32
Environmental Science	14	28
Liberal Arts	4	8
Economics	3	6
Geology	3	6
Chemistry	2	4
Engineering	2	4
Business	1	2
Math	1	2
Anthropology	1	2
Psychology	1	2
Philosophy	1	2
Journalism	1	2

Approximately 60% of the students who have graduated in the past 6 years have chosen the HS option. A list of their Professional Project titles is contained in Appendix III of the Program Guidelines (Appendix I of this report).

The WRP does not have information on the age distribution of its students, but the average age is estimated at 33. Approximately a quarter of the students have entered the WRP immediately after completing their undergraduate degree. At the other end of the spectrum, two of the current students have retired from previous professions (a US Air Force officer and a high school teacher). Another student who graduated in the summer of 2010 defended his Professional Project one month before his 60th birthday.

Of the current students, all but five are part time students. Approximately half of the students have permanent full time employment and 12 of these students work in water resources or environmental fields. 12 of the students have student intern positions with local resource management agencies (USGS, Sandia or Los Alamos National Labs, local water utility, and local government). In past years many students have worked as interns for the NM Environment Department or the Office of the State Engineer, however, due to budget shortfalls neither agency has hired any students in two years. At present four students are funded as Research or Teaching Assistants at UNM.

Water Resource Student Advising & Mentoring

Upon entry to the program students are invited, but not required to attend an orientation session. This orientation discusses the degree requirements and introduces them to UNM and WRP policies and procedures.

UNM does not require graduate students to have a faculty advisor upon entry to graduate school. Nevertheless, all students are encouraged to discuss their curriculum plans with the Director or Associate Director at the end of each semester and prior to registering for classes in the subsequent semester. Approximately half of the students do so.

Students are encouraged to select an advisor after completing approximately 12 credits of course work. Advisors can be any tenured/tenure track or research faculty at UNM. Generally the advisor also becomes the director of the student's Professional Project research.

After completing 18 to 24 credits of classes students are expected to complete a WRP "Coursework Proposal" form (Appendix V in the Program Guidelines). This form identifies the classes that the student has completed and expects to take to finish the degree. It is a form internal to the WRP and requires signatures of the adviser and WRP Director.

After completing 21 to 30 credits of coursework students are required to complete a UNM "Program of Studies" form. This form is approved by the student's advisor, the WRP Director, and the Dean of the Office of Graduate Studies. The "Program of Studies" must be submitted and approved at least one semester before the student graduates. In essence, it becomes a contract between UNM and the student that states UNM will grant a degree if the student completes all of the work identified in the "Program of Studies."

Internships

In years past there have been internship opportunities with federal, state and local agencies, as well as opportunities with consulting firms. The WRP needs to aggressively pursue more opportunities in this area to support its students and to provide them with experience that can improve their future career opportunities.

Post Graduate Success of WRP Students

One hundred one students have graduated from the WRP since 2000 and the program has information regarding employment for all but 24 of these. More than 90% of these students have remained in NM. Information on their employment is tabulated in Table 5. Nearly half of these

students work for federal, state or local governments (publicly owned water utilities are listed as local government. 13% work for either Sandia or Los Alamos National Laboratories, usually in a facilities support function. 26% of the graduates are employed in the private sector; nearly all are with consulting firms. Graduates in the "other" category include those who have not sought employment, are retired, work for non-profit organizations (three students), or have pursued other graduate work (law, PhD, engineering).

Table 5. Employment categories of 77 students who have graduated since 2000.

Employment Category	%
Local Govt.	6
State Govt.	28
Federal Govt.	11
National Labs	13
Private Sector	26
Other	17

The WRP does not have statistics on the job success rate of recent graduates, but it is believed that all students who have graduated since 2008 have found employment within six months of graduating.

Association of Water Professionals

The Association of Water Professionals (AWP) is the official WRP student organization. The AWP arranges professional talks, field trips, and social events, engages in outreach, and helps students find employment opportunities. AWP is a chartered graduate student organization at UNM and as such receives a modest amount of support from the Graduate and Professional Student Association (GPSA). AWP officers include a President, Vice-President, Secretary, and Treasurer. The AWP has an office in the Economics building. The AWP owns a canoe which can be checked out for student use.

Student Issues Facing the WRP

Can Student Preparation for the WRP Be Improved?

The large number of applicants to the program who have not satisfied the microeconomics prerequisite constitutes a significant challenge to faculty teaching the WRP core classes (WR 571 and WR 572). The WRP needs to develop guidance as to how to address this issue.

Advising Issues

Because so many of the WRP students are part-time students, once they complete the core curriculum many of them have little direct contact with the WRP Director. Even though they are sent frequent reminders each semester, perhaps one-quarter of the students neglect to fill out their "Coursework Proposal" and "Program of Studies" forms until very late in their curriculum. This presents a problem when students have not taken the proper distribution of courses, or have not submitted their "Program of Studies" form prior to the semester in which they expect to graduate.

Mentoring Issues

The highly interdisciplinary nature of the MWR curriculum means that most students do not take more than one or two classes in any department. Therefore, they do not have the opportunity to get to know faculty and their research interests. This presents a challenge when it comes time to select an advisor that is especially acute for students who are shy or uncertain about approaching a faculty member. A better mechanism is needed for connecting students with faculty mentors.

Graduate Student Support

There is very little financial support for WRP students, principally because little externally funded research is conducted in the program. The WRP needs to develop improved funding for graduate student support in the form of internships, scholarships, and research assistantships.

Budget, Facilities and Equipment

This section discusses the budget, facilities and equipment for the Water Resources Program (WRP). The WRP's experienced a 20% cut in AY 2008-2009 that has significantly impacted teaching of its core classes. Nevertheless, in considering its budget, it is necessary to recognize that severe decreases in New Mexico state revenues has forced

Budget

The total amount budgeted to the WRP for the past five academic years is summarized in Figure 3. This does not include funds allocated to teach WR 573 Water Resources III – Field Problems during each summer. $5,233 is allocated for this class and is split evenly between the two faculty who teach it, Drs. Thomson and Ali. As a point of reference, the annual budget for the WRP in 1996 was also $126, 295.

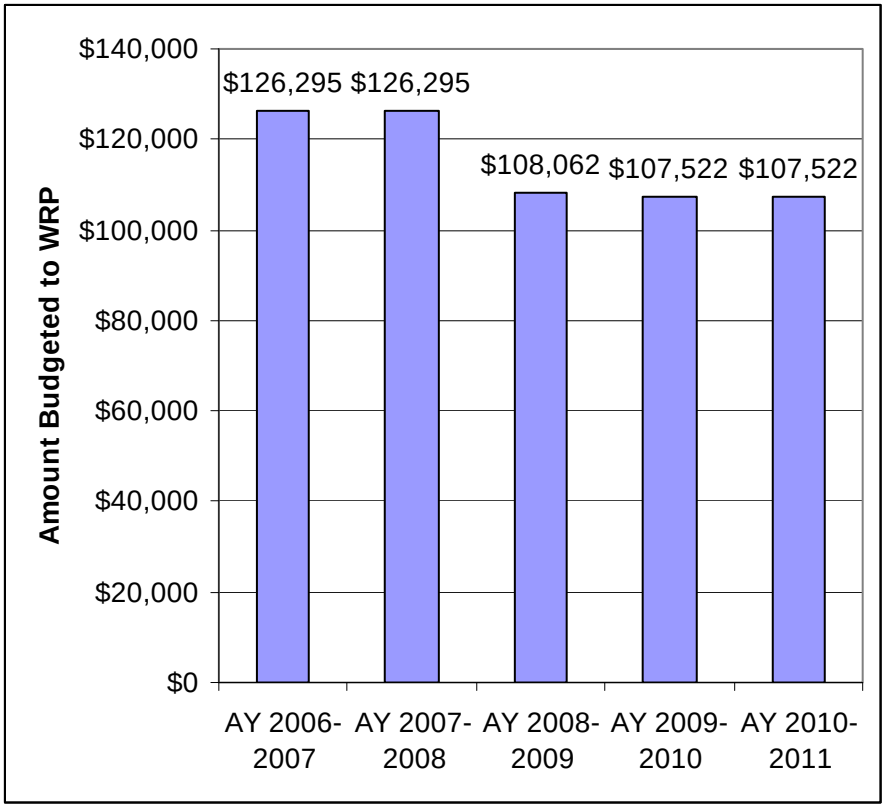


Figure 3. Water Resources Program budget totals for academic years 2006-2007 through 2010-2011.

The WRP budget is distributed among five categories: Director's salary, Administrative Assistant's salary, funds disbursed to affiliated faculty for teaching the WR 571 and WR 572 core classes, office supplies and telecommunications, and other (travel, professional dues, etc.). The distribution of expenses for AY 2009-2010 is shown in Figure 4. This shows that all but three percent of the expenditures was associated with program salaries or course delivery costs. In AY 2009-2010 approximately $14,000 was used to buy release time or pay extra

compensation to UNM faculty (Professors Brookshire and Chermak) and adjunct faculty (Vince Tidwell from Sandia National Labs) for assistance in teaching the WR 571 Water Resources I – Contemporary Issues, and WR 572 Water Resources II – Models.

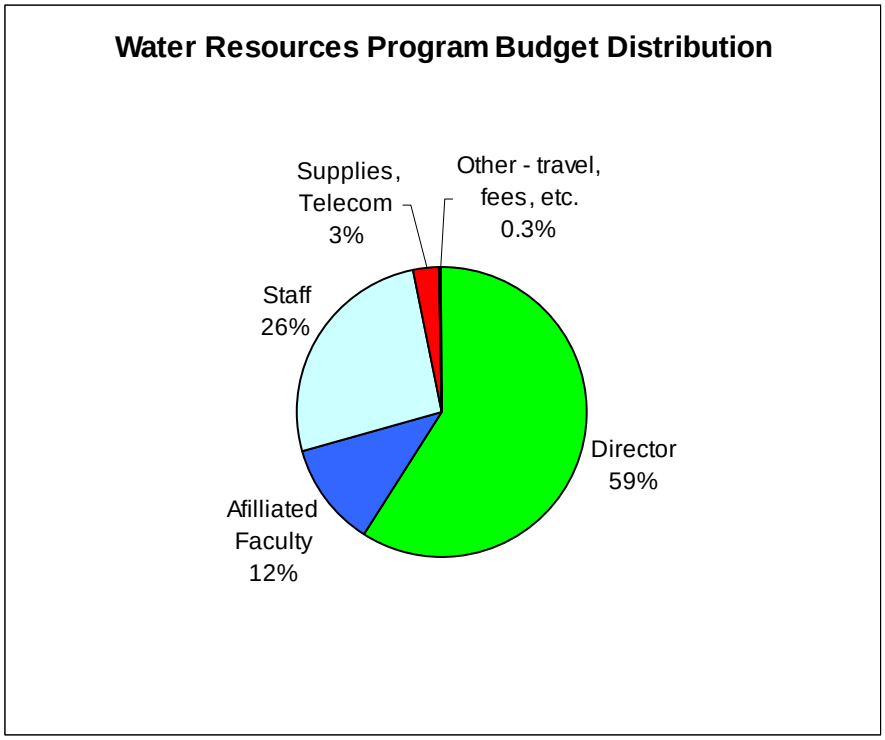


Figure 4. Expense distribution of the Water Resource Program budget for AY 2009-2010.

A confounding factor in the WRP budget situation is the increased cost for course buy-out imposed by the College of Arts and Sciences. The cost of buying out of a course to allow participation in the WRP core classes was raised to $4,000 from $3,500 in AY 2009-2010. Three A&S faculty normally participate in teaching WRP 571 and WRP 572, which would increase annual instructional costs by $1,500. The program has absorbed some of this cost by using an adjunct professor (Tidwell from Sandi National Labs) who receives a smaller honorarium and a second faculty member who receives extra compensation instead of a course buy-out. This inequity in pay for co-instructors needs to be addressed in the near future, however it is not clear where the money will come from.

In examining the budget situation for the WRP it is informative to consider items which have been eliminated from the program since AY 2006-2007. These include:

- Elimination of a third faculty member in WR 571 Water Resources I – Contemporary Issues. Until AY 2009-2010 this class was co-taught by three professors whose background reflected the breadth of water resources issues: Bruce Thomson (engineering & hydrology), David Brookshire (economics) and Paul Matthews (geography). Prof. Matthews has recently retired from UNM and no longer co-teaches this class, though he continues to give guest lectures in it.

- Elimination of communication instructor from all of the WRP core classes. Until AY 2008-2009 an adjunct instructor was integrally involved in all three of the core classes to teach written and oral communications.

- Elimination of all graduate student support. Until AY 2008-2009 approximately $4,000/yr was available to support a graduate student who provided teaching assistance with the core classes and provided web support for the program.

- Elimination of professional organization membership. UNM has been a long time member of the Universities Council on Water Resources. This membership will expire in 2010 and will not be renewed.

- Elimination of funds for computers and software.

- Elimination of travel funds.

In 2008 Professor Stephen Cabaniss was appointed Associate Director of the WRP, which is nominally a half-time position. His appointment came with no additional fiscal resources, but to date his salary has not been charged to the WRP.

Research Productivity

Almost no research is conducted under the auspices of the WRP. Even the Director conducts most of his research in his home department (Civil Engineering). The exceptions are generally research contracts which are specifically focused on water resources problems that are intended to support a WRP graduate student.

Nevertheless, the amount of research conducted by faculty affiliated with the program is quite impressive. Since 2005, 38 WRP faculty have generated more than twenty million dollars ($20,495,631) in external funding for contracts and grants in areas related to water, sustainability and the environment. Recent awards in policy and management include an evaluating the priorities and preferences of water utility customers (J. Thacher, Water Research Foundation, $325K), developing a systems dynamics toolbox for water resources planning (J. Chernak, US Dept. Energy, $100K) and an economic evaluation of water leasing in the Upper Mimbres basin (D. Brookshire, NM State Engineer, $100K).

Ongoing projects in environmental science include modeling and predicting the chemistry of uranium in the groundwater at abandoned mill and mining sites (S. Cabaniss, US Dept. Energy, $190K), examining the relationship between mantle degassing and water quality (L. Crossey, NSF, $112K), monitoring water quality in the middle Rio Grande (C. Dahm, US Dept. Interior, $60K) and evaluating the relationship between aquifer heterogeneity and contaminant transport (G. Weissman, US Dept. Energy, $187K).

Research in water engineering and technology includes determining the state of practice for vegetative levee barriers (J. Stormont, Army Corps of Engineers, $90K), evaluating a bed load sampler on the Rio Grande (J. Coonrod, Army Corps of Engineers, $99K), improving methods of

membrane desalination for water re-use (K. Howe, WateReuse Foundation, $300K), and improving methods of removing fluoride from drinking water sources in New Mexico (B. Thomson, NM Dept. Finance and Administration, $135K).

Other Revenue

There are two other sources of revenue that have helped keep the WRP fiscally solvent.

Water Resources Program Endowment:
The WRP has established a small endowment of $15,000 that generates approximately 5% interest ($750/yr) which can be used for discretionary purposes. The WRP Director and Program Committee believe that opportunities exist to add to this endowment through fund raising and have been meeting with the UNM Development Office to develop a strategy for doing so.

Research Overhead Return
Because it does not require students to do fundamental research and because it does not offer the Ph.D. degree, the WRP is not a research intensive program. Further, the WRP has no full time faculty, no tenure lines, no laboratories, and very limited field equipment that can be used to support a research program. Nevertheless, several research projects have been conducted through the program which have generated research overhead return. Research overhead return in recent years has been primarily used to support the summer field class, WRP 573 Water Resources III – Field Problems.

To date all research overhead generated by the Program has been returned to it, none was kept by University College. At present the WRP has approximately $17,000 in its research overhead account. The program believes that some of these funds are in jeopardy of being captured by the UNM administration through a "sweeping" process to help meet university costs in light of dramatic shortfalls in state revenues.

UNM Budget Perspective

Although the WRP has suffered dramatic cuts in its budget in the past three years, potential restoration of these cuts must be considered in light of the financial situation of the state of NM and the University. A recent explanation of the University's projected cuts was provided by UNM Provost and is summarized in Table 6. This shows that the University is expecting cuts of nearly 20% and that these are expected to be in effect for years to come.

Table 6. Summary of UNM current & projected budget cuts through FY 2012.

State Budget Cuts - UNM Main Campus		
I&G and Special Projects		
	Amount	**Percent**
FY 09 Original State Appropriation	$211,838,500	
FY 09 - 11 Appropriation Reductions	$25,992,500	12.3
FY 11 Orginal State Appropriation	$185,946,000	
FY 11 Mid-Year Recision	$5,950,200	3.2
FY 11 Adjusted State Appropriation	$179,995,800	
FY 12 Appropriation Reducton (projected)	$8,999,800	5.0
FY 12 Appropriation (projected)	$170,996,000	
Total Reduction (Projected) in State Appropriations	**$40,842,500**	**19.3**

Student Credit Hour Generation

Almost 10 years ago a former UNM President made an off-handed remark that, in terms of dollars per degree produced, the WRP was one of the more expensive programs on campus. This comment is very simplistic and deserves closer examination.

The WRP is a highly interdisciplinary program. Of the 39 credits in the MWR curriculum, most students only take 15 credits of WRP classes; the three core classes (12 credits) plus thee credits of WR 598 Professional Project. Thus, these students take at least 24 credits of existing classes that generate student credit hours for their respective departments. Students in the dual degree program with Community and Regional Planning take only 12 credits of WRP classes out of a total of 59 credits.

An analysis was performed of all of the MWR students who graduated in AY 2008-2009 in which the total number of credits in each of five colleges or schools was determined (Table 7). In addition, the amount of revenue generated for UNM according to the NM state higher education funding formula was calculated. These 15 students needed a minimum of 585 credits to graduate but actually took a total of 705 credits. In principle this enrollment generated $535,000 of revenue for UNM of which two-thirds went to departments other than the WRP. Recognize further, that these were credit hours generated only by students who completed their degree; roughly one-fourth of the students who start never graduate so that their credit hours are not included in this analysis.

Table 7. Total number of student credit hours generated and associated revenue generated for 15 Master of Water Resources students who graduated in AY 2008-2009

College/School	Grad. SCH	Revenue Generated	Undergrad SCH	Revenue Generated
WR	298	$175,260		$0
H&SS & CRP	123	$72,339		$0
Nat. Science	153	$123,803	4	$1,702
Engr.	72	$93,128	3	$1,466
Law	52	$67,259		$0
Total Credits Gen.	**705**			
Total Revenue Gen.	**$534,957**			

The WRP recognizes that the revenue generated by an analysis such as that presented in Table 7 is simplistic and that actual funds are not realized by the generating department based on enrollment. However, it is also clear that many faculty recognize that WRP students can be recruited to increase enrollments in marginal classes. Faculty in these classes actively recruit WRP students for this purpose which benefits both the WRP students and the students in the home department by increasing the number and diversity of courses offered as well as broadening the perspectives of students in the courses.

Even though the WRP makes contributions to the UNM community in the form of enrollments, degree production, public recognition, and as a focus for much interdisciplinary collaboration, there is some frustration that the UNM colleges and schools have not provided as much support as might be expected. Faculty participation is strictly on an ad-hoc basis and, with the exception of the faculty who co-teach the core classes, there is no compensation whatsoever. The WRP believes there may be ways of obtaining support from the colleges and schools. Perhaps the most pressing need is for faculty release time to participate in the WRP teaching mission.

Facilities and Equipment

The WRP is physically located in the Social Sciences Building. This building also houses the Department of Economics and is thus frequently referred to as the Economics Building. The WRP has three small offices for the Director, Associate Director, and Administrative Assistant. An additional office is used for storage of field equipment and other equipment, and is used by the student group, the Association of Water Professionals. Two other offices have been converted to a student lounge and a computer pod.

The WRP computer pod has four desk top computers and two color printers that are connected to the UNM campus network. The computers have current versions of Microsoft Office suite, Adobe Acrobat and other miscellaneous software. Older versions of ArcView GIS, Visual Modflow, and other software have been loaded on some of the computers. In addition, all of the computers have licensed copies of PowerSim Studio 7 dynamic simulation software. This software is heavily used in the Water Resources 572 – Models class, and by some students in their Professional Projects. Technical support for the WRP computing equipment is provided by the IT staff from University College.

The WRP has acquired some field equipment to support the Water Resources 573 – Field Methods class. This includes two Marsh McBirney Flo-Mate 2000 electronic flow meters, a field pH/conductivity, and miscellaneous field equipment. This equipment is available for use by students in WRP and other departments for field projects including class projects and student research.

The Association of Water Professionals (AWP) acquired a water sampling craft (i.e. a canoe) that is available for use for field research projects and social activities.

UNM Libraries

The University Libraries (UL) is a member of the Association of Research Libraries, and is composed of four separate facilities on the University of New Mexico's main campus in Albuquerque: Centennial Science and Engineering Library (CSEL); Parish Memorial Library (business and economics); Zimmerman Library (education, social sciences, and humanities); and the Fine Arts and Design Library. The WRP also utilizes the resources of the separately administered Law Library.

The UL hold over 2,600,000 print volumes in their collections, including complete collections of state and federal publications relating to water resources. The UL currently subscribe to over 75,000 print and online journals in all disciplines. There are numerous special collections in the UL, notably the historical material at the Center for Southwest Research (CSWR) in Zimmerman Library and the print and online resources in the Map and Geographic Information Center (MAGIC).

The UL provides 24/7 on-campus or remote electronic access to important databases, online journals, electronic books and reference sources, and the library catalog of print and electronic holdings, with over 338,000 e-Books. Many of these resources specifically support water research in the sciences, engineering, social sciences, and legal disciplines. Access is provided to Water Resources Abstracts and the Western Waters Digital Library (of which the CSWR is a contributing member).

The Research Data Librarian responsible for Water Resources, Jeff Dickey, holds a Ph.D. in geography. Professor Dickey previously worked for the NM Office of the State Engineer and has extensive knowledge of water data in the state. Additional reference support is provided by all CSEL librarians via the reference desk, which is staffed in person, by phone, and by e-mail over 75 hours per week. The Research Data Librarian facilitates communication of the Water Resources program research results by posting the capstone project report in UNM's institutional repository LoboVault. These reports are cataloged and freely available to other researchers and the public.

Budget Issues Facing the WRP

Restore Interdisciplinary Faculty Participation in the Core Curriculum

Perhaps the single greatest threat to the WRP posed by recent budget cuts is elimination of the communications component from the three core classes and reduction of the teaching team in WR 571 from three faculty to two. Further cuts (or increased cost of faculty release time) will

have a similar impact on WR 572. The Program must find a way of restoring participation by faculty from multiple disciplines in the teaching mission.

Support for Program Operations
Elimination of funds for computers, software, field equipment and travel will soon begin to be felt in both the teaching and research activities. These are not large costs but are not affordable within the current budget.

The WRP Needs An Advocate for Interdisciplinary Graduate Programs at the Deans' Level
The WRP needs an advocate at the Deans' Council who understands and can articulate the contribution the WRP makes to the greater UNM community and can encourage their support in seeking resources for it.

Issues to be Considered by the APR Team Regarding Budget

Can the WRP Program be Modified to Accommodate Past & Future Budget Cuts?
Perhaps the single greatest threat to the WRP posed by recent budget cuts is reduction of the teaching team in WR 571 from three faculty to two and elimination of the communications component from the three core classes. Further cuts (or increased cost of faculty release time) will have a similar impact on WR 572. The Program must find a way of restoring participation by faculty from multiple disciplines in the teaching mission or possibly change the way the core curriculum is delivered.

Public Engagement by the WRP and Its Faculty

Because of the importance of water to the environment, economy, culture, and social structure of NM the WRP is a highly visible member of the state, local and UNM communities. Some of the activities that WRP faculty participate in include:

- Represent UNM on the Middle Rio Grande Endangered Species Collaborative
- Service on national, state and local water and environmental management committees
- Presentations to civic groups
- Sponsoring meetings and seminars on specific water challenges in NM and the southwest
- Leadership role in the Middle Rio Grande regional water planning committee

The WRP has played an important role at UNM as a focal point for interdisciplinary research and teaching in water related topics. A number of on-campus seminars are sponsored each semester. Interest has been expressed in an evening film series to encourage off-campus participation in the program, however, issues associated with evening room availability and lack of public parking have prevented this from happening to date.

Appendix I – Program Guidelines

This document is also available on-line at www.unm.edu/~wrp.

Program Guidelines

Master of Water Resources Degree

Water Resources Program

University of New Mexico

August 2010

Bruce M. Thomson, Ph.D., P.E.
Professor & Director

Water Resources Program
Social Sciences-Economics Building, Room 1048
University of New Mexico
Albuquerque, NM 87131-1217

www.unm.edu/~wrp

Program Guidelines
August 2010
The Master of Water Resources Degree

Table of Contents

Water Resources Program
Social Sciences-Economics Bldg. #57, Room 1048
MSC05 3110
1 University of New Mexico
Albuquerque, NM 87131-0001 USA
Voice: 505-277-7759; Fax: 505-277-5226
www.unm.edu/~wrp/ **wrp@unm.edu**

Note: These *Program Guidelines* are not a comprehensive collection of the requirements for Master's degrees at UNM. Such information can be found on in the current UNM Catalog. All MWR students should familiarize themselves with UNM requirements and procedures for Master's degrees.

Rev 15: 8/12/10

The Master's Degree in Water Resources

MISSION STATEMENT AND INTRODUCTION

The Water Resources Program (WRP) offers the Master of Water Resources (MWR) degree, an interdisciplinary professional degree designed to prepare students for careers in water resources management and related fields. The University of New Mexico's location in the Southwestern USA means that there is a natural emphasis on dry-region water issues; however, the MWR degree is designed to provide its students a firm grounding in water resources that is applicable throughout the world. The MWR degree is generally directed towards students wishing to further develop their qualifications and expertise in the practice of water resources management. Therefore, although it does include considerable exposure to research topics and methods in this area, its principal orientation is towards practice rather than research. Entering students are assumed to have a basic proficiency in at least one water-related discipline (defined rather broadly) such as engineering, sociology, management, public administration, environmental studies, economics, law, chemistry, planning, political science, geology, geography, and biology, or professional experience in a water related field. The program seeks to expand and deepen students' knowledge of their primary disciplines, provide them with an integrated perspective on water in nature and society, improve their capacity to think carefully and comprehensively, and develop their technical and communications skills.

The MWR degree is obtained by following one of two tracks or options: the Hydroscience (HS) track or the Policy/Management (PM) track. Each track consists of 39 semester credits: 36 credits of coursework plus 3 credits for a professional project. The Hydroscience track is designed primarily for students with technical backgrounds (biology, chemistry, earth/environmental sciences, mathematics, toxicology, physics, physical geography, engineering, etc.) who wish to complement their primary discipline by obtaining expertise in the scientific and/or engineering aspects of water resources and its management. Students without technical backgrounds may select this track but may need to take remedial hydroscience classes to prepare for graduate level course work. The Policy/Management track is designed for students with backgrounds in the natural sciences, political science, economics, sociology, management, engineering, geography, psychology, public administration, law, community and regional planning, public health, etc. who wish to emphasize aspects of water dealing with economics, policy, administration, management and planning. The curriculum for each track is flexible, enabling a student, with guidance from his/her advisor and committee, to design a course of study in accord with his/her career objectives.

The interdisciplinary character and practical orientation of the MWR program reflect the growing complexity of water issues. Over the past several decades, population shifts, industrial developments, changes in water law, and advances in technology have intensified competition for water resources and placed new burdens of decision on the people who manage them.

Increasing problems of water pollution, for example, require not only an understanding of water chemistry and transport systems but an appreciation for the short- and long-term implications of water allocation and land-use practices as well as an ability to communicate and work effectively with specialists in various fields, policymakers, and concerned citizens. In short, effective water resource professionals need many competencies. Establishing those competencies is the goal of the MWR degree program.

HISTORY

The Master of Water Resources Administration (MWRA) degree was formally initiated at the University of New Mexico in 1991 in response to the need for well-educated water resources administrators, who could balance competing economic, social, technological, ecological and cultural requirements. This 39 semester-credit professional degree helped organize and package the considerable water expertise of the UNM campus in a manner that made it readily available to students and citizens of New Mexico. The interdisciplinary nature of the degree assured that its graduates were exposed to the issues and conflicts facing today's water managers as well as the solutions being proposed. The core of the degree brought diverse faculty together to present their knowledge in an integrated manner. Without the MWRA degree, this integrated view of water management problems and potential solutions was not possible within highly structured, discipline-focused university departments and traditional degree programs. Our first student graduated in 1991.

In 1995, a Professional Project was initiated in place of the Master's comprehensive examination. No semester credits were given for the project.

In 1998, the highly-structured MWRA degree became the current Master of Water Resources (MWR) degree. The more flexible two-track MWR degree affords students greater options in their coursework program (Policy/Management or Hydroscience) and expands the number of available participating faculty. Three semester credits were given for the Professional Project, bringing the total number of semester credits to 39. The Water Resources Program (WRP), the graduate unit responsible for administering the degree, was transferred to UNM's University College in 1998. In part because University College is primarily focused on lower division education advisement and also because other interdisciplinary graduate programs have been instituted at UNM, in spring 2010 UNM asked the WRP to consider whether it would be appropriate to report to a different college or school that has a graduate mission. This is currently in progress and a final decision on an administrative home for the WRP is expected by the end of 2010.

WHAT DO WRP GRADUATES DO?

Graduates of the Water Resources program enjoy a wide range of employment opportunities. These fall into four categories:

- Public resource management agencies including federal (EPA, US Park Service, US Forest Service, US Fish and Wildlife Service, US Geological Survey), state (NM Environment

Department, NM Office of the State Engineer), and local (city and county water utilities, public works departments, and environmental health departments).

- Consulting firms, usually consultants to federal, state, and local water resource management agencies, as well as firms that provide consulting services to industries and other entities which are large users of water.
- Private industries and other entities that use large amounts of water such as power, mining, and agricultural businesses
- Further graduate education leading to the Ph.D. degree, or in professional schools such as law or engineering.

WATER RESOURCES PROGRAM CONTACT INFORMATION

The Water Resources Program is housed in the Social Sciences - Economics Building (#57), on Roma Avenue. It is directly north of Zimmerman Library, south of Parish Memorial Library, and east of the University House (a campus map is available at www.unm.edu/campusmap/). The WRP office is located in room 1048 (voice: 505-277-7759; fax: 505-277-5226; email: acordova@unm.edu). The program is administered by the following:

Name	Title	E-Mail	Phone
Bruce Thomson	Director & Professor	bthomson@unm.edu	505-277-5249
Stephen Cabaniss	Associate Director & Professor	cabaniss@unm.edu	505-277-4445
Annamarie Cordova	Administrative Assistant	acordova@unm.edu	505-277-7759

The mailing address is:

Water Resources Program MSC05-3110
1 University of New Mexico
Albuquerque, NM 87131-0001 USA

The WRP's web site is www.unm.edu/~wrp/ and its e-mail address is wrp@unm.edu.

GOVERNANCE

The Water Resources Program is administered by a Director, Professor Bruce Thomson (bthomsone@unm.edu), Associate Director, Professor Stephen Cabaniss (cabaniss@unm.edu), and a Program Administrator, Annamarie Cordova (acordova@unm.edu). Together they are responsible for day-to-day operations of the program including advising students, supervising the academic program, and preparing and administering program budgets.

A Program Committee is responsible for setting policy and establishing the rules and regulations governing the Water Resources Program and its Master of Water Resources degree. The 2009-2010 academic year Program Committee members are: Dr. Bruce Thomson (Director, Water Resources Program); Dr. David Brookshire (Economics), Dr. Bruce Milne (Biology), Dr. Mark Stone (Civil Engineering); Dr. José A. Rivera (Community and Regional Planning); Susan Kelly

(Director, Utton Center for Transboundary Resources, School of Law); Dr. Melinda Harm Benson (Geography); and Dr. John W. Shomaker (President, JWS & Associates, Inc.); Katie Lee (Alumni Representative, RT Hicks and Associates) and Lani Tsinajinnie (President, Association of Water Professionals).

The Water Resources Program has also established an external advisory board comprised of MWR alumni and others in the water resources community.

ADMISSION

Information on admission and application procedures is available at: http://www.unm.edu/~grad/admissions/admissions.html. Applications must include a transcript of all previous college work, three letters of recommendation and a letter of intent. The letters of recommendation and a letter of intent must be sent directly to the WRP Office, not the Office of Graduate Studies (OGS). Admission deadlines are November 15 for the spring semester and July 15 for the fall semester. Only former MWR students seeking readmission are admitted for the summer semester. ***Early application is encouraged for best consideration.***

The Office of Graduate Studies may be reached at 505-277-2711 or grad@unm.edu; its web address is www.unm.edu/~grad/.

The admission requirements for the MWR degree program are:

- A Bachelor's degree from an accredited college or university.
- A GPA of at least 3.0 out of 4.0 for the last two years of undergraduate work. A student with a GPA under 3.0 may be admitted if he/she has other exceptional qualifications indicating their likelihood of success in the program.
- Three references from individuals (not friends) qualified to assess the applicant's academic and/or professional qualifications. At least one of these letters must be from a former professor. Letters from friends or personal acquaintances are not acceptable. Letters of reference must be sent to the WRP Office, not OGS.
- A 1-2 page letter of intent describing the student's background, interests in water resources, experience in the field, objectives, desired concentration, and future plans. A resume or *curriculum vitae* is helpful, but does not replace the letter of intent. This letter must be sent to the WRP Office, not OGS. Please put your name and all contact information on your letter.
- Successful completion of the MWR prerequisites in the student's intended area of study (see below).

The Graduate Record Examination (GRE) is *not* required for admission.

MWR students who have not been enrolled for three or more consecutive semesters will be dropped from the degree program by OGS. Application forms for readmission are available at www.unm.edu/apply/. The application fee must be repaid. Readmission is not automatic.

Admission can be deferred for up to one calendar year. Students must submit a written request to OGS and the WRP requesting deferral.

Prerequisites

Admission to the program requires completion of the prerequisite courses listed below. Generally students should not apply until all prerequisites have been completed. However, students with a strong academic preparation may, upon occasion, be admitted with only one or two unfulfilled prerequisites.

Hydroscience Concentration

- Calculus I (Math 180 or 162L), Calculus II (Math 181 or 163L), and Statistics (Stat 145). Note: Math 162L and 163L are highly recommended.
- Introductory Microeconomics (Economics 106) or Intermediate Microeconomics I (Economics 300)
- Three semesters of introductory (or higher) science courses (UNM 100-level) in at least *two different* disciplines

Policy/Management Concentration

- Calculus I (Math 180 or 162L) and Statistics (Stat 145)
- Introductory Microeconomics I (Economics 106) or Intermediate Microeconomics I (Economics 300)
- Two semesters of introductory (or higher) science courses (UNM 100-level)
- One introductory or higher course in: sociology (Sociology 101); political science (Political Science 110); or psychology (Psychology 105). Note: a student entering with a degree in one of the above must have taken a course in one of the other two disciplines.

INTERNATIONAL APPLICANTS

International students (non-U.S. citizens) must apply through the UNM Office of International Admissions. Application materials may be requested from the Office of International Admissions, Student Services Building, MSC06 3270, 1 University of New Mexico, Albuquerque, NM 87131-0001 USA. This office may be reached via phone at 505-277-5829 (www.unm.edu/admissions/newInternational/graduate.html).

International applicants must have a TOEFL exam score of at least 550 on the paper exam or 213 on the computer exam, a certification of financial responsibility form, three copies of their official transcripts and certified English translations (if necessary) with their application package. Deadlines for international applicants for the MWR degree program are August 1 for the Spring semester and March 1 for the Fall semester.

Amigo International Scholarship information and applications can be found at www.unm.edu/%7eschol/trans/amigoint.html. These scholarships allow international students to attend UNM for resident tuition fees only.

STUDENT RESPONSIBILITIES

Each graduate student is responsible for complying with all regulations and meeting all deadlines of the University and the Department and College or School in which he or she is enrolled. The student is responsible for reading the UNM Catalog. Copies can be purchased at the University Bookstore and it is available online at http://registrar.unm.edu/catalog.htm. . Particular attention should be paid to the section on *The Graduate Program.* This section contains the requirements and regulations governing graduate degrees, many of which are not covered in the *Program Guidelines*. The Catalog also has course descriptions. Some departments have course syllabi on their home pages (go to www.unm.edu and click on "Departments").

Students should give careful attention to the sections in the UNM Catalog on General Academic Regulations and Master's Degrees and, in particular, the following items from those sections.

- Students must maintain a cumulative GPA of at least 3.0 in all courses offered for graduate credit at UNM. Failure to maintain a 3.0 GPA will result in a student being placed on Academic Probation, and may lead to dismissal from UNM by OGS.
- UNM requires that all work applied to a Master's degree, including transfer work from another institution or work taken as a UNM non-degree student, must be completed within a seven-year period.
- Incomplete ("I") grades must be resolved within one year from the published end date of the semester in which the grade was assigned. An "I" grade not resolved within this time reverts to an "F".
- Students must be registered for at least one credit of WR 598 during the semester in which they complete their degree requirements.
- The OGS *Program of Studies* (PoS) form is due to OGS by October 1 (Spring graduation), March 1 (Summer graduation), or July 1 (Fall graduation). Submit the form to the WRP Office 4 working days before it is due in OGS. The PoS form will not be processed until an approved *Coursework Proposal* form, a WRP internal form, has been submitted to the WRP Office. Non-degree and transfer courses are listed on the PoS form.

Students in the MWR degree program are encouraged to confer with their advisor at least once a semester regarding their course plan in order to avoid any problems. Students are also advised to pick up a free copy of *The Pathfinder* which covers additional UNM policies and available university services. *The Pathfinder* is available on line at www.unm.edu/~pathfind/.

On occasion, students may wish to seek interpretation or modification of requirements. This can be done by submitting a petition to the Program Committee or the Dean of OGS. Petitions must be submitted in writing to the WRP office at least two weeks prior to a Program Committee

meeting. Consult the OGS homepage for instructions regarding the preparation of petitions. Students should consult with their faculty advisor and the Director before submitting a petition.

All students are eligible for e-mail accounts through UNM. The WRP uses e-mail and its web site to inform students and faculty of important issues. UNM e-mail can be obtained on-line by visiting http://it.unm.edu/accts/ and looking under "E-Mail" or by visiting one of Information Technology's computer pods.

A flow chart depicting the sequence of events in moving through the MWR degree program is in Appendix IV of this document.

THE MWR CURRICULUM

[Note: The following curriculum became effective Fall 2005. Students who entered the WRP before Fall 2005 should consult the WWW site for the curriculum applicable to them. Students who entered prior to Fall 2005 can also opt to follow the "new" curriculum.]

Prerequisites

The MWR degree prerequisites are:

Hydroscience (HS) Concentration

- Calculus I (Math 180 or 162L), Calculus II (Math 181 or 163L), and Statistics (Stat 145). Note: Math 162L and 163L are highly recommended.
- Introductory Microeconomics (Economics 106) or Intermediate Microeconomics I (Economics 300)
- Three semesters of introductory (or higher) science courses (UNM 100-level) from at least *two different* disciplines

Policy/Management (PM) Concentration

- Calculus I (Math 180 or 162L) and Statistics (Stat 145)
- Introductory Microeconomics I (Economics 106) or Intermediate Microeconomics I (Economics 300)
- Two semesters of introductory (or higher) science courses (UNM 100-level)
- One introductory or higher course in: sociology (Sociology 101); political science (Political Science 110); or psychology (Psychology 105). Note: a student entering with a degree in one of the above must take a course in one of the remaining two disciplines.

Students entering the MWR program with deficiencies in the prerequisites must take them as soon as possible. They must be taken for a letter grade. A student who takes the prerequisite courses as an MWR student must receive a grade of B or better in each course. Note that students

applying to the MWR degree program will not be admitted if they are lacking more than two of the above prerequisites.

Degree Requirements

The MWR degree is recognized by the Office of Graduate Studies as a Plan II (non-thesis) degree. There are two concentrations: 1) Hydroscience (HS); and 2) Policy/Management (PM). Concentrations will appear on the student's transcript.

Thirty-nine (39) credits are required for the degree. Three (3) of these are WR 598 - Professional Project; the remaining 36 credits are distributed as follows:

All Students
All students must take the core curriculum (WR 571, WR 572, and WR 573) and 3 credits of WR 598 - Professional Project (note: you can take as many credits of WR 598 as you want, but only 3 count towards the degree). This is a total of 15 credits. The remaining courses are taken from three different groups ("distribution requirements"); the distribution of courses taken from these groups depends upon the student's concentration.

MWR-HS Concentration. 15 credits from Group I, with at least one course from each category; 6 credits from Group II, from two different categories; 3 credits from Group III (total: 24 credits).

or

MWR- PM Concentration
6 credits from Group I with courses from two different categories; 15 credits from GroupII, with at least one course in any 3 of the 4 categories; 3 credits from Group III (total: 24 credits)

Water Resources Course Categories

Courses for the MWR program are divided into three groups and, within each group, further subdivided into categories. The courses listed below are not all-inclusive as courses are continually being added and deleted. Students seeking to substitute other courses, such as Problems, Topics, or other courses, must consult with the Director and his/her Advisor before taking them. Course titles and descriptions can be viewed in the catalog (www.unm.edu/~unmreg) or on departmental web pages. Note that WR policy precludes acceptance of any 300-level courses for credit towards the MWR degree, except CE 335 – Introduction to Water and Wastewater Treatment.

Group I: HS Courses (3 categories)

- **Hydrology and Hydraulics** (WR 576, E&PS 562, 572, 576, 580, 581L; Civil Engineering 442, 540, 541, 542, 543, 544, 545, 549)
- **Ecosystems, Environment, Health, and Water Quality** (Biology 502, 507L, 558, 535, 495 or 514; E&PS 515, 558; Civil Engineering 335, 531, 532, 534, 536, or 537L; Environmental Science 530; Public Health 502)

- **Climatology** (E&PS 522, 536, 570)

Group II: PM Courses (4 categories)

- **Law** (Law 547, 554)
- **Economics** (Economics 541, 542, 543, 544)
- **Policy, Administration and Management** (Geography 514, 561, 562, 563; CRP 527, 524, 564, 577; Public Administration AD 500, 521, 524, 525, 544, 546, 577; Political Science 470, 475; Public Health 501, etc.)
- **Sociology, Communication, and Culture** (CRP 569, 574; American Studies 523, 524, 525; C&J 554)

Group III: Utilities Courses (3 categories)

These are courses that are not classifiable as HS or PM courses but are applicable to a variety of water issues and include:

- **GIS** (CE 547; Geography 559, 587L, 588L)
- **Methods** (Statistics 538, 539; Economics 504; E&PS 533; Political Science 581; CRP 515)
- **Modeling** (E&PS 557L; Economics 540; Modeling the Environment - usually CRP 570)

WR 590 - Internship can substitute for a Group I, II, or III course, depending upon the nature of the internship.

Students taking 400-level courses should ensure that these courses are available for graduate credit and, if so, that they are registered for graduate credit (see the instructor). 400-level courses available for graduate credit are marked with an asterisk in the UNM Catalog. Dual-listed (400/500) courses must be taken as the 500 number to receive graduate credit.

Courses

The following list of courses is not exhaustive. New courses are continuously being developed and existing courses deleted. Indeed, other courses may be suitable for a student's program of study. Students considering courses not listed here should contact their advisor or the Director to confirm their applicability to their program before enrolling in the course.

Each semester the WR Program compiles a list of all of the water-related graduate classes to be offered at UNM for the following semester. This list is available on the WR web site.

Main-campus course descriptions and prerequisites are available at www.unm.edu/~unmreg/ (click on "UNM Catalog"). Each semester the UNM course schedules are available from a link on the UNM home page. Law School courses and schedules are at lawschool.unm.edu/curriculum/upperclass/index.php.

To obtain detailed information on a particular course, contact the instructor. Note that some of the courses listed below may have prerequisites beyond those required for the MWR degree. It is up to the student to satisfy these, or seek the instructor's permission to take the course.

Group I: Suggested Hydroscience Courses

Listed by category and, within a category, by department or program. The number of credit hours for each course is shown in parentheses; "AOA" means "also offered as".

Hydrology and Hydraulics
Water Resources
576 Physical Hydrology (AOA E&PS 576) (3)
Earth and Planetary Sciences
562 Hydrogeology (3)
572 Subsurface Fate and Transport Processes (3)
576 Physical Hydrology (AOA WR 576) (3)
580 Advanced Hydrogeology (3)
581L Geomorphology and Surficial Geology (4)
Civil Engineering
442 Hydraulic Engineering and Hydrology (3)
541 Groundwater Engineering (3)
542 Intermediate Hydrology (3)
543 Introduction to Groundwater and Contaminant Transport Modeling (3)
544 Water Resources Engineering (3)
545 Open Channel Hydraulics (3)
549 Vadose Zone Hydrology (3)

Ecosystems, Environment, Health, and Water Quality
Biology
495 Limnology (3)
496L Limnology Laboratory (1)
507L Bosque Biology (3)
514 Ecosystem Studies (3)
535 Freshwater Ecosystems (AOA E&PS 535) (3)
558 Geomicrobiology (AOA E&PS 558) (3)
Civil Engineering
335 Introduction to Water & Wastewater Treatment (3)
531 Physical-Chemical Water and Wastewater Treatment (3)
532 Advanced Physical-Chemical Water and Wastewater Treatment (3)
534 Environmental Engineering Chemistry (3)
536 Biological Wastewater Treatment (3)
537L Aqueous Environmental Chemistry and Analysis (3)
Earth and Planetary Sciences
515 Geochemistry of Natural Waters (3)
535 Freshwater Ecosystems (AOA Biology 535) (3)
558 Geomicrobiology (AOA Biology 558) (3)

Environmental Science
530 Advanced Environmental Science (3)
Public Health
502 Epidemiologic Methods I (3)

Climatology category
Earth and Planetary Sciences
522 Hydrometeorology of the Southwestern USA
536 Climate Dynamics (3)
570 Physical Climatology (AOA Geography 570) (3)
Geography
570 Physical Climatology (AOA E&PS 570) (3)

Group II: Suggested Policy/Management Courses

Listed by category and, within a category, by department or program. The number of credit hours for each course is shown in parentheses; "AOA" means "also offered as".

Law
Law
547 Water Law (3)
554 Indian Water Rights (2-3)

Economics
Economics
541 Sustainable Development (3)
542 Environmental and Natural Resource Economics: Survey (3)
543 Natural Resource Economics (3)
544 Environmental Economics (3)

Policy, Administration, and Management
Community and Regional Planning
524 Environmental Planning Methods (3)
527 Watershed Management (3)
564 Foundations of Natural Resources (3)
577 Practice of Policy Development (AOA Public Administration 577) (3)
Geography
514 Natural Resources Management Seminar(3)
561 Environmental Management (3)
562 Water Resources Management (3)
563 Public Land Management (3)
Public Administration
500 Public Management and Policy (3)
521 Institutional Development and Behavior (3)
524 Intergovernmental Administrative Problems (3)
525 Human Resources Management in the Public Sector (3)
544 Public Budgeting (3)

546 Public Financial Administration (3)
577 Practice of Policy Development (AOA CRP 577) (3)
Public Health
501 Principles of Public Health (3)

Sociology, Communication, and Culture
American Studies
523 Environmental Justice (3)
524 Environmental Conflicts in the U.S. West (3)
525 Environmental Theory and Practice (3)
Communication and Journalism
554 Diffusion of Innovations (3)
Community and Regional Planning
569 Rural Community Development (3)
574 Cultural Aspects of Community Development Planning (3)

Group III: Suggested Utilities Courses

Listed by category and, within a category, by department or program. The number of credit hours for each course is shown in parentheses; "AOA" means "also offered as".

GIS
Civil Engineering
547 GIS in Water Resources Engineering (3)
559 Natural Resources and GIS (3)
587L Intermediate Geographic Information Systems (3)
588L Advanced Geographic Information Systems (3)
Earth and Planetary Sciences
555L Computational and GIS Applications in Geomorphology (3)

Modeling
Community and Regional Planning
570 Seminar - Modeling the Environment (3)
Earth and Planetary Sciences
557L Mathematical Modeling in the Geosciences (3)
Economics
540 Environmental and Natural Resource Modeling (3)
Geography
521 Environmental Modeling and Geographic Information Systems (3-6)

Methods
Community and Regional Planning
515 Natural Resources Field Methods (3)
Earth and Planetary Sciences
533 Statistics and Data Analysis in Earth Science (3)
Economics

504 Mathematical Tools and Economic Models (3)
Statistics
538 Biostatistical Methods I (3)
539 Biostatistical Methods II (3)
Political Science
581 Statistics for Social Research (3)

Water Resources Internships (WR 590)

The WRP recognizes the value of "real-world" experience. To that end, students may obtain three (3) semester credits by serving an internship with a government agency, private firm or other, non-UNM organization. The topic of the internship should be consistent with the student's concentration (HS or PM). A key element of the internship is that the student work under the mentorship of a water resources professional. It is not intended to be an "independent studies" or Problems course.

The student must obtain advance approval from his/her Advisor and the Director before the semester in which he/she intends to serve an internship. The student must submit a proposal of at least two (2) pages with the following elements:

- where the internship will be served;
- nature of the tasks to be performed and/or the problem to be solved;
- how the internship will benefit the student and its relevance to the student's concentration;
- course requirement (concentration, group, category) it will fulfill;
- the student's mentor/supervisor;
- outline of final report describing the student's internship experience.

This proposal must be submitted to the WRP office at least one month prior to the start of the semester during which the student will serve the internship. Once approved, the student will then register for 3 credits of Internship (WR 590). Students may not take WR 590 for any reason other than serving an internship according to the above requirements.

At the end of the semester, the student must submit a report describing the internship experience, what was accomplished, and giving recommendations for improvements. This report should be written as a formal technical report with title page, abstract, table of contents, text, and references. Figures, photos, and tables should be included to document the experience. The final report should not exceed 15 pages total.

The Water Resources Interdisciplinary Courses

The core of the WR curriculum consists of three 4-credit classes, WR 571, WR 572 and WR 573. They are described below.

WR 571. Water Resources I - Contemporary Issues (4)
The course structure involves collaborative investigation of water resource issues in a basin or political region, generally outside of New Mexico. Students examine issues in water resource systems, including water quality; ecosystem health; stakeholder concerns; economics; and water supply, policy, management and allocation. Analysis of these issues is given in group oral and written presentations and culminates in a team-produced final report and oral presentation. Emphasis is on defining the water resources issues faced in a basin, teamwork, cooperation, coordination, and communication. This course is normally taken at the start of a student's program [Fall].

WR 572. Water Resources II - Models (4)
(also offered as Economics 545). Practical aspects of the different technical models used by water resource professionals: hydrological, economic, ecological, etc. Students use models to solve problems. Emphasis is on oral, written and graphic communication. Prerequisites: WR 571, Economics 300, and one course in hydrology or hydrogeology (e.g., E&PS 562, WR 576, CE 541, CE 542); or permission of instructor. [Spring].

This course emphasizes the use of models: hydrological, economic, and other related models. It is not an in-depth exposure to modeling but is designed to give the students an appreciation of the limitations and uses of models. Students are given exercises using computer models of water resources systems (hydrology, economics, etc.).

This course should be taken only after students have had (at a minimum) microeconomics and coursework in hydrology or hydrogeology (e.g., E&PS 562, WR 576, CE 542, CE 441); it does not have to be taken immediately after WR 571.

WR 573. Water Resources III - Field Problems (4)
Intensive experience with a field-based problem or suite of problems. Students work through problem identification and definition, collect/analyze data, propose solutions and present conclusions and recommendations in a appropriate forum. Prerequisites: WR 571 and WR 572; or permission of instructor. [Summer].

This is the last of the interdisciplinary courses and is offered each summer. It is a capstone course in that it requires integration of knowledge gained from the previous classes in the WRP. In the course, teams of students work on actual field problems to produce a final written and/or oral report that quantitatively analyzes the issues. Links to previous WR 573 class reports are on the WR web site.

Policy on Substitutions for WR 573
Occasionally students in the WRP believe that they have gained knowledge and experience in field methods of water resources investigations equivalent to that covered in WR 573. They request that this requirement be waived and that they be allowed to substitute alternative courses to meet the credit requirements for the MWR degree. In considering such requests the WRP will compare the student's knowledge and experience to that taught in the WR 573. The objectives of WR 573 are:

- Learn to design a field study to collect information on the hydrology, hydraulics, and quality of a watershed, together with its socio-economic characteristics.
- Learn common field and laboratory methods for evaluating watersheds including methods of measuring flow, water quality, stream morphology, and biological characteristics of stream
- Learn to integrate the hydrologic information with economic, legal, and cultural knowledge that is relevant to management of the watershed.
- Learn the basic principals of quality assurance and quality control (QA/QC).
- Learn to process data collected from field investigations to develop a quantitative and qualitative understanding of the characteristics of the watershed and stream
- Learn to work in a group to prepare a comprehensive written report and corresponding technical presentation that describes the results of the investigation.

Students who can demonstrate experience, knowledge, and competence that achieve at least half of these objectives through employment experience may request a substitution of WR 573. This is accomplished by submitting a petition that contains the following:

- A summary (1 to 2 pages) describing the student's experience and how it achieves the objectives of WR 573
- A proposed course work substitution plan to make up the 4 credits that would otherwise be earned by taking WR 573.
- Copies of work products (i.e. technical reports or other documents) that demonstrate knowledge and experience

The WRP Director will review the material and approve/deny the request. The student may appeal the Director's decision to the WRP Program Committee.

WR 598 Professional Project (1-3)
Required for Master of Water Resources degree. Maximum of 3 credits can be counted toward degree. **Offered on a PR/CR/NC basis only.**

All students must take at least 3 credits of WR 598. More than 3 credits can be taken, and usually are, but only 3 count. It should generally not be taken until a student has a committee and an approved Professional Project proposal. Not all the credits must be taken in the same semester. There are many different sections of WR 598 – sign up for the section corresponding to your committee chair. If one does not exist, contact the Director. A student must be registered for at least 1 credit of WR 598 during the semester in which he/she graduates.

DUAL DEGREE PROGRAM WITH COMMUNITY & REGIONAL PLANNING

A dual degree program leading to the Master of Water Resources and Master in Community and Regional Planning was established in 2009. The course requirements are (total of 59 credits):

<u>Classes in Planning:</u>

CRP 500 - Planning Theory and Process (4)
CRP 510 - Planning Communications Workshop (2)
CRP 521 - Advanced Planning Studio (5)
CRP 580 - Community Growth and Land Use Planning (3)
CRP 511 - Analytical Methods for Planning (4)
CRP 532 - Foundations of Natural Resources Planning (3)
CRP 527 - Watershed Management (3)
CRP 588 Professional Project and Thesis Preparation (2)
CRP 589 Professional Project or Thesis (6)

Classes in Water Resources:
WR 571 - Contemporary Issues in Water Resources (4)
WR 572 - Water Resources Models (4)
WR 573 – Field Methods (4)
Electives from MWR groups 1, 2 and 3 (15)
- Hydroscience electives – 2 classes (6)
- Policy & Management electives – 1 class (3)
- Utilities elective – 1 class (3)
- General elective approved by advisor – 1 class (3)

A Coursework Proposal form must be submitted to the WRP that identifies the courses to be taken for the dual degrees when the student has completed roughly half of his/her classes. Furthermore, the Program of Studies (PoS) form must be submitted to OGS at least one semester prior to graduation.

FACULTY ADVISOR

Each student will be assigned a temporary faculty advisor upon admission – usually the Director or Associate Director. As the student progresses through the program, he/she will select an advisor that will likely also serve as Chair of their Professional Project committee. As the student develops a proposal for their professional project, he/she should work with the advisor to select a Professional Project Committee consistent with his/her interests in the broad field of water resources. The Committee usually consists of three members, two of whom must be UNM tenure/tenure track or research faculty. Qualified professionals from off-campus frequently serve on Professional Project Committees. UNM requirements for graduate committees is given on page 73 of the UNM 2009-2010 Catalog http://registrar.unm.edu/Catalogs/2009-10Catalog.pdf

Each student, in consultation with his/her faculty advisor, must complete a Coursework Proposal form (downloadable from the WRP web site) by the time the student has taken 15 to 18 graduate credits. This will be submitted to the WRP Office and serve as a guide for future course selection. The courses listed on this form may change, but it will help the student focus his or her interests.

The role of the faculty advisor is to mentor the student with regard to academic questions relating to the MWR degree (such as identifying appropriate classes or chairing the student's project

committee), and to support the student in his/her professional development. At least once each semester, the student should meet with the advisor to review his or her progress, proposed coursework, and to consider future academic and career decisions. A student may change his/her advisor, but must keep the WRP Office informed as to his/her current faculty advisor. Once a student selects a chair for his/her Professional Project committee, that person becomes the student's advisor.

NON-DEGREE AND TRANSFER STUDENTS

Prospective MWR students may choose to enroll in MWR classes as non-degree students. Non-degree students are limited to a maximum of 9 credit hours per semester. Non-degree application information and forms is available at www.unm.edu/~grad/admissions/admissions.html.

A maximum of 12 graduate credit hours taken under non-degree status may be transferred into the program. Graduate courses taken at another accredited institution may count as much as 50% (18 credits) of the MWR course work. These courses must be approved by the WRP. Each course, whether non-degree or transfer, must have been taken for a letter grade with a grade no lower than B and must not have counted towards another degree. The seven-year rule, which requires students to complete their Master's degree within seven years, becomes effective with the first class a student takes that is going to be applied to the program's degree requirement, independent of the fact that the class was taken as a non-degree or MWR student. Non-degree and transfer courses are listed on the OGS Program of Studies form.

IMPORTANT DEADLINES AND FORMS

Application Deadlines

Admission deadlines for US citizens and permanent residents are November 15 for the Spring semester and July 15 for the Fall semester. For international students the deadlines are August 1 for the Spring semester and March 1 for the Fall semester. Students (except those seeking readmission to the MWR degree program) are not admitted for the summer session. Students seeking financial aid should apply as early as possible. Students are encouraged to apply early as the WRP may limit the number of students admitted each semester.

Administrative Requirements for MWR Students

All students must familiarize themselves with UNM administrative requirements for this academic program and bear ultimate responsibility for complying with these criteria. A flow chart depicting the sequence of events in progressing through the MWR program is given in Appendix II. Students should consult the Program Guidelines frequently to ensure they are familiar with all degree requirements.

Note: The UNM Office of Graduate Studies strictly enforces all deadlines. Failure to comply may delay the student's graduation. It is the student's responsibility to be aware of these dates and to meet these deadlines. A list of deadlines is available at www.unm.edu/~grad/.

Coursework Proposal (WRP form)
Submit a ***Coursework Proposal*** to the WRP Office by the time the student has completed 15 to 18 graduate credits. This is a WRP internal form and is downloadable from the WRP web site. OGS *Program of Study* forms will not be signed until the *Coursework Proposal* form is on file.

Professional Project Proposal

Students must submit a proposal describing their Professional Project. The proposal should have a signature page similar to the Professional Project signature page, and must be signed by each committee member. The OGS form specifically pertaining to graduation (the *Announcement of Examination* form) ***will not be signed*** nor will a student be placed on the OGS Graduation List until an approved *Professional Project Proposal* has been submitted.

Program of Studies (POS; OGS form)
The UNM Office of Graduate Studies requires that students submit a ***Program of Stud***ies (www.unm.edu/~grad/forms/forms.html) at least one semester prior to that in which they expect to graduate. The deadlines are: October 1 for Spring graduation; March 1 for Summer graduation; and July 1 for Fall graduation. This form lists the courses that apply towards the degree, including non-degree and transfer courses. Submit the form to the WRP Office at least four working days prior to the OGS due date. The POS requires the signatures of the student, his/her advisor, and the WRP Director.

The following information is required on the POS.
- The graduate unit is the "Water Resources Program"
- The major code is 429
- The degree name is "Master of Water Resources" and its abbreviation is "MWR"
- The MWR degree is a Plan II (non-thesis) degree
- The concentrations are either Hydroscience or Policy/Management.

Once a student has submitted the POS, s/he must not deviate from the courses listed without his/her advisor's permission and without informing the WRP and OGS. This is done in the form of a petition to the Director of the WRP and through him, to the Dean of OGS. Unreported deviations could delay a student's graduation when OGS performs its final graduation check.

Notice of Intent to Graduate – OGS Graduation List
Students must notify the WRP Office of their intent to graduate according to the following deadlines: December 1 (Spring graduation); May 1 (Summer graduation); and July 15 (Fall graduation).

Announcement of Examination (AOE; OGS form)

An *Announcement of Examination* form must be submitted to OGS at least two weeks before the date of the Professional Project defense. Submit to the WRP office at least four working days prior to the OGS due date.

Graduation/Defense Dates
All graduation requirements including defense of the Professional Project, except for completion of courses in progress must be completed by: November 15 for fall graduation; April 15 for spring graduation; and July 15 for summer graduation.

A student can schedule his/her Professional Project defense after these dates, but the graduation date will then become the end of the following semester. For example, a student who successfully defends her professional project on April 28 would not formally receive her degree until August (the end of the summer session).

A student must be registered for at least one credit of WR 598 during the semester in which graduation occurs.

OTHER RELEVANT INFORMATION

Students are often in a quandary about where to submit forms, whom to ask about certain matters, etc. This section will help clear up those issues.

Flow Chart
A flow chart depicting the sequence of events in moving through the MWR degree program is in the Appendix IV of the Program Guidelines. Students should consult it frequently to ensure they are on track for completing all degree requirements.

"Nuts and Bolts"
Questions involving deadlines, status of applications (admissions, financial aid, etc.), the scheduling of professional project defenses, all forms, and similar issues should be directed to the Water Resources Program's Administrative Assistant II, Annamarie Cordova (Economics Building room 1048; Fax: 277-5226; Voice: 277-7759; Email: acordova@unm.edu).

Coursework, Advisement, Program of Study

Questions involving coursework, program of study, etc., (i.e., advisement issues) should be addressed to the Director or the student's advisor/committee chair (the Director serves as a student's temporary advisor until the student selects a permanent advisor). A student's advisor serves as the chair of his/her Professional Project committee.

For questions about a specific course (prerequisites, topics covered, etc.) it is best to contact the course instructor. Courses evolve over time, so the best source of information is the instructor. All main campus UNM course descriptions, including prerequisites, are in the UNM Catalog, (http://registrar.unm.edu/Catalogs/2010-2011Catalog.pdf)). School of Law courses and schedules

are at lawschool.unm.edu/courses/. Note that School of Law classes may have different start/end dates than classes on the Main Campus

Professional Project

Guidance on selecting a topic and completing a Professional Topic are provided in Appendix II of the Program Guidelines. Questions involving the Professional Project, the Professional Project report, and Professional Project defense should be directed to the chair of the student's Professional Project committee. The time/date of the Professional Project defense is set by the student and his/her committee. Once the time and date are set, the WRP Office will provide assistance in scheduling a room and completing the Announcement of Examination form.

Students are encouraged to examine previous Professional Project reports. All projects since 1999 are available electronically in the UNM Libraries' digital collection (https://repository.unm.edu/dspace/).

Forms-R-Us

There are a number of UNM forms that must be submitted on time. All forms are submitted to OGS through the WRP Office. If an advisor or committee chair's signature is required on the form and it is someone other than the Director, please obtain the signature(s) before submitting it to the WRP Office. Please note that the WRP Office needs to receive OGS forms *at least four working days* (sooner if possible) before they are due to OGS the forms are checked for accuracy before securing the Director's signature. Late forms may cause a delay in the student's graduation.

Staying Enrolled after Completing Coursework, Readmission

After completing all of their coursework students are strongly encouraged to continue to enroll for at least 1 credit of classes to retain their UNM privileges (e-mail, library access, etc.) and prevent disenrollment. The most expedient strategy is to register for at least one credit of Professional Project (WR 598) each semester. However, only 3 credits of WR 598 will count towards the degree.

Students must also be registered for at least one credit of WR 598 during the semester in which they complete their degree requirements

Students who have not been enrolled for three or more consecutive semesters may be disenrolled from UNM by OGS. To apply for readmission (Fall, Spring or Summer semesters) visit http://www.unm.edu/~grad/admissions/admitcrit.html#Anchor-Readmissio-44968**.** An application fee is required. Applications for readmission are reviewed by the WRP, and evaluated based on the student's academic record and progress toward their degree.

Deferral of Admission

Admission can be deferred for up to one calendar year. Students must submit a written request to OGS and the WRP requesting deferral.

Computer Lab and Other Resources

The WRP has a Computer Lab that all students are welcome to use. It is located in room 1036 of the Economics Building. Students may obtain keys for access to the building after hours. The Computer Lab also is equipped with a monitored alarm system. You will receive instructions on how to arm/disarm the system. The computer lab contains several computers, scanners and printers, one of which is a Dell color laser printer. A Canon multifunction machine (B&W printer; B&W copier; fax; color scanner) is also available.

Please note that WRP computers are for the use of WRP students, faculty and staff. Friends and relatives are not permitted to use them. Lock the doors and arm the alarm system when you leave.

The WRP has a student workroom (room 1040) with a microwave oven, coffeemaker, refrigerator, couch and desks. The WRP has also equipment that may be checked out for student work. Items include: a Kodak digital camera, altimeter, GPS units, a rangefinder, a clinometer, tape measures, etc.

Building Access - Keys

All WRP students may obtain keys to the Economics Building (outside entrance key), the WRP computer lab and the workroom. The WRP Administrator (Annamarie Cordova) will issue key authorization cards. Keys must be turned in to the Lock Shop when you graduate.

E-mail

All students must have an e-mail account and should check it frequently. It is the principal form of communication between faculty and students in the program. All UNM students are entitled to free e-mail through UNM (www.unm.edu/computing/). Private e-mail accounts are also acceptable. Students should make sure that the WRP Administrator has their current e-mail address as well as other contact information (mailing address and phone number)**.**

7-Year Rule

UNM requires that students complete their Master's degree within seven years. If the student exceeds this time limit, classes older than seven years will not count towards their degree and they will therefore have to take additional courses to have the required credits for the program.

Incomplete Grades ("I")

Incomplete ("I") grades received in classes taken after the spring semester 2005 must be resolved within one year from the end date of the semester in which the grade was assigned. An "I" grade that is not resolved within this time frame automatically reverts to an "F" which cannot be removed from the student's transcript. Students have sole responsibility for removing their "I" grades on time.

WRP Web Site

The Program's web site **(**www.unm.edu/~wrp/**)** is a great resource—links, recent developments, news, speakers, etc. Suggestions for improving it are welcome.

FINANCIAL AID AND HOUSING

The MWR degree program is one of the Western Regional Graduate (also known as the WICHE program) programs which allows graduates from the participating 14 western states to enroll at New Mexico resident tuition rates. Participating states are: AK, AZ, CO, HI, ID, MT, NV, NM, ND, SD, OR, UT, WA and WY. Residents of these states can enroll in the MWR degree program at New Mexico resident tuition rates. A separate application to the WRP is not necessary, but the Director should be notified of your status.

Students taking fewer than 7 credits per semester are charged New Mexico resident tuition rates, regardless of their residency status. Many students who cannot qualify for resident tuition use this approach and apply for New Mexico resident status after establishing residency. Consult the criteria for determining residency in the UNM Catalog (www.unm.edu/~unmreg/ and click on "Catalog").

The WRP does not offer Teaching Assistantships (TAs). However, on occasion, Research Assistantships (RAs) are available to appropriately-qualified MWR students. In addition, the WRP sometimes has fellowships, work-study positions, or internships available. Students are encouraged to keep a brief (2-3 pages) up-to-date *curriculum vitae* in their files in the WRP office so the Director may effectively match them with internship/employment opportunities.

Individual faculty sometime have student employment or RAs available for students who wish to work in their labs, on research projects, etc. Internships are often available with government agencies such as the City of Albuquerque, U.S. Geological Survey (USGS), Bernalillo County, New Mexico Environment Department, Office of the State Engineer, etc. The WRP Office makes every effort to inform students of these opportunities. Notifications are almost always sent via e-mail, so it is imperative that students read their electronic mail on a regular basis.

Work-study funds are available for qualified students; regular student employment is also available. Information on both programs is at www.unm.edu/~wsestudy/ or the Work-Study and Student Employment (277-3511) Office in Mesa Vista Hall 1040 (wsestudy@unm.edu).

The work-study program provides Federal funds to work on campus; the campus hiring unit provides funding as well, usually 30% or so, with the rest provided by the Federal government. Students must qualify for work-study funds.

There are also University-wide fellowships and other aid programs. The Office of Graduate Studies offers a number of financial aid options, including various fellowships: Challenge Assistantships; Graduate Fellowships; Graduate Scholars Program; and Graduate Tuition Fellowships. Application procedures and deadlines for the aforementioned programs vary; a pamphlet describing these programs is available from the OGS. The WRP Office will keep students informed of these opportunities, but students can check with the Office of Graduate Studies Financial Aid Coordinator, Ms. Edwina Chavez-Salazar (505-277-2711; edwinac@unm.edu). Financial aid information can be found at the end of this document and at www.unm.edu/~finaid.

Funding for travel and research related to Professional Projects is available from the Graduate and Professional Student Association (GPSA) through the Student Research Allocations Committee (SRAC) grants, which are competitive. Visit www.unm.edu/~gpsa for more information. The OGS offers Research, Project and Travel (RPT) grants (visit the OGS WWW site for complete information); deadlines for proposals are generally in late September and January.

Most students live in off-campus housing. A good place to check is the Off-Campus Housing Office at och.unm.edu (och@unm.edu)**.** Information on UNM residence hall housing is at www.unm.edu/~reshalls.

Below is a list of scholarship and possible funding sites. The first three are very good sites sponsored by graduate departments at UC-Berkeley, NYU and Duke. They are specifically science-related, organized, and include many links. The next seven are specific organizations' web sites that offer scholarships/funding (note that many other professional societies offer scholarships/fellowships: American Water Resources Association, American Geophysical Union, American Society of Civil Engineers, American Society of Agricultural Engineers, Soil Science Society of America, American Society of Limnology and Oceanography, etc.). The last two WWW sites are clearinghouse/scholarship search sites.

www.cnr.berkeley.edu/community_forestry/
www.nyu.edu/pages/gsas/GIGS/gsas/science/
www.ors.duke.edu/find/student/grad/index.html
www.wef.org/membershipServices/MembershipInformation/Awards/
www.aauw.org/fga/fellowships_grants/index.cfm
www.gwis.org/grants/default.htm
www.geosociety.org/grants/gradgrants.htm
www.werf.org/funding/funding_werf.cfm
www.nawc.org/scholarship.html
www.awwa.org/About/scholars/
www.scholarsite.com/
www.back2college.com/library/scholarships.htm

ASSOCIATION OF WATER PROFESSIONALS

The Association of Water Professionals (AWP) is the official WRP student organization. The AWP arranges talks and social events, engages in outreach, and helps students find employment opportunities. AWP is a chartered graduate student organization at UNM and as such receives a modest amount of support from the Graduate and Professional Student Association (GPSA). AWP officers include a President, Vice-President, Secretary, and Treasurer. The AWP's office is in room 1041. The AWP WWW site is www.unm.edu/~wrp/awp.htm and its email is awp@unm.edu. The AWP owns a canoe which can be checked out for student use.

APPENDIX I - FACULTY

There are approximately 60 UNM faculty members who are affiliated with the Water Resources Program. They constitute a diverse group of individuals from six different schools or colleges with expertise in just about every aspect of water resources. The schools or colleges represented by the faculty are Arts and Sciences, Architecture and Planning, Engineering, Law, Medicine and the UNM Libraries. Affiliation with the program is on a voluntary basis and there are no specific selection criteria nor are there any specific responsibilities required (faculty who are members of the Program Committee are indicated by an asterisk (*)).

Biology

Rebecca Bixby, Research Assistant Professor
505-277-3411, bbixby@unm.edu
Ph.D., Michigan. Aquatic ecology

Clifford N. Dahm, Professor
505-277-2850, cdahm@sevilleta.unm.edu, http://biology.unm.edu/fac_list.htm
Ph.D., Aquatic Ecology, Oregon State University. Aquatic ecology, stream/groundwater interactions, microbial ecology, nutrient cycling, microbial and chemical processes in volcanic environments.

Marcy Litvak, Assistant Professor
505-277-5580, mlitvak@unm.edu
Ph.D., University of Colorado. Plant physiological ecology.

Manuel C. Molles, Jr., Professor Emeritus
molles@sevilleta.unm.edu, http://biology.unm.edu/fac_list.htm
Ph.D., Zoology, University of Arizona. Riparian ecology, ecology of desert streams, ecology of exotic species.

Kelly Miller, Assistant Professor
505-277-2496, kbmiller@unm.edu

Bruce Milne*, Professor
505-277-5356, bmilne@sevilleta.unm.edu
Ph.D., Rutgers University. Botany & Plant Physiology.

Thomas Turner, Director, Museum of Southwestern Biology
505-277-7541, turnert@unm.edu, http://www.msb.unm.edu/fishes/index.html
Ph.D., Florida International University

Chemistry

Stephen E. Cabaniss, Professor

505-277-4445; cabaniss@unm.edu, http://www.unm.edu/~cabrsrch/index.htm
Ph.D., University of North Carolina. Environmental chemistry, molecular spectroscopy, HPLC, stochastic and deterministic programming.

Civil Engineering
Julia E. Allred Coonrod*, P.E., Associate Professor
505-277-3233, jcoonrod@unm.edu, http://www.unm.edu/~civil/faculty.htm
Ph.D., Environmental and Water Resources, University of Texas at Austin. Water resources, GIS applications.

John C. Stormont, P.E., Professor
505-277-6063, jcstorm@unm.edu, http://www.unm.edu/~civil/faculty.htm
Ph.D., Geological Engineering with minor in Civil Engineering, University of Arizona. Vadose zone hydrology, geotechnical engineering.

Kerry J. Howe, P.E., Assistant Professor

505-277-2702, howe@unm.edu, www.unm.edu/~civil/howe.htm
Ph.D., Civil Engineering, University of Illinois at Urbana-Champaign. Environmental engineering, water treatment processes and design, membrane technologies

Andrew Schuler, P.E., Assistant Professor
505-277-4556, aschuler@unm.edu
Ph.D. Civil Engineering, University of California, Berkeley. Environmental engineering, wastewater microbiology & wastewater treatment

Mark Stone*, P.D., Assistant Professor
505-277-0115, stone@unm.edu
Ph.D. Civil Engineering, Washington State University. Water resources, arid hydrology, hydraulics

Bruce M. Thomson*, P.E., Regents' Professor
505-277-4729, bthomson@unm.edu, http://www.unm.edu/~civil/faculty.htm
Ph.D., Environmental Science and Engineering, Rice University. Environmental engineering, water management, chemistry & treatment

Communication and Journalism
Tema Milstein, Assistant Professor
tema@unm.edu, www.unm.edu/~tema
Ph.D., Communication, University of Washington. Environmental communication, Cultural approaches to human relations with nature.

Community and Regional Planning
Claudia B. Isaac, Associate Professor
505-277-5939, cisaac@unm.edu, http://www.unm.edu/~saap/People/Isaac.html

Ph.D., University of California-Los Angeles. Community and regional economic development, social theory, gender and development, Latin American studies.

Theodore Jojola, Professor
505-277-6428, tjojola@unm.edu, http://www.unm.edu/~saap/People/Jojola.html
Ph.D., University of Hawaii. Community development, environmental design, indigenous rights, tribal economic development, microcomputer applications in education and planning.

James R. Richardson, Professor
505-277-6460, jrich@unm.edu, http://www.unm.edu/~saap/People/Richardson.html

M.Arch./A.S., M.C.P., Massachusetts Institute of Technology. Land-use planning, community development, citizen participation, negotiation and environmental dispute resolution, urban design.

José A. Rivera*, Professor
505-277-2257, jrivera@unm.edu, http://www.unm.edu/~spagrad
Ph.D., Brandeis University. Social policy and planning, strategic management, and rural community development in a regional setting

David S. Henkel, Jr., Professor Emeritus
505-277-1276, cymro@unm.edu, http://www.unm.edu/~saap/People/Henkel.html
Ph.D., Cornell University. Cultural aspects of community development, natural resources and regional planning.

William M. Fleming, Associate Professor
505-277-6455, fleming@la.unm.edu, http://www.unm.edu/~saap/People/Fleming.html
Ph.D., University of British Columbia. Watershed management, impacts of land use on water quality.

Earth and Planetary Sciences
Abdulmehdi Ali, Senior Research Scientist I
505-277-1637, mehdiali@unm.edu
Ph.D. Chemistry, University of Arizona. Water chemistry, analytical methods.

Yemane Asmerom, Professor
505-277-4434, asmerom@unm.edu, http://epswww.unm.edu/faculty.htm
Ph.D., Geochemistry, University of Arizona. Applications of radiogenic isotopes (U-Series, Nd-Sr-Pb-Hf) to the study of the solid earth, oceans and climate through time.

Laura J. Crossey, Professor

505-277-5349, lcrossey@unm.edu, http://epswww.unm.edu/faculty.htm
Ph.D., Geochemistry, University of Wyoming. Clastic diagenesis and organic geochemistry, with emphasis on interaction of organic and inorganic constituents of sedimentary rocks during progressive burial, and diagenetic model development.

Peter J. Fawcett, Associate Professor
505-277-3867, fawcett@unm.edu, epswww.unm.edu/faculty.htm
Ph.D., Paleoclimatology and Sedimentology, Pennsylvania State University. Long-term evolution of the climate system and patterns of past global change, quaternary paleoclimatology, and climatic influences on sedimentation.

Joseph Galewsky, Assistant Professor
505-277-2361, galewsky@unm.edu, epswww.unm.edu/facstaff/galewsky/home.htm
Ph.D., University of California - Santa Cruz. Interactions between meteorological and land surface processes, climate dynamics, orographic precipitation.

David S. Gutzler, Professor
505-277-3328, gutzler@unm.edu, epswww.unm.edu/faculty.htm
Ph.D., Climatology and Meteorology, Massachusetts Institute of Technology. Data analysis and modeling of interactions between the atmosphere, ocean, and land surfaces and climatic variability of Southwestern North America.

Grant A. Meyer, Associate Professor
505-277-5384, gmeyer@unm.edu, epswww.unm.edu/faculty.htm
Ph.D., Earth and Planetary Sciences, University of New Mexico. Hillslopes and fluvial systems; climatic, tectonic and environmental geomorphology; Quaternary geology and ecosystem processes.

Leslie D. McFadden, Professor
505-277-6121, lmcfadnm@unm.edu, epswww.unm.edu/faculty.htm
Ph.D., Quaternary Geology, University of Arizona. Soil development in arid and semiarid regions; applications of soil studies to geomorphology, paleoclimate, environmental research, and geohazard evaluation.

Louis A. Scuderi, Associate Professor
505-277-2644, tree@unm.edu, epswww.unm.edu/faculty.htm
Ph.D., Geography, University of California-Los Angeles. Paleoclimatic reconstructions utilizing dendrochronology, climatology, geographic Information Systems (GIS), image processing, global positioning systems (GPS), creation and analysis of historical and paleoclimatic databases.

Gary A. Smith, Professor
505-277-2348, gsmith@unm.edu, epswww.unm.edu/faculty.htm

Ph.D., Sedimentology and Physical Volcanology, Oregon State University. Sedimentology related to rift tectonics, aquifer heterogeneity, and volcanism, physical volcanology of pyroclastic deposits and composite volcanoes.

Zachary D. Sharp, Professor
505-277-2000, zsharp@unm.edu, http://epswww.unm.edu/facstaff/zsharp/home.htm
Ph.D., University of Michigan. Stable isotope geochemistry, with application to paleoclimate reconstruction, metamorphic and igneous petrology and structural geology.

Gary Weissmann, Associate Professor
505- 277-3636 weissman@unm.edu, epswww.unm.edu/facstaff/weissman/home.htm
Ph.D., University of California, Davis. Hydrogeology, sedimentology, and basin analysis. Research focuses on a basin analysis approach to characterizing and modeling groundwater flow and contaminant transport.

John W. Shomaker*, Adjunct Professor
505-345-3407, jshomaker@shomaker.com
Ph.D., University of Birmingham (England). Hydrogeology, water resources planning and management.

Economics
David S. Brookshire*, Professor
505-277-1964, brookshi@unm.edu, http://www.unm.edu/~brookshi/
Ph.D., Economics, University of New Mexico. Environmental and resource economics, policy issues associated with endangered species, natural hazards and water resources.

Robert Berrens, Associate Professor
505-277-9004, rberrens@unm.edu, http://www.unm.edu/~econ/faculty/berrens.html
Ph.D., Economics, Oregon State University. Environmental economics, nonmarket valuation, sustainability and ecological economics, environmental equity, institutional economics, riverine and public lands management, survey research.

Janie Chermak, Associate Professor
505-277-4906, jchermak@unm.edu, http://www.unm.edu/~econ/faculty/chermak.html Ph.D., Economics, Colorado School of Mines. Environmental economics and natural resources, applied microeconomics, empirical testing of the theory of exhaustible resources, exhaustible resource production.

Catherine (Kate) Krause, Associate Professor
505-277-3429, kkrause@unm.edu, http://www.unm.edu/~econ/faculty/krause/krause_home.html
Ph.D., Economics, University of Wisconsin. Public finance, law and economics, experimental and behavioral economics, economic learning and behavior in children, economic issues for children and families, law and economics, sustainable resource use.

Jennifer Thacher, Associate Professor
505-277-1965, jthacher@unm.edu
Ph.D., University of Colorado, Boulder

Family & Community Medicine (Public Health)
Kristine Tollestrup, Associate Professor
505-272-9555, ktollestrup@salud.unm.edu
Ph.D., University of California, Berkeley. Public health, epidemiology

Floyd Frost, Assistant Professor
505-272-2165, ffrost@salud.unm.edu

Geography
O. Paul Matthews, Professor Emeritus
505-277-2607, opmatt@unm.edu, http://www.unm.edu/~geog/MATTHEWS.htm
Ph.D., Geography, University of Washington. Water resources management, water law, Federal-state relations.

Melinda Benson*, Assistant Professor
505-277-1629, mhbenson@unm.edu
J.D., University of Idaho College of Law. Environmental management.

Paul Zandbergen, Associate Professor
505-277-3105, zandberg@unm.edu
Ph.D., University of British Columbia, Geographic information systems

Law
Marilyn C. O'Leary, Adjunct Professor Emeritus
505-277-3253, oleary@law.unm.edu
J.D., University of New Mexico. Water, utility and environmental law, transboundary resource issues.

Denise Fort, Professor
505-277-1094, fortde@law.unm.edu
J.D., Catholic University of America. Environmental law

G. Emlen Hall, Professor Emeritus
505-277-2866, hall@law.unm.edu, http://lawschool.unm.edu
J.D., Harvard Law School. Property and federal public lands, history of natural resource development in New Mexico.

Reed Benson, Professor
505-277-1119, benson@law.unm.edu
J.D. University of Michigan. Water Law.

Susan Kelly*, Research Professor
Director, Utton Transboundary Resources Center, UNM School of Law
505-277-0514, skelly@law.unm.edu
J.D. University of New Mexico, Water law.

Political Science
Gregory W. Gleason, Professor
505-277-7391, gleasong@unm.edu, http://www.unm.edu/~polsci/faculty_listing/index.htm
Ph.D., University of California, Davis. Public policy, federal relations, and international relations.

Public Administration
F. Lee Brown, Professor Emeritus Economics, Professor Emeritus Public Administration
505-277-2845, flbrown@unm.edu
505 277-2845

Santa Falcone, Professor
505-277-4934, falcone@unm.edu, http://www.unm.edu/~spagrad
Ph.D., Syracuse University. Administrative behavior, science policy and administrative and environmental issues.

T. Zane Reeves, Visiting Professor
505-277-3312, tzane@unm.edu, http://www.unm.edu/~spagrad
Ph.D., University of Southern California. Human resources management, alternative dispute resolution, discipline and grievance handling, collective bargaining.

Mario A. Rivera, Professor
505-277-3312, marivera@unm.edu, http://www.unm.edu/~spagrad
Ph.D., University of Notre Dame. Program policy evaluation, and comparative public management systems.

Water Resources
Bruce M. Thomson (Director)
505-277-4729, bthomson@unm.edu, http://www.unm.edu/~civil/faculty.htm
Ph.D., Rice University. Water chemistry & treatment, waste management

Stephen Cabaniss (Associate Director)
505-277-4445; cabaniss@unm.edu, http://www.unm.edu/~cabrsrch/index.htm
Ph.D., University of North Carolina. Environmental chemistry, molecular spectroscopy, HPLC, stochastic and deterministic programming.

APPENDIX II - THE PROFESSIONAL PROJECT

Introduction

The Professional Project is the culmination of the student's graduate experience and demonstrates the student's ability to perform professional quality independent work on a topic related to water resources management. The topic of the project is selected by the student in an area of his/her choosing, and with guidance of a faculty advisor and graduate committee. The project can be related to a student's employment, however, additional independent work is required for the project to serve as a UNM Professional Project. The end product of the Professional Project is a formal, professional report that is defended before a faculty graduate committee in a public forum.

Identifying a research topic, performing the appropriate research and writing a Professional Project is one of the most under estimated requirements associated with a graduate degree. This requirement demonstrates the student's ability to independently formulate a research question, develop an appropriate scope of work, generate information to address the question, communicate the ideas and conclusions in a written document and defend the work before a committee of experts.

There are nearly as many ways of conducting graduate research as there are university faculty. Nevertheless, experience has allowed identification of some common attributes that can provide guidance to students in developing their own research proposals, then performing the work needed to complete the project.

Identifying a Topic

Identifying a topic for one's Professional Project research is, in my experience, the single most difficult task in all of graduate school. The difficulty lies in selecting a topic that satisfies many different criteria. For example the project must be interesting and meaningful to the student and his/her advisor, and there must be adequate resources available to perform the work. The resources that are needed include intellectual resources (i.e. expertise from one's advisors), financial resources, laboratory/library/computing resources, and time; the project must be something that can be accomplished within the time constraints available to the student. Under the best circumstances the graduate student is working as a Research Assistant (RA) for a professor on a funded research project, the professor becomes the student's advisor and the project, or some component of it, forms the basis of the student's Professional Project. These few lucky students often enjoy the additional advantage that the professor has already written a research proposal. In this case the structure and ideas from the proposal can be incorporated into the student's own research program.

Before selecting a topic the student should understand the attributes of a good research proposal. These include:

- The proposed project has a clear and concise title.

- The proposed project has a clearly stated hypothesis or clearly articulated research question.
- The proposed project has a clear statement of objectives. The statement of objectives is important because once they have been achieved, the research for the project is finished.
- Resources should be available to assist in conducting the project. These include time, library resources, laboratory or field access, and most importantly, one or more faculty members knowledgeable in the topic and willing to work with you.

There are two approaches one can take to identify a research project referred to here as the Traditional Approach and the Inverse Approach. Clearly there is some overlap between the two, but it is useful to describe them as it can lead a student to new ideas for developing their proposal.

Traditional Approach to Identifying a Project

The traditional method for identifying a research project is for the student to develop a research hypothesis or question in their field of interest after extensive reading, analysis, careful thinking and discussion with their advisor. A clear statement of this hypothesis or question then leads to a research program that is designed specifically to answer that question. The student performs the scope of work, collects the data, analyses it to answer the hypothesis or question then writes it up to complete the Professional Project. Thus, the traditional approach to identifying a research project follows the following steps:

- Develop a research hypothesis/question
- Develop a plan of study to address the hypothesis/question
- Follow the research plan to generate data or information
- Analyze the data or information to test the hypothesis or answer the question
- Write and defend the Professional Project

It is called the traditional approach because historically most graduate students were full time students and had the luxury of using some variation of this method. The really lucky students are those supported by research projects where the professor has already formulated a research hypothesis or question in the grant proposal and the student simply joins the project and is given guidance on what needs to be done.

Inverse Approach to Identifying a Project

Most part time or unsupported grad students cannot use the traditional approach for selecting a research project because they don't have the time or financial resources needed to address an academic topic. Nevertheless, many of these students work professionally and often have access to large amounts of interesting information that, with proper analysis, can tell an interesting story. In the inverse approach the research project follows these steps:

- Consider and conduct a preliminary analysis of information or data to determine if it is of suitable quality and sufficient quantity to answer a well formulated research question.
- Using the data, develop a research hypothesis/question that can be answered by the data.
- Develop a plan of study to address the hypothesis/question.

- Analyze the data. Generate more data/information if needed.
- Write and defend the Professional Project..

The inverse strategy is frequently used by part time students who have employment in a field closely related to their area of study. Most employers are very willing to support this kind of research because it provides information or analysis that can benefit their firm or agency, as well as providing additional training and credentials to their employee.

Regardless of the strategy one uses in identifying a research project, the student should expect to work closely with their advisor; the enthusiastic and willing participation of the advisor is essential to the success of the project. It is equally important that the student recognize that identifying a research project is very challenging. It will almost certainly require multiple iterations in which an idea is proposed, some preliminary information is gathered on the topic and a scope of work is developed, then the ideas are discussed with the advisor. It is not uncommon for students to take 6 months or longer to develop a proposal for a Masters project or thesis.

Bad Research Statements

One of the most common problems encountered with student research proposals begins when the student states "I want to look at ….." While this might be appropriate for a career goal it offers no guidance towards developing a scope of work that will lead to completion of a Professional Project. "Looking at" a topic might be as simple as reading a couple of papers, or as complex as devoting the next five years of one's life to become a world class expert. A much better proposal might starts with "I believe that the following will occur if…," This constitutes a hypothesis that can be tested, at least in principle. Properly phrased it will lead to articulation of a set of objectives. The student will then devise a way of generating data or information to achieve those objectives, thereby testing the hypothesis. A clear ending point is achieved when the hypothesis has been successfully tested. Then the student graduates, has a big celebration party, and everybody lives happily ever after.

Bad Research Proposal Statements	Better Research Proposal Statements
I want to look at methods of removing arsenic from water	I believe that better removal of arsenic from water can be achieved through adsorption onto amorphous ferric hydroxide
How does bosque restoration affect ground water?	Will bosque restoration cause reduced measurable evapotranspiration losses from shallow ground water?
Evaluate the effectiveness of various water conservation measures.	The following water conservation measures can successfully be implemented to achieve at least XX% reduction in water use.

The Research Proposal

As the student develops a research topic in conjunction with her advisor, she/he needs to begin thinking about preparing a research proposal. Graduate research proposals are formal documents and should be written as though they were to be submitted to a funding agency. There are two objectives to be accomplished in the research proposal:

- Clearly identify the problem or issue to be addressed and convince the graduate committee that it is a topic worthy of investigation. Provide a clear statement of objectives that will be accomplished in the research.
- Develop a research plan that will accomplish these objectives and present it in sufficient detail that the graduate committee has confidence in the project's success.

The research proposal is written as a formal document; all statements of fact are referenced, tables and figures have captions, and the language is careful, concise, and to the point. The body of the research proposal should not exceed 15 pages. The organization of a research proposal is usually very simple. It should have the following components:

Title Page
Abstract (1 page)
Introduction
- General description of the problem under consideration
- Clear statement of the research question or hypothesis to be addressed
- Clear statement of the research objectives
- General summary of the methods that will be used to achieve the objectives

Background or Literature Review
- Provide a thorough review of relevant information that has been done on the topic. This should include a summary and analysis of published literature and reports. If the topic involves a field study, maps, diagrams and photos should be included. This chapter will draw heavily on previous work by others and other sources of data and should be extensively referenced.
- It is suggested that references be cited as Last Name (date). For example (Smith, 1995; Jones and Allen, 2002; Sanchez et al., 2005). Remember, you're citing the paper not the individuals. List the references in alphabetical order at the end of the paper.
- This section will almost certainly form the basis of the second chapter of the Professional Project, and therefore should have the same organization as expected in the final document.

Research Methods
- Describe how the research will be conducted. Identify methods of collecting data. Provide diagrams of experimental equipment to be built. Identify analytical methods to be use (give references). Provide maps showing locations of field sampling stations. Develop the theory of modeling studies. Identify sources of information.
- Provide a research schedule with specific tasks and specific milestones that can be used to track the progress of the project.

Expected Results and Methods of Analyses

- Describe the data or information expected to be generated by the research. Identify its form (statistical data from questionnaires, tables of data from instruments, papers from library & internet searches, computer model results, etc.).
- Describe how the data will be processed, summarized, or analyzed. Identify statistical methods to process the data. Describe how literature, interviews, or other non-quantitative information will be assimilated and interpreted.

References

- References should be presented using the same formatting style as will be used in the final Professional Project.

Students should expect to put a lot of work into their research proposal. Keep in mind that the proposal constitutes the first draft of the Professional Project. In this respect, the research proposal establishes the organization for the final document. Indeed, if done well, nearly every bit of material contained in the proposal will be used in the final Professional Project. Thus, extra effort devoted to producing a high quality research proposal will be recovered in the form of a more efficient and productive research process, and ultimately, a better final document.

The Graduate Committee

Throughout this document emphasis has been placed on the need for close collaboration between the student and their advisor. It is important to remember that the student's graduate committee is also an integral part of the process and should be utilized as a resource to assist in all phases of the research project. Most university faculty members choose this career because of a desire to help students learn. Assisting with a productive and successful research project is one of the more rewarding parts of the job because not only do you have the opportunity to play a role in the professional development of a bright young person, but there is the additional satisfaction associated with the intellectual rewards of contributing new knowledge to one's profession. Conversely, one of the most difficult situations a faculty member can be in is to be added to a student's graduate committee after most of the work has been completed, only to find the project is weak. In such cases, the committee member's role is limited to that of gate keeper – a person who is forced to make the very difficult decision as to whether a weak piece of work is nevertheless good enough to allow the student to graduate.

Choosing the Committee

Committees for masters students at UNM require a minimum of three members, two of which must be regular or research faculty. The third member must be have qualifications appropriate for the student's area of study. Ph.D. committees must have four members, three must be regular or research faculty, and one of these must be from a different graduate unit than the student's major department (i.e. a different department at UNM or a different university). All committees must be approved by OGS. Specific guidance on the composition of graduate committees is given in the UNM catalog.

Generally, students pick a committee based on faculty they know and/or people they work with. The characteristics of an ideal committee member are: 1) they are knowledgeable in the field of interest, 2) they are available and willing to serve on the committee, and most importantly, 3) the student has confidence that they will provide constructive assistance during the course of the project. Part-time students who have selected a topic related to work are encouraged to select a supervisor or other senior member of the organization for their committee. Senior staff from work are beneficial because they have frequent contact with the student, usually have good knowledge of the subject, understand the constraints the student faces, and can provide immediate suggestions when questions arise. Furthermore, because the student's project is work-related, a supervisor can sometimes make resources available to assist in completing the project.

Working with the Committee

Students are strongly encouraged to take full advantage of the expertise, knowledge, and experience of their entire graduate committee by involving them in the research project from the beginning. At the same time, this involvement must be balanced against the challenges of obtaining meaningful input from very busy people. In other words, most committee members do not want to have weekly reports on the student's progress. But neither is it appropriate for the student to simply show up one day after months or years without contact, plop a document on the desk and say, "here's my Professional Project, let me know what you think."

It is suggested that during the research project the student arrange two formal meetings of their full committee. The occasion of these meetings and their objectives are:

- 30% Completion Meeting – Obtain Committee Buy-In. This meeting should be held when the student has completed roughly one third of the proposed research. The objective of this meeting is to obtain the committee's agreement that the research project is well framed, the methods are appropriate, and the project has a high chance of success. The student will formally present their research proposal to the committee, describe the project objectives, the scope of work and the research methods.

- 70% Completion Meeting – Identify Fatal Flaws. This meeting occurs after the student has collected most of the information needed for the project. The objective is for the committee to consider this information and the student's preliminary conclusions and determine whether the work has been done with sufficient care and the results have been interpreted by proper methods to support these conclusions. It is important to have this meeting while the research is still in progress so that if new data is needed, or new experiments must be conducted, it can be accomplished with minimal additional work.

In addition to these formal committee meetings, it is important to continue regular meetings with the student's advisor. It is suggested that biweekly progress reports is an appropriate frequency if there is not regular personal contact. Similarly, monthly reports to the rest of the committee are helpful. These reports need not be overly detailed and in many cases can be one page bulleted lists of Accomplishments and Planned Activities. The purpose is to maintain regular contact and avoid surprises.

Conducting Research and Writing the Professional Project

It is difficult to provide generic guidance to students conducting research projects because each project, each advisor, and each discipline is so different. Thus, a strategy that works well for lab oriented engineering research is likely of limited value for a project investigating cultural characteristics. Listed below are some ideas that may appropriate for some projects.

Prepare a Schedule and Regularly Revisit It

A detailed scope of work and research schedule should be part of the research proposal. Periodically go back to this schedule and consider your scope of work and the progress made towards completing it. Revise as appropriate.

Keep a Project Noteboook

Science and engineering students are strongly encouraged to keep a project notebook, a recommendation that has value to students in other fields as well. Project notebooks should be bound (not 3 ring binders) and the pages numbered. Entries should be made in ink. Errors are crossed out by a single line through the erroneous material. The notebook thus becomes a combination of diary and repository of information collected in the library, field or laboratory. While data files might be stored on a computer, the procedures used to collect the data, any hand written notes or information, and the name of the data file should be written in the notebook.

Backups

Back up your work and data by storing it on a flash drive or CD. Back it up frequently. All of it.

Writing

Writing a Professional Project is always much more time consuming than students estimate. The rule of Pi should be used in predicting how long it takes to write the final document: Estimate the time required, then multiply by Pi.

The Professional Project is a formal academic document and should be written as such. It is generally written in the third person impersonal tense and should be clear and succinct. Adjectives should be used sparingly and superlatives are almost never used. In my experience the style editor in MS Word has apoplexy when analyzing most well written projects/theses/dissertations.

Most academic documents including papers/projects/theses/dissertations as well as technical reports should be written in the past tense to the extent reasonable because the document describes work that has been done. While it sometimes makes sense to write in the

present tense, six months, a year or a decade later it won't make any sense at all (unless you're still working on the darn project).

The Professional Project should follow the formatting and organization criteria set by the UNM Office of Graduate Studies (www.unm.edu/~grad). The report should be double-spaced, with 1" (1.50" left-hand) margins, and generally contain the following:

- A title page including student name, month and year of graduation, and the citation that this document is submitted in partial fulfillment of the requirements for the degree of Master of Water Resources, Water Resources Program, University of New Mexico. A sample title page can be downloaded from the WRP web site.
- A signature page, signed by all committee members. The signature page can be downloaded from the WRP web site.
- A table of contents and separate lists of tables and figures.
- Acknowledgements page.
- An abstract stating the problem or hypothesis, its significance, results, summary and conclusions. The abstract should not exceed two pages.
- An introductory chapter or section identifying the problem/hypothesis, previous work, etc.
- Other chapters or sections, as cited in the table of contents.
- A glossary of terms.
- Appendices (where appropriate).
- Literature cited (references). Because of the diversity of water resources disciplines, citation styles vary. Choose one style that is dominant in the particular field and stick with it. For water resources, the *Journal of the American Water Resources Association* (JAWRA) is a good reference. The student's committee can provide guidance.

For issues of style, references, and formatting there are numerous books on writing academic papers. I have used A Manual for Writers of Term Papers, Theses and Dissertations by K. Turebian, 6th ed., University of Chicago Press. There are many others.

Web Sites With Good Information

http://www.ldeo.columbia.edu/~martins/sen_res/how_to_thesis_proposal.html

The Oral Exam/Professional Project Defense

Once the student has finished the report, he/she submits a draft to the committee for their comments. Usually the Chair reviews it before submitting to the rest of the committee. The committee may require corrections to the draft prior to scheduling the oral exam. The student should provide a Draft Final copy of their report to the committee *at least* two full weeks prior to the defense.

Students must inform the WRP office by December 1 (Spring graduation), May 1 (Summer graduation), July 15 (Fall graduation) of their intention to graduate in the following semester. No form is required.

The oral exam is open to the public and OGS must be notified two weeks before it occurs by submitting and *Announcement of Examination* form. The student and the committee should decide on a time and date for the examination. After the student and their committee have agreed on a date and time, the WRP Administrator must be notified who will help fill out the proper forms. The student should also reserve a room and audio-visual equipment for the defense (usually an LCD projector and a laptop computer).

During the exam, the student makes a formal presentation lasting 30 minutes or less. The presentation should follow the same organization as the written report and should emphasize work done by the student and especially his/her analysis, interpretation and conclusions. Following the presentation the graduate committee and the audience will be encouraged to ask questions about the project.

After the presentation and public questioning, the committee may close the meeting to the public and continue the examination. At the conclusion of the examination the committee and student will discuss the results.

On the final exam, the student can receive a grade of "Pass", "Fail", "Pass with Distinction", or "Conditional Pass". Almost always the committee will identify some changes needed to the written report. Depending on the nature of the changes, the final report may need to be re-reviewed by the entire committee or simply by the advisor. Obtaining the committee members' signatures on the second page of the final report is their indication that the student has submitted a report satisfying the requirements of the MWR program.

Final Copies of the Professional Project Report

Four soft-bound copies of the final, committee-approved report will be submitted to WRP Office for filing; two of these will be deposited in the UNM Library. Binding should be permanent (glued, wire spiral, or similar); looseleaf or similar binding (plastic "comb" binding) is unacceptable. Glued binding is preferable. The front and back covers of the final report must be on heavy paper stock, not the same paper used for the body of the report. Do not include a clear plastic page in front of the cover.

All Professional Projects must include a CD containing a PDF of the completed project in a CD envelope pasted to the inside front cover of the bound copies of the final report. This CD may also contain supporting data, spreadsheets or computer results, photographs, PDFs of important references or other information the student believes is relevant to the project. The electronic copy of the report will be placed on the WRP web site. The CD should have a computer generated label that contains the title of the project, the student's name, and date.

The title page (see the end of this document or the WRP web site) is the first page of the report and the signed signature page follows that page. The student may use the title page as the cover or can design his/her own cover, perhaps with a picture or drawing. At a minimum, the cover should display the title, degree name and option, and student's name, with the following at the bottom:

A Professional Project Report Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Water Resources
Hydroscience or Policy/Management Concentration
Water Resources Program
The University of New Mexico
Albuquerque, New Mexico
Month Year

The month and year will be that month (May, August, or December) and year in which the student will *graduate*, not the month in which the student *defended.* As a matter of courtesy, the student should provide each committee member with a copy of the PP (either paper or electronic depending on the member's preference). A final grade in WR 598 will not be issued until the WRP Office receives the final report signed by all committee members.

Some Common Pitfalls

Below are some of the common problems associated with professional projects.

- Waiting too long to identify a project.
- Poor topic definition or too broad a topic.
- Inadequate resources (time, financial, faculty or other intellectual assistance) to complete the task.
- Failure to seek committee help, especially during the initial stages of project development.
- Inadequate data to complete the project.
- Believing one draft will be sufficient.
- Underestimating the amount of time it will take. This is especially true of projects involving a field and/or lab component. In the field or lab, things rarely go as planned; Murphy's Law ("If things can go wrong, they will.") often controls.
- Leaving school before turning in a first draft of the report. Students may leave school before completing all requirements, often to accept a job. Keep in mind that doing so will, in most cases, greatly prolong the amount of time (perhaps by a factor of 3 – 6 times) it will take a student to finish the degree. It is not uncommon for a student to leave, thinking he or she is just a few months away from finishing up and; before one knows it, a year has gone by. The demands of a new job often preclude work on a professional project. If a student must leave before finishing, he/she should endeavor to turn in a first draft of the Professional Project report to his/her committee.

If a student experiences problems, he/she should promptly discuss them with their advisor and then their graduate committee. An informed advisor and committee is the student's best ally in completing their degree.

Publishing Your Professional Project

WRP students are strongly encouraged to publish their PP work in journals and/or present their results at regional and national professional meetings. The following language should be included to gain recognition for the program.

"This work is based upon the Professional Project of (your name), submitted in partial fulfillment of the requirements for the degree of Master of Water Resources at the University of New Mexico."

APPENDIX III - PREVIOUS PROFESSIONAL PROJECTS

(Note: professional projects were not required prior to 1995. All those completed after 1999 are in Zimmerman Library. The committee chair is shown in parentheses)

Harwood, A. Kyle. *The Urban Stormwater Contribution of Dissolved Trace Metals from the North Floodway Channel, Albuquerque, NM, to the Rio Grande.* April 1995. (M. Campana and C. White)

Sandoval, Tina Marie. *Striking A Balance: Potential Legal And Institutional Constraints On The Use Of San Juan-Chama Water and Groundwater As-Needed To Meet Albuquerque's Long-Term Water Demand*. November 1995. (F. L. Brown)

Newman, Gretchen. *Erosion Study in Tajique Watershed*. February 1996. (R. Heggen)

Hofstad, Steven C. *Sediment and Nutrient Loss Following Prescribed Fire in Semiarid Grasslands: the Potential for Water Resource Impairment.* December 1996. (F.L. Brown)

Nelson, Terry. *Past and Present Solid Waste Landfills in Bernalillo County, New Mexico.* June 1997. (F. L. Brown)

Hauck, Bill. *A Water Audit of Albuquerque Manor Retirement Home: A Potential for Water Savings Study and Economic Analysis*. June 1998. (F. Lee Brown)

Krause, Tom. *Who Speaks for the Rio Jemez? A Management Plan for the Lower Jemez River Basin.* June 1998. (M. Campana)

Fitzner, April. *Physical and Legal Aspects of River Rehabilitation, Middle Rio Grande, New Mexico.* December 1998. (M. Campana)

Brouillard, Elaine S. *Erosion Potential of the Main Branch of the Piedras Marcadas Watershed, Petroglyph National Monument, New Mexico.* March 1999. (M. Campana)

Renn, Richard M. *Assessment and Management of the Arroyo Del Coyote Watershed, Sandia National Laboratories and Environs, New Mexico.* March 1999. (W. Fleming)

Childs, Marquis B. *Soil Radionuclide Concentrations and Preliminary Stormwater Model Assessment at Material Disposal Area G, Los Alamos National Laboratory.* April 1999. (M. Campana)

Peterson, Jeffrey L. *Coordinated Water Resource Planning for the Sandia Basin - A Perspective into Regional Water Planning Needs.* May 1999. (M. Campana)

Sato, Hirotaka. *Water Pricing Strategy for the City of Albuquerque's Sustainable Water Use.* July 1999. (D. Brookshire)

Gordan, Linda I. *Water Supply Sustainability Through Water Banking*. April 2000. (M. Campana)

McLean, Christopher T. *Estimates of Radionuclide Loading to Cochiti Lake from Los Alamos Canyon using Manual and Automated Sampling*. April 2000. (M. Campana)

McDonald, William S. *Urbanization of Seven Springs, New Mexico: An Evaluation of Current and Projected Impacts on Ground- and Surface-Water Resources*. June 2000. (M. Campana)

Gillard, Nancy J. *An Environmental Analysis of the Drycleaning Industry: A New Mexico Perspective*. July 2000. (B. Thomson)

O'Neil, Joy K. *Volunteer River Monitoring Plan for the Urban Reach of the Santa Fe Watershed.* July 2000. (W. Fleming)

Gray, Neil W. *Issues in Managing Erosion: The Spring Timber Sale Case Study, El Rito Ranger District, Carson National Forest, New Mexico.* July 2000. (W. Fleming)

Just, Robin L. *Modeling Flow and Sediment Transport in the Rio Puerco Using a SWAT/GIS Interface*. September 2000. (W. Fleming)

Cook, Casey W. *A Mixing Cell Model of the Fernley, Nevada, Groundwater System.* November 2000. (M. Campana)

Smith, Katherine A. *Comparison of Two Riparian Assesment Surveys: Proper Functioning Condition and the New Mexico Watershed Watch Riparian Survey.* November 2000. (W. Fleming)

Walters, Tobin K. *PCB Remediation Alternatives on the St. Lawrence River near Massena, New York: Quantitative Impacts to the Industry the Mohawk Indian Nation and the United States Environmental Protection Agency*. November 2000. (M. Campana)

Bitner, Kelly A. *Cost of Compliance with a Lower Arsenic Drinking Water Standard in New Mexico*. January 2001.(B. Thomson)

Vardaro-Charles, Patricia. *An Evaluation of Water Treatment Technologies Piloted at LANL to Improve Cooling Tower Water Efficiency*. February 2001. (B. Thomson)

Hunter, Andrea. *Environmental Disturbance of Oligotrophic Bacteria and Effects on Water Quality in Deep Karst Pools.* March 2001. (C. Dahm)

Cotter, T. Jeffery. *Point-of-Use Arsenic Remediation Using Activated Alumina*. June 2001. (B. Thomson)

Mandeville, Debby. *Erosion Impacts from Recreation in the Enchanted Tower Climbing Area, New Mexico*. August 2001. (T.J. Ward)

Kerven, Claire. *Benefits and Costs of Diverting 0.2 MGD Influent from Los Alamos County Wastewater System to Los Alamos National Laboratory Sanitary Wastewater System.* November 2001. (W. Fleming)

Evans-Carmichael, Sherry. *Rancho West Estates Water Distribution System Replacement Funding Project.* November 2001. (M. Campana)

Diehl, Danielle D. *Microbially Mediated Reduction of U(VI) in Groundwater at a Site in Konigstein, Germany.* December 2001. (B. Thomson)

Grassel, Kathy. *Taking Out the Jacks: Issues of Jetty Jack Removal in Bosque and River Restoration Planning.* April 2002. (M. Campana)

Shean, Jr, Frederic L. *Assessment of Conjunctive-Use Strategies for Water Resources Development in the South Valley Area, Bernalillo County, New Mexico*. July 2002. (B. Thomson)

Romero, Orlando C. *A Convective Thunderstorm Case Study in Albuquerque, New Mexico: Does the Urban Heat Island Affect Precipitation?* July 2002. (J. Coonrod)

Van Eeckhout, Mark. *Integrating HEC-RAS and ArcView in Predicting Post-wildfire 100-year Floodplains on the Pajarito Plateau, Los Alamos, New Mexico*. August 2002. (J. Coonrod)

Nims, Joshua S. *Effects of Summer Climate on Water Demand in Albuquerque, New Mexico.* August 2002. (D. Gutzler)

Bruerd, Barak. *Designing A Village Water Supply System in Papua New Guinea: A Case Study in Third World Development.* May 2003. (J. Coonrod)

Gabora, Michael M. *A $\delta^{18}O$ Calibrated Compartmental Mixing Cell Model of Groundwater Flow in the Roswell Basin, Southeastern New Mexico*. May 2003. (M. Campana)

Riebsomer, Eric. *Chemistry Variation During Purging of Alluvial Wells at Los Alamos National Laboratory*. May 2003. (M. Campana and D. Rogers)

Bentley, Jessica. *Constructed Surface Flow Wetlands for Oil Refinery Wastewater Treatment in New Mexico*. May 2003. (M. Campana)

Paretchan, Lynne M. *Water Resource Management Strategies: Deschutes Basin, Oregon* August 2003. (M. Campana)

Ewing, Amy. *Water Quality and Public Health Monitoring of Surface Waters in the Kura-Araks River Basin of Armenia, Azerbaijan and Georgia.* August 2003. (M. Campana)

Stropki, Cody Lee. *Restoration Treatments in the Middle Rio Grande Bosque: Effects on Soil Compaction.* December 2003. (J. Coonrod)

Gregg Bassore, Kerry. *Evaluating Stormwater Best Management Practices in a Small Urban Watershed: A Case Study of the Adobe Acres Drainage Basin in Bernalillo County, New Mexico*. December 2003. (J. Coonrod and W. Fleming)
Joshi, Uday V. *Selective Tree Thinning in the Santa Fe Municipal Watershed for Water Yield Augmentation*. May 2004 (W. Fleming)

Kolk, Stephen M. *Assessment and Preliminary Design of a Water Supply Project for the Village of Altos de las Paz, Honduras*. May 2004. (J. Coonrod)

Amato, Ron. *Surface Water Quality of the Gallinas River in and around Las Vegas, New Mexico.* August 2004. (L. Crossey)

O'Rourke, Meaghan. *Appropriate Erosion Control Techniques for the Rural Hillsides of Honduras.* August 2004. (M. Campana)

Brown, Kathyrn D. *Pharmaceutically Active Compounds in Residential and Hospital Effluent, Municipal Wastewater, and the Rio Grande in Albuquerque, New Mexico.* December 2004. (B. Thomson)

Louise, Amy. *Sustainable Water Supply for the Village of Kpandu Dafor, Volta Region, Ghana.* December 2004. (M. Campana and V. Perry)

Iwhish, Hani. *Fresh Water Supply Enhancement Through Rooftop Rainwater Harvesting for West Bank Rural Communities.* December 2004. (M. Campana)

Marcell, Nicole L. *Exposure Evaluation of an Aviation Gasoline Release at a Municipal Airport in Central Wisconsin.* December 2004. (M. Campana)

Robinson, Eric C. *Point-of-Use Water Treatment Using Solar Pasteurization.* May 2005. (B. Thomson)

Luna, Melanie L. *Potential for Ground-Water Contamination from Deep Well Injection of Produced Waters in the Salt Basin, New Mexico.* May 2005. (M. Campana)

Chora, Rosemarie. *The Management of Nonpoint Sources of Contamination from the Embudo Watershed in the Vicinity of Albuquerque, New Mexico*. August 2005. (W. Fleming)

Klise, Geoffrey T. *Potential Options to Reduce ESA Liability for Private New Mexico Irrigators Who May be Liable for a Section 9 'Take'*. August 2005. (O.P. Matthews)

Henderson, Heidi R. *Nutrient Criteria Recommendations for Eutrophication Management of New Mexico Reservoirs.* August 2005. (M. Campana)

Kundargi, Darrell. *Effects of Bovine Exclosure Fencing on Water Quality and Vegetative Conditions, Bluewater Creek, New Mexico.* August 2005. (M. Campana and R. Jemison)

Campbell Parrish, Jules. *Dynamic Simulation Modeling of Groundwater Basins in the Upper Rio Grande Basin, Colorado-New Mexico*. August 2005. (M. Campana)

Stansifer, Gary. *Analysis of the Mixing of Treated Effluent Discharge, Surface Water and Shallow Ground Water Using Anionic Constituents.* December 2005. (C. Dahm)
Neir, Alyssa. *The History of the Federal Government's Involvement in Water Resources: An Attempt to Correct Externalities?* December 2005 (D. Brookshire)

Sanchez. Blane M. *Chical Area On-Site Wastewater Treatment System Management, Pueblo of Isleta, New Mexico.* December 2005 (B. Thomson)

Heemink, Barbara. *An Assessment of Domestic Water Consumption Discrepancies Between Commercial Farms and Majengos Along South Moi Lake Road, Lake Naivasha, Kenya.* December 2005 (M. Campana)

Demint, Ann. *Integrating a GIS-Produced, Reach-Based Hydrological Analysis into a Dynamic Surface Water Model of the Middle Rio Grande, New Mexico.* December 2005. (J. Coonrod)

Martinez, A. Pete. *Using Geographic Information Systems to Predict Changes in Water Quality due to Erosional Processes.* December 2005. (J. Coonrod)

Montaño Allred, Jennifer. *Evaluating the Effectiveness of Induced Meandering Within an Incised, Discontinuous Gully System Post-Wildfire Within the Valle Vidal, Carson National Forest, New Mexico.* December 2005. (W. Fleming)

Casey, Christine. *Community Management for Improved Sustainability: Case Studies of Three Rural Community Water Supply and Sanitation Projects in Honduras.* December 2005. (C. Issac)

Rawlings, Matthew. *Variables to Consider When Transferring Water Rights in New Mexico.* December 2005. (O.P. Matthews)

Mozumder, Pallab. *Exploring Flood Mitigation Strategies in Bangladesh.* December 2005. (M. Campana)

Arvidson, Julie. *Relationship of Forest Thinning and Selected Water Quality Parameters in the Santa Fe Municipal Watershed, New Mexico.* May 2006. (T. J. Ward)

Lundahl, Anders. *Quantifying, Monitoring, and Improving the Efficiency of Flood Irrigation in the Hydrosphere of Candelaria Farms Preserve, Albuquerque, New Mexico.* May 2006. (J. Stormont)

Putney, Tara. *The Sustainable Restoration and Development of Parque Landeta and the Presa de Las Colinas Wetland Through Effective Community Participation San Miguel de Allende, Guanajuato, Mexico.* May 2006. (M. Campana)

Matthew Lane. *Corrective Action Plan for the New Mexico Landfill*. August 2006. (M. Campana)

Berrin Basak Vener. *The Kura-Araks BasinL Obstacles and Common Objectives for an Integrated Water Resources Management Model among Armenia, Azerbaijan, and Georgia.* August 2006. (M. Campana)

Funk, Andrew. *The Potential of Water Saving and Water Capturing Innovations: A Case Study of Albuquerque Single Family Homes.* December 2006. (J. Chermak, J. Coonrod)

Geery, Emily. *Using Instream Flows on the Gila River to Provide Benefits for the Environment and the Economy.* December 2006. (W. Fleming)

McGann, Jeanine K. *The Effects of a Prescribed Burn on Streambed Sediments, Macroinvertebrate Assemblages, and Water Quality in the Valle Toledo, Valles Caldera National Preserve, New Mexico*. December 2006. (C. Dahm)

Dyer, James R. *Groundwater-Surface Water Interactions: Effects of Geothermal Spring Inputs to Jemez River Water Quality.* May 2007. (L. Crossey)

Humphries, Christina. *Rural Sustainability Using Rainwater Harvesting: From Rainwater to Tap Water in Alto, New Mexico.* May 2007. (O. P. Matthews)

Tinklenberg, Annelia. *Will the Minute System Work to Modernize the International Boundary and Water Commission?* August 2007. (O. P. Matthews)

Shuryn, Danielle M. *Monitoring and Assessment of Sedimentation in Stream Channels of New Mexico*. August 2007. (T. Ward)

Kindel, Sharon. *Ten Things You Should Know About Water before Going to High School: Incorporating Local Water Resources Issues Into the Albuquerque, New Mexico Public School System Science Curriculum.* August 2007. (W. Fleming)

Phillips, Robert W. *Measuring Deep Percolation for an Irrigated Alfalfa Crop in South Central Colorado.* August 2007. (J. Stormont)

Weber, Sherry L. *Evaluation of Two Washington State Department of Transportation Stormwater Facilities along State Route 18 Highway*. August 2007. (B. Thomson)

Jones, Kerry M. *Relationship Between a 700-MB "Dry/Wind" Index and Springtime Precipitation and Streamflow Within Four Snowmelt-Dominated Basins in Northern New Mexico and Southern Colorado*. December 2007. (D. Gutzler)

Edwards, Anthony D. *Detection of Polychlorinated Biphenyls in the Rio Grande Basin above Cochiti Dam: Sources & Significance*. December 2007. (Constantine Hadjilambrinos)

Wiley, Cody. *Modeling Third Party Effects of Water Rights Transfers in a Hypothetical Middle Rio Grande Irrigation Community*. December 2007. (O. P. Matthews)

Skancke, Jennie R. *Evaluation of Constructed Wetland Performance in New Mexico, 2007.* December 2007. (B. M. Thomson)

Bonfantine, Krista. *Fuel Reduction Treatment Effects on Semiarid Woodland Ecohydrology.* December 2007. (W. Fleming)

Stokes, Cynthia. *Managing Water Resources in New Mexico: Climate Trends and Cropping Patterns in the Lower Rio Grande.* December 2007. (D. Henkel)

Lee, Katharyn M. *Evaluation of Selected Ground Water Abatement Strategies for Two Produced Water Impact Sites.* December 2007. (K. Howe)

Torres, Leanna T. *Habitat Availability for Rio Grande Silvery Minnow (Hybognathus amarus) Pena Blanca, Rio Grande, New Mexico.* December 2007. (B. Thomson)

Price, Lynda. *The Response of Shallow Groundwater Levels to Fuel Reduction in the Middle Rio Grande Bosque.* December 2007

Nolan, Emma O. *Cost Comparison of Perchlorate Treatment Options.* May 2008. (J. Chermak)

Erdmann, Andrew. *Watershed Health and Mechanical Fuel Reduction in the Walker Flats.* May 2008.

Paz-Solis, Alicia. *Development of a Water Education Module for Middle School Students under the Guidance of the Chihuahuan Desert Nature Park and based on EPSCoR funded Research on Evapotranspiration along the Middle Rio Grande.* August 2008. (J. Coonrod)

LeJeune, Christian. *Multi-Year Investigation of Groundwater – Surface Water Interactions in the Vicinity of the Albuquerque Drinking Water Diversion Dam.* August 2008. (J. Stormont)

Schultz, Krista M. *Modeling Road Erosion in the Upper Torreon Wash, New Mexico.* December 2008. (B. Thomson)

Robertson, Andrew. *Surface Water and Ground Water Interactions of the Rio de las Vacas, NM; Characterizing Exchange and Predicting Response Using Thermal Data.* December 2008. (J. Coonrod)

Wollak, Jordan. *Modeling Capture Zones to Determine Potential Threats to the Public Water Supply Wells.* December 2008. (B. Thomson)

Meadows, Jake. *Comparison of Predicted and Observed Flood Flows in Pajarito Canyon Following the 2000 Cerro Grande Fire.* December 2008. (B. Thomson)

Hardeman, Shawn. *A Cost-Benefit Analysis of Leak Detection and the Potential of Real Water Savings for New Mexico Water Systems.* December 2008. (B. Thomson)

Keleher, Christina L. *Nitrate Contaminated Groundwater in Albuquerque's South Valley: Is Monitored Natural Attenuation an Appropriate Strategy?* December 2008 (B. Thomson)

Weiss, Ryan M. *Fluvial Geomorphic Response to In-Stream Structures: The Effects of Design, Planning and Restoration of the Comanche Creek Catchment, New Mexico, USA.* December 2008. (W. Fleming)

Curtis, Jan M. *An Assessment of Surface Water-Groundwater Interactions and Water Quality in Bluewater Creek New Mexico.* December 2008. (L. Crossey)

Brosnan, Sara Henchey. *A Case Study of Water Sharing in the San Juan Basin.* May 2009. (P. Matthews)

Martinez, Louis. *Utility Response to Drought: Business of Water Management Practices and Function In View of Decreased Consumption.* August 2009. (B. Thomson)

Chudnoff, Sara. *A Water Quality Assessment of the Rio Katari River and its Principle Tributaries, Bolivia.* December 2009. (B. Thomson)

Kryder, Leslie R. *Preparing Water Users in the Lower Rio Grande for Adjudication Through an Informative Workshop*. December 2009. (D. Henkel)

LaBadie, Katherine. *Identifying Barriers to Low Impact Development and Green Infrastructure in the Albuquerque Area.* May 2010. (W. Fleming)

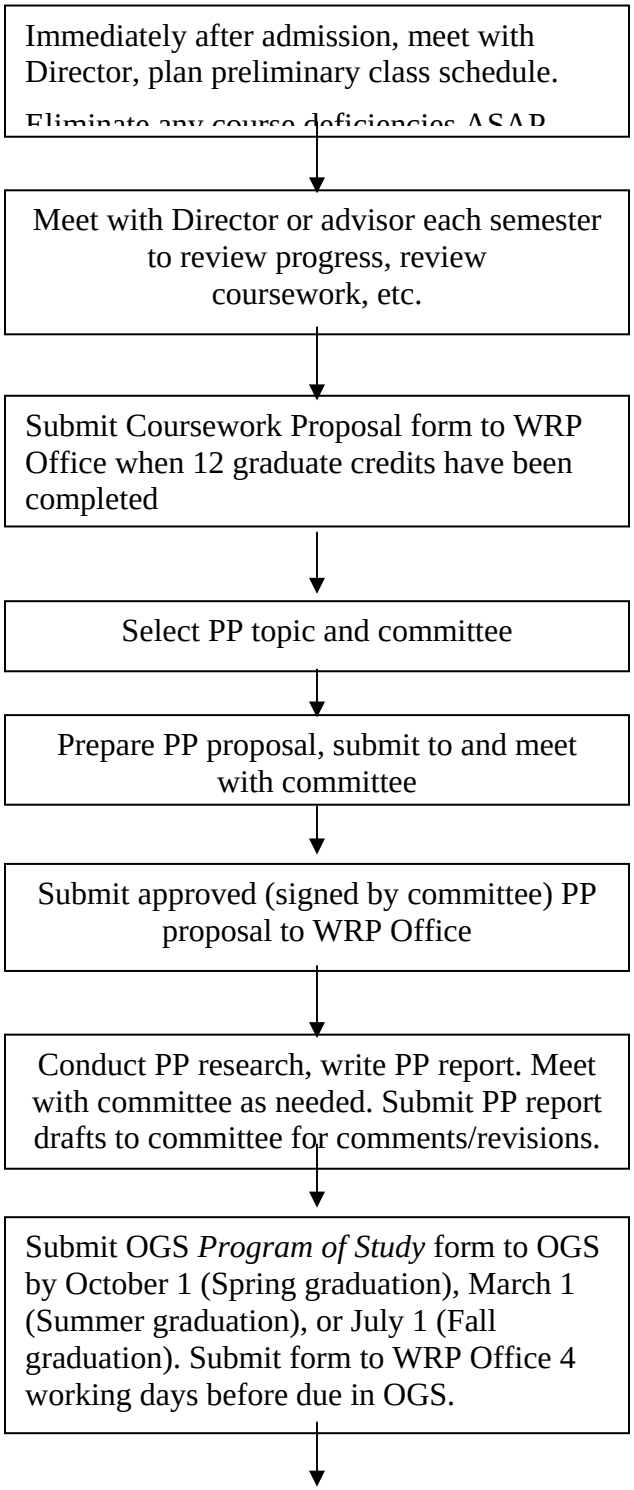
Schoener, Gerhard. *Comparison of AHYMO and HEC-HMS for Runoff Modeling in New Mexico Urban Watersheds.* May 2010. (J. Coonrod)

Rae, Rebecca. *Utilizing Jicarilla Apache Knowledge to Enrich the Watershed Watch Program Curriculum for the Benefit of the Jicarilla Apache Youth.* December 2009. (T. Jojola)

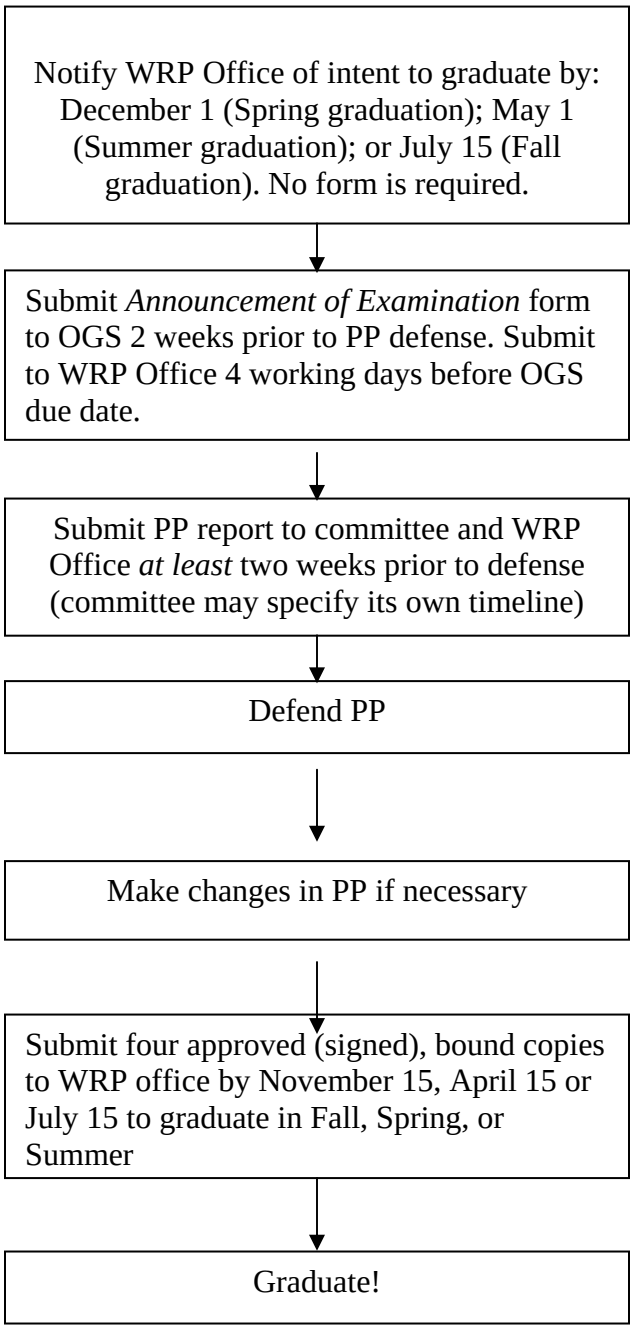
Padilla, Mariana. *An Analysis of the Los Padillas Wildlife Sanctuary a Place-Based Environmental Education Model.* May 2010. (T. Jojola)

Young, Rick. *Performance of a Green Roof Lysimeter in an Arid Climate.* August 2010. (B. Thomson)

APPENDIX IV - MWR Degree Flow Chart



MWR Degree Flow Chart
(Continued)



APPENDIX V – Coursework Proposal Form

Water Resources Program
Coursework Proposal Form

Name_____**Date**_____**Concentration** (HS or PM)_____
Semester & Year Entered_____**Expected Graduation** (Semester & Year)_____
Prerequisites (for each one: circle course (or equivalent) taken, list semester/year taken)

All Students: 1) Microecon (Econ106 or 300)_____2) Statistics (Stat 145)_____
3) Calc I (Math 180 or 162)_____, 4) 2 semesters of Science _____
PM Students: 1 semester Social Science_____

HS Students: Calc II (Math 181 or 163)_____ 3rd semester of Science_____

Courses in Concentration (HS or PM) (15 credits minimum; list school if not UNM)
Course (department, number & title) **Semester & Year** **School**

Other HS or PM Water Courses (6 credits minimum; list school if not UNM). If your concentration is HS, these need to be PM courses and vice-versa.
Course (department, number & title) Semester & Year School

Utilities Course (3 credits; list school if not UNM). Courses in GIS, modeling, or methods.
Course (department, number & title) **Semester & Year** **School**

Water Resources Interdisciplinary Courses (12 credits)

Course	**Semester & Year**
WR 571	
WR 572	
WR 573	

Professional Project (3 credits) **Semester & Year** **Advisor**
WR 598

Professional Project Title (tentative)_____
_____
Committee (if you have one; indicate chair)_____
_____

Student Approval_____**Date**_____

Advisor/Chair Approval_____**Date**_____

Director Approval_____**Date**_____

APPENDIX VI – Professional Project Cover Page Format

Title Goes Here (18 pt. Bold Font)

by

Name Goes Here (16 pt. Bold Font)

Committee
Dr. Bruce M. Thomson, Chair
Dr. William M. Fleming
Dr. Timothy J. Ward

A Professional Project Proposal Submitted in Partial Fulfillment of the Requirements
for the Degree of

Master of Water Resources

Water Resources Program
The University of New Mexico
Albuquerque, New Mexico
September 2010

Committee Approval

The Master of Water Resources Professional Project Proposal of **Your Name** is approved by the committee:

Chair	Date

Appendix II – Course Syllabi for Water Resources Core Classes

Fall 2010

WR 571 – Contemporary Issues

Preliminary Syllabus

TR 3:30-6:15 p.m. Ortega 153

Date	Topic	Instructor
8/24	Introductions, course objectives, & expectations	All
8/26	Communication skills, research writing, presentation skills. Library research skills	Thomson
8/31	Legal research methods	Matthews
9/2	Introduction to hydrology, hydrologic cycle, sources of information	Thomson
97	Economics & scarcity	Brookshire
9/9	Value of water	Brookshire
9/14	Water resources of NM	Thomson
9/16	Water use in NM – Longworth	Thomson
9/21	Municipal water supply – how a municipal system works. Water & wastewater treatment & distribution	Thomson
9/23	Tour of Southside Water Reclamation Plant	Thomson
9/28	Water law related to allocation & reallocation NM Water Law – rights, adjudication, compacts	Matthews
9/30	Water Law of the West	Benson
10/5	Adjudication	Bushnell
10/7	Value of water in NM **Assignment 1 due**	Brookshire
10/12	Experimental economics	Brookshire
10/14	Fall Break	
10/19	Student presentations	All
10/21	Student presentations	All
10/26	Transboundary conflicts – federal state conflicts	Matthews
10/28	Water & Energy	Thomson
11/2	Water leasing and markets	Brookshire
11/4	Water leasing experiment **Assignment 2 due**	Brookshire
11/9	Issue RFP, discuss, make group assignments	All
11/11	International law – Berlin rules	Matthews
11/16	Ethical issues in water supply & professional practice	Thomson
11/18	Bottled water – quality, costs, risks.	Thomson
11/23	Group work	
11/25	Thanksgiving Break	
11/30	Sustainability & water resources	Thomson/Milne?
12/2	Proposals due	
12/7	Group presentations	
12/9	**Assignment 3 & Final presentations**	

Instructors:

Bruce Thomson	Economics 1044	277-5249/4729	bthomson@unm.edu
David Brookshire	Econmics 1006c	277-1964	brookshi@unm.edu

Course Description

WR571, Water Resources I: Contemporary Issues, is the first of three interdisciplinary courses in the Master of Water Resources (MWR) core curriculum. This course, like the next two in the series, emphasizes the development of skills in critical and comparative analysis, and in technical communication.

Objectives

This course focuses on identifying, analyzing, and reporting on water issues, both individually and in groups. Students in this course will learn how to: 1) Identify a water issue or problem in a particular region, river basin, or ground water system and prepare a review of the technical, policy, and management aspects that create the issue. 2) Prepare a written proposal to address this water issue or problem. 3) Communicate the results of these activities in written and oral presentations.

Grading

Grades will be based on 4 factors: 1) individual written assignments & presentations, 2) group written assignments & presentations, and 3) class preparation. These are discussed below.

Individual Assignments: These will consist of:

- Two individually prepared reports and one presentation on a topic of current relevance to water resources, selected in collaboration with the instructors. These reports are not to exceed 10 pages of text, exclusive of front matter (title page, table of contents, abstract) and back matter (references, appendices).
- Short, written assignments associated with topics presented in class
- Attendance and written analysis of a public meeting related to water resources

Group Assignments:

- A response to a hypothetical Request for Proposals (RFP) that will be prepared by the instructors to address a topic of current relevance to water resources management in the southwest. The proposal will contain a discussion of the problem/issue to be addressed, a statement of the objectives of the project, and a scope of work to be accomplished, including a time line and cost proposal. uidance for the proposals, a maximum contract amount, and billing rates for project staff will be provided. The proposal will consist of both a written document and an oral presentation.

Class Presence:

- A topic of current interest will be discussed during the second half of each Wednesday's lecture. Students will be evaluated based on:

  Preparation – Students will critically read all assignments and pose relevant questions

Engagement – Students will actively participate in discussion by offering relevant comments and analysis, and through use of examples and supporting information to substantiate their points.

Course Evaluation: Students are required to complete an end-of-term course evaluation. Failure to do so will result in deduction of 30 points from their point total.

Confidentiality – Each person in this course must feel free to express their ideas openly without fear of adverse judgment or consequences. Opinions and positions stated in the classroom must remain in the classroom and are not to be attributed to individuals, their employers, the WR program or UNM.

Grading

Component	Points
Individual projects (2) Written review of problems in a single region/basin/ground water system (2) Oral presentation (1)	 300 150
Group project Written proposal Oral presentation	 200 100
Class "presence" – preparation and participation in class	100
Other written assignments	150
Course evaluation	(-30)
Total	1000

Course Theme

The theme of the WR 571 course for fall, 2010 will be "water for agriculture, energy, and growth in the southwest." The southwest will be defined according to watersheds and will consist of portions of the southwestern US in the Colorado River, Gila, and Rio Grande watershed. Since much of the lower Colorado is transported to southern California, we will also include this region in our discussion.

There will be three major assignments, each consisting of a written report and an oral presentation. The first assignment will be done individually. The second and third will be done in small groups to be assigned by the instructors. The third assignment will involve preparation of a written proposal to conduct a water resource investigation in response to a hypothetical "Request for Proposals." Guidance for each of these assignments will include a description of the product as well as page and time limits for the presentation.

WR 572 –Water Resources II: Models

Course Description

(AOA Economics 545)
Spring 2010 - 4 credit hours
Tuesdays & Thursdays, 5:00 p.m. Dane Smith Hall Room 333

Faculty

Janie Chermak	Economics Bldg. Rm. 2008	277-4906	jchermak@unm.edu
Bruce Thomson	Econ 1044, Tapy Hall 119	277-4729	bthomson@unm.edu
Vince Tidwell	Sandia National Labs	844-6023	vctidwe@sandia.gov

Course Objectives

*Model*s is the second of three interdisciplinary courses in the core curriculum for the Master of Water Resources (MWR) degree. The principal objectives of this course:

- Develop an understanding of how a quantitative representation of physical, environmental and socio-economic phenomenon can be derived from a conceptual understanding of these phenomenon
- Introduce basic concepts in modeling water resources systems and related social behavior.
- Lean how analytic and numerical models of water resources phenomenon are developed, calibrated, and used
- Develop an appreciation of the utility and limitations of water resources models
- Provide practice in constructing cross-disciplinary hybrid models.
- Develop students' ability to make good technical presentations and write good technical reports. Desirable attributes of these presentations and reports include clarity, organization, and containing unambiguous, defensible conclusions.
- Learn to work in small groups on complicated technical assignments.

Materials

Recommended Texts

Modeling the Environment, by A. Ford (see www.islandpress.org/ford) (*ME*)
Dynamic Modeling, 2/e, by B. Hannon & M. Ruth (*DM*)
Elements of Physical Hydrology by Hornberger, George M.; Raffensperger, Jeff P

The first book (*ME*) has a website with software and exercises. The second book (*DM*) has a CD with STELLA software. STELLA is similar to PowerSim, the software that will be used in this class. Hornberger *et al.* will be used as a reference for the hydrologic portions of the course (Thomson and Tidwell). All of these texts will be placed on reserve.

Content

The course is divided into three topical segments, each taught by a single instructor:

- Surface Water Modeling—Dr. Thomson
- Ground Water and Ecosystems Modeling—Dr. Tidwell

- Economic/Behavioral Systems Modeling—Dr. Chermak

In addition, a written and oral communication component will be implemented throughout the course. This will consist of three major writing assignments in which students' will write technical reports describing their work to produce a surface water model, ground water model, and economic/behavioral model

Assignments

Each course segment will include a quiz, submittal of a written report, and a formal presentation. From time to time, there will be reading assignments and, possibly, homework to be turned in. The course will culminate in a final presentation that will require students to integrate model elements developed earlier in the semester.

Presentations will be made by pairs of students. The pairs will change with each presentation: that is, students will always present with a partner, but with a different partner each time.

Grades

Each course segment will count 25% towards one's final grade. Grading parameters will be announced by each instructor at the beginning of his/her segment.

Modeling Software

Students may have some familiarity with surface water (e.g. HEC HMS, HEC RAS) and ground water (e.g. MODFLOW); and input-output and optimization models for economics questions. Learning to use these specific models has the following limitations:

- Specific models change and/or become obsolete.
- Emphasis on "plug-and-chug" (get the model to run, plug in some numbers, get an answer, repeat) does not help students learn a general philosophy of modeling or how to construct a model.
- Combining models to model interdisciplinary phenomenon (ground water, surface water, human behavior, ecosystems) is very difficult.

To circumvent these difficulties general purpose dynamic simulation software (PowerSim http://www.powersim.com/) will be used in this class. This software is a general purpose dynamic simulation code that is widely used in environmental, ecological, economic and other types of applications. PowerSim is not a model, but rather is a modeling framework that can be use to represent almost any dynamic system. PowerSim does not solve the fundamental equations that describe a physical or socioeconomic phenomenon, but rather uses a combination of analytic and observational relationships to develop a quantitative understanding of the processes of interest. Although it may initially seem to be a black box approach to modeling, use of a dynamic simulation model requires a thorough understanding of the system being modeled and a quantitative relationship of the processes occurring in it. Sandia National Laboratories used this approach and this software to create a very powerful model of the middle Rio Grande that students may be familiar with.

PowerSim is installed on the computers in the WR computer lab. This is commercial software and may not be copied by students in the class.

References:

Green, C. (2003). Water Economics Principles and Practice, John Wiley and Sons, Chichester, England.

Griffin, R.C. (2006). Water Resource Economics: The Analysis of Scarcity, Policies, and Projects, MIT Press

Shaw, W. D. (2005). Water Resource Economics and Policy: An Introduction, Edwin Elgar, Northampton, MA.

Ford. A. (1999). Modeling the Environment: An introduction to System Dynamics Modeling of Environmental Systems, Island Press, Washington, D.C.

Wurbs, R.A., James, W.P. (2002). Water Resources Engineering, Prentice Hall, Upper Saddle River, NJ.

WR 572 – Models
Preliminary Schedule
Tuesdays & Thursdays, 5:00-6:45 p.m. Room 333, Dane Smith Hall

Date	Topic	Instructor
1/19	Introductions – course objectives, introduction to modeling, watershed description, Discussion of the course project & basin	All
1/21	Hydraulics of Pipelines	Thomson
1/26	Verhines presentation ?	Thomson
1/28	PowerSim Modeling	???
2/2	Surface Water Hydrology (SWH) - hydrologic cycle	Thomson
2/4	SWH – rainfall runoff relationships	Thomson
2/9	SWH – open channel flow	Thomson
2/11	SWH – flood hydrographs	Thomson
2/16	SWH – flood routing	Thomson
2/18	SWH – models, storm drainage	Thomson
2/23	SWH – **quiz**, work on hydrologic model	Thomson
2/25	SWH – class presentation of models	Thomson
3/2	Ground water hydrology (GWH) – introduction	Tidwell/Thomson
3/4	GWH – fluid flow through porous media	Tidwell
3/9	GWH – Darcy's law	Tidwell
3/11	Break	
3/16	Break	
3/18	GWH – GW budget/ GW management	Tidwell
3/23	GWH – eqns. of regional flow	Tidwell
3/25	GWH – SW/GW coupling	Tidwell
3/30	GWH – well hydraulics	Tidwell
4/1	GWH – **quiz**, work on ground water model	Tidwll
4/6	GWH – class presentation of model	Tidwell
4/8	Econ – intro to economics & human behavior	Chermak
4/13	Econ – incorporating behavior into public policy	Chermak
4/15	Econ – static optimization (unconstrained & constrained)	Chermak
4/20	Econ – static optimization	Chermak
4/22	Econ – dynamic models	Chermak
4/27	Econ – dynamic models	Chermak
4/29	Econ – dynamic models	
5/4	Econ – **quiz**, work on economics model	Chermak
5/6	Final presentations	---

Recommended Texts:

Modeling the Environment, by A. Ford (see www.islandpress.org/ford) GE45.D37 F67 1999

Dynamic Modeling, 2/e, by B. Hannon & M. Ruth QA76.9 C65 H35 2001

Elements of Physical Hydrology, by Hornberger, George M.; Raffensperger, Jeff P, GB661.2 E44 1998

Quotes to Live By:

If you generate data, nobody believes the results but you.
If you construct a model, everybody believes the results but you.

All models are wrong. Some models are useful.

5/31/10

WR 573 Course Description

WR 573 Field Methods Course
Summer, 2010

Bruce Thomson
(bthomson@unm.edu)

Introduction

WR 573, Field Methods, is the third of three required courses in the UNM Water Resources Program. It is intended to provide a capstone experience for students in the program to allow them to integrate knowledge gained in other classes in the curriculum, and to learn some of the basic skills used in field studies of water resources issues. Past classes have conducted studies in the U.S. (principally New Mexico), and Latin America (Mexico and Honduras). This document describes a course that will be taught during the early part of the summer, 2010 to be conducted on the Cimarron River, principally in Colfax County, NM.

The purpose of the Field Methods course is to learn the field and to a lesser degree the laboratory methods used in measurement and analysis of physical, chemical, and socioeconomic factors associated with watersheds. These methods are used to assess an actual watershed. The focus of the class during the summer of 2010 will be to evaluate the characteristics of the Cimarron River including: 1) surface water resources, 2) ground water recharge, and 3) stream and water quality characteristics. These changes are likely to have environmental, economic and cultural impacts as well and will be included in the study.

The proposed studies are briefly outlined below.

Proposed Investigations

Surface Water Resources:

- Stream flow measurements – measurements of the flow of the Cimarron River will be conducted at 9 or more locations along the stream including near the head waters, near the town of Cimarron, and near its confluence with the Canadian River near Springer, NM. The objective will be to determine its flow and whether it is a gaining or losing stream and to identify changes as the stream moves from the high elevations of the Sangre de Christo mountains to the plains of NM. Water diverted for irrigation districts and acequias will also be measured.
- Gaging station location – locations for long duration temporal studies will be identified. These may include sites for future stream gaging.

Ground Water Resources:

- Ground water-surface water interactions – sites will be identified for possible installation of shallow monitoring wells to investigate the relationship between surface and ground water. Wells in the vicinity of the community of Cimarron will be identified from State Engineer

records, and unrecorded wells will be identified. Emphasis will be on developing information to understand surface water-ground water interactions

- Ground water resources – information will be gathered to determine the hydrogeology of the ranch. This may include collection of data collected & published by state and federal agencies, examination of well logs filed with the Office of the State Engineer, identification of nearby water supply wells, and possibly measurement of ground water levels in these wells.
- Shallow monitoring wells – a limited number of shallow monitoring wells will be located near riparian vegetation projects (i.e. pole plantings and elk exclusion areas) to develop information on the hyporheic zone and the impacts of riparian vegetation.

Stream and Water Quality Characteristics

- Stream quality – the aquatic communities in the Cimarron River will be characterized using stream assessment procedures developed by the NMED and USEPA. These may include use of kick nets to collect invertebrates, characterization of stream bottom sediments, and other methods as appropriate.
- Water quality – water samples of the surface and ground water along the river will be collected and analyzed for major cations and anions, nutrients (N & P), and selected trace metals. Emphasis will be placed on parameters which cause non-attainment of the designated use of the Cimarron River as well as those parameters which affect possible re-introduction of native fish species.

Social, Economic and Institutional Considerations

- Economic considerations – information will be collected to establish a baseline of the economic benefits of range improvements
- Institutional constraints – information will collected to summarize the institutional constraints affecting water management in the watershed. These will include summaries of regulations and policies administered by the NM Office of the State Engineer, NM Environment Department, and other resource management agencies.
- Cultural considerations – the connection between residents of the valley and its water resources will be explored, particularly the importance of acequias.

Schedule

The duration of the project will be three weeks, two weeks at UNM and one week in the field. Activities during these weeks are as follows:

Week 1 (6/1 – 6/5) – At UNM – Preparation for the field campaign. Activities include assembling field equipment and learning how to operate it. Collecting available information on the watershed including data relevant to water resources, land cover and topography, and land ownership and management.

Week 2 (6/7-6/11) – In the Cimarron watershed – Field activities to measure water resources and characteristics of the watershed. Use of field instruments and meters, flow and water level measurements, sample collection, and other field surveys as appropriate

Week 3 (6/14 – 6/18) – At UNM – Analysis and interpretation of data collected during the course of the project. Preparation of a final report and project presentation.

A presentation describing the study and its findings will be prepared for possible presentation to the Cimarron Village Council, the Cimarron Watershed Alliance and other local soil and water conservation district, or other appropriate organization.

Logistics

The study team will consist of UNM WR graduate students, 2 UNM faculty, and undergraduate students from the UNM Biology Department.

UNM will provide its own food and transportation to the community. UNM will provide its own field and sampling equipment and sample containers. The team will stay at the Maxwell National Wildlife Refuge.

Final Product

The culmination of this project will be a report and formal presentation describing the current water resources and aquatic environment of the Cimarron River. The report will serve as a baseline for comparison of the impacts of future watershed improvements in the watershed. Recommendations and designs will be provided for long term monitoring programs related to water resources, stream quality, and surface water-ground water interactions.

WR 573 – Field Problems
Preliminary Schedule

Bruce Thomson – bthomson@unm.edu
Mehdi Ali – mehdiali@unm.edu

Week 1 – Planning & Preparation

Day & Time	Activity	Leader
6/1		
900-1100	Group meeting – Organization & objectives. Groups: • Mapping, GIS • History, policy (water rights), economics • Field preparation • Logistics – transportation, camping, food	Thomson
1300	Heidi Henderson – NMED SWQB	
1400-1700	Group work	
6/2		
900-1000	Group meeting – progress reports	
1000-1200	Flow measurement Sampling, preservation, field meters	Thomson
1330	Bill Fleming – Rapid Assessment	
1600-1700	Group meeting & progress report	
6/3		
900-1200	Stream assessment – Mark Stone	Mark Stone
1300-1400	Cimarron Watershed & Protection	Joanne Hilton
1400-1700	Field sampling & analysis methods	Mehdi Ali
6/4		
900-1200	EMAP Procedures	Thomson
1300-1700	Shopping, packing & loading	

Field Measurement Sampling & Analysis

Day & Time	Activity	Leader
6/7		
0800	Meet & load – UNM Centennial Engineering	
1200	Travel to Maxwell NWR - Arrive at 1200	
1300	Water quality & sediment sampling at Maxwell NWR	
1900	Dinner	
6/8		
0800	Cienguilla Creek – EMAP training	
1300	Upper Cimarron	
6/9		
0800	Upper Cimarron River	
1300	Cimarroncito Ranch	
6/10		
0800	Middle Cimarron River & Ponil Creek	
1700	Vermejo Rank	

6/11		
0800	Gaging & sampling of Vermejo River, Canadian River, confluence at Taylor Springs	
1330	Depart for UNM	

Week 3 – Analysis, Interpretation & Report Preparation

Day & Time	Activity	Assignment
6/14		
0900	Group Meeting • Review of trip • Assignments: Water quality, gaging/hydrology, mapping, water budget, economic & social factors, regulatory perspective	
1000-1700	Lab analyses, data analyses, report writing	
6/15		
0900	Status report	
1000 – 1700	Lab analyses, data analyses, report writing	
6/16		
0900	Status report	
1300	First draft due Group meeting to discuss conclusions & recommendations	
6/17		
0900	Status report – Receive comments on first draft	
1000-1700	Data analyses, report writing	
6/18		
1500	Final report due Final presentation	

Group Assignments

Mapping & GIS
- Create base map with streams, roads, towns
- Elevation
- Precipitation
- Vegetation
- Land ownership

Policy & Management Issues
- History of the basin
- Cultural features – acequias, tribes, etc.
- Government – federal state, local,
- Watershed groups
- Land use – ownership, development, etc.
- Water rights, adjudication,

Hydroscience Issues
- Surface hydrology – stream gages, precipitation,
- Ground water hydrology – major aquifers
- Water use
- Water quality issues
- Stream restoration activities

Logistics
- Assemble field equipment
- Field measurement methods
- Sample collection, preservation, storage methods
- Transportation
- Camping
- Food

Table of Contents and Abstract for Final Report, WR 573, Spring 2010

Water Resources Assessment of the Cimarron River

and

Evaluation of Water Quality Characteristics at the

Maxwell National Wildlife Refuge

Final Report

Editors:
Dr. Bruce Thomson
Dr. Abdul-Mehdi Ali

Water Resources Program
University of New Mexico
Albuquerque, NM 87131
(www.unm.edu/~wrp)
June 2010

Table of Contents

List of Figures

List of Tables

Abstract

During the second week of June 2010, the UNM Masters of Water Resources students, staff, and collaborators studied the Cimarron River watershed from its head waters above Eagle Nest Lake to its confluence with the Canadian River near Taylor Springs, NM, and the Maxwell National Wildlife Refuge (NWR) near Maxwell, NM. The investigation included measuring flows and water quality characteristics at 34 surface water sites in the two study areas. The main objectives of the study were to conduct a river assessment of the Cimarron River and evaluate water quality characteristics and playa lake sediment chemistry at the Maxwell NWR. It is expected that this report will serve as a basis for future research on the hydrology, water quality, and to a lesser extent, the socioeconomic characteristics of the river and its watershed and the Maxwell NWR. The report is divided into two sections, the first second describes the work done on the Cimarron River watershed and the second section describes work done at the Maxwell NWR.

The Cimarron River watershed drains 1,032 square miles and is located on the eastern slopes of the Sangre de Cristo Mountains in northeastern New Mexico, originating in mountains with elevations over 12,000 feet above sea level. The Cimarron River then flows eastward onto the eastern plains of New Mexico, draining into the successively larger Canadian and Arkansas Rivers, which ultimately flows into the Mississippi River.

The principal source of water supply in the watershed is surface water, and most is used for agricultural activities consisting of irrigation and livestock watering. Drinking water is supplied almost entirely by ground water except for the communities of Cimarron, Miami and Springer. Raton, located outside of the watershed, also supplements its drinking water supply with surface water from the Cimarron watershed

Six reaches of the Cimarron River and one reach of Rayado Creek were subjected to intensive evaluation using EPA's Environmental Monitoring Assessment Program (EMAP) protocol. Data was collected and analyzed concerning the hydrology, geomorphology, riparian vegetation, human impacts, benthic macroinvertebrates, and water quality. In addition, flow measurements and water quality samples were taken at 24 other locations within the basin.

This assessment found generally high quality conditions of the river and riparian environment throughout the Cimarron River. This conclusion was supported by the type and diversity of benthic macroinvertebrates, by channel geomorphic criteria, and by water quality measurements. Electrical conductivity, an indirect measure of salinity, was found to increase as the river flows onto the eastern plains; the source was not identified. The water in the river is hard and is dominated by calcium, magnesium and sulfate ions. It is recognized that this assessment was done near the peak of spring runoff; it is likely that low flow conditions later in the summer will present environmental stresses to the system. Low but measurable concentrations of nitrates were found throughout the watershed with the highest concentrations occurring in samples collected near a residential area and golf course in Cieneguilla Creek near the town of Angel Fire.

Recommendations are included for further studies to quantify stream flows and diversions in the watershed to gain a better understanding of water use. Information is also needed on the

seasonal concentrations of chemical constituents in the river and its tributaries to understand the impact of development, especially that associated with non-residential vacation homes and potential development of coal bed methane.

The water quality in lakes and irrigation ditches at the Maxwell NWR was of generally high quality and dominated by calcium, magnesium and sulfate salts. Salt crust collected on the surface of a dry playa lake contained high concentrations of calcium, magnesium, sodium, and sulfate ions. Slightly elevated selenium concentrations were detected in sediment samples collected from a playa lake at the refuge. However, selenium concentrations in lake water and irrigation ditch samples were less than 1 µg/L.

Appendix III – Listing of UNM Water Related Classes, Spring 2010 and Fall 2010

Water Related Classes Offered at UNM – Fall 2010

This is a partial list of classes that will be of interest to graduate students in the Water Resources Program, as well as students in other programs who are interested in studying topics related to the management, policy, science and engineering of water resources. Send additions or corrections to Annamarie Cordova (acordova@unm.edu) with a copy to Bruce Thomson (bthomson@unm.edu).

Course No.	Title	Description	Instructor	Time
Biology				
Biology 535 AOA EPS 535	Freshwater Ecosystems	This course looks at the interface between hydrology and aquatic ecology. Basic concepts in hydrology and aquatic ecology will be presented followed by examination of current research in ecohydrology and hydroecology.	Dahm	F 1100-1400
BIOL 502-013 (1 credit)	Algal Biofuels	It will be a combination of discussing journal articles, guest lectures, and lectures on algal physiology as needed.	Hanson	TR 1400-1500
BIOL 402/502	Global Change Biology	Explores the causes and consequences of global change from the biological perspective	Litvak	TR 1400-1515
Chemistry				
AOA WR 595	Environmental Chemistry		Cabaniss	TR 1530-1645
Chem & Nucl. Engr.				
ChNE 539 (AOA CE 539)	Radioactive Waste Management	Intro. to the nuclear fuel cycle emphasizing sources, chars., & mgt. of rad. wastes. Types of radiation, rad. decay calcs., shielding reqts. Radwaste mgt. technologies. Non engineers welcome	Busch	MW 1600-1715
Civil Engr.				
CE 331	Fluid Mechanics	Basic principles of fluid mechanics including pressure distributions, fundamental flow equations, scaling, and pipeflow.	Stone	MWF 1000-1050

Course No.	Title	Description	Instructor	Time
CE 441/541 AOA EPS 462/562	Hydrogeology	Introduction to the hydraulics and hydrology of ground water	Weissmann	TR 1500-1615
CE 442/542	Hydraulic Engineering & Hydrology	Design of water distribution systems & open channels; selection of pumps & turbines; hydraulics of wells; basic engineering hydrology including precipitation, infiltration, runoff, flood routing, statistical measures & water resources planning	Coonrod	TR 1100-1215
CE 531	Physical-Chemical Water & Wastewater Treatment	Theory and design of common physical-chemical treatment processes including coagulation, flocculation, sedimentation, granular filtration, membrane filtration, and disinfection. Also covers conservation of mass, reactor design, and tracer testing.	Howe	TR 1530-1645
CE 539 (AOA ChNE 539)	Rad. Waste Management	See ChNE 539	Busch	MW 4-5:15
CE 436/536	Biological Wastewater Treatment	Principles of biodegradation processes with application to wastewater treatment.	Andrew Schuler	TR 9:30 - 10:45 AM
CE 549	Vadose Zone Hydrology	This class focuses on the properties and behavior of water in the vadose or unsaturated zone. There are numerous important applications of vadose zone hydrology, including topics as diverse as flow of contaminants to groundwater; recharge of groundwater supplies; agricultural irrigation; and the influence of water on the stability of slopes and other earth structures.	Stormont	MW 2:00 - 3:15 PM
CE 491/598	Industrial Ecology	This course is an introduction into techniques and methods for exploring and quantifying the environmental impact of, and minimizing pollution from, products and industrial systems.	Howe	MW 1400-1515
CE 545	Open Channel Hydraulics	Application of fluid mechanics principles to open channels including uniform flow, gradually varied flow, flood routing, hydraulic models, and channel design.	Stone	TR 1400-1515
CE 598-015	Water Resources of NM	This course will conduct a quantitative survey of the surface & ground water resources and water use in the state. Water budgets will be developed for each major basin	Thomson	TR 1400-1515
Community & Regional Planning				

Course No.	Title	Description	Instructor	Time
CRP 570	Modeling the Environment	Simulation modeling of natural systems, focusing on watersheds and natural systems.	Fleming	T 10:00 - 12:30 PM
CRP 515	Natural Resources Planning Field Methods	In cooperation with the Santa Fe NGO Earth Works Institute, this course teaches applied rapid assessment techniques for analyzing the relative health of natural systems, land use suitability, and monitoring for ecological impact. The skills presented (forestry, grassland, and riparian health assessment) are designed to allow students to re-translate quantitative findings into qualitative terms with a community audience.	Henkel	Offered during the month of October as a compressed/ intensive course
Earth & Planetary Sci.				
EPS 462/562 AOA CE 441/541	Groundwater Hydrology	Groundwater Hydrology	Weissmann	TR 3 - 4:15 PM
EPS 545				
EPS 436/536	Climate Dynamics	A quantitative survey of climate science principles (prerequisites: one semester physics and one semester calculus). This course is listed in the 'Climatology' category in Group I (hydroscience) of the WRP curriculum.	Gutzler	TR 9:30 – 10:45 AM
EPS 415/515	Geochemistry of Natural Waters	This course covers aqueous geochemistry as an interdisciplinary topic that relates geological, chemical, hydrological and biological processes in ways that are increasingly relevant to a variety of water-related issues. This course lays a foundation for understanding and using aqueous geochemistry in a diverse set of applications	Crossey	MWF 10 - 10:50 AM
EPS 481/581	Geomorphology and Surficial Geology	Processes and history of landform development with emphasis on weathering, soils, hillslopes, drainage basins, and fluvial systems; frequent field trips during lab time to conduct research including a major project on Jemez River geomorphology and hydrology.	Meyer	TR 11-12:15, Lab:T 1:00-5:00
EPS 516	Fluvial Geomorphology	A graduate seminar covering quantitative processes and resulting landforms of streams, with relevance to understanding human and natural influences on fluvial systems and stream renaturalization.	Meyer	W 1400-1650

Course No.	Title	Description	Instructor	Time
EPS 428/528	Appl. Math for Earth & Environ. Scientists	This class provides a low-stress, hands-on introduction to vector calculus and differential equations with applications to hydrology, geophysics, and atmosphericsciences.	Galewsky	TR 1230-1345
Economics				
ECON 542	Environmental and Natural Resource Economics: Survey	Suggested Policy/Management course	Chermak	M 1:00 - 3:30 PM
Geography				
Geog 463/563	Public Land Management	History of public lands and their development in the United gain a basic understanding of the current types of public lan designations, including Bureau of Land Management lands, Forest Service Lands, National Conservation Areas and Nat Parks; and explore current public land management challen facing New Mexico and other states in the West, including protection of biodiversity, oil and gas development, grazing recreational use.	Benson	TR 4:00 - 5:15 PM
Geog 461/561	Environmental Management	Gain a basic understanding of environmental laws and regulations, including how they are created and enforced; apply existing environmental laws and regulations to natural resource issues in problem-based learning opportunities, with a focus on environmental challenges relevant to New Mexico and the region; and increase their critical thinking skills with regard to natural resource problems.	Benson	TR 12:30 – 1:45 PM
GEOG 581	GIS Fundamentals			MW 1730-1845
GEOG 586	Applications of GIS			MW 1600-1715
Law				
Law 547	Water Law	Water Law deals with the laws and institutions governing water allocation and use, with an emphasis on water rights. The primary focus is on the Western United States, particularly the prior appropriation doctrine and state laws dealing with groundwater use. The course also deals with interstate water disputes and the water rights of federal and tribal lands.	Benson	TBA

Course No.	Title	Description	Instructor	Time
Law 545-001	Western Water Policy	This seminar will consider subjects such as water transfers, tribal water rights, the interrelationship of water quality and water allocation schemes, the role of the federal and state governments, the protection of biodiversity in aquatic ecosystems, and groundwater policies.	Fort	MW 1300-1415
Law 593-009	Climate Law & Energy	The course will cover climate science, methods to mitigate & adapt to climate change, international issues (Kyoto Protocol etc.), and domestic issues. Legal issues will consider existing & proposed laws, tort actions & court cases.	Guana (gauna@law.unm.edu)	MWF 1100-1150
Public Health				
PH 502	Epidem. Methods I	This course provides an overivew of the methods used in epidemiologic research as they are integrated into the practice of public health.	Tollestrup	TR 1315-1515
Water Resources				
WR 571	Contemporary Issues	Students examine contemporary issues in water resource systems, including water quality; ecosystem health; stakeholder concerns; economics; & water supply, policy, management & allocation	Brookshire, Thomson	TR 1530-1815

11/2/9

Water Related Classes Offered at UNM – Spring 2010

This is a partial list of classes that will be of interest to graduate students in the Water Resources Program, as well as students in other programs who are interested in studying topics related to the management, policy, science and engineering of water resources. Send additions or corrections to Annamarie Cordova (acordova@unm.edu) with a copy to Bruce Thomson (bthomson@unm.edu).

Course No.	Title	Description	Instructor	Time
Biology				
Biol 495	Limnology	Chemistry, physical and biological components of lakes and rivers	Bixby	MWF 1100-1150 F 1400-1700
Chemistry				
Civil Engr.				
CE 335**	Intro. to Water & Wastewater Trt.	Basic design concepts of water & wastewater treatment. Flow rates, characterization of water, materials, balances, coagulation, flocculation, filtration, sedimentation, biological trt., & disinfection	Schuler	MWF 0900
CE 440/540	Des. of Hydr. Systems	Applications of the principles of fluid mechanics to the design & analysis of pipe systems. Topics include pipe network analysis, design & selection of hydraulic machinery and analysis of transient & compressible flow	Thomson	MWF 1300
CE 437L/537L	Aq. Envi. Chem. & Analysis	Intro. to water chemistry and analytical methods used in lab & field research	Undetermined	TR 1530-1645
CE 542	Intermed. Hydrology	Rainfall runoff relationships, flood routing, urban hydrology, groundwater analysis & utilization	Coonrod	TR 1400-1515
CE 547	GIS in Water Resources Engineering	Principles & operation of GIS using ArcGIS, work with surface & subsurface digital representation of the environment considering hydrologic & transport processes	Coonrod	MW 1000-1115
CE 598	River Restoration		Stone	MW 1600
Community & Regional Planning				
CRP 527	Watershed Management	The watershed as a planning unit, with case studies to	Fleming	T 1400-1630

		illustrate the formulation of plans for protection and rehabilitation.		
CRP 532 001	Found of Natural Resources Planning	Environmental planning principles, with emphasis on water and land evaluation for land use suitability.	* Fleming, W	W 0930-1200
Earth & Planetary Sci.				
EPS 437/537	Applied Meteorology	Analysis and prediction of weather systems; weather observing techniques; application of conceptual and numerical models; simple kinematic and dynamic constraints; applications to prediction of wind, fire, and hydrological processes.	Galewsky	TR 1400-1515
EPS 476-576 (AOA) WR 576	Physical Hydrology	Quantitative treatment of the hydrologic cycle - precipitation, evapotranspiration, infiltration, runoff and subsurface flow, global change and hydrology, catchment and hillslope hydrology, hydrologic system - ecosystem interactions, hydrology and water resources management. Prerequisites: Upper-division standing. Math 163L and Physics 160, or permission of instructor.	Weismann	TR 1530-1645
Environmental Science				
ENVS 430/530	Adv. Env. Sci.	Application of basic science to the nterdisciplinary study of environmental systems. Causes of and solutions to land, air, water and ecosystem degradation	Crossey	TR 1100-1215 W 2-5
Economics				
ECON 543 001	Natural Resource Economics	Models of natural resource utilization. Fossil fuels, hard rock minerals, fisheries, forest resources, groundwater and surface water.	* Chermak, J	W 1600-1830
ECON 544 001	Environmental Economics	Causes and consequences of environmental externalities. Design and implementation of alternative policy instruments. Theory and methods to measure economic value of market and non-market environmental services.	* Berrens, R	TR 1400-1515
ECON 545 001	Water Resources II Models	(Also offered as WR 572.) Use of technical models in water resources management addresses conceptual formulation and practical application of models from administrators perspective. Lab focuses on use of graphic aids to explain technical information.	* Thomson, B	TR 1700-1845
Geography				

GEOG 514 011	Sem: Nat Res Management	This course explores the interdisciplinary nature of natural resource challenges. Topics will vary each semester. Field trips will be included to investigate issues relevant to the class.	* Benson, M	W 1730-2000
GEOG 562 001	Water Resources Management	An examination of the problems and trends in the use of water resources in the United States, with emphasis on the physical and social aspects related to its management.	* Matthews, O	TR 1230-1345
Law				
LAW 580 001	Environmental Law		* Fort, D	Arranged
LAW 593 010	T: Federal Law:Water Resources		* Benson, R	Arranged
Math, Sci, Env & Tech Ed				
MSET 525 001	Multicultural Env Ed	This course studies various cultural perspectives as they apply to the natural and human environment and to explore their specific influences on environmental education pedagogy.	* Spurlin, Q	W 1600-1830
Public Health				
Water Resources				
WR 572 (AOA Econ 545)	Water Resources II-Models	Practical aspects of the different technical models used by water resource professionals; hydrological, economic, ecological, etc.	Thomson, Chermak,	TR 1700-1845
WR 576 (AOA E&PS 576)	Physical Hydrology	Quantitative treatment of the hydrologic cycle - precipitation, evapotranspiration, infiltration, runoff and subsurface flow, global change and hydrology, catchment and hillslope hydrology, hydrologic system - ecosystem interactions, hydrology and water resources management. Prerequisites: Upper-division standing. Math 163L and Physics 160, or permission of instructor.	Weissmann	TR 1530-1645

Appendix IV - Results of Strategic Planning

UNM Water Resources Program Planning Retreat

February 5, 2010 • Spiritual Renewal Center, Albuquerque

Summary of the Discussion

Twelve faculty of the UNM Water Resources Program (WR) met for a one-day planning retreat on February 5, 2010, with the following objectives:

- To review the program in the context of four years with Bruce Thomson as the director;
- To set out a 5-year vision for the program.
- To define the "way forward."

The retreat began with a full report of the program's status by the program director. This was followed by a discussion of the program's strengths and accomplishments, as well as suggestions for improvements.

With this information and the respective views of the participants in mind, the group outlined a set of six 5-year goals, which collectively represent a "practical vision" of a preferred future. The goals for 2015 are:

- **WRP will have an organizational "home" that appreciates the value of graduate interdisciplinary studies;**
- **A physical home for the Water Resources Program;**
- **The Provost supports faculty and student lines of revenue;**
- **A New Mexico Universities Consortium;**
- **A Water Resources Research Program—and more publishable research produced; and**
- **More flexibility within the degree programs**

The program director, Bruce Thomson, summarized the retreat by stating that the goals provided him with a strong platform for moving forward, and that he can advocate for these goals with the confidence that there is broad support for them.

The following summary presents the results and agreements of the retreat under the following sections:

- *WRP Review Discussion Comments*—Comments on the program's strengths, and suggestions for improvements;
- *Five-Year Practical Vision*—A chart outlining the six major goals and the ideas that led to their identification.
- *WRP's 2010-15 Vision*—The five-year practical vision in a different format: Information from the chart is presented as a set of goals in narrative form.

WRP Review Discussion Comments

Following the presentation on the WRP's status by the program director, and before identifying five-year goals, the retreat participants engaged in a general discussion informally reviewing and evaluating the program. Two categories of comments were collected: Program Strengths/Accomplishments; and Suggestions for Improvements

Recorded comments under each topic are listed below.

Program Strengths, Accomplishments	**Suggestions for Improvements**
•WRP is a degree program. •Clearly defined interdisciplinary nature of the program: Hydroscience, environmental studies, and policy components. •Dual degree options. •Approximately 100 graduates, an estimated 2/3 of whom are still in New Mexico. •Students who are drawn to the program are dedicated to it—are reformers. •Some of the best student workers are in WRP—they "stick with it" (their projects and work). •WRP is a cohesive point of contact for the Utton Center. •WRP has strong communication and linkage with the community. •The Field Measurements Course: --doing it within New Mexico --getting more recognition within the state, e.g., 80 people at the Sapello presentation. •More program visibility: more grads are in visible jobs; faculty serve on boards and commissions. •Willingness to take on controversial issues. •Water, and WRP, are critical to the state's future. •Support from UNM ($100,000). •Intellectual contributions from students, e.g., K.T. Labadie, Kelly Collins.	•WRP should have one, not two, tracks. The Policy Track needs greater definition. •Increase WRP recognition around the state. •Increased funding from UNM. •"Academic diversity" (passionate students, with a range of adequate preparation) is a mixed blessing for the program. We need to determine whether to require more from all students. •Conduct a survey of students and alumni to determine current and future needs. (This may be a focus group.) Convene a customer focus group, too. •Update aging field equipment. •Clarify the expectations, selection criteria and external funding r professional projects. •Develop a network of stakeholder groups and the type of student outcomes needed. •Create/take advantage of cross-university collaboration opportunities. •Develop a water resources research program. •Find a more supportive university "home." •Increase external funding—there is a lack of support or incentive for moving. •Collect tracking data on student/grads. •WRP must "grow" (in reputation and funding, not necessarily number of students or faculty) or it will become marginalized.

UNM Water Resources Program Planning Retreat • February 5, 2010

Five-Year Practical Vision: *"What do we see having in place by 2015?"*

(Major agreements are in bold at the top of each column; back-up, additional & provisional ideas are in bullets beneath.)

An Organizational Home that Appreciates the Value of Graduate Interdisciplinary Studies	**The Water Resources Program has a Physical Home**	**The Provost supports Faculty and Student Lines of Revenue**	**New Mexico Universities Consortium**	**A Water Resources Research Program—and more Publishable Research**	**More Flexibility within the Degree Programs**
• An organizational home—redefined and interdisciplinary, possibly in University College. • We are located in a college of interdisciplinary studies. • An Environmental Institute at UNM. • WR facilitates cross-campus research projects	• Physical space for WRP.	• A cost-sharing and rewards mechanism. • Funding of WRP comes from the Colleges. • Joint appointments and/or dedicated WRP faculty. • Provost-level support.	• New Mexico Universities Consortium.	• More rigorous project research. • Funded graduate student positions. • A student chapter of AWRA. • A Ph.D. program.	• A more flexible degree-granting mechanism.

The Water Resources Program's 2010-2015 Vision

Goal #1: An organizational home that appreciates the value of graduate interdisciplinary studies. Faculty appointments and overall program administration at UNM are done according to department (and discipline). As an interdisciplinary program, the WRP does not command the full fiscal or administrative attention of any department of college. To be sustainable, the WRP will redefine its place within University College or find another administrative "home" that aligns with its curricular objectives and fiscal requirements.

Back-up and additional ideas and considerations:

- An organizational home—redefined and interdisciplinary, possibly in University College.
- We are located in a college of interdisciplinary studies.
- An Environmental Institute at UNM.
- WR facilitates cross-campus research projects

Goal #2: The Water Resources Program has a physical home. The WRP will have sufficient space to co-locate faculty and create a sense of a community for faculty and students.

Back-up ideas and considerations:

- A physical space for the WRP.

Goal #3: The Provost supports faculty and student lines of revenue. Sustainability for WRP requires upper-level support for creating official lines of revenue, including joint appointments, cost sharing among departments, colleges and schools, and supporting graduate and post-graduate research. The WRP will work with the Provost and other University administrators to create fair and effective means of creating faculty and student lines.

Back-up and additional ideas and considerations:

- A cost-sharing and rewards mechanism.
- Funding of WRP comes from the Colleges.
- Joint appointments and/or dedicated WRP faculty.
- Provost-level support.

Goal #4: A New Mexico Universities Consortium. WRP will work to create a water resources-related consortium that includes other New Mexico universities.

Back-up ideas and considerations:

- A New Mexico Universities consortium.

Goal #5: A Water Resource Research Program—and more publishable research. The WRP will emphasize the importance of producing high quality work, and will encourage students and faculty to increase the conduct and publication of research.

Back-up and additional ideas and considerations:

- More rigorous project research.
- Funded graduate student positions.
- A student chapter of AWRA.
- A Ph.D. program.

Goal #6: More flexibility within the degree programs. Faculty will continue to bring innovation to the curriculum and the pathways students may take or create to obtain a robust, interdisciplinary degree.

Back-up ideas and considerations:

- A more flexible degree-granting mechanism.

Appendix V – Resumes of Key Water Resource Program Faculty

Bruce M. Thomson
Director, UNM Water Resources Program
Professor, UNM Department of Civil Engineering
(bthomson@unm.edu)
Water Resources Program MSC05-3110
University of New Mexico
Albuquerque, NM 87131
505-277-5249

Civil Engineering MSC01-1070
University of New Mexico
Albuquerque, NM 87131
505-277-4729

A. Professional Preparation

Humboldt State College, 1967 to 1969
University of California at Davis, Civil Engineering, B.S., 1971
Rice University, Houston, TX, Environmental Science & Engineering, M.S., 1974
Rice University, Houston, TX, Environmental Science & Engineering, Ph.D., 1979
Licensed Professional Engineer, State of New Mexico, no. 7131

B. Appointments:

2006-present	Director, Water Resources Program, University of New Mexico
1994-present	Professor, Department of Civil Engineering, University of New Mexico
1982-1994	Associate Professor, Dept.of Civil Engineering, University of New Mexico
1995-1996	Visiting Prof., Sandia National Laboratories, Albuquerque, NM
1978-1982	Assistant Professor, Dept. of Civil Engineering, University of New Mexico
1985-1986	Visiting Prof., Envir. Engr. Branch, HQ Air Force Engr. & Services Center Tyndall AFB, FL
1977-1978	Visiting Assistant Professor, Environmental Science & Engineering Rice University, Houston, TX
1973-1974	Environmental Engineer, USEPA, San Francisco, CA

C Publications

Thomson, B.M. (2010). Water Resources of New Mexico, book chapter in Water Policy and Management Issues: Science, Modeling, Institutions and the Future, Edited by Brookshire, Gupta, Matthews (Susan Kelly, co-author of a chapter on the effect of water rates on water conservation), to be published by RFF.

Liang, H.C.; Thomson, Bruce M. (2008). Minerals and Mine Drainage, Water Environment Research, Literature Review, 1481-1509.

Thomson, B, Howe, K. (2009). Saline Water – Considerations for Future Supply in New Mexico, Water, Natural Resources, and the Urban Landscape: The Albuquerque Region, L.G. Price et al. eds. NM Bureau of Geol. and Min. Resources, Socorro, NM p. 120-126.

Thomson, B.M., Smith, C.L., Busch, R.D., Siegel, M.D., Baldwin (2003). "Removal of Metals and Radionuclides Using Apatite and Other Natural Sorbents," J. Environ. Engr., vol. 129, pp. 492-499.

Thomson, B.M., Cotter, T.J., Chwirka, J.D. (2003). "Design and Operation of a Point-Of-Use Trt. System for Arsenic Removal," Tech. Note. J. Environ. Engr., vol. 129, pp. 561-564.

Chwirka, J.D., B.M. Thomson, J.M. Stomp III. "Removing Arsenic From Groundwater," J. Am. Water Works Assoc., vol. 92, issue 3, pp. 79-88, (2000).

DeJohnghe, P.A., Clarke, A.N., Exner, J.H., Hansen, K.F., Lighty, J.S., Samelson, R.J., Steindler, M.J., Thomson, B.M., (1999). The State of Development of Waste Forms for Mixed Wastes, Natl. Academy Press, Washington, D.C., 129 p

Brown, K.D., Kulis, J., Thomson, B., Chapman, T.H., Mawhinney, D.B. (2006). "Occurrence of antibiotics in hospital, residential, and dairy effluent, 2 municipal wastewater, and the Rio Grande in New Mexico, Science of the Total Environment, vol. 336, pp. 772-783.

Frost, F.J., Muller, T., Petersen, H.V., Thomson, B., Tollestrup, K. (2003). "Identifying US Populations for the Study of Health Effects Related to Drinking Water Arsenic," J. of Exposure Analysis and Environmental Epidemiology, vol. 13, pp. 231-239.

Hanson, A., Zachritz, W., Polka, R., Mimbela, L.-E., Thomson, B. (2003). "Alternative Small-Flow Wastewater Technologies in the Arid Southwest," Small Flows Quarterly, vol. 3, no. 3, pp. 32-37.

Frost, F.J., Chwirka, J.D., Craun, G.F., Thomson, B.M., Brown, K.G., Stomp, J. (2002). "Physical Injury Risks Associated with Drinking Water Arsenic Treatment," Risk Analysis, vol. 22, pp. 235-243Tucker, M.D., Barton, L.L., Thomson, B.M., "Reduction and Immobilization of Molybdenum by *Desulfovibrio desulfuricans*," J. Environmental Quality, vol. 26, pp. 1146-1152, (1997).

Reith, C.C., Thomson, B.M., (editors), Deserts As Dumps?: The Disposal of Hazardous Materials in Arid Ecosystems, University of New Mexico Press, Albuquerque, NM, 330 p., (1992).

D. Synergistic Activities:

- Development of treatment methods and technology transfer for arsenic removal from drinking water. Short courses offered to USPHS and Am. Water Works Assoc.
- Appointments to state and national advisory & review committees on radioactive and hazardous waste management, ground water protection, and environmental engineering
- International research & training on the geochemistry, treatment, and management of mine and mill waste materials (tailings).

E. Collaborators & Other Affiliations

Collaborators and Co-Editors

Pat Brady (Sandia National Labs), Joe Chwirka (Albq. Bernalillo County Water Utility Authority), Floyd Frost (Lovelace Respiratory Research Inst.) , Kerry Howe (UNM), Jerry Lowry (Lowry Environmental Engineers), Stephen Cabaniss (UNM).

Graduate Advisors

Kessick, M. (M.S.) – Alberta Research Council, Edmonton, Alberta
Tomson, M. (Ph.D.) – Rice University, Houston, TX

Recent Graduate Thesis/Project Advisees (>120 students supervised)

Martinez, Louis – Master of Water Resources (2009), Wollak, Jordan – Master of Water Resources (2009), Schultz, Krista – Master of Water Resources (2008), Arviso – MSCE (2007), Johnson, David – MSCE (2006), Aragon, Alicia – Ph.D., Civil Engr. (2004), Anderson, Jeremy – MSCE (2004),

Melinda Harm Benson, Assistant Professor
Department of Geography
Bandelier Hall West Room 223
MSC01 1110
1 University of New Mexico
Albuquerque, NM 87131-0001
Phone: 1-505-277-1629
FAX: 1-505-277-3614
mhbenson@unm.edu
http://www.unm.edu/~mhbenson

Professional Preparation

B.A., UNIVERSITY OF OREGON, 1991, *Magna Cum Laude*
J.D., UNIVERSITY OF IDAHO COLLEGE OF LAW, 1998, *Summa Cum Laude*

Appointments and Professional Background

Assistant Professor, 2008-present
UNIVERSITY OF NEW MEXICO, GEOGRAPHY DEPARTMENT

Lecturer and Research Scientist, 2004-08
UNIVERSITY OF WYOMING, HAUB SCHOOL AND RUCKELSHAUS INSTITUTE OF ENVIRONMENT AND NATURAL RESOURCES

Staff Attorney, 2002-04
WESTERN RESOURCE ADVOCATES

Natural Resources Law Institute Fellow and Adjunct Faculty, 2001-02
LEWIS & CLARK LAW SCHOOL

Law Clerk, 1998-99.
UNITED STATES COURT OF APPEALS FOR THE NINTH CIRCUIT

State Affairs Director and Lobbyist, 1992-95.
IDAHO CONSERVATION LEAGUE

Publications

Benson, M. H. and A. S. Garmestani (2010) "Embracing Panarchy, Building Resilience and integrating adaptive management through a rebirth of the National Environmental Policy Act," *Journal of Environmental Management* In press.

Benson, M.H. (2010) "Regional Initiatives: Scaling the Climate Response and Responding to Conceptions of Scale," Annals of the Association of American Geographers (2010 Special Issue on Climate Change) In press.

Benson, M.H. (2010) “Adaptive Management Approaches by Resource Management Agencies in the United States: Implications for Energy Development in the Interior West,” *Journal of Energy & Natural Resources Law* 28 (1) 87-118.

Benson, M.H. (2010) “Legislative Reallocation: How Compliance with Federal Legislative Initiatives including the Endangered Species Act Results in the Redistribution of Water Resources,” *Journal of Contemporary Water Research and Education* 144 (1-7).

Benson, M.H. (2009) "Integrating Adaptive Management and Oil and Gas Development: Existing Obstacles and Opportunities for Reform," *Environmental Law Reporter* 39: 10962-78.

Benson, M.H. “The Tulare Case: Water Rights, the Endangered Species Act, and the Fifth Amendment,” *Environmental Law 32: 551-587 (2002).*

Benson, M.H. 2010 “The Policy Arena: Removing Roadblocks for Conservation on Public Lands in the United States” in *Energy Development & Wildlife Conservation in Western North America*. David Naugle, ed. Island Press: Washington, D.C. In Press.

Courses

Geog 463/563, Public Lands
Geog 461/561, Environmental Management
Geog 365, Nature and Society
Geog 514, Seminar in Natural Resource Management

Synergistic Activities

Presenter and Session Organizer. Collaborative Adaptive Management Network Annual Rendezvous, Tucson, AZ. 9 March 2010.

Workshop Organizer and Facilitator. Water, Climate and Drought Workshop. University of Wyoming Ruckelshaus Institute of Environment and Natural Resources. Laramie, Wyoming. October 10, 2008.

Workshop Facilitator. Research Needs and Management Strategies for Pallid Sturgeon Recovery. University of Wyoming Ruckelshaus Institute of Environment and Natural Resources. St. Louis, Missouri. July 31–August 2, 2007.

Founding Member, Transdisciplinary Research Group, University of New Mexico, 2008-present.
Collaborators
Cliff Dahm, University of New Mexico, Department of Biology; Julie Coonrod, University of New Mexico, Civil Engineering; Ahjond Garmestani, U.S. Environmental Protection Agency; Susan Kelly, University of New Mexico, Utton Transboundary Resources Center; Fred Ogden, University of Wyoming, Department of Civil Engineering; Scott N. Miller, University of Wyoming Department of Renewable Resources; Grant Meyer, University of New Mexico, Earth & Planetary Sciences; Mark Stone, University of New Mexico, Department of Civil Engineering.

Reed D. Benson
Professor
University of New Mexico School of Law
505-277-1119
benson@law.unm.edu

Academic Experience

University of New Mexico School of Law, Albuquerque, NM, 2008. *Professor*. Hired as full professor with tenure, beginning in the 2008-2009 academic year. Serve as faculty advisor to the Natural Resources Journal (NRJ). Teach Water Law, Natural Resources Law, Administrative Law, Federal Law of Water Resources, and a writing seminar for NRJ students. Serve on various School of Law committees (Curriculum co-chair, 2009-10).

University of Wyoming College of Law, Laramie, WY, 2002 – 2005, *Assistant Professor;* 2005 – 2008, *Associate Professor;* 2008, *Professor.* Taught Administrative Law, Legislation, Water Law, Environmental Law, and Federal Law of Water Resources (seminar). Researched and wrote scholarly materials, emphasizing environmental aspects of water resources law and policy. Advised students, particularly those interested in environmental, nonprofit, and government work. Served on various College of Law committees and on the UW School of Environment & Natural Resources Faculty Advisory Committee. Advised the Wyoming Law Review, Natural Resources and Environmental Law Club, the environmental moot court competition, and law review casenotes and comments regarding environmental and natural resources law topics. Named Winston S. Howard Distinguished Professor in 2006.

Northwestern School of Law, Lewis & Clark College, Portland, OR, January – May 2000. *Adjunct Professor.* Taught water law to a class of 50 second- and third-year students.

Other Professional Experience

WaterWatch of Oregon, Portland, OR.
August 1997 – June 2002, *Executive Director.* Duties: Raised funds, oversaw programs, managed personnel, and provided strategic direction for a nonprofit river conservation group with a budget of approximately $500,000 and a full-time staff of seven people. Served as primary spokesperson for WaterWatch in working with the media and legislature. Coordinated the Western Water Project, a joint venture of WaterWatch and Trout Unlimited that sought to protect instream flows throughout the West by working at the state and federal levels. Served on several state-level task forces.
October 1993 – July 1997, *Reclamation Issues Director*. Duties: Sought improved streamflows in the Umatilla River by working with state and federal officials, irrigators and Indian Tribes. Advocated agency action at the local, regional and national levels to correct the unauthorized use of water from federal irrigation projects. Pursued opportunities for environmental gains through changes in the use of federal project water, working with other conservationists and with federal and state agencies.

Land and Water Fund of the Rockies, Boulder, CO, June 1992 - September 1993. *Staff attorney*. Duties: Represented Idaho conservation groups in adjudication of rights to use water in the Snake River Basin. Sought resolution of toxic pollution issues on behalf of low-income Latino groups in

Questa and Albuquerque, New Mexico. Coordinated program of free legal assistance for conservation groups in Utah and Arizona. Advised conservation groups in seven states on a broad range of matters involving state and federal environmental laws.

U.S. Environmental Protection Agency, Washington, DC, January 1990 - May 1992. *Attorney Advisor*. Duties: Served as Congressional liaison for Assistant Administrator for Pesticides and Toxic Substances. Worked with federal officials, congressional staff and interest groups on legislative and oversight matters involving pesticides and commercial chemicals. Represented EPA in international trade negotiations under the General Agreement on Tariffs and Trade (GATT) and North American Free Trade Agreement (NAFTA). Received EPA Gold Medal (for work on NAFTA), 1992; Assistant Administrator's Award (for pesticides program funding bill), 1991; Silver Medal (for 1990 Farm Bill), 1990.

Hutchinson, Black, Hill & Cook, Boulder, CO, June 1988 - December 1989. *Associate attorney*. Duties: Represented a Denver-area municipality in water matters including new water rights, transfers, exchanges, and river administration. Represented other clients in various other civil matters.

ADMITTED TO PRACTICE LAW in Colorado, 1988; Oregon, 1994 (currently on inactive status in both states).

Significant Articles:

New Adventures of the Old Bureau: Modern-Day Reclamation Statutes and Congress' Unfinished Environmental Business, forthcoming in 48 HARVARD JOURNAL ON LEGISLATION (2011).

A Bright Idea from the Black Canyon: Federal Judicial Review of Reserved Water Right Settlements, 13 UNIVERSITY OF DENVER WATER LAW REVIEW 229 (2010).

Dams, Duties, and Discretion: Bureau of Reclamation Water Project Operations and the Endangered Species Act, 33 COLUMBIA JOURNAL OF ENVIRONMENTAL LAW 1 (2008).

Rivers to Live By: Can western water law help communities embrace their streams? 27 JOURNAL OF LAND, RESOURCES & ENVIRONMENTAL LAW 1 (2007).

"Adequate Progress," or Rivers Left Behind? Developments in Colorado and Wyoming instream flow laws since 2000, 36 ENVIRONMENTAL LAW 1283 (2006).

Deflating the Deference Myth: National interests vs. state authority under federal laws affecting water use, 2006 UTAH LAW REVIEW 242 (2006).

A Few Ironies of Western Water Law, 6 WYOMING LAW REVIEW 331 (2006).

Pollution Without Solution: Flow impairment problems under Clean Water Act section 303, 24 STANFORD ENVIRONMENTAL LAW JOURNAL 199 (2005).

"The Supreme Court of Science" Speaks on Water Rights: The National Academy of Sciences' Columbia River report and its water policy implications, 35 ENVIRONMENTAL LAW 85 (2005).

So Much Conflict, Yet So Much in Common: Considering the similarities between western water law and the Endangered Species Act, 44 NATURAL RESOURCES JOURNAL 29 (2004).

The Interior Department's Water 2025*: Blueprint for balance, or just better business as usual?* 33 ENVIRONMENTAL LAW REPORTER 10837 (2003).

Giving Suckers (and Salmon) an Even Break: Klamath Basin water and the Endangered Species Act, 15 TULANE ENVIRONMENTAL LAW JOURNAL 197 (2002).

Can't Get No Satisfaction: Securing water for federal and tribal lands in the West, 30 ENVIRONMENTAL LAW REPORTER 11056 (2000).

Maintaining the Status Quo: Protecting established water uses in the Pacific Northwest, despite the rules of prior appropriation, 28 ENVIRONMENTAL LAW 881 (1998).

Recommendations for an Environmentally Sound Federal Policy on Western Water, 17 STANFORD ENVIRONMENTAL LAW JOURNAL 247 (1998).

Saying the Right Thing at the Wrong Time: A conservationist considers Water in the West, 6 RIVERS 281 (1998).

Whose Water Is It? Private rights and public authority over reclamation project water, 16 VIRGINIA ENVIRONMENTAL LAW JOURNAL 363 (1997).

A Watershed Issue: The role of streamflow protection in Northwest river basin management, 26 ENVIRONMENTAL LAW 175 (1996).

Making a Wrong Thing Right: Ending the "spread" of reclamation project water, with Kimberley J. Priestley, 9 *JOURNAL OF ENVIRONMENTAL LAW & LITIGATION* 89 (1994), reprinted in WATER LAW--TRENDS, POLICIES, AND PRACTICE, (Kathleen Marion Carr and James D. Crammond eds., 1995).

Clean Water Act Citizen Suits after Gwaltney*: Applying mootness principles in private enforcement actions*, 4 JOURNAL OF LAND USE & ENVIRONMENTAL LAW 143 (1988).

Book Projects:

WATERS & WATER RIGHTS Chapter 41, Federal Reclamation Law (Robert E. Beck and Amy K. Kelley eds., 3rd ed., LexisNexis/Matthew Bender 2009) (co-author with Amy K. Kelley).

WATER RESOURCE MANAGEMENT: A CASEBOOK IN LAW AND PUBLIC POLICY, 6th Ed. (new co-author with A. Dan Tarlock, James N. Corbridge and David H. Getches) (2009).

A New Deal for a 1933 Water Right: The Black Canyon of the Gunnison Instream Flow Controversy, chapter in a forthcoming book on the centennial of the *Winters* doctrine (University of New Mexico Press, 2011).

Education:

University of Michigan Law School, J.D. *magna cum laude*, 1988. Cumulative GPA: 3.73 (of 4.0), 20th in class of 380. Order of the Coif. Course work emphasized environmental and natural resources law and policy. Full-time externship with U.S. Department of Justice, Lands & Natural Resources Division, Fall 1987.

Iowa State University, B.S. with honors, Economics with Environmental Studies Program, 1985. Cumulative GPA: 3.97 (of 4.0). Highest-ranking 1985 graduate in Economics Department. Course work emphasized environmental and natural resource matters. Major papers analyzed options for achieving sustainable use of High Plains groundwater. Awarded national Phi Kappa Phi Graduate Fellowship.

David S. Brookshire

Professor of Economics
Department of Economics
University of New Mexico, Albuquerque, New Mexico 87131

Education

University of New Mexico	Department of Economics	PhD 1976
San Diego State University	Department of Economics	B.A. 1970

Appointments

1990 - Professor of Economics, Department of Economics, University of New Mexico
1976-1989 Assistant, Associate, Professor of Economics, University of Wyoming

David Brookshire is a resource and environmental economist with over 100 peer-reviewed publications on nonmarket valuation, hazards assessment, endangered species, water value and allocation, and air quality. These papers use and develop survey and experimental methods as applied to public policy issues.

Relevant Publications

Measuring the Value of a Public Good: An Empirical Comparison of Elicitation Procedures, *American Economic Review*, Vol. 77, No. 4 (1987): 554-566, (with D. Coursey),

Western Urban Water Demand, *Natural Resources Journal*, Vol. 42, No. 4 (2002), (with S. Burness, J. Chermak, and K. Krause)

Uncertainty, Benefit Transfers, and Physical Models: A Middle Rio Grande Valley Focus, Environmental Value Transfer: Issues and Methods, Vol. 9, 2007,, Eds. S. Navrud, R. Ready and O. Olvar, in the Kluwer Academic Publishers series entitled The Economics of Non-Market Goods and Resources, (with J. Chermak and R. DeSimone)

"Water Leasing: Evaluating Temporary Water Rights Transfers in New Mexico through Experimental Methods", forthcoming 2010, *Natural Resources Journal* (with Craig Broadbent, Don Coursey, and Vince Tidwell)

"After Restoration: A Framework for Preserving Semi-Arid Regions in the Southwest", No. 144, Pages 60-74, March 2010, *Journal of Contemporary Water Research and Education*, (with David Goodrich, Mark D. Dixon, L. Arriana Brand, Karl Benedict, Kevin Lansey, Jennifer Thacher, Craig D. Broadbent, Steve Stewart, Molly McIntosh and Doosun Kang).

Other Relevant Publications

Parallelism in the Laboratory and the Field: Testing the Robustness of the MCS Mechanism, *Pacific Economic Review*, Vol. 5, No. 3 (2000): 429-446, (with S. Stewart, M. McKee, R. Berrens and A. Bohara)

Contingent Valuation of In-stream Flows in New Mexico: With Tests of Scope, Group-Size Reminder and Temporal Reliability, *Journal of Environmental Management*, Vol. 58, No.1 (2000): 73-91, (with R. Berrens, A. Bohara, C. Silva, M. McKee)

The Informational Role of the EPA SO_2 Permit Auction: Was It Necessary, Did it work?, *Journal of Regulatory Economics*, Vol. 20, No. 1 (2001): 43-60, (with Stu Burness).

Water Management in a Mountain Front Recharge Aquifer, Water Resources Research, Vol. 40, (2004), (with S. Burness and J. Chermak).

"Creating Real Time Water Leasing Market Institutions: An Integrated Economic and Hydrological Methodology", *Journal of Contemporary Water Research & Education*, No. 144, Pages 50-59, March 2010, (with C. Broadbent, D. Coursey and V. Tidwell).

Synergistic Activities

Policy Sciences Editor, Water Resources Research
Director of Science Impact Laboratory for Policy and Economics
Executive Board, NSF Science and Technology Center
Session organizer and chair of sessions at the ACES conference
Key note speaker 3rd National Conference on Ecosystem Restoration, July 21, 2009, Los Angeles, CA.

Current and Past Collaborators

Karl Benedict (UNM), Richard Bernknopf (USGS), Jim Boyd (RFF), Doug Boyle (DRI), Arriana Brand (USGS), Craig Broadbent (IWU), Janie Chermak (UNM), Don Coursey (UC), Mark Dixon (USD), David Goodrich (ARS), Hoshin Gupta (UA), Kate Krause (UNM), Paul Mathews (UNM), Tom Maddock (UA), Carl Shapiro (USGS), Julie Stromberg (ASU), Vince Tidwell (Sandia National Laboratories)

Graduate Advisees (7)

Craig Broadbent (IWU), Helen Neil (UNLV), Hirotaka Sato (Japan), Christian Schmidt (Unknown); Steven Stewart (UA); Hale Thurston (USEPA); Mary Ewers (LANL)

Stephen E. Cabaniss

Born June 6, 1958 in Charleston, South Carolina

Work Address
Chemistry Department
University of New Mexico
Albuquerque, NM 87131
(505) 277-4445
cabaniss@unm.edu

Home Address
1501 Canyon Hills Dr., NE
Albuquerque NM 87112

Education

B.S. Chemistry, 1980, Massachusetts Institute of Technology
M.S. Environmental Science and Engineering, 1982, University of North Carolina
Ph.D. Environmental Science and Engineering, 1986, University of North Carolina

Positions Held

Fellow, Interdisciplinary Programs in Health, 1987, Harvard University
Research associate, 1988-1989, Department of Chemistry, University of North Carolina
Assistant Professor, 1989-1994, Department of Chemistry, Kent State University
Associate Professor, 1994-2000, Department of Chemistry, Kent State University
Professor, 2000-2002, Department of Chemistry, Kent State University
Professor, 2002-present, Department of Chemistry, University of New Mexico
Associate Director, 2008-present UNM Water Resources Program

Professional Societies

American Chemical Soc., Geochemical Soc., American Soc. Limnology and Oceanography, AAAS, Assoc. Environmental Science and Engineering Professors

Classes Taught (last 5 years)

General Chemistry, Instrumental Analysis, Trace Metals in the Environment, Organic Compounds in the Environment, In Situ Uranium Mining (seminar)

Synergistic activities

Organized or co-organized symposia on Computational Methods in Environmental Chemistry at ACS national meetings (Fall 1995, Chicago; Spring 2000, San Francisco; Fall 2005, Philadelphia).

Coding and distributing equilibrium calculation program TITRATOR.

Coding and distributing natural organic matter simulator AlphaStep.

Collaborators (last 10 years)

Patricia Maurice, Greg Madey, Laura Leff, Robert Sinsabaugh, Michael Pullin, Susan Sutheimer, Yu-Ping Chin, Jerry Leenheer, Robert Heath, Qunhui Zhou, George Aiken, Ksenija Namjesnik-Dejanovic, Leigh McAllister, Rudolf , William Cooper, Aaron Peacock, Kirk Hatfield, James Ranville

Ten relevant publications

Cabaniss, S.E. "Forward Modeling of Metal Complexation by NOM: I. A priori Prediction of Conditional Constants and Speciation" 2009, Environ. Sci. Technol., 43:2838-2844.

Cabaniss, S.E. "Quantitative structure-property relationships for predicting metal binding by organic ligands" 2008, Environ. Sci. Technol. 42:5210-5216.

Cabaniss, S.E., Madey, G., Leff, L., Maurice, P.A., Wetzel, R. "A stochastic model for the synthesis and degradation of natural organic matter. Part II. Molecular property distributions" Biogeochem. 2007, 86, 269-286.

Cabaniss, S.E., Maurice, P.A., Madey, G. "Stochastic synthesis of DOM: Predicting Cu(II) complexation from precursor structures" 2007 Appl. Geochem. 22, 1646-1658.

McAuley, B and Cabaniss, S.E., "Quantitative detection of aqueous arsenic and other oxoanions using attenuated total reflectance infrared spectroscopy utilizing iron oxide coated internal reflection elements to enhance the limits of detection." 2007 Anal. Chim. Acta, 581, 309-317.

Cabaniss, S.E., Madey, G., Leff, L., Maurice, P.A., Wetzel, R. "A stochastic model for the synthesis and degradation of natural organic matter. Part I. Data structures and reaction kinetics" 2005, Biogeochem. 76, 319-347.

Dejanovic, K.N. and S.E. Cabaniss "A reverse phase HPLC method for determining polarity distributions in natural organic matter" 2004 Envr. Sci. Technol. 38, 1108-1114.

Pullin, M. J. and S.E. Cabaniss, "The effects of pH, ionic strength, and iron-fulvic acid interactions on the kinetics of non-photochemical iron transformations. I. Iron(II) oxidation and iron colloid formation" 2003 Geochim. Cosmochim. Acta 21, 4067-4077.

Lenhart J.J., Cabaniss S.E., MacCarthy P., Honeyman B.D. "Uranium(VI) complexation with citric, humic and fulvic acids" 2000 Radiochimica Acta 88, 345-353.

Sutheimer, S.H. and Cabaniss, S.E. 1997 "Aluminum Binding to Humic Substances Determined by High Performance Cation Exchange Chromatography" Geochim. Cosmochim.Acta 61, 1-11.

Janie M. Chermak

Professor of Economics
Phone: 505-277-4906
jchermak@unm.edu
www.unm.edu/~econ/faculty/chermak.html
.

Department of Economics

University of New Mexico
MSC05 3060, 1UNM
Albuquerque, NM 87131

Professional Preparedness

Western State College, Gunnison, CO. Geology, B.A. 1979
Colorado School of Mines, Golden, CO. Mineral Economics, MSc., 1988
Colorado School of Mines, Golden, CO. Mineral Economics, PhD., 1991

Appointments

UNIVERSITY OF NEW MEXICO, Department of Economics, Albuquerque, NM

Professor of Economics	July 2007-present:
Associate Professor of Economics	July 2000-June 2007:
Assistant Professor of Economics	August 1995-June 2000:

Department of Economics,
NAVAL POSTGRADUATE SCHOOL, Defense Resources Management Institute, Monterey, CA

Assistant Professor of Economics	August 1992-August 1995:

Select Publications

Chermak, J.M., R.H. Patrick and D.S. Brookshire. 2005. "Economics of Transboundary Aquifer Management," with R.H. Patrick and D.S. Brookshire, Ground Water, 43(5): 731-36.

Burness, H.S., J.M. Chermak and K. Krause. 2005. "Western Municipal Water Conservation Policy: The Case of Disaggregated Demand," with H.S. Burness and K. Krause, Water Resources Research, 41(3).

Burness, H.S., J.M. Chermak, and D.S. Brookshire. 2004. "Water Use in a Mountain Front Recharge Aquifer," with S. Burness and D. Brookshire, Water Resources Research, 40(W0621).

Krause, K., J.M. Chermak, and D.S. Brookshire. "The Demand for Water: Consumer Response to Scarcity," with K. Krause and D. Brookshire, Journal of Regulatory Economics; 23(2): 167-191.

Chermak, J.M. and K. Krause. 2002. "Individual Responses and Intergenerational Common Pool Problems," with K. Krause, Journal of Environmental Economics and Management; 43:47-70.

Chermak, J.M. and R.H. Patrick 2002. "Comparing Tests of the Theory of Exhaustible Resources," *Resource and Energy Economics*; 24:301-325.

Chermak, J.M. and R.H. Patrick 2001. "A Microeconometric Test of the Theory of Exhaustible Resources," with R.H. Patrick, *Journal of Environmental Economics and Management;* 42:82-103.

Chermak, J.M. and R.H. Patrick. 1995. "A Well-Based Cost Function and the Economics of Exhaustible Resources: The Case of Natural Gas," with R.H. Patrick, *Journal of Environmental Economics and Management* 28:174-189.

Chermak, J.M. 1994. "Emerging Environmental Markets: Improving the Competitiveness of Natural Gas," *The Energy Journal;* 15(3):75-91.

Denise D. Fort

Professor of Law
University of New Mexico School of Law: Professor of Environmental Law, Water Policy, Natural Resources Law and related subjects.

Professor Fort is a well known expert in western water policy. She was the Chair of the Western Water Policy Review Advisory Commission, 1995-1998 which issued a report, Water in the West, following numerous meetings across the West. In the course of doing so, the Commission devised a research plan, commissioned a number of reports on policy issues, and solicited comments from the public and interest groups. The Commission had a budget of approximately $2 million, staff assigned from the Bureau of Reclamation, and the assistance of outside consultants. Professor Fort had executive responsibility for the Commission.

Education

Legal: Catholic University of America, Washington D.C., J.D., May 1975
Undergraduate: St. John's College, Santa Fe, New Mexico, May 1972

Background and experience

Professor of Environmental Law, Water Policy, Natural Resources Law and related subjects, University of New Mexico School of Law (1991-present); Chair, Western Water Policy Review Advisory Commission (November 1995 - July 1998); Director, Water Resources Administration Program, University of New Mexico (1991-1996); Consultant, National Heritage Institute, California (1990-1992); Executive Director, Citizens for a Better Environment, California (1988-1990); Adjunct Faculty Santa Clara University, School of Law (Fall 1989); Research and Visiting Scholar, University of New Mexico, Institute of Public Policy (1987-1988); Director, Environmental Improvement Division, State of New Mexico (1984-1986); Cabinet Secretary, Department of Finance and Administration, State of New Mexico (January 1983 - August 1984); Legal Counsel, Taxation and Revenue Department, State of New Mexico (1979-1982).

Publications

The Western Water Policy Review Advisory Commission delved into restoration efforts in specific basins and the role of the federal government. As Chair, Professor Fort commissioned reports on these topics and structured and contributed to the final report: Water in the West: Challenge for the Next Century, Report of the Western Water Policy Review Advisory Commission, UNM Press, 1998.

Western Progress, A New Western Water Agenda, with Larry MacDonnell, http://www.WesternProgress.org, visited February 25, 2008; revised version published in The Water Report, February 15, 2008.

Yale University School of Forestry, Bulletin 107, Human Population and Freshwater Resources: U.S. Cases and International Perspectives, "Case Study: Western Water" (2002).

"Instream Flows in New Mexico", 7 Rivers 155 (peer reviewed journal) (2000).

Plum Creek Lecture Series, University of Montana, Our Aspirations for the West's People and Rivers: An Anthem for the Turn of the Century, Missoula, Montana, March 7, 1999. Published in Water in the West, School of Forestry, University of Montana, 2000.

"The Western Water Policy Review Advisory Commission: Watershed and Basin Management Receive the Attention of a New Generation," Journal of the American Water Resources Association (1999).

"Federal Water Policy for the West in the 21st Century," 25 Rocky Mountain Mineral Law Foundation (1998). Co-authored with Donna Griffin.

"A Perspective from the Chair of the Western Water Policy Review Advisory Commission," Update, University Council on Water Resources, 110 Water Resources Update 23 (Winter 1998).

"Restoring the Rio Grande: A Case Study in Environmental Federalism," 28 Environmental Law 15 (1998).

"The Western Water Policy Review Advisory Commission: Another Look at Western Water," 37 Natural Resources Journal 909 (1997).

Western Water Policy Review Advisory Commission Issues Draft Report," 2 Western Law and Policy Reporter 1 (1997).

"The Western Water Policy Review Advisory Commission: A New Mexico Chair Reports," Section on Natural Resources, Energy and Environment Newsletter, State Bar of New Mexico (1997).

Philadelphia Academy of Natural Sciences, "The Management of Water in the West: Leaving Room for the Future," in Proceedings of the 5th National Conference: Water: Our Next Crisis? Academy of Natural Sciences, January 11-12, 1994.

Selected Presentations

New Mexico Water Dialogue, 16th Annual Statewide Meeting, Panel: Facing Conflicting Priorities and Other Challenges, Albuquerque, NM, January 14, 2010.

Ecological Society of America, Water: Ecosystem Services, Drought and Environmental Justice Keynote address, Maintaining Freshwater Aquatic Ecosystems in a Changed Climate: The Fundamental Changes We Must Make, Atlanta, GA, Nov 9-12, 2009.

From Mountaintop to River Bottom: Restoring New Mexico's Watersheds, Funding Your Watershed Project, Albuquerque, NM, October 1, 2008. www.watershedforum.org.

David S. Gutzler, Ph.D.

Dept. of Earth & Planetary Sciences
University of New Mexico MSC03-2040
Albuquerque NM 87131 USA
Telephone: (505) 277-3328
Fax: (505) 277-8843
Email: gutzler@unm.edu

Research Expertise

Theory and observations of large-scale atmospheric variability; climate change; statistical climatology;
large-scale interactions between the atmosphere and the oceans, biosphere, and land surface; tropical meteorology; predictability of weather and climate; dissemination of climate science to the public and to policy makers.

Education

B.S.	1977	University of California, Berkeley (Engineering Physics)
M.S.	1980	University of Washington (Atmospheric Sciences)
Ph.D.	1986	Massachusetts Institute of Technology (Meteorology)

Professional Experience

1986 – 1992	Staff Scientist, Senior Staff Scientist Atmospheric and Environmental Research, Inc., Cambridge MA
1992 – 1995	Physicist, Tropical Dynamics and Climate Program NOAA Aeronomy Laboratory, Boulder CO.
1995 – present	Associate Professor, Professor, Earth & Planetary Sciences Department University of New Mexico, Albuquerque.
1997 – present	Professional consulting services for government and private sector clients

Selected Scientific & Professional Activities

American Meteorological Society, member 1979-present.
American Geophysical Union, member 1984-present.
New Mexico Geological Society, member 1999-present.
Journal of Climate (American Meteorological Society): Associate Editor, 1989-1993; Editor, 1994-1995.
American Meteorological Society Committee on Interaction of the Sea and Atmosphere, member 1992-1998.
Science Advisory Panel member, U.S. Rep. Heather Wilson (NM district 1), 1999-2001.
New Mexico State Weather Modification Commission member, 2000-2005.
U.S. CLIVAR Program PanAmerican Implementation Panel Co-Chair, 2002-2007.
International CLIVAR Program American Monsoons Panel member, 2003-2009.
NOAA Climate Prediction Program for the Americas, Scientific Steering Group member, 2006-2009.
World Meteorological Organization, Expert Team on Climate Impacts on Monsoon Weather, 2007-present.
US CLIVAR Working Group on Long-term Drought Prediction, co-chair, 2007-2009.

External Advisory Committee, Los Alamos National Lab Institute for Geophysics & Planetary Physics, 2008-present.
Co-organizer, Southwest Hydrometeorological Symposium, 2009.
Lead Author, Intergovernmental Panel on Climate Change Fifth Assessment Report, Working Group 1,
Chapter 10 (Detection and Attribution of Climate Change), 2010-2013.
American Meteorological Society Certified Consulting Meteorologist #612.

External Scientific Research Funding

Continuous funding from competitive grants from the National Science Foundation, NOAA Climate Program Office, and Los Alamos National Laboratory.

Honors & Awards

National Merit Scholar, 1973; Tau Beta Pi (national engineering honor society), 1976.
Editor's Award, American Meteorological Society, 1993.
Superior Performance Award, U.S. Department of Commerce, 1993, 1994.
Regents' Lecturer, University of New Mexico, 2000-2003.
UNM College of Arts & Sciences Outstanding Teaching Award, 2008.

Peer-Reviewed Publications: approx. 100 peer-reviewed publications in total; > 3000 citations, h-index=24

Invited Scientific Presentations: more than forty since the mid-1980s at universities and laboratories in seven countries

Selected Recent Publications:

Gutzler, D.S., 2000: Covariability of spring snowpack and summer rainfall across the Southwest United States. *J. Climate*, **13**, 4018-4027.

Gutzler, D.S., 2000: Evaluating global warming: A post-1990s perspective. *GSA Today*, **10**(10), 1-7.

Gutzler, D.S., D.M. Kann and C. Thornbrugh, 2002: Modulation of ENSO-based long-lead outlooks of precipitation by the Pacific Decadal Oscillation. *Weather and Forecasting,* **17,** 1163-1172.

Gutzler, D.S., 2003: Climate variability: Seasonal and interannual variability. *Encyclopedia of Atmospheric Sciences*, J. Holton, J. Curry and J. Pyle, eds., Academic Press, **2**, 445-451.

Weiss, J.L., **D.S. Gutzler**, J.E. Coonrod, and C. Dahm, 2004: Seasonal and interannual relationships between vegetation and climate in Central New Mexico, U.S.A. *J. Arid Environments*, **57**, 507-534.

Gutzler, D.S., 2005: New Mexico's Changing Climate. *Natural Resources Journal*, **45**, 277-282.

Gutzler, D.S., and J.S. Nims, 2005: Climatic modulation of water demand in the City of Albuquerque, New Mexico USA. *J. Applied Meteor.*, **44**, 1777-1787.

Gutzler, D.S., H.-K. Kim, R. W. Higgins, H. Juang, M. Kanamitsu, K. Mitchell, K. Mo, P. Pegion, E. Ritchie, J.-K. Schemm, S. Schubert, Y. Song and R. Yang, 2005: The North American Monsoon Model Assessment Project: Integrating numerical modeling into a field-based process study. *Bull. Amer. Meteor. Soc.*, **86**, 1423-1429.

Vera, C., R.W. Higgins, J. Amador, T. Ambrizzi, R. Garreaud, D. Gochis, **D. Gutzler**, D. Lettenmaier, J. Marengo, C.R. Mechoso, J. Nogues-Paegle, P. Silva Dias and C. Zhang, 2006: A unified view of the American monsoon systems. *J. Climate* **19**, 4977-5000.

Gutzler, D.S., 2007: Climate change and water resources in New Mexico. *New Mexico Earth Matters*, p. 1-4, New Mexico Bureau of Geology and Mineral Resources, New Mexico Tech.

Schubert, S., R. Koster, M. Hoerling, R. Seager, D. Lettenmaier, A. Kumar and **D. Gutzler**, 2007: Observational and modeling requirements for predicting drought on seasonal to decadal time scales. *Bull. American Meteorological Soc.* **88**, 1625-1630.

Strong, M., Z. Sharp and **D.S. Gutzler**, 2007: Diagnosing moisture transport using D/H ratios of water vapor. *Geophys. Res. Lett.* **34**, L03404, doi:10.1029/2006GL028307.

Gutzler, D.S., L.N. Long, J.K. Schemm, S.Baidya Roy, M. Bosilovich, C. Collier, M. Kanamitsu, P. Kelly, D. Lawrence, M.-I. Lee, R. Lobato S., B. Mapes, K. Mo, A. Nunes, E. Ritchie, J. Roads,S. Schubert, H. Wei and G. Zhang, 2009: Simulations of the North American Monsoon: NAMAP2. *J. Climate* **22**, 6716-6740.

Schubert, S., **D. Gutzler**, H. Wang, A, Dai, T. Delworth, C. Deser, K. Findell, R. Fu, W. Higgins, M. Hoerling, B. Kirtman, R. Koster, A. Kumar, D. Legler, D. Lettenmaier, B. Lyon, V. Magaña, K. Mo, S. Nigam, P. Pegion, A. Phillips, R. Pulwarty, D. Rind, A. Ruiz-Barradas, J. Schemm, R. Seager, R. Stewart, M. Suarez, J. Syktus, M. Ting, C. Wang, S. Weaver and N. Zeng, 2009: A US CLIVAR project to assess and compare the responses of global climate models to drought-related SST forcing patterns: Overview and results. *J. Climate* **22**, 5251-5272.

Kennedy, T., **D.S. Gutzler** and R.L. Leung, 2009: Predicting future threats to the long-term survival of Gila Trout using a high-resolution simulation of climate change. *Climatic Change* **94**, 503-515.

Gutzler, D.S., and T.O. Robbins, 2010: Climate variability and projected change in the western United States: Regional downscaling and drought statistics. *Climate Dynamics*, DOI 10.1007/s00382-010-0838-7.

Gutzler, D.S., 2010: Climate and drought in New Mexico. Chapter 4 of *New Mexico Water Policy and Management Issues*, eds. D. Brookshire, H. Gupta and O.P. Matthews (now in review).

Notaro, M., Z. Liu, R.G. Gallimore, J.W. Williams, **D.S. Gutzler** and S. Collins, 2010: The complex seasonal cycle of ecohydrology in the Southwest United States, *J. Geophyical Research-Biogeosciences*, submitted for publication (now in review).

Rango, A., B. Hurd, **D.S. Gutzler** and E.R. Vivoni, 2010: Effects of climate change on mountain hydrology and water management in the upper Rio Grande watershed: Assessment methods and strategies. *Climate Research*, submitted for publication (now in review).

Susan Kelly, Director

The Utton Transboundary Resources Center
School of Law, MSC11-6070
The University of New Mexico (505) 277-0514
Albuquerque, NM 87131 skelly@law.unm.edu

Professional Preparation

Arizona State University, Tempe, Arizona, B.A., English, 1977.
University of New Mexico, Albuquerque, New Mexico, Juris Doctor, May 1981.

Professional Appointments

2003 to present – Interim Director and Associate Director, Utton Transboundary Resources Center, University of New Mexico School of Law. Directs the activities, programs and projects of the Center, including research, writing, educational initiatives, policy analysis on water issues, and organization of symposia and workshops; teaches water law as adjunct professor.

1998 - 2003 – Water Rights Manager and Senior Planner, City of Albuquerque, New Mexico. Managed the City's water rights portfolio, acquisition of water rights and administration of well permits and water storage contracts; worked on City's future water strategy; represented City in a multi-agency program to address endangered species issues; participated in regional water planning activities and development of habitat restoration proposals.

August 1988 – November 1997 – Municipal Planning, City of Albuquerque. Worked in community and regional planning, including developing policy and capital planning for infrastructure.

March 1985 – August 1988 – City Attorney's Office, City of Albuquerque. Dealt with open space acquisition; land use planning; development review process and infrastructure issues.

Publications

Susan Kelly, Iris Augusten, Joshua Mann & Laura Katz, History of the Rio Grande Reservoirs in New Mexico: Legislation and Litigation, *Natural Resources Journal* (Summer 2007, Vol. 47, No. 3).

Susan Kelly, Geoff Klise, How Science Can Create Pathways to Solutions – The Technical Toolbox, Decision-Makers Field Guide 2007, published by New Mexico Tech. Available at http://geoinfo.nmt.edu/publications/decisionmakers/home.cfm

Susan Kelly, Modeling Reservoir Storage Scenarios by Consensus, *Natural Resources Journal* (Summer 2007, Vol. 47, No. 3).

Susan Kelly, Urban Water Administration in the Albuquerque Urban Area, *Decision-Makers Field Guide 2009*, published by New Mexico Institute of Mining and Technology. Available at http://geoinfo.nmt.edu/publications/decisionmakers/home.cfm

McNamara, Chermak, Cockerill, Jarratt, **Susan Kelly**, et al., Modeling the Transfer of Land and Water from Agricultural to Urban Uses in the Middle Rio Grande Basin, New Mexico, Sandia National Laboratories Report (2004)

Susan Kelly editor and writer, *Water Matters*!, Background on Selected Water Issues for Members of the 48th New Mexico Legislature 2nd Session – 2010 and 1st Session 2009; and 2nd Session – 2008; 49th New Mexico Legislature 2nd Session – 2008 and 1st Session – 2007. Available at http://uttoncenter.unm.edu/Water_Matters!.html

Voices of the Jemez River, video produced by the Utton Center with Electronic Films, Inc. New Deal Films, Inc and Dale Kruzic, Susan Kelly and Mary Lance (writers) 2004

[In progress] New Mexico Water Policy and Management Issues: Science, Modeling, Institutions and the Future, Edited by Brookshire, Gupta, Matthews (Susan Kelly, co-author of a chapter on the effect of water rates on water conservation), to be published by RFF.

Synergistic Activities

The Utton Center is developing proceedings from an Environmental Flows workshop (March 2010) to address the state of the science in New Mexico and learn how other states approach the issue. Currently, technical work is being formulated to support future policy initiatives.

The Utton Center, through Susan Kelly, represents UNM on the coordinating committee of the Middle Rio Grande Endangered Species Act Collaborative Program. The Utton Center is working to organize UNM's multi-disciplinary involvement in this recovery program.

The Utton Center is developing a land and water planning initiative. Following a workshop which convened a variety of disciplines, agencies, and stakeholders, the Center is working with a group of NGOs on policy objectives and implementation strategies to better connect land use approvals with water availability considerations.

The Utton Center is currently proposing a project for the Bureau of Reclamation that will include development of recommendations for the institutional structure of ecological restoration programs throughout the West to better organize future restoration activities to achieve success.

Collaborators & Other Affiliations

Memberships: Natural Resources Section, State Bar of New Mexico; American Planning Association; American Institute of Certified Planners; American Water Resources Association; Urban Land Institute; New Mexico-Chihuahua Commission Water Work Table.
Collaborators: Tom McGuckin (Economics, NM State University); David Brookshire (Economics, UNM); Paul Matthews (Geography, UNM); Denise Fort (Law, UNM); Peggy Johnson (Hydrology, New Mexico Tech); Greer Price (Geologist, New Mexico Tech).

José A. Rivera, Ph.D.
Professor of Community and Regional Planning

Education

Ph.D., Social Policy, Brandeis University, Waltham, Massachusetts, 1972
M.S.W., Florence Heller School for Advanced Graduate Studies in Social Welfare, Brandeis University, 1970
M.A., English Literature, University of Arizona, 1968
B.A., English Literature major; minors in Spanish and Secondary School Education, New Mexico Highlands University, 1966

Teaching Experience

Teaching Fields: Rural Community Development; The Practice of Policy Development; Water Resources Policy & Management
Full Professor, School of Architecture & Planning, University of New Mexico, January 2005-Present
Full Professor, School of Public Administration, University of New Mexico, Fall 1999 to Fall 2004
Associate Professor of Public Administration & Community and Regional Planning, 1988 to 1999
Assistant Professor of Public Administration, 1982-1988 (Tenured in Fall 1988)

Administrative and Professional Experience

Research Scholar, Center for Regional Studies, University of New Mexico, July 2006-Present
Assist the CRS Director with the development of research initiatives and special projects related to the Southwestern United States and comparative regional studies; evaluate proposals for faculty research projects, graduate student fellowships, and other applications for funding; prepare manuscripts for submission to publishers based on archival resources, special collections and regional studies fieldwork in the Southwest and comparative regions in the world.

Special Assistant to the Provost and Vice President for Research, University of New Mexico, April 1996 to June 2006
Duties and Responsibilities. July 2000 to 2006: manage main campus Research Compliance Services; Chair the UNM main campus Institutional Review Board for Human Subjects Research (IRB); coordinate research initiatives in multidisciplinary Water Resources, Latin American and Southwestern Regional Studies. April 1996 to June 2000:

Director, Southwest Hispanic Research Institute, University of New Mexico, July 1982-1994
Duties & Responsibilities: Administered an interdisciplinary research center focused on Southwestern and Hispanic Studies; collaborated with University departments, colleges, and schools on the design and implementation of research projects; developed extramural and endowment funding from governmental, legislative, and private foundation sources to underwrite research projects.

Research Contracts and Grants

Co-Principal Investigator, $36,000 in grants to support a national Rural Latinos Working Group, awarded by the Farm Foundation, the USDA Western Rural Development Center, the Kellogg Foundation, and the Inter-University Program for Latino Research, 1992-96

Principal Investigator/Project Director, "Strengthening the Skills Component of Integrated Resources Management Curricula," funded by the USDA Cooperative State Research, Education, and Extension Service, $90,000, four-year grant, 1997-2001, to support graduate fellowships for students in Water Resources Administration and Community and Regional Planning at UNM

Collaborator, $360,000 grant from the USDA Forest Service to La Jicarita Enterprise Community, Inc., for a forest restoration program in the Upper Rio Mora Watershed, Phase II with a $15,000 cost share from the Center for Regional Studies for the support of three UNM CRP graduate students, fall 2006-summer 2009, Professor William Fleming, Co-Advisor and Collaborator

Co-Investigator, Socioeconomics Group, "Climate Change Impacts on New Mexico's Mountain Sources of Water," funded by the National Science Foundation to New Mexico EPSCoR Office, $144,825 subaward to Professors José Rivera and William Fleming at UNM to support eight graduate and undergraduate students

Books and Articles

José A. Rivera, *La Cultura de la Acequia*, book translation of 1998 edition, *Acequia Culture*, published in May of 2009 by the University of Valencia Press, Valencia, Spain

José A. Rivera, *Acequia Culture: Water, Land, and Community in the Southwest*, University of New Mexico Press, Albuquerque, 1998

Frederic O. Sargent, Paul Lusk, José A. Rivera & María Varela, *Rural Environmental Planning for Sustainable Communities*, Island Press, Washington, D.C., 1991

José A. Rivera, "Restoring the Oldest Water Right in Texas: The Mission San Juan Acequia of San Antonio," *Southwestern Historical Quarterly*, January 2003, Vol. CVI, No. 3 (28 pp) (refereed journal)

José A. Rivera, "Water Democracies on the Upper Rio Grande: 1598-1998," in *Rio Grande Ecosystems: Linking Land, Water, and People*, General Technical Report, USDA Rocky Mountain Research Station, Fort Collins, CO, RMRS-P-7, March 1999 (27 pp.) (invited chapter for symposium volume)

José A. Rivera, "Irrigation Communities of the Upper Rio Grande Bioregion: Sustainable Resource Use in the Global Context," *Natural Resources Journal*, UNM School of Law, Vol. 36, Fall 1996 (29 pp) (refereed journal)

Abdul-Mehdi Ali
mehdiali@unm.edu
Earth & Planetary Sciences Department
The University of New Mexico
Northrop Hall, MSC03-2040
1 University of New Mexico
Albuquerque, NM 87131
Phone: (505) 277 -1637
Fax: (505) 277 -8843

A. Professional Preparation
1989 Ph.D. Soil, Water, and Environmental Chemistry, Soil, Water, and Environmental Science Department, University of Arizona, Tucson. (USA).
1981 M.Sc. Soil, Water, and Environmental Chemistry, Soil, Water, and Environmental Science Department, University of Arizona, Tucson. (USA)
1975 B.Sc. Plant Production, Land Reclamation - Soils and Water Chemistry, University of Basrah, Basrah. (IRAQ)

B. Appointments 2003-Present
2003-present Staff, Senior Research Scientist I, Analytical Chemistry Laboratory Manager and SafetyOfficer. The University of New Mexico, Department of Earth and Planetary Sciences, Albuquerque, New Mexico.

2002 Technical Director, Applied Environmental Services (AES), Environmental and Construction Consulting Firm, El Paso, Texas

1992-2003 Faculty, Associate Research Scientist, Laboratory Director and Safety Officer. Texas A&MUniversity System, Texas Agricultural Experiment Station (TAES), El Paso Research Center, El Paso, Texas.

1989-1992 Faculty, Assistant Research Scientist, Laboratory Manager. University of Arizona, Soil,Water, and Environmental Science Department, Soil, Water, and Plant Analysis Laboratory (SWPAL), Tucson, Arizona.

1988-1989 Research Associate, Laboratory Manager. University of Arizona, Soil, Water, and Environmental Science Department, Soil, Water, and Plant Analysis Laboratory (SWPAL), Tucson, Arizona.

B.1. Description of Responsibilities
One of my main responsibilities is GeoAnalytical Environmental Chemistry Laboratory Management, which includes operation, maintenance, and trouble shooting of highly specialized computer controlled instruments. Responsible for data processing, validation, and quality assurance and quality control plans (QA/QC-QAP). Implementing US EPA analytical protocols for the analysi of samples. Participated in the US EPA Performance Evaluation Studies (Water Pollution (WP), Water Supply (WS), and Solid and Hazardous Waste). Compiled and wrote

Quality Assurance Plan (QAP) and Standard Operating Procedures (SOP's) as partial fulfillment for laboratory accreditation with the American Association for Laboratory Accreditation (A2LA) and the National Environmental Laboratory Accreditation Conference (NELAC). The scope of accreditation was Potable Water, Nonpotable Water, and Solid and Hazardous Waste. Also, working with and instructing students and technicians on the proper use and operation of instruments and sample processing according to US EPA analytical protocols.

Taught graduate and undergraduate courses in the instrumental/analytical chemistry fields. I was invited speaker to present seminars and lectures at different universities and workshops at corporations. Wrote lesson plans, gave laboratory demonstrations, assisted students during laboratory design phases, provided academic and career counseling. Prepared reagents, standardized instruments and equipment for both laboratory and field experiments, operated and maintained laboratory and field instruments.

B.2. National Committees

1997 National Environmental Laboratory Accreditation Conference (NELAC). Member of the program policy and structure committee.

C.1. Publications

Bader, J.L., G. Gonzalez, P.C. Goodel, A.S. Ali, and S.D. Pillai, 1999. Chromium-Resistant Bacterial Populations from A site Heavily Contaminated with Hexavalent Chromium. Water, Air, and Soil Pollution Journal, 109: 263-276.

Bader, J.L., G. Gonzalez, P.C. Goodel, A.S. Ali, and S.D. Pillai, 1999. Aerobic Reduction of Hexavalent Chromium in Soil By Indigenous Microorganisms. Bioremediation Journal, 3 (3): 201-211.

Samocha, Tzachi, S. Patnaik, M. Speed, A Ali, J. M. Burger, R. V. Almeida, Z. Ayub, M. Harisanto, A. Horowitz, and D. Brock, 2007. Use of Molasses as Carbon Source in Limited Discharge Nursery and Grow-Out Systems for Litopenaeus vannamei.Aquaculture Engineering 36: 184-191.

C.2. Presentations

Open Vessel Microwave Digestion of Plant Tissues as Compared to Traditional Methods. Paper presented at the ASA, CSSA, SSSA Annual Meeting, Salt Lake City, Utah, 1999.

Comparison of Plant Chloride analysis via ICP and other Standard Methods. Paper presented at the ASA, CSSA, SSSA Annual Meeting, Salt Lake City, Utah, 1999.

Alternative Catalyst Used in Plant Kjeldahl Methods. Paper presented at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN, 2000.

Impact of Various Acid Pre – Treatments on Organic Carbon Analysis of Soil. Paper presented at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN, 2000.

Modified Hexavalent Chromium Determination Via Spectrophotometric Techniques as Compared to Ion Chromatography. Paper presented at the ASA, CSSA, SSSA Annual Meeting, Minneapolis, MN, 2000.

D. Training

Leeman Labs. Inc., 1991. Operation, maintenance, and trouble shooting of ICP/Echelle PS Series. Dionex Corporation, 1997.

Operation, maintenance, and trouble shooting of Ion Chromatography.

US EPA Region 6, 1994-1999. Quality Assurance Drinking Water.

Perkin Elmer Corporation, 1998. Inductively Coupled Plasma Axial Viewing Analysis.

Invited gust speaker at the ICP workshops (Phoenix, AZ. and Albuquerque, NM.) conducted by the Perkin Elmer Corporation, 2000 - 2004.

Invited speaker at the Texas A&M University System – Corpus Christi to present a lecture and training on water quality in aquaculture and effluent water recycling and remediation in shrimp farming, 2001.

E. Recent Funding

Acquisition of an ICP-OES for Geosciences Research at the University of New Mexico. NSF Proposal No. 0447402, NSF 04-507, date 07/16/04. Amount $210,832.