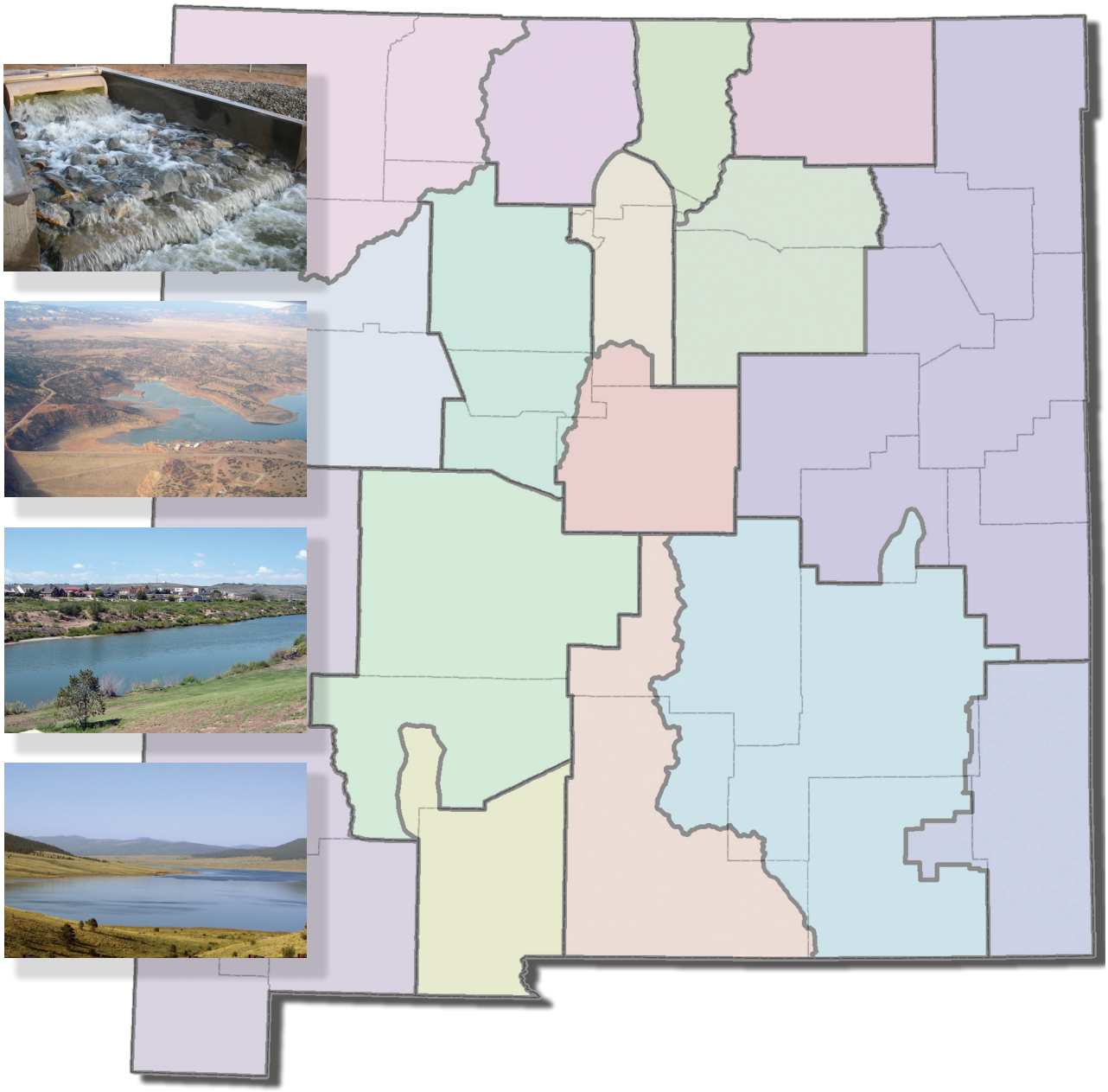
Water Planning in a Time of *Uncertainty*



54th Annual New Mexico Water Conference Proceedings

October 15 – 16, 2009
Isleta Casino and Resort

54th Annual
New Mexico Water Conference

Water Planning in a Time of *Uncertainty*

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Isleta Casino and Resort
Isleta, New Mexico

New Mexico
Water Resources Research Institute

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54th Annual New Mexico Water Conference Program

Water Planning in a Time of Uncertainty

Thursday, October 15

8:30 am	Welcome by WRRI Director *Karl Wood* and Isleta Pueblo Governor *Robert Benavides*
9:00	New Mexico's 16 Regional Water Plans: One Size Does Not Fit All *Angela Bordegaray* and *Gretel Follingstad*, Interstate Stream Commission
9:30	Updating New Mexico's State Water Plan *Estevan Lopez*, Interstate Stream Commission
10:00	Break
10:30	The Legislative Perspective on Funding the State Water Plan Representative *Andy Nuñez*, Chair, Water & Natural Resources Committee
11:00	New Mexico Planning Areas Versus Management Areas: Is There a Difference? *Blane Sanchez*, Commissioner, Interstate Stream Commission
11:30	The Texas Water Planning Process *David Meesey*, Texas Water Development Board
12:00 pm	Utton Memorial Water Lecture: A Kaleidoscope of Water Issues Representative *Joe Stell*, retired New Mexico Legislator
1:30	New Mexico's Water and Wastewater Infrastructure Development: Implementation of the American Recovery and Reinvestment Act and into the Future *Karen Gallegos*, New Mexico Environment Department
2:00	The Hidden Value of Science in Planning *Wes Danskin*, USGS, San Diego
2:30	The Land and Water Supply Connection: Does Water Limit Growth? *Susan Kelly*, Utton Transboundary Resources Center, UNM
3:00	Scenario Planning: Making Strategic Decisions in Uncertain Times *Timothy Thomure*, HDR Engineering, Tucson
3:30	Break
4:00	Panel Discussion: Regional Water Planners San Juan Basin – *Randy Kirkpatrick*, San Juan Water Commission Southwest Region – *Tom Bates*, City of Deming Middle Rio Grande – *Joe Quintana*, Mid Region Council of Government
5:00	Daniel B. Stephens and Associates will host a reception as soon as we adjourn for the day. Please join your colleagues for good food and more great conversations. Cash bar available

Friday, October 16

8:00 am	Flood Control in an Urban Area: Challenges for AMAFCA *John Kelly*, Albuquerque Metro Area Flood Control Authority
8:30	NMED's Approach to Aquifer Storage and Recovery Water Quality Issues *Robert George*, New Mexico Environment Department
8:45	The Future of New Mexico's Deep Water: *John D'Antonio*, Office of the State Engineer *Michelle Henrie*, MHenrie | Land | Water | Law *Ann Rodgers*, Chestnut Law Office *Guy Bralley*, Sandoval County
10:15	Break
10:45	Using New Mexico's AIS Management Plan and Legislation to Protect Our Aquatic Resources *Barbara Coulter*, New Mexico Department of Game and Fish
11:45	They Are Going to Miss Me When I'm Gone: The Loss of Knowledge and Institutional Memory Due to Retirement *Karl Wood*, NMWRRI
12:00	Water conference drawing – must be present to win (one-night stay at Isleta Resort and Casino)
	Adjourn

New Mexico's 16 Regional Water Plans: One Size Does Not Fit All

Angela Bordegary and Gretel Follingstad, Interstate Stream Commission

Angela is senior water planner at the New Mexico Interstate Stream Commission (ISC) of the Office of the State Engineer. She manages and coordinates the state and regional water planning programs. The New Mexico State Legislature recognizes the need for current and future water planning, and has given the Interstate Stream Commission the responsibility for overseeing the process. The ISC provides grants and technical assistance to the state's 16 water-planning regions and currently is updating the 2003 New Mexico State Water Plan. A native New Mexican, Angela received a BA degree in political science from the University of New Mexico. She earned an MS in community and regional planning at the University of Texas at Austin. A planner for 12 years, she has worked in other planning positions for the City of Santa Fe and City of Austin, Texas, including in the private sector. She has been working in water-related planning issues for the past nine years.

Gretel has worked for the New Mexico Interstate Stream Commission since June 2007. Her career has focused on natural resource management and stewardship through long-term conservation planning. Gretel's graduate studies and professional work experience include a variety of projects focused on land use and open space planning and conservation, watershed restoration and management, and natural resource management and sustainability. She has worked for both government agencies and private organizations on natural resource and environmental planning project. Gretel earned a master's degree in natural resource planning.

Editor's note: The following paper represents an unedited version of the speaker's remarks at the conference.

Angela Bordegary

Good morning. How nice it is to be here today to talk about our State Water Plan. I want to thank the wisdom of the organizers involved in the State Water Plan. As Karl Wood said, we are here to give you the full picture from the Office of the State Engineer and the Interstate Stream Commission's water plan activities.

As many of you know, we have 16 regional water plans and a State Water Plan. The regional planning program came first in 1987. The State Water Plan was first required by the New Mexico legislature in 2003 and completed that same year by the New Mexico Interstate Stream Commission (ISC) with the Office of the State Engineer (OSE). The ISC oversees both programs because state law requires integration of the regional water plans as appropriate into a comprehensive State Water Plan. Today we are weaving together the two programs in our presentation. I will talk about the regional water plans, their background, and status, and discuss some findings and recommendations from our recently completed compilation and synthesis report of the 16 completed and in some cases updated regional water plans. I will also talk about the input from folks like yourselves who participated in regional and state water planning over the past two decades. Gretel Follingstad, also a water planner with the ISC, will discuss a key component in water planning, which is public involvement. She will talk about the extensive program that we conducted earlier this year for statewide public meetings on the State Water Plan update. She will go into some of the lessons learned and input that we received from those meetings as well. We would like to give our whole presentation and save any questions for after that.

Regional water plans are important tools because they describe a region's available water supply, they capture the region's future water demands, and they explain how the region will undertake meeting demand with supply. They are a result of collaboration between water users in the region, usually involving overlapping jurisdictions. Regional water planning is necessary, not only to protect New Mexico's water, but also to allow all stakeholders within a region to help determine the direction of water use within a region and among regions of the state. The original impetus for regional water planning came from a federal court ruling that New Mexico's prohibition against out of state water transfers of New Mexico's groundwater was unconstitutional. As a result of this ruling, it became evident that New Mexico needed to plan actively for its water future and demonstrate the need for water in New Mexico. The New Mexico state legislature in 1987 widely recognized the need for water planning to protect water by enacting legislation. Also, they gave the ISC responsibility to fund water planning efforts. Regional water planning began in an effort to balance current and future needs for a region. The legislature gave the ISC responsibility for overseeing a regional planning grant program and the planning process itself. The commission has worked with all regions of the state to prepare regional water plans.

Once regional water plans are completed, the OSE and commission staff reviews them. A regional plan is considered complete when it is accepted by the commission. Figure 1 is a map of the 16 water planning regions. Regional water planning efforts have been going on simultaneously with the State Water Plan. This map shows where the 16 planning regions are located around the state. The 16 planning regions were self-selected by the residents of these areas as part of the 1987 Regional Water Planning Act. The first regional water plan to be accepted by the Interstate Stream Commission was the Lea County Regional Water Plan, which was finalized in the year 2000. The last regional water plan to be accepted by the commission was the Taos Regional Water Plan, which was completed in 2008.

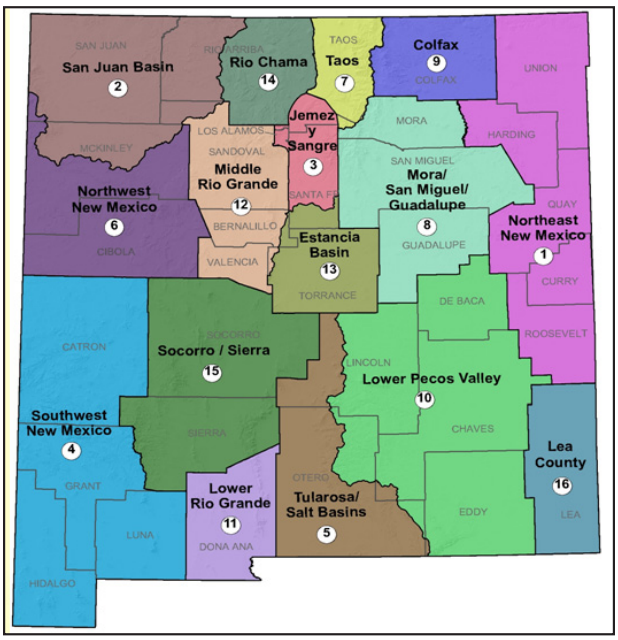

Figure 1. Sixteen Planning Regions

Figure 2 depicts just a few covers of some of the regional water plans. You may view and download all 16 of them from the Office of the State Engineer's website. Each plan is unique to its region, each plan is different just like their covers, and one size definitely does not fit all. For the purpose of integrating the regional water plans into the State Water Plan, an ad hoc committee was formed in 2003, which is now called the Regional Water Planning Advisory Council. The Interstate Stream Commission continues to support and staff this group. Regional representation is needed, but since this is a volunteer group and there is little funding, concerned citizens can keep it going by making valuable contributions to the regional planning process. I see several faces out there today that I have seen before.

Figure 2. Regional Water Plans

One of the ISC's tasks in collaborating with the Regional Water Planning Advisory Council and other stakeholder groups will be to revise and update the Regional Water Planning Handbook so as regional water plans are updated, they will also be consistent. Our agency undertook preparing a report that was done by Daniel B. Stephens and Associates to look at all the regional water plans and provide a basis for comparing and contrasting plans for consistency to determine among other things, how each region estimated its future water supply and demand gap. This draft study is available for viewing in our office, titled "first staff analysis of the regional water committee through the lens of institutional constraints," the premise for the study being that all of New Mexico's water is appropriated. The compilation report provides findings and recommendations for improving our region's and state's assessment of water resources to meet future demands.

Some the interesting points revealed by the report included that many of the first plans completed contain outdated information. Not all the regional plans are consistent, and they are often like comparing apples to oranges, common terminology is not used, terms vary from plan to plan, some plans have public welfare statements and some do not, and all plans need to better address climate variability. Some of the interesting points revealed by the report include that different sources were used to project population growth, most plans did address municipal conservation, and all plans discuss or include some common elements of agricultural water conservation.

The report also offered a few recommendations to increase stakeholder involvement: get more involvement from the business community and chambers of commerce when updating the regional water plans; use more consistent methodologies, although the agency should allow some latitude to ensure consistency, especially with respect to population forecasts; make stronger linkages to municipal 40-year plans; and encourage greater dialogue with neighboring regions, because the first round of regional water plans were done largely in a vacuum, regions that share watersheds need to plan accordingly.

Regions that hope to export water from another region also need to plan accordingly. The recent Upstream-Downstream Project, established on the Rio Grande to enhance communication and collaboration among regions within the watershed, held a number of workshops that have led to greater understanding of mutual needs. The project was a good model of what should have been done in other regions to enhance communication and to identify areas of common concern and areas of common resolve.

Other recommendations include placing greater emphasis on constraints of water availability. It was recommended that regional water plans give greater emphasis to constraints on supply and how to overcome them by examining the relationship between supply and demand and to place greater emphasis on potential environmental impact such as endangered species and water quality issues. Also, it was recommended that more emphasis be placed on energy considerations, as there is a close relationship between energy use and water use. Any energy supply project requires water for cooling purposes, and any water project requires energy to pump groundwater and to run equipment.

Another recommendation was to increase the focus on implementation of key projects. Plans are intended to lead to action; plans should highlight regional projects that are to be undertaken in the years the plan discusses. Regional plans should be updated as assumptions and conditions change. They should be reviewed every five years just like the State Water Plan to determine whether there is a need for an update.

The plans should not only be updated regularly, but they should also be monitored to determine whether they are being implemented. Each region should address regularly whether the projects contained in the plan are being implemented. If the projects are not being implemented, then a progress report should indicate the obstacles that need to be overcome in funding or staffing in order to move forward as scheduled in the plan. And finally there is a need for ongoing funding for regional water plans. Proper regional planning costs money, without a dedicated and consistent source of funding for regions, it isn't reasonable to expect them to meet the standards imposed on them.

In order to move forward with regional water planning, in addition to revising the Water Planning Handbook, we will continue to support updates to regional water plans as money becomes available. Currently, the regional water planning program receives $50,000 in recurring funding annually, and we are trying to hang on to that during this year's budget crisis.

Gretel Follingstad

Welcome and thank you all for having us today. My name is Gretel Follingstad and I am also a water planner with the Interstate Stream Commission and the Office of the State Engineer. I am going to give you a progress report on the 2009 State Water Plan update. I see many familiar faces in the audience, many of you attended some of our meetings that were held from April to June of this year around the state in our extensive public involvement program to gain the public's input on the State Water Planning update.

I'll give a small segment of the presentation that we gave around the state just to give you a flavor of that presentation. We started by asking our audience, why prepare a State Water Plan? Water planning is very important for our state because it is a less expensive approach than reacting to crisis situations, it provides an avenue for public involvement on water management issues, it provides an opportunity for integration of water quality with water management, and it also promotes collaborative regional cooperation. Water planning protects our water availability because it improves efficiency, it prioritizes infrastructure funding, and it links local, regional, and statewide planning efforts.

Figure 3 is a map of water planning by western states to give you an idea of which other western states have state planning efforts. The blue states have state water plans and water planning programs, while the tan states have a water planning program but no comprehensive state water plan.

Figure 3. Western Water States Planning Map

Figure 4 is the cover of our 2003 State Water Plan, with which I hope many of you are familiar. In 2003, legislators charged the Interstate Stream Commission in collaboration with the Office of the State Engineer and the Water Trust Board to prepare and implement a comprehensive State Water Plan. The State Water Planning statute is NMSA 72-14-3.1. Governor Richardson said the plan needed to be completed before the end of that year, and the first State Water Plan basically provided a policy framework for the state to manage water issues and prioritize funding needs.

Figure 4. Cover of the 2003 State Water Plan

In 2007, the Office of the State Engineer and the Interstate Stream Commission instigated a State Water Plan review, which was published in 2008. It was prepared in conjunction with the Water Cabinet, the Governor's Blue Ribbon Task Force on Water, and the Regional Water Planning Advisory Council as well as other state agencies to review how well we've met legislative objectives in that 2003 plan and what areas need improvement.

The water conditions have changed since the 2003 State Water Plan update. New Mexico's population has nearly reached the 2 million mark and is expected to continue to grow, leading to increased demands on water. Legal changes have affected water management statutes and decisions. There has been an increased emphasis on water conservation throughout the state, especially in municipalities. Also, the State Engineer has adopted new rules and regulations on the safety of dams; there are new groundwater and surface water rules and regulations; there has been the declaration and extension of groundwater basins; increased public concern over climate variability and long-term drought situations has occurred; and there is a need to improve aging infrastructure around the state. Other changed conditions include private parties proposing significant new interstate water transfers, a resurgence of uranium mining around the state, and increased federal and state listings of critical and endangered riparian species.

From these lists of changed conditions, we find our priorities for the 2009 update: continued population growth and higher demands on water, the need for statewide water conservation, the need to address the impact of climate change around the state, and the need to update water projects, programming, and infrastructure projects around the state. These issues were addressed in our 22 meetings held around the state. Figure 5 is a map of the locations of those meetings. The public input from those meetings will be incorporated into our State Water Plan Update. Our final meeting was a State-Tribal Water Institute meeting in August, which was held for representatives of all of our tribes and pueblos.

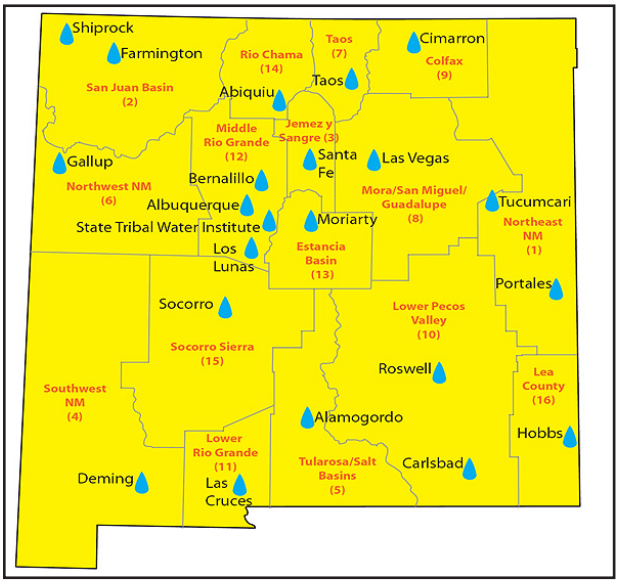

Figure 5. Map of 22 Public Meetings Held Across the State

Figure 6 is a map of the 95 communities that we reached through our efforts with the 750 people who attended the meetings. We had two teams and we split up the state to hold these meetings and present four focus areas for the State Water Plan Update. Statewide news releases were sent to help publicize our meeting efforts, and these were sent about 10 days before each meeting. We generated numerous news stories to help promote the meetings, some of which you may have seen. There were media advisories that targeted specific communities and were sent out a week prior to each meeting. These advisories were often picked up by local media and newspapers to help us get the word out. In some cases we took out paid ads to help gain public input for these meetings. We

also distributed flyers for our meetings with the help of our Regional Water Planning Advisory Council and we'd like to thank all of those who are here, in addition to our district managers who also helped us get the word out on the ground. In addition, we had extensive email invitations to our meetings, which included a list of various target audiences, including state legislators, city and county leaders, public works directors, water conservationists, federal agencies, sister state agencies, acequia associations, pueblos, tribes, and nations (reservations), in addition to congressional representatives, recreational advocates, environmental groups, and economic development advocates.

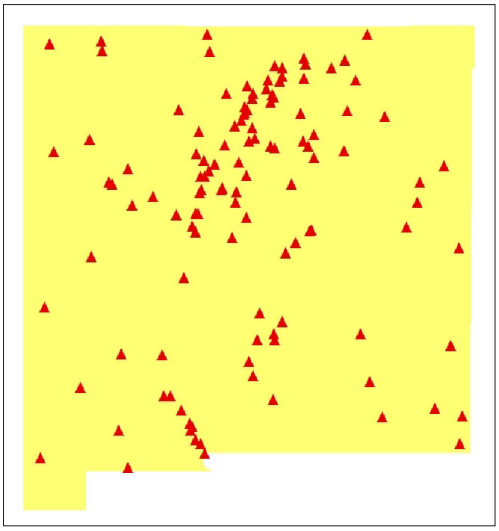

Figure 6. Map of 95 Communities Reached

At our meetings, we had entrance and exit surveys so that we could gain some idea of participant level of understanding not only of the meeting topics, but also how they heard about our meetings so that we can continue to fine-tune our efforts for next time. Some of the survey results include that most people heard about the meetings via email, newspapers, and radio as well as word of mouth, and that most people entered the meeting with some familiarity with state and regional water planning. In addition, the majority of people surveyed learned something new about the State Water Plan, regional water planning, and New Mexico's water needs in general. Most people said the meetings provided a good balance of education and listening to input from the audience.

The 2009 State Water Plan public meetings were held at various locations around the state. The 22nd meeting was our State-Tribal Water Institute held in Albuquerque and attended by representatives of about a dozen tribes, pueblos, and nations. The agenda that we covered at each meeting included the history of water planning in new Mexico, which Angela touched on earlier today, the four focus areas that I just mentioned, followed by a statewide "water snapshot" to give people an understanding of water supply and demand around the state. We also looked at the region-specific picture and what their region looks like in terms of supply and demand and water planning. Then we asked the questions on our four focus areas, the purpose being again to gain public input on the State Water Plan Update.

We showed a pie chart that comes directly from the Office of the State Engineers 2008 Annual Report. It shows 77 percent of water is used for irrigated agriculture, 10 percent goes to public supply and domestic uses, 7 percent is lost to evaporation, and 6 percent is used for livestock, commercial, industrial mining, and power plants. We also used regional map to show the percentage of groundwater versus surface water in the region. We took those maps from our Water Use and Conservation Bureau's 2005 Water Use Report. We also looked at New Mexico's water availability of both groundwater and surface water in the presentation so that people could get an understanding of the fact that we are a conjunctive management state.

We showed participants the regional water planning map (Fig. 1) that Angela showed you earlier today. We then looked at what's going on in their region, showed them the cover of their regional water plan in case they weren't familiar with it, and we let them know that their regional plan is available online along with the other 15 regional water plans. That was followed by a snapshot of what was going on regionally – specific for each region and their water needs. Then we got into the four focus areas about population growth. The Interstate Stream Commission had asked the University of New Mexico's Bureau of Academic Research to do a population report specifically for the 16 water regions so that each region can refer back to that report with some reference as to how their region is expected to grow.

We also shared information from our Water Use and Conservation Report that was published in 2005 by the Water Use and Conservation Bureau

and the Office of the State Engineer, also available on our website. Then we asked our audience the specific four questions about our four focus areas. The first question dealt with population growth and demand, "What should your region and the state as a whole do to ensure water for a growing population?" The second question was, "What water conservation strategies would help meet reduced constraints such as population growth and climate variability within your region and the state as a whole?" Next was on climate variability, "Have you observed climate variability, drought, flooding, or severe storms in your region and what should be done to prepare for these extreme circumstances in your region and the state as a whole?" And the fourth question was about water programs, projects, and infrastructure needs, "What water projects and programs are needed in your region, and how should these projects be prioritized for funding?"

From those questions we gained a very good amount of information. The notes from each one of these meetings are available on the website if you are interested in taking a look at your region, a neighboring region, or all regions if you'd like. We pulled together some common threads or themes from what we heard throughout the state.

The following is not a comprehensive list of everything that came up at these meetings but these are the common threads that continuously came up in these meetings across the state. The list here is in reference to all 16 regions so that you can gain an idea of how much common ground there really is in water planning across the state. There are many differences as well, but for the purposes of the State Water Plan Update and the areas that we feel should be addressed, this matrix helps us see the commonalities across the state.

Common Threads:

- Statewide water conservation program – household and outdoor water use
- Agricultural conservation incentives – improve water use efficiencies
- Municipal water conservation – rate structuring, water re-use
- Watershed management (e.g., forest thinning, removal of invasive species, restore fisheries, wetland restoration)
- Water quality protection
- Public Education on water use conservation and supply/demand gap
- Growth management – land use and subdivision regulations based on water availability
- Collaboration between federal/state/local water agencies
- Statewide adjudication/priority calls (senior water rights)
- Water transfers – regulation between regions
- Improve metering /monitoring for better data
- Consideration of interstate groundwater compacts
- Up-to-date hydrologic surveys – better water supply data
- Deep well water policy
- Aquifer recharge and underground storage to reduce losses from evaporation
- Address aging infrastructure – flood control, infrastructure repairs

At this point in the presentation we would be happy to take any questions or comments you may have on either the state or regional water conservation program or our efforts for updating the State Water Plan. I would also like to add that in addition to our public outreach efforts and our four focus areas, we are also looking at the whole State Water Plan internally to update where our divisions have completed some of the projects and priorities that are currently listed in the 2003 State Water Plan. Some of that language will change based not only on the input of the state but also based on some of the hard work that the agency has done since 2003. There is also a document that will be available on our website that incorporates this matrix and the reports of the State Water Plan outreach for 2009. In addition, the compilation reports Angela mentioned earlier will be available on our website and in our office. Thank you.

The Legislative Perspective on Funding the State Water Plan

Andy Nuñez, Chair, Water & Natural Resources Committee

Andy was born and raised on the family ranch in Roswell, New Mexico. He is one of 11 children, seven boys and four girls. Six boys served in the military; the youngest was killed in Vietnam. Andy served three years in the US Marine Corps from 1953 to 1956. In 1957, he entered New Mexico State University on the GI Bill and received bachelor's and master's degrees. Andy went to work for the US Department of Agriculture for seven years in the Gallup area. He then returned to NMSU to work in the International Program office for seven years traveling to Mexico and Central and South America. Subsequently, Andy left NMSU and took a position in Puerto Rico on a two-year contract to establish a Farm Bureau organization. Upon returning to New Mexico, he started farming and ranching in the Roswell area until 1986 when he bought a farm in Hatch. In 1990, Andy started working for the New Mexico Farm and Livestock Bureau as Organizational Director and Lobbyist. In 1992, he was hired by NMSU as Legislative Liaison and General Director including roles as Area Director for Extension, Director of the Rural Agricultural Improvement and Public Affairs Project, and International Program Director. He remained in this position until 2000 when he won the election as State Representative.

Good morning all and thank you for having me here. My talk will be shorter than my introduction. I don't want to repeat what Angela Bordegaray talked about this morning but a lot of what she said is what I have on my prepared notes.

My topic today is a legislator's perspective on funding the State Water Plan. There is no money. See how short this talk was? In 1987, the legislature recognized the need to establish a statewide water plan but we have been remiss in funding the requirements for such a plan. It is another one of those unfunded mandates but I haven't been responsible for that because in every legislative session I have introduced bills to secure money and I will continue to do so. A lot of my friends in Santa Fe who serve on the legislature with me do not realize how important water is to the state of New Mexico. In my estimation, water is the biggest problem – or a lack of water – is the biggest problem that we have in the state. We must get a handle on how much water we have and that's the job of the State Engineer and he is working on it. But the legislature needs to fund the plan; we need to fund the agencies involved in this work, and I know that Angela Bordegaray and Gretel Follingstad have been working hard with very little funding. This year we again will introduce legislation to appropriate funds for these agencies.

Water plans are extremely important; the budget deficit is bad, but if we ever get in a water deficit, we will be in worse shape than we would be with a budget deficit. As chairman of the Agriculture and Water Committee and as chairman of the Interim Water and Natural Resources Committee, I am committed to making sure that our water programs in the state of New Mexico are properly funded

and taken care of. I will be introducing legislation and will have Estefan Lopez from the Interstate Stream Commission provide me some figures by November 30 for the final meeting of our Water and Natural Resources Committee about what will be needed. And even though we have no money supposedly, we are going into a Special Session on Saturday where we should learn how much money we really do have. There a lot of places where we could cut funding. It doesn't make sense to me that I go in and request $50,000-$100,000 from the total state budget, which is nothing, and for something as important as water, and I can't get even that much money to fund projects. We must keep our legislators informed on the importance of water. That is what I'll be working on this coming year. As I said, the amount that we request is a very small amount in the total budget. We could eliminate one of the governor's staff positions in order to pay for it. I know several people we could go ahead and eliminate and thereby have funds for a lot of bills, but don't tell the governor I said that. We will be in Santa Fe on Saturday debating what we are going to do. At this point, the legislators have given the governor three options and he has rejected all three of them.

In my estimation, and I may lose some votes for this but I didn't come in here to please everybody anyway, everyone is going to have to take a cut: education, Medicaid, everyone. If we don't cut everybody a little, then those who are left will really be hit hard. I am a firm believer that if the administration doesn't come up with a plan where everybody gets hit some, I won't vote for it. I will be sticking with that notion and we will see how it goes this weekend. We have no idea how long we will be in the Special Session, but rest assured that I will be sticking by the water issues hoping we get some money for them. Water has been a target for cuts for a long time.

We also need to get money for the Utton Transboundary Resource Center's Joe M. Stell Water Ombudsman Program. The Center's staff is helping people who are going through adjudications, and we need to help Susan Kelly from the Center get funding to keep that going. The program is named for Joe Stell who will be your speaker at lunchtime. To me, Joe Stell is the most knowledgeable man in water in the state of New Mexico. In my estimation he knows more about water than any two people in the state, but we will talk about him at lunchtime.

The State Water Plan and the regional water plans are living documents and they need to be updated and kept current. The State Water Plan is up for renewal and updating every five years and hopefully we will get the money for that this coming year. Angela Bordegaray and the rest of the staff cannot introduce the bill to the legislature because the governor has said that you cannot introduce bills if you are on his cabinet. However, they can direct me and I can introduce the bill. If anyone has any questions, I will be willing to answer them.

New Mexico's Planning Areas Versus Management Areas: Is There a Difference?

Blane Sanchez, Interstate Stream Commission

Blane is from both Isleta and Acoma Pueblos. He is the first Pueblo/Tribal person appointed by a Governor of New Mexico in 2003 as a member of the Interstate Stream Commission. Blane is also the first Pueblo/Tribal person to have earned a Master of Water Resources from the University of New Mexico in 2005. His college education foundation comes from a BS in agriculture in 1981 from New Mexico State University. With over 30 years of combined education, professional, and personal experience related to but not limited to Pueblo natural and water resources management, environmental protection, education, and economic development, Blane has worked directly or indirectly with all 19 Pueblos. Blane continues to dedicate his efforts toward working with and on behalf of all Native American Tribal Governments, their Tribal members and others in the those areas. He would like to play a role in helping mentor and develop the next generation of tribal leaders and professionals.

Editor's note: The following paper represents an unedited version of the speaker's remarks at the conference.

Greetings everybody. Thank you for this opportunity to speak at the 54th annual New Mexico water conference. As always, I have to put forth my disclaimer that my talk reflects only my opinion and does not represent the positions of either the Interstate Stream Commission (ISC), or any pueblo or tribe. A lot has transpired since I last spoke at the 44th annual water conference. Back then, I challenged New Mexico to place a tribal member on the Interstate Stream Commission. In 2003, that challenge was answered by Governor Richardson when he appointed me as the first tribal member of the ISC. In addition, and to Governor Richardson's credit, a number of tribal members were also appointed and integrated into state government. Thank you Governor Richardson.

I have had the pleasure of seeing many significant accomplishments while with the ISC including the first State Water Plan and several water rights settlement agreements reached involving the Navajo Tribe in the San Juan Basin and settlements involving the pueblos of Nambe, San Ildefonso, Zuni, and Taos. Now comes the hard part of funding and implementing these settlement agreements. Other significant accomplishments include the Gila River Settlement, the completion and acceptance of all 16 regional water plans, and most recently, the signing of the Pecos settlement and implementation. Much credit goes to Office of the State Engineer (OSE) and the ISC staff, and to citizens who volunteered their time and effort to make these accomplishments come about. However, all this planning sidestepped the question of following boundaries and thus provided us with a challenge in managing our water resources. I recall some college coursework that emphasized watershed planning and management based on the boundaries of that defined system, hence my topic: New Mexico Planning Areas Versus Management Areas: Is There a Difference? (Fig. 1)

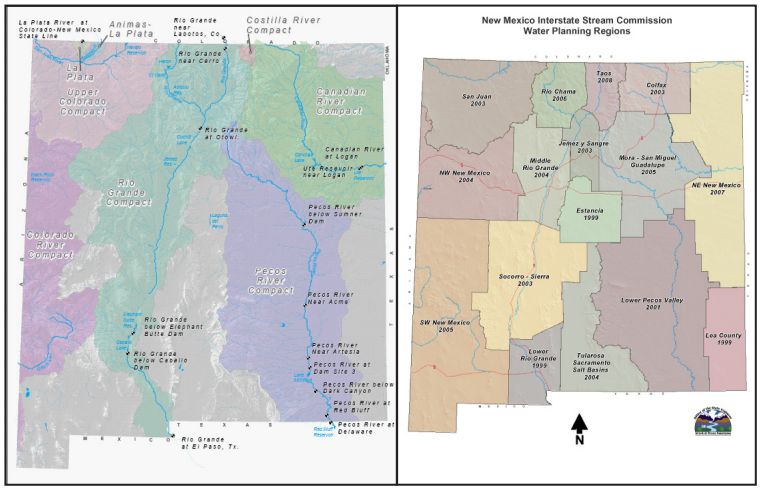

Figure 1. New Mexico Planning Areas Vs. Management Area: Is There a Difference?

A tremendous amount of work and effort has gone into the 16 regional water plans and I've always wondered why the planning boundaries were not based on hydrologic boundaries, instead of artificial county boundary lines. While looking at other states' water plans and other planning efforts, I noticed that some states like Arizona and Utah have their planning areas defined for the most part by water boundaries, although Arizona fudged on some of the water boundaries. Figure 2 is a map of Arizona's water planning areas. The state is divided into groundwater basins and sub-basins, and Arizona's active management areas are a corollary to New Mexico's active water resource priority basins. The red arrow indicates that Arizona's planning areas do include and denote the presence of tribal reservations.

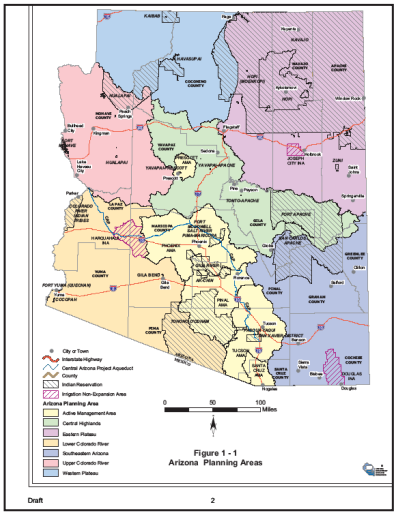

Figure 2. Arizona Planning Areas

New Mexico water planning regions are shown on Figure 3. With the exception of the San Juan Basin and San Juan region, the boundaries are county delineated. Taos and Rio Chama come close but do not follow the exact hydrologic boundaries. Note that this regional water planning map excludes New Mexico's reservation lands. To qualify that statement, some of the regional water plans containing reservations within their planning area boundaries have noted their presence. Given the change in state and tribal relationships during this administration, hopefully in the next revision of the State Water Plan, the tribes and reservation boundaries will be given due credit in the planning areas. As you can see from Figure 4, the New Mexico hydrologic code of basin delineates watershed boundaries. If you point at any of the basins, you would get a description of the area encompassed within them.

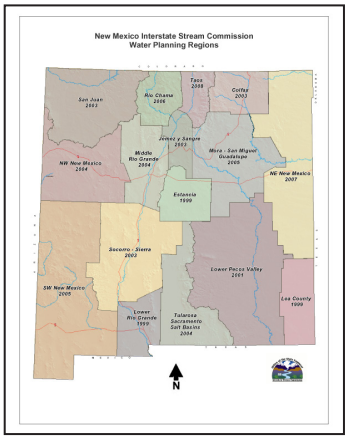

Figure 3.

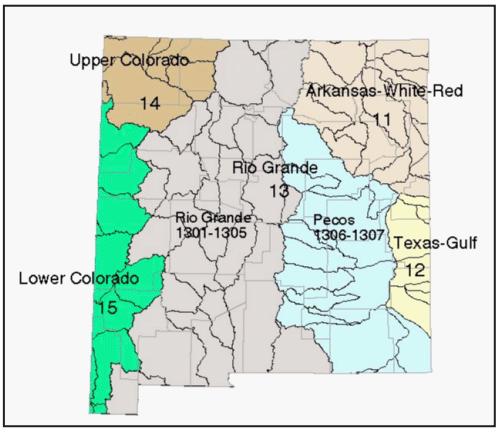

Figure 4.

The following slides were taken from New Mexico Water Resource Atlas. In looking through the atlas, maps reflect the hydrologic delineation based on identified watershed basins. Figure 5 shows the New Mexico river basins governed by interstate stream compacts, which directly impacts management. For the most part, New Mexico is covered by basin compacts, with the exception of those areas that have no connection to any compact or are closed basins. Nonetheless, each of these areas has distinct boundaries for consideration in planning and management attempts. Figure 6 shows New Mexico's basins and sub-basins and are identified with water contours. Again, distinct hydrologic boundaries are identified.

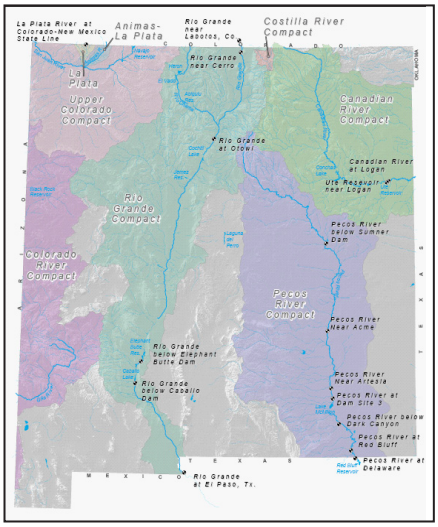

Figure 5.

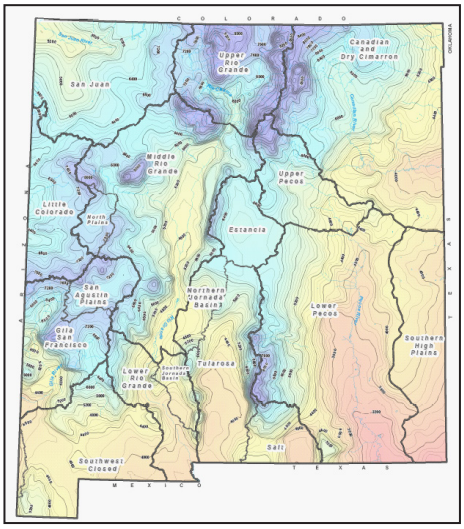

Figure 6.

Thomas Springer wrote a paper in March 2006 when he served on an ISC ad hoc planning group and I would like to quote from that paper. "Watershed management: The issue is, at the time 15 of the 16 New Mexico regional water plans addressed the need for preserving and improving watersheds, the key factors in achieving this goal include increasing surface absorption, the prevention of catastrophic fires, soil erosion, surface runoff, and silt in reservoirs. The coordination of and cooperation between federal, state, and tribal, local and regional plans is a necessity for the success of water management plans." The key here is the identification of the watershed and hydrologic boundaries. The report went on to indicate that OSE/ISC leadership and guidance is necessary in watershed management to enhance the quality and quantity of state's water supply. Findings indicated that current watershed management in New Mexico is piecemeal, with no single agency sponsoring a comprehensive water management program. Implementation of the State Water Plan mandates that the ISC, the State Engineer, and the Water Trust Board provide leadership to watershed restoration efforts, and that has not occurred. A Memorandum of Understanding does not exist between the state's land and water managers, federal and state entities, and tribal and local governments that expressly supports implementation strategies as established in the New Mexico State Water Plan, the New Mexico regional water plans, New Mexico Forest and Health Plan, and the New Mexico Non-native Phreatophyte/Watershed Management Plan.

The group recommended that the OSE and ISC coordinate state and federal agencies to collaborate on watershed restoration efforts. The ISC should enter into a Memorandum of Understanding for data sharing and partnerships with federal land managers, and state, and local governments including tribes. The ISC should support and implement the strategies and appropriations identified in New Mexico watershed, forestry health, and planning and the Non-native Phreatophyte/Watershed Management Plan. Again, the emphasis is on watershed management.

Figure 7 looks at the Middle Rio Grande region showing the different tribal lands of Isleta, Zuni, Acoma, Sandia, San Felipe, San Domingo, Cochiti, Santa Ana, Zia, Jemez, and some Navajo land. A lot of tribal land exists within the boundaries. In planning for the Middle Rio Grande, I propose that we take a look not only at our regional water

plans, but also at all regional plans - not just the Middle Rio Grande – and give a second thought to having our planning regions based on hydrologic boundaries or basin boundaries.

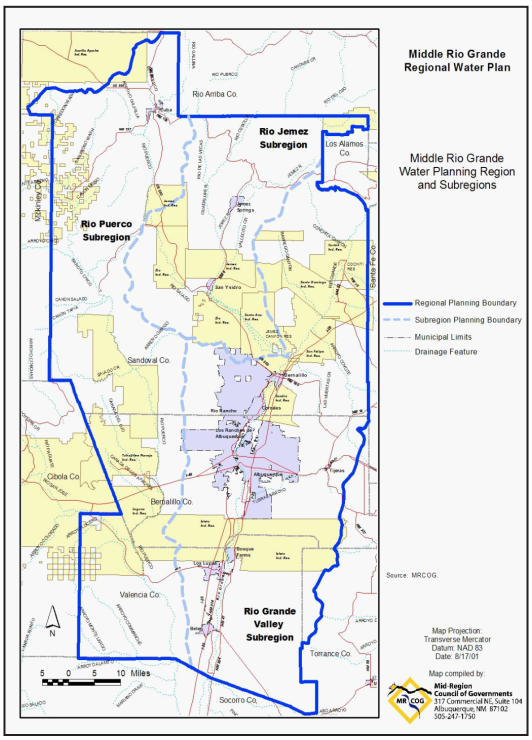

Figure 7. Middle Rio Grande Water Planning Region and Subregions

Implementation of a regional plan and ultimate distribution of water resources are dependent upon the hydrologic properties of that basin. The state has utilized basin delineation to implement Active Water Resources Management, managed by hydrologic basins but planning by non-hydrologic boundaries. A difference does exist between planning and management. Although I know this concept will probably not gain support because of the amount of work that currently is going into regional water planning with the existing boundaries, I believe that to plan and manage our water resources correctly, we need to rethink the boundaries that we are planning and managing for.

I want to move to a related subject. I always try to include something to do with tribal water resources. The theme of this conference is water planning in a time of uncertainty, and let me talk about tribal water planning in a time of uncertainty. The New Mexico State Water Plan sets a policy for formal consultation between state and tribal agencies and the regional water plans provide for tribal participation. The Office of the State Engineer has hired a full-time liaison to work on water issues and to create a tribal water initiative to address water planning and related issues. The state/tribal group met on August 17 and it was the 22nd meeting in the State Water Plan update. The public outreach was created specifically for tribal input. Part of the importance of tribal participation resulted in House Bill 37, which amended a subdivision act to provide for tribal notification. This offers even more opportunity for tribes to collaborate in planning. The tribal liaison, Byron Armijo, emphasized the importance of tribal input and cited the passing of House Bill 37 as an example of the effect of state tribal bodies can have on water planning.

Also, there was a question asked about whether the tribal water plans will be integrated into the State Water Plan. The ISC director responded that the OSE will not dictate any amount of integration, but that it would be the tribe's decision to share and determine what should be included. The policy director noted that any part of the update process is subordinate to the Tribal Water Plan. I think that is a pretty significant statement. Another comment was made that the State Water Plan does not address water quality and several pueblos have water quality standards. I was involved in water quality for a number of years. I don't know what is happening in terms of state/tribal relations on water quality, but in terms of the regional plans, the State Water Plan should emphasize tribal water quality standards and there should be a clear policy on how coordination will occur between the state and tribes. Mr. Bill Hume, the governor's assistant, also noted that Governor Richardson has only one year left in office and the more we can implement now the better.

As part of the initiative meeting, most participants expressed an interest in workshops outlining issues concerning water transfer processes, effects on both areas, dedications and a gap analysis. The water initiative is moving forward to address these concerns and create such a workshop. I'm sure others are out there ready to address state and tribal water concerns.

Another comment noted that questions were framed toward the state and regions, not toward the pueblos individually or collectively. Each tribe should have to answer the questions individually as they are their own entity and outside of regional boundary or state restraints. The ISC director responded that tribes are able to execute policy,

projects, and programs within their jurisdictional boundaries and the state or region may not have any input. However, tribal perspective can shed light on conditions statewide or regional efforts that will affect all constituencies. One statement made by the State Engineer is that the Rio Grande adjudications need to be carefully planned and he made a direct connection to Section E of the State Water Plan that indicates that a policy must be formulated before any type of adjudication or negotiated settlement is done as part of the planning process. That will go a long way to address water adjudication in the Middle Rio Grande by providing a policy and formulating a process that can be undertaken, which will hopefully smooth out the issues that will surely come up in such a process.

Planning for tribes is more essential than ever. Changes in climate, the economy, coupled with natural resources protection and economic development, and population growth makes planning essential. Unfortunately, the continued premise is that planning cannot be done because certain sensitive information would be given, or planning cannot be done without full adjudication. In my opinion, those are the wrong reasons not to plan. For the pueblos in the Middle Rio Grande, water planning should not be premised on an un-quantified supply, but rather on identifying the uses of the water resources that ultimately will require a quantified amount. By not planning on use, how can the amount of water required be substantiated? Anyway you look at it, whether under the current Middle Rio Grande planning area delineation or based on my proposal of basin hydrologic boundaries, pueblos should ultimately be the driving force behind planning in this region, not only for uses within the reservation boundary, but also to ensure that off-reservation areas will be able to meet their prior and paramount needs and uses.

Rather than planning on what to do with the water resource after it has been quantified and how much you might get, plan now to start using the water resource because the longer you wait, the less resource there will be for you to use. I hope I have the continued opportunity to participate in future New Mexico Water Conferences. I am coming to the end of my second year on the ISC. I anticipate, look forward, and welcome the next tribal member to follow me in this position. As a member of the elite 10 percent of the population out there, I hope I can use what I have learned to contribute to the planning and management of our shared resources, whether in tribal or non-tribal settings.

Thank you.

The Texas Water Planning Process

W. David Meesey, Texas Water Development Board

Meesey holds a master's degree in public administration from Southwest Texas State University (now Texas State). He is employed by the Texas Water Development Board (TWDB) as a program specialist and special assistant to the Deputy Executive Administrator for Water Resources Planning and Information. David was formerly the Manager for Regional Water Planning, overseeing a staff of project managers who work with 16 water planning groups to produce regional water plans. He is also the project manager for the Lower Colorado regional water planning area, which includes Austin (and formerly for the Brazos and Lavaca regions), providing assistance to the regional planning group with contracts, rules, technical assistance such as developing water demand and supply projections, and all other facets of water planning. The main purpose of a water planning group is to produce a unique water supply plan for their region. The approved regional plans form the basis of the State Water Plan every five years. David assisted with the development of the 2002 and 2007 State Water Plans and presented them at public meetings around the state. Currently, he is assisting with the development of the 2011 plan, Water for Texas.

Thank you. I am proud to be here and am enjoying it too. Like I said earlier I get a kick out of just being on the other side of the microphone because sometimes it is nice to see other people, their perspective and find out what their issues are. Let's figure out how you guys do it here and how we do it there; in some ways it is very different and in other ways it is not so different.

Figure 1 is our most recent state water plan that we completed in 2007. We are now on a five-year cycle, which means we never leave this either, it is perpetual planning, so good thing I am a planner. We are working on our next state water plan, which will come out in 2012.

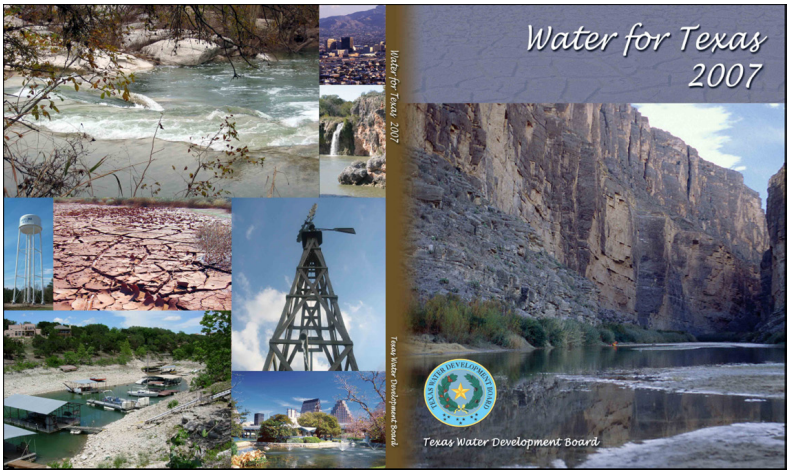

Figure 1. State Water Plan Completed in 2007

I work for the Texas Water Development Board. We do regional and state water planning, which includes 16 Regional Water Plans and 1 State Water Plan every 5 years. We also do flood mitigation

planning, which is new responsibility, we have only been doing that for the last couple of years. The legislature transferred that duty from the Texas Commission on Environmental Quality to our agency a couple of years ago, and with that comes the national flood insurance program requirements and flood mitigation planning, so we are kind of on the learning curve for the flood programs. These are actually the opposite of what I do, regional water planning, which is drought based. I also administer a regional water and wastewater facility planning grant program. That is a 50% matching grant program to do regional infrastructure facility planning studies. We do a lot of financial assistance that helps implement some of the things that we do in planning, we have various loan programs, and we do everything from financing water development to some of the infrastructure that is needed in water and wastewater in the state. We have an economically distressed area program that even provides very low interest rate loans, in some cases no interest and in other cases even outright grants for our poor communities to implement some of their water needs.

We also do data dissemination through the Texas Natural Resources Information System (Fig. 3). What I mean by that is when I started in the business data were maps and quad sheets, as my kids say I learned how to count on the abacus but that is a different story, now days it is all digital. Now we have aerial photography, satellite photos, digital maps, GIS, all the things that can be used in the next generation of planning, and we also assist with national disaster response efforts statewide.

Water planning in Texas was a legislative response to drought. In the 1950s, most of our state had just gone through our worst drought in recorded history, which is probably only 100-150 years, but most of Texas suffered through extreme drought in the 50s, anywhere from 7-10 years. At the end of that period, this being Texas, of course we had a flood, but also the legislature created our agency, the Water Development Board and provided constitutional bond authorization of $200 million for water development. So we have been in the planning, water development, and financing business ever since. Since that time, we have produced eight state water plans and now we are on a regular cycle, after our first one in 1961 to our most recent in 2007. Then in the mid-90s we had another pretty extensive drought, pretty severe, although short in duration. It was not like the long one in the 50s, it lasted a couple of years, but it caused $6 billion of economic losses in 1996, mostly from agriculture, and threatened the water supplies of nearly 300 entities. You know a drought coming along at the right time is good for financing your programs if you have that kind of weird perspective about things, and that drought got the impetus behind the legislature to create the current planning paradigm that we have, and also to provide appropriations to pay for it. In the past we have suffered from not having adequate funding , but lately we have had the legislature step up to the plate and appropriate money for us to do our planning and also implement our plans.

Figure 2 depicts what is not drought planning, but that is kind of what comes along at the end of each one of these drought cycles it seems like. We will go a few years of drought and then we will have these unbelievable floods. That is actually a picture of Canyon Lake spillway being breached for the first time ever in the early 90s.

Figure 2. Canyon Lake Spillway Being Breached for the First Time Ever in the Early 90s

Figure 3 shows how our state is divided into 16 regions, the closest one to you being far west Texas, which goes out to El Paso, and I know we have people here, Bobby Creel for one, and some other folks like the Bureau of Reclamation guys that actually do participate in the regional planning effort in that region occasionally. I think Bobby said they are non-voting members. I am a non-voting member of the planning group that I work with also, but that is a good thing and I think that is maybe something to recommend to anyone else who might consider doing this type of thing, to go a little bit farther, reach out to the next state, and talk to Mexico, which we try to do as well, and

actually participate in each other's planning efforts. I think you get a lot better perspective for what the other guy is doing if he is at your meeting or you are at his meeting or at least you do some work together.

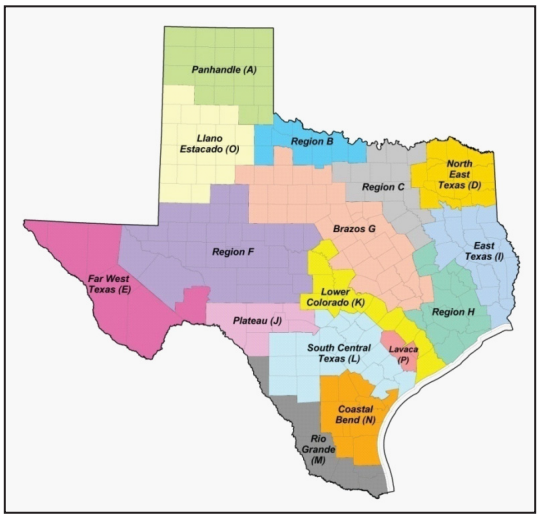

Figure 3. Texas is Divided into 16 Regions

Well how do you do a water plan? First of all, when we do a regional water plan we plan for 50 years because it is drought based. We project the population, how many people do we have as of the last census, how many we expect to have region by region and then on the state level by decade for 50 years. Then we ask how much water we are going to need, and project demands for 50 years. How much water do we have? What are our supplies of groundwater, surface water, and what will happen when we compare the two? We do that region by region for each water user group within the region, we compare the supplies with the projected demands, and in areas where it appears to be short we develop water management strategies or projects or other efforts to meet those future water needs. Those can be anything from structural projects like a reservoir or a groundwater well field to something as simple as implementing additional water conservation or reusing wastewater effluent, desalination, or any of those kinds of things. Once the planning groups select their water management strategies then they produce a regional water plan every 5 years.

Our agency is involved in several roles, such as resolving conflicts, but one of the reasons that we don't always have to resolve conflicts is because we do have the requirement in statute to approve each regional water plan, so although they do conflict sometimes we are able to work with them normally to get them resolved because in the end we have to approve them to be official. At the end of the five-year process, we take all the completed plans and the data, blow it up into a statewide water plan and add our own experiences and our own policy recommendations for the legislature.

The regional water planning process is a very open and collaborative process. All meetings are open to the public, in fact, there is a public member on each of the regional water planning groups. At least 11 different statutory interests are represented in each water planning group; most regions have an average of 18-20 members. The 11 interests include the public, environment, municipalities, industry, agriculture, counties, small business, water districts, electric generating utilities, river authorities, and water utilities.

So what is going on in our state? Figure 4 is pretty graphic. Since 2000, when our population was about 21 million to say 2010, we are almost at 25 million and by the way, that number is going to come in pretty close to being accurate. We project 45.5 million people by the year 2060. That is pretty good growth, which means we have more than doubled over that 60 year period.

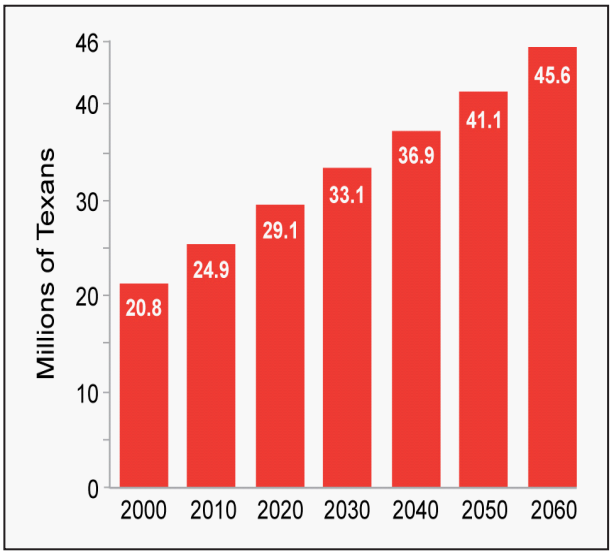

Figure 4. Statewide Projected Population Growth

In the meantime, what happens to our water demands; how much water are we going to need? Figure 5 shows that it is increasing as well. You can see our projections are going from about 17 million acre-ft of water usage in 2000 to about 21.5 million acre-ft, the projected usage by 2060. That is

a healthy increase in water, but it is nothing like the doubling of population.

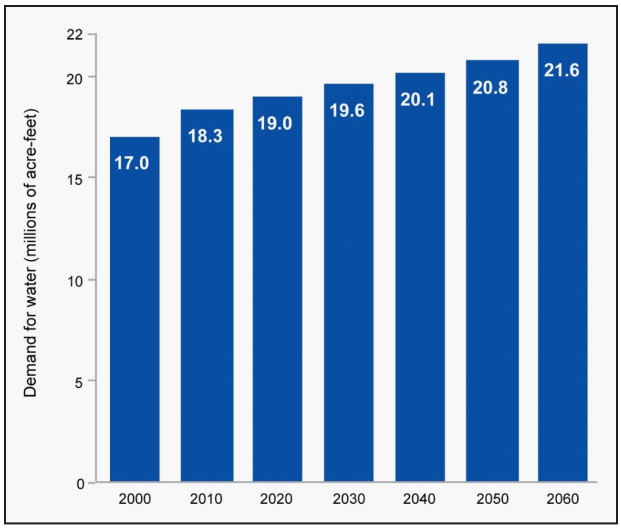

Figure 5. Projected Water Demands

Why would one suspect that is the case? Why does population double and projected water use not double?. Two reasons: conservation is one and irrigated agriculture the other. Conservation is a conscious effort both on the municipal side and on the agricultural side to reduce the water demand. But look at our long-term irrigation trend (Fig. 6), that is the one that has been declining and is projected to continue to decline over time. You can see our municipal usage graph just about doubles, that one follows the population growth pretty closely, but our irrigated agricultural sector is declining and will continue to decline over time. In fact, 10 years farther out beyond that graph those two lines will cross.

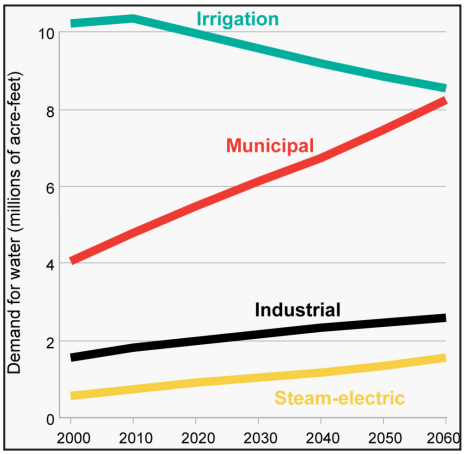

Figure 6. Project Demand Treads

In the meantime, what happens to our water supply (Fig 7)? If we do nothing, it declines over time, both groundwater and surface water. Why would the amount of water you have decline? Groundwater declines over time because we are overdeveloping and overusing. Sometimes you hear the word mining; we are over-reliant on the aquifer and we are using it faster than it can recharge. Surface water and reservoir storage on the other hand, is reduced over time through sedimentation, so if you do nothing the amount of water that you have in 50 years is less than you have today. You can see that projected decline is about 18 million acre-ft currently to about 14.5 million acre-ft in 2060, and again that is if you don't do anything. It is a fact today that, in our state, we don't have enough water to meet all of our needs now if we were to have a drought of record recur. Figure 8 is an actual picture of a lake that is at about 60 percent capacity in west Texas.

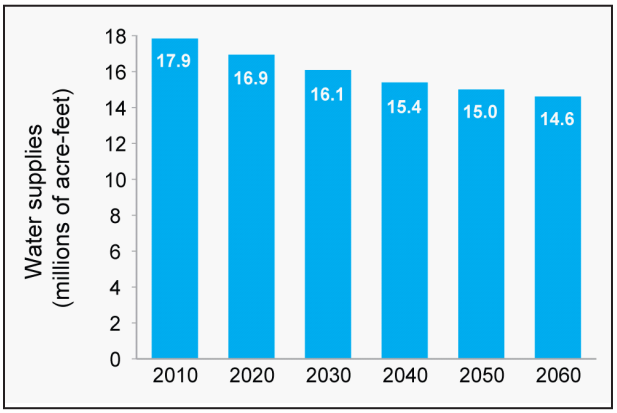

Figure 7. Projected Water Supply

Figure 8. An Actual Picture of a Lake that is at about 6 Percent Capacity in West Texas

Figure 9 shows how much water we need during a drought, it increases from about 3.7 million acre-ft in 2010 to 8.8 million acre-ft in 2060. That is a pretty healthy increase, and that is where that growing population comes in.

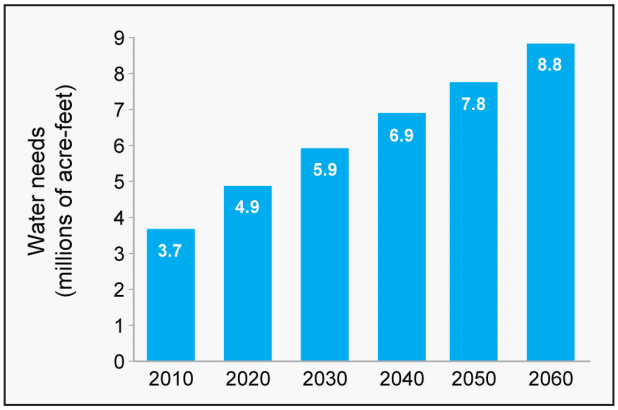

Figure 9. Water Supply Needs in a Drought

Water management strategy evaluations are done by each regional planning group. As I mentioned a while ago, each region has to evaluate all of the potential ways to meet the needs for additional water. Some of the factors that are taken into consideration include water quantity and reliability, financial costs, impacts to environment and agriculture, impacts to water quality, and other factors such as regulatory requirements, time required to implement, and so on. In our state water plan, if all the strategies are adopted, then it does produce enough water to meet their needs, almost exactly the same amount as how much they need (Fig. 10).

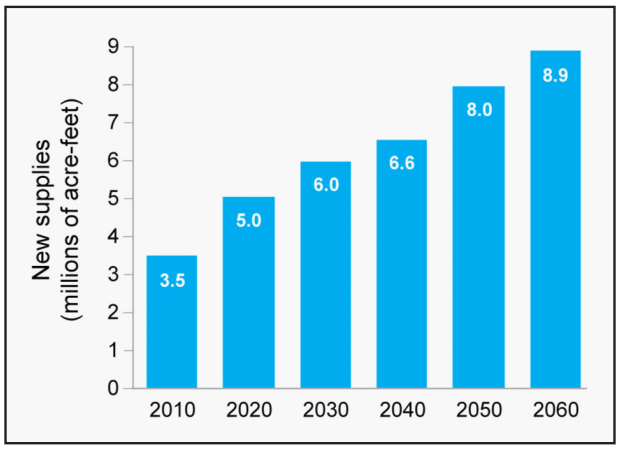

Figure 10. Water Volume from Recommended Water Management Strategies

Part of the recommendations deals with reservoirs; new reservoirs were recommended in our most recent state water plan (Fig. 11). They tend to occur in the eastern half of the state and that is because it rains considerably more in the east. We get an average of eight inches of rain a year in El Paso at one extreme to nearly 50 inches of rain at Orange, Texas, and every several miles it varies all the way across the state. We have 21 recommended reservoirs, in this picture. Actually some of these had already been recommended, but the water plan recommends anything from small off- channel reservoirs to full-size reservoirs depending on the need of the region. This will not be cheap. In fact just the capital cost alone in 2005 dollars was approaching $31 billion and that is not including the operation and maintenance costs and it is not in current dollars. It costs a lot of money, and the future cost is going to be higher.

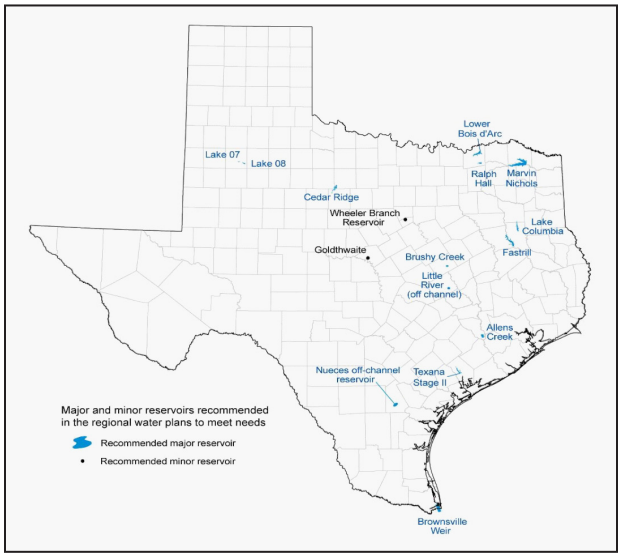

Figure 11. Recommended Major and Minor Reservoirs

What is the cost of not implementing the plan? We have done a bit of economic analysis on that question and we estimate a $9.1 billion loss to our economy if we do nothing and we do not implement some of the recommendations in 2010. The loss of local and state taxes is estimated at $466 million in 2010 and $5.4 billion in 2060. But the big kicker is that as much as 85 percent of the state would not have enough water to meet all of their needs if we had a recurrence of the drought of record by 2060.

One important aspect has been a fairly recent legislative change in Texas that in order to get funding from the Water Development Board, a proposed project must be consistent with the approved regional and state plans. That connects the planning with the financing and implementation programs. This does not affect private financing but it does affect state financing. We have some newer funding programs from the last two sessions where we received appropriations that pay for programs that have a little bit lower interest rate, better terms, but in order to access that funding the recommended project actually has to be in the plan.

Something in our projections we call rural county - other, which only a planning nerd could love. We plan for communities with populations of 500 or greater or large supply corporations; and entities with 280 connections or greater. That still leaves rural portions of counties unaccounted for and we tend to lump those together and call that remainder county - other. We do projections based on that remaining county entity. In order to get financing for a project, if you are in that county portion, the project at least has to be consistent with the recommendations in the regional water plans for county - other entities.

Entities can do several things to access funding and to be consistent with state and regional water plans: they can have discussions with the regional planning group; the current plan may be amended; or the project may be included in the next plan. If a project is not consistent with the regional water plan, we streamline the process a little bit and a minor amendment may be possible or perhaps a waiver may be requested from the TWDB.

Another reason why we plan concerns the regulatory side of things and the Texas Commission on Environmental Quality (TCEQ). In order to get a water right permit, what you propose also has to be consistent with the regional water plan and with the state water plan, although the TCEQ has a right to grant a waiver too.

Some of the things that are coming along, we talked about extensively already: west Texas as well as New Mexico using desalination and some of the less traditional sources like wastewater reuse and water conservation, rainwater harvesting, conjunctive use of ground and surface water and aquifer storage and recovery (ASR). I heard a lot of talk already today about conjunctive use and even some about aquifer storage and recovery.

Sometimes people accuse us or at least our groundwater process as being a little bit combative and here is the proof: we are a rule of capture state, which is very different from our surface water law. Our groundwater law operates entirely differently, except where it is modified by groundwater districts, and we have a lot of groundwater districts but they are not statewide.

We also have something called groundwater management areas, which cover the state; each grouping of groundwater management areas has individual groundwater districts in it. Figure 12 is a map of the groundwater management areas. Each district comes up with its desired future conditions, which is how they want to manage aquifers in their districts. I guess really what I am trying to say here is although we use groundwater availability models and they are very good tools, that we are fortunate enough to have the funding to produce them. In the end, the final decision on groundwater availability is more political than it is a scientific one. Certainly the science is in the background and it will get you to a certain point, but the final decision is as much about politics and I know that is probably true in just about every state.

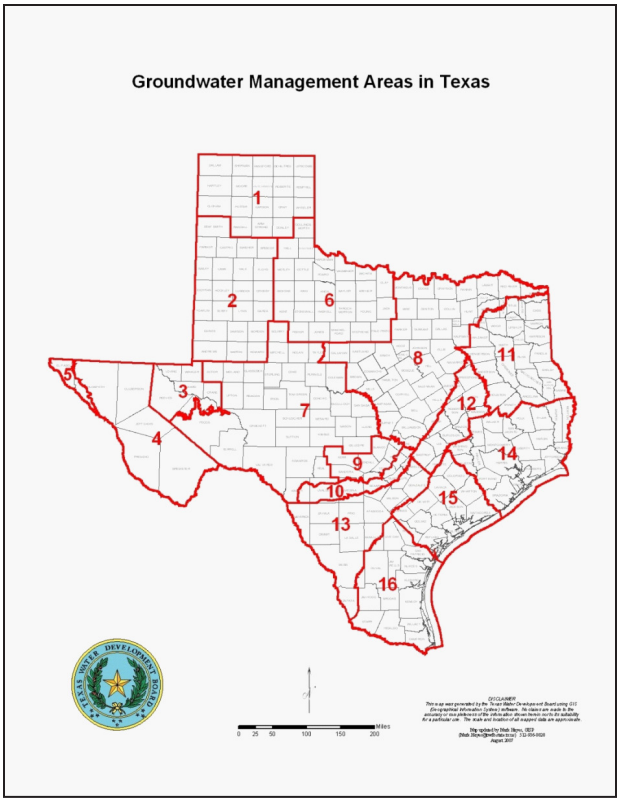

Figure 12. GMA Map

We have an alphabet soup of so many acronyms you can't keep up with them all. We will produce managed available groundwater (MAG) estimates once each district comes up with its desired future conditions (DFC) calculated by the TWDB. To me this could spell t-r-o-u-b-l-e because it has not been entirely tested in court. Some people predict that is where it is finally going to go but we will wait and see about that.

One of the things right now is that groundwater management process is not yet in sync with regional water planning, mainly because the statutory deadlines don't match up. This will be corrected in a few years once all of the desired future conditions are developed, then the regional water planning groups will have to use those numbers as their available groundwater, but right now they don't.

We have made some policy recommendations to our legislature in the last plan: Both regional planning groups and the state water plan made these recommendations. One of the recommendations was for funding; we recommended that they continue to appropriate money for our regional and state planning efforts and also provide appropriations for implementation. In the last two sessions we have been very fortunate because they have appropriated money mainly to leverage lending. It's to pay the debt service on loans so that we can take a $90 million appropriation and stretch it out to over $900 million in actual available capital. We had a recommendation to designate the unique reservoir sites that we have identified However, we would also like to find a way to acquire some of those sites so that we can build some of the future reservoirs, but that is very expensive and that has not happened yet.

We have an issue with interbasin transfers of surface water. This came up as an issue and it is in the constitution but it is also in statute for about the last 10 years. A new interbasin transfer of surface water loses its priority and becomes the most junior water right in the basin, so obviously it is not too reliable. We asked the legislature to provide some guidance on that or some relief and that has not happened yet.

For wastewater reuse there are varying opinions on what happens to treated wastewater when it is discharged into a stream; does it become property of the state and subject to appropriation doctrine or is it available for that discharging entity to pick up downstream and reuse? The traditional answer has always been not without another permit from the TCEQ. Also there are different legal opinions on the difference between surface water-based wastewater effluent and groundwater- based effluent. We have asked the legislature for guidance on that and that one is still pending.

So how do you get a hold of us if you have any other questions? We have a pretty good website at www.twdb.stat.tx.us. We have information there about our financial programs, our planning programs, regional water plans, state water plans, all of our produced reports, most of them are scanned now and available online, different program areas are explained, and different program contacts. We are trying to make as much available online as possible. I am available for questions and I will stick around too. Thank you very much.

Albert E. Utton Memorial Water Lecture: A Kaleidoscope of Water Issues

Representative Joe Stell, retired New Mexico Legislator

Joe is the 2009 Albert E. Utton Memorial Water Lecturer. Former Representative Stell retired from the New Mexico Legislature after serving twenty years and being recognized as the preeminent legislative expert on water issues in New Mexico. Governor Richardson referred to him as "Mr. Water." He served as chair of the Agriculture & Water Resources committee and was a member of the Energy & Natural Resources committee during his tenure. A former school teacher and football and basketball coach, Mr. Stell was educated in New Mexico and has received degrees from UNM and WNMU and has earned graduate credits from NMSU and ENMU. In retirement, Mr. Stell continues to work his cattle ranch near Carlsbad.

I want to thank you for allowing me to be here today as a speaker. It is quite humbling to be speaking after all the very capable speakers that I heard this morning and also the fine speakers in prior years of the WRRI water conference.

I would like to thank Andy Nuñez for his glowing introduction of me. Andy is a State Representative and is chairman of the important Agricultural and Water Resources Committee. Thank you Andy for your time and effort as a legislator and committee chairman, and good luck in the upcoming special session.

Karl, I thank you for organizing and putting the year's agenda together for this year's conference. However, I can't omit Bobby Creel, Cathy Klett and others of your staff who always play a big part in organizing WRRI functions.

Also, since we are meeting here at Isleta Pueblo, it is of historical significance that I should mention the 1680 Northern Pueblo revolt. About 2,000 refugees including many Isleta Pueblo members and Hispanics fled south to El Paso and Del Norte to avoid annihilation. The Native Americans settled in the present day Texas communities of Ysleta and Socorro southeast of El Paso, Texas. Their descendants are there to this day.

One other personality that I would like to acknowledge is Em Hall. He has made presentations to this conference in past years. Em is also the author of the book "High and Dry", a documentary of the origination of the Pecos River Compact. He was employed by the Office of the State Engineer when the noted Steve Reynolds was state engineer. Em is a professor at UNM and has authored other books regarding water and water issues. Thank you, Em.

I want to issue my usual disclaimer that any information that I disclose is strictly my own opinion and not necessarily anyone else's.

Andy Nuñez told you my age is 81. That reminds me of a story of an old fellow who was hard of hearing and who had a mild heart condition. He went to his doctor for a periodic checkup, and the doctor gave him advice regarding his heart problem. A week later the doctor was surprised to see the old gentleman with a young

lady coming down the sidewalk arm in arm, laughing and skipping. The doctor approached the pair and asked what was going on. The old gentleman said "Doctor I'm following your advice, you told me to get a hot mama and be cheerful." The doctor replied, "I never said that, I said you have a heart murmur, be careful."

I have written out several things that I wanted to convey to you, then I rewrote them several times and each time they came out differently. I have ended up with a few note cards so here we go.

Everyone has probably got an opinion regarding climate change and global warming. Let's go back in time: climate change is with us now, and it has been with us in the past and undoubtedly will be with us in the future. The climate is changing and always has changed. Around 570 million years ago water covered the southern part of New Mexico, west Texas and northern Mexico. Then some of the earth's crust started rising, thus causing the water to recede to lower elevations. This geological activity continued, and 140 million years ago some of the earth's crust rose to form some mountain chains, some depressed and then water returned to the lower elevations and formed inland seas. About 90 million years ago, the water left again. Thus there has been continuing climate change for eons of time.

Another bit of information regarding climate and environmental change and then I'll get on to other topics. Fifty million years ago there existed different animal and plant life. Dinosaurs and reptiles ruled the world of that day and time. There are different theories as to why they no longer exist, with some of the theories suggesting that climate and environmental change played an important role during that age.

I want to talk about ice caps. Throughout time the earth has had numerous ice caps. Some of the ice caps have extended further south than where we are located today. We are now in the process of the last ice caps receding further to the north at a rapid rate in geological time. The glaciers are melting and moving from the Alaskan mountains toward the ocean. Will the recession stop and an advancement of the ice caps begin again as it has many times in the past? How far will the present recession go? The present receding of the ice caps has not retreated as far as past ice caps receded. I have read a publication of the University of New Mexico that scientists are finding signs of early man such as tools, spear points, weapons, and arrow shafts at sites that have been under the ice cap for thousands of years. Alaska was once a warmer place than it is at the present time. Core drilling that is occurring at the present time has established that plants subtropical in nature grew before the advancement of the ice caps and glaciers covered the area.

Other evidence of climate change is substantiated by the skeletal remains of animals, now extinct, that were cold weather animals killed by the early man Clovis culture. The signs of Clovis man have been found in south eastern and southern New Mexico and west Texas. Arrow points and spear points of the Clovis culture have been recovered from the bones and skeletons of now extinct animals that were used for food by early man.

Climate change in New Mexico has made us a drier area than it was a few thousand years ago. Even during my lifetime, I have witnessed tributaries of the Pecos River diminish in stream flow. Tributaries that were fish laden, crystal clear waters that flowed year round into the Pecos river are now dry or only occasionally flow into the Pecos. Many springs in the Guadalupe and Sacramento Mountains have diminished or dried up as well. Part of the reason for weaker flows has been population growth, Over 5,000 domestic wells have been drilled on the upper Penasco River west of Artesia, New Mexico. Similarly, the community of Ruidoso has grown tremendously and utilized water that would normally recharge the artesian aquifer in the Pecos Valley.

I have used the lower Pecos to exemplify some water problems in that area but other parts of the state have water problems also. As you go west on I-40 from Gallup into Arizona and observe the Painted Desert, within the Painted Desert is the Petrified Forest National Park. Those petrified trees were under water at some time in the past. Again, a different climate exists now as compared to the past.

Walter Clay Lowdermilk (deceased), former Asst. Chief of Soil Conservation Service, now known as the National Resource Conservation Service, made an 18-month study of agriculture in ancient Mesopotamia in 1938-39. I would like to quote some of his words. No religious intent is intended here, only historical. "For at least 11 empires have risen and fallen in this tragic land in 7,000 years. It is a story of a precarious agriculture practiced by people who lived and grew up

under the threat of raids and invasions from the denizens of grasslands and the desert, and of the failure of their irrigation canals because of silt. Agriculture was practiced in a very dry climate by canal irrigation with muddy water from the Tigris and Euphrates Rivers. This muddy water was the undoing of empire after empire. As muddy waters slowed down, they choked up the canals with silt. It was necessary to keep the silt out of the canals year after year to supply life-giving waters to farm lands and to cities of the plain. As the population grew, canals were dug farther and farther from the rivers. This great system of canals called for great force of hand labor to keep them clean of silt. Now we know understand why the captive Israelites 'sat down by the waters of Babylon and wept'. They also were, doubtless, required to dig silt out of canals of Mesopotamia. The peoples of Mesopotamia were brought face to face with disaster in canals choked with silt. Stoppage of canals by silt depopulated villages and cities more effectively than the slaughter of people by an invading army."

Here in New Mexico we have silt being deposited in the Rio Grande by tributaries such as the Rio Puerco. Already a channel has been dredged at the delta of upper Elephant Butte Lake. The old McMillan Lake on the Pecos River was abandoned because of silt and a new dam has replaced it (Brantley). Are we following in the footsteps of the Mesopotamians?

Another topic to mention is the loss of productive farm and agricultural land to development of subdivisions. Areas all over the nation are experiencing the growth and sprawling of cities like Chicago and other Midwest cities in the heart of farming regions. Albuquerque and Las Cruces and other New Mexico cities are not exempt from this problem. As you know by the prices we pay for gasoline, we are dependent on foreign oil. If our supply of foreign oil were to be stopped our nation would see some extreme difficulty, likewise regarding our nation's food supply. For years the U.S. has imported approaching 50 percent of our fruit and vegetables. How would we be with both our food and fuel supply interrupted?

A nation's wealth is determined by its natural resources and its ability to produce and feed its population. How do we compare now as a nation in our ability to support our population compared to 50 years ago? Have we lost many thousands of acres of prime farm land to subdivisions, thus lowering our farmer's ability to produce food and fiber and making our nation more dependent on foreign imported food?

I have talked about some of the problems and challenges we are facing, let's talk about some solutions.

One good program that needs recognition is the U.S. Interior Department and Bureau of Land Management, in cooperation with the Natural Resource Conservation Service and individual farmers and ranchers, is the Restore New Mexico initiative. The program involves the removal of invasive plants by chemical application and fire control creating range conditions as they were in the mid 1800s. Thus far, over one million acres in southeastern New Mexico have been treated. Land that was once erosive and contributed silt in our waterways are now again covered with native grass thus holding the soil firmly in place and slowing rainfall run off. This is a program that benefits wildlife and our population in general. The Rio Puerco drainage as well as other silt producing drainages could benefit if similar programs could be developed in those areas.

Some communities are filtering and reusing gray water in their water systems. Using this water on municipal and public golf courses is becoming more common and is a conservation measure. Also, filtering brackish water and blending it with fresher and sweeter water is becoming more common.

New Mexico currently is not utilizing some water sources that could be used to take pressure off of some presently over-used or fully-used aquifers. One such source that comes to mind is the Salt Basin. The Salt Basin name is somewhat misleading. It is a basin on the extreme southern boundary of New Mexico just north of Dell City, Texas. The basin is on both the New Mexico and the Texas side of the state line. The recharge of water for the Salt Basin is almost entirely on the New Mexico side of the border from the western slopes of the Sacramento Mountains and the western slopes of the Broke-Off Mountains. The water is not salty as the name Salt Basin would indicate. The water is entirely potable and is used as such by many of the area residents. When flood waters from rain storms in New Mexico rush southward, the waters collect in a shallow basin called Salt Flat, thus the reason for the name Salt Basin. Salt Flat is in Texas and Straddles US highway 62-180. This water source is estimated to yield from 75,000 to 125,000 acre-feet per year. What is used from this aquifer is used predominately in Texas. It is a

source of water that could be used, if transported, by New Mexico communities. Holloman Air Force Base and Alamogordo would be the closest big users that could benefit from this source of water. Expensive, yes, but it is a source of good fresh clean water. Albuquerque or Santa Fe could benefit from it. Perhaps the State could build a pipeline and sell it to customers along the way.

The state of Arizona years ago constructed a water conveyance system across their state from the Colorado River to Phoenix and Tucson. This has allowed billions of dollars in economic development in Arizona. Phoenix has become the 5th largest metropolitan area in the U.S. and much of this is due to their far-sightedness in building the Central Arizona Project as their water conveyance system is known as. While I am mentioning Arizona and complimenting them on their insight as to the value of providing water for economic development, I will mention the Gila River.

The Gila River is a free-flowing stream from its headwaters in New Mexico to the Arizona- New Mexico state boundaries. An agreement has been made between interested parties, including New Mexico, to allow a diversion of water to be used by certain parties for beneficial use. There is a time limit for a plan to be presented. If a plan is not approved in time, New Mexico loses its rights to waters of the Gila River. I have simplified this complicated issue, but my point is that water is available from the Gila if New Mexico will act and not default. Arizona will benefit from the share of water that could have been for New Mexico.

The state legislature is a body of people that works without a salary, only per diem and travel expenses. For the most part they are intelligent, knowledgeable, and willing to learn. However, they come from different backgrounds and walks of life. Water knowledge may not be one of their strong points. This possible lack of knowledge may affect their vote in the legislature regarding water issues. I would suggest an educational program targeting legislative members and certain legislative employees such as legislative Finance Committee directors and bill drafters in the Legislative Council. The Office of the State Engineer has more knowledgeable, informed, trained personnel than any other group. Water is their job and responsibility. The legislators and other decision makers must be made aware of the problems, the issues, the necessity, and the actions they need to take to benefit the state. They need to provide funding to properly resolve various problems as pointed out by the Office of the State Engineer.

Various methods of educating decision makers can be used.

1. Written information short but concise on a regular basis.
2. Personal consultation with legislators at every opportunity.
3. Request being a presenter at interim committee meetings.
4. Develop friendly and amiable relationships with decision makers.

It will pay off to inform and educate the people who make the budget. Be straight forward and patient with them. We have a good, intelligent group of people in Mr. D'Antonio's staff and we are counting on them to lead us into the future regarding water issues.

I have told you about some historical facts about water such as climate change, global warming, ice caps, and some of New Mexico's water conditions. I have touched on some possible actions that might be taken to alter some of those conditions such as conservation, restoration, transportation, and education. Any one of the topics I have mentioned could stand hours, if not days, of elaboration but time does not allow that today. I thank you for your time and attention as I now conclude my presentation.

New Mexico's Water and Wastewater Infrastructure Development: Implementation of the American Recovery and Reinvestment Act and into the Future

Karen Gallegos, New Mexico
Environment Department

Karen was appointed by Governor Richardson as the Director of the New Mexico Environment Department's Division of Water and Wastewater Infrastructure Development in May 2008. Karen has substantive knowledge of energy and environment issues, including oil and gas, natural resources, biodiversity and conservation and global climate change. She holds a juris doctorate degree with a concentration in natural resources and international law and a bachelor's degree in university studies from the University of New Mexico. She also has a diploma in Advanced International Legal Studies from McGeorge School of Law in Salzburg, Austria, and has completed doctoral level coursework at Emmanuel College, Cambridge University. Prior to returning to New Mexico, Karen served for 17 years as a Foreign Service Officer with the U.S. Department of State. As a Political Officer in the diplomatic service, Karen's overseas assignments included the U.S. embassies in Bogota, Colombia, San Jose, Costa Rica, and Port-au-Prince, Haiti where she worked on issues including human rights, judicial affairs, counternarcotics, counter-terrorism, elections, and democracy promotion. Her service in Washington, DC, included work as an Environmental and Scientific Affairs Officer addressing global climate change issues, desk officer for Panamanian affairs, and as Political-Military Affairs Officer for African regional security issues. Gallegos is also fluent in Spanish and French. Karen was born and raised just outside of London, England. She traces her New Mexico roots to Roswell, where she graduated from Goddard High School.

Thank you very much, and thank you for the invitation to be before you and speaking today, it is quite an honor. I attended the University of New Mexico School of Law, and it was actually Professor Al Utton who convinced me to pursue a career at the State Department, which is where I was before I came to the Environment Department. I like to think that Professor Utton is smiling somewhere knowing that I was smart enough to take his advice to join the Foreign Service, but equally as smart to finally come back home. It is kind of a full circle for me so I'm very pleased to be here today.

I would like to run through how we are looking at the implementation of the American Recovery and Reinvestment Act, the economic stimulus bill. I work directly with two rather limited cases: the Clean Water State Revolving Loan Fund and the Drinking Water State Revolving Loan Fund. I have some information about other programs that are being funded, but those are the two programs are where my remarks will be directed today. The ARARA, American Recovery and Reinvestment Act, has provided a great opportunity to get some serious and critically needed projects on

wastewater funded and off the ground, but with that great opportunity have arrived significant challenges. The ARARA is a piece of legislation where Congress had a desire and a need to meet national multiple objectives, and so oftentimes the programs within the ARARA legislation are shoehorned into a method of deploying the funds that Congress wanted to make available. It was a giant piece of legislation, over 1,000 pages. The State Revolving Loan Funds and the EPA's portion are significantly shorter, although it did provide in those few pages significant additional program requirements for use of the funds. We are fortunate to have the State Revolving Loan Fund program in place so that Congress was able to use it as a mechanism to deploy the ARARA funding for particularly water and wastewater infrastructure projects.

As an appropriation to those two funds, $6 billion was appropriated nationwide under the ARARA rubric, which is significantly more than the annual appropriation. We were presented with an opportunity, but also with the challenges that come along with that opportunity. Of those funds, $4 billion went to the Clean Water Program on a nationwide basis, and $2 billion to the Drinking Water Program. To New Mexico, it meant that the Clean Water Program will receive $19.2 million for wastewater funding, and on the drinking water side, it will receive $19.5 million. Those are the funds we must mobilize and get out the door to fund projects across the state in the two areas.

As I mentioned, the program does have its challenges. In the past, program changes to the State Revolving Loan Fund have required a 12-18 month process for EPA to develop implementation guidelines. That is a thoughtful process where all stakeholders are included. At the end of 12-18 months, we have implementation guidelines and we know exactly how we are going to move forward. Most people have had time to digest the new requirements and have figured out how they will go about meeting those requirements. Of course this is impossible with the ARARA legislation, and let me begin with some of the implementation issues.

The first implementation issue that is of significance and is almost frightening is the readiness factor. It was completely clear in the ARARA legislation with respect to these two programs the necessity of having all of the money awarded to the states under contract and construction by February 17, 2010. That is a hard deadline and a significantly reduced timeframe than what we are used to dealing with when we look at financing water and wastewater infrastructure development. But there is no way around the deadline and as a result, one of the things we've had to do under both programs is to develop a timeline of equally firm deadlines moving backward from that February 17th date. Basically on February 18, 2010, Governor Richardson has to certify to EPA and the Office of Management and Budget that New Mexico has all of its money appropriately under contract. Any money that we cannot certify as being under contract must go back to EPA for reallocation to other states. Not only would a community who has been awarded funds lose that money, New Mexico loses those funds as well as the opportunity to compete for funds that other states were unable to use. I don't want to wake up on February 18th and have to ask Governor Richardson to please sign a check for Lisa Jackson and then have to put that check into the mail as I am on my way out of town to Texas because we have to send money back. We have tried to be very upfront with our communities with which we are working. Let me just mention on the clean water side, there are approximately 17 communities across the state participating and on the drinking water side, it fluctuates a bit between 21 to 23 communities that are receiving ARARA funds. This readiness factor – and I hesitate to say it but the new term in our lexicon is "shovel-ready" – means many different things to many different people. What it has come to mean to us and to the communities receiving funding is if you can't meet the timeline and the firm February 17 deadline, you are not shovel ready. We will be working with communities to make sure that they hit the mark and the funding gets out the door. In the event that a community misses a deadline, we do have contingency plans to move that funding that is lost by a particular community into another project. And that is just the first implementation challenge.

The second challenge is the Davis Bacon wage requirements. For New Mexico, this is not as big an issue as we do have Davis Bacon wage coverage. We thought we were really ahead on this issue. There is a wrinkle though that I'll mention in a moment, but we are probably going to be ok with at least meeting this requirement.

The Buy American Provision on its face sounds like it belongs in the American Recovery and Reinvestment Act piece of legislation and of

course there is a certain political expediency to the concept. However, what we have found is much of the technology and many of the manufacturing goods that are required by our participant counties can only be obtained by acquiring a waiver to the Buy American Provision. That obviously does mean that there is a waiver provision within the legislation but it is not an easy process. But a waiver is available and the EPA makes the decisions on our waiver requests (New Mexico is in EPA Region 6, which is headquartered in Dallas). Region 6 makes the decision on our waiver requests; however, all Buy American waivers go through a clearinghouse at the headquarters level so that there is some consistency across regions for the waivers provided. All waivers of the Buy American Provision require publication in the Federal Register with the attendant justifications. It is not an easy process but we have two communities that have had to go through the process on clean water side.

The fourth implementation issue is called the Green Project Reserve. Twenty percent of the money a state receives through its capitalization grant under the ARARA legislation must fund green projects up to at least twenty percent. When I first heard that, I thought it wasn't going to be a problem because we are protecting public health, we are insuring water quality for the future, and we are protecting the environment. Thus, water and wastewater infrastructure seems to me inherently a green project. Well, I was wrong. The requirement has a significantly more narrow and specialized definition of green projects. You will be pleased to know that we have been able to meet that requirement on both the clean water and drinking water side in this go around. We haven't needed to request a waiver or give up any funding, but it was a challenge. The four areas of green projects that were considered included: 1) water conservation, and this means significant water conservation, water conservation as a percentage of actual use; 2) energy conservation, again a rather high limit that must be reached before the energy conservation green project reserve is counted; 3) green infrastructure, and a lot of that meant roof gardens to people everywhere but the dry Southwest because that would mean greater water use for us – I'm not an engineer but it's not really an option for New Mexico; and 4) innovative technology.

I want to mention that we have two projects in the Ruidoso area; both the City of Ruidoso Downs and the Village of Ruidoso are joining together and completing a wastewater treatment plant. After we got the Buy American Provision waiver for the membrane technology that is really leading technology, but only produced in Japan, we were able to apply for the Green Project Reserve to have some of that funding for those two projects count against our twenty percent on the Green Project Reserve. We supported the communities putting forth a business case on the significant water conservation and the energy conservation. They hit each of these four areas that EPA requires. It turns out the Office of Management and Budget (OMB) is interested in energy conservation associated with using high-energy pumps and also, interestingly enough, reducing the carbon footprint by not using as many chemicals thus reducing the amount of transportation costs and carbon expended in transportation, all due to the innovative technology being used. To the engineers here today, I'm going to simplify this too much and their heads are going to spin, but basically this technology is such that it shortens the treatment process, and that is where some of the water and energy savings occur. Also with the membrane bio-reactors, they are again using the leading edge of technology and really the only way that Ruidoso and Ruidoso Downs are going to be able to make their effluent discharge requirements. This was a significant process to go through, especially the Buy American waiver and then once that was clear, to go through the Green Project Reserve to make sure we could receive our complete funding allocation. It has been a very time consuming process and the February 17 deadline looms.

The road to guidance that I mentioned earlier, that 12-18 month road that we usually have, was not available. Guidance on all of these implementation guidelines has changed almost by the day. We've started in one place and gone through a whole series of back and forth efforts and have almost ended up in the same place on a couple of different issues. So it has been difficult. I will mention here that the Green Project Reserve for funding is probably not going away. It is an issue that OMB is directly interested in and a requirement that is currently in the federal fiscal year 2010 budget documents including in all versions currently under discussion. The Green Project Reserve is there for the future. In addition, there is also re-authorization legislation for both of these programs that contains the Green Project Reserve, so it is not going away and something of which we must be very cognizant.

One additional issue has been transparency and accountability. There is an exceptional level of oversight of ARARA funds from reporting requirements down to the contractor level. It is very significant and to where we must account for jobs created, jobs maintained, work hours, and so on. It is going to be onerous to collect the data and it will be very difficult to provide the level and the detail of reporting information being required. Concerning oversight, contractors must keep records sufficient for audits on whether Davis-Bacon wage rates are being met as well as the Buy American Provision. Those records have already been identified by the General Accounting Office as well as the inspectors within EPA. Significant scrutiny will be made to make sure that the Buy American Provision is maintained.

The good part and the opportunity with ARARA funding is the further subsidization of the amounts provided to states. Fifty percent are required to be given out as either negative interest loans or principle forgiveness (grants). Of course if you can figure out a negative interest loan, and the principle forgiveness is a little bit easier to understand, those operate essentially as grants. In New Mexico under the Drinking Water Program, each community receives between 50 to 80 percent principle forgiveness. In the Clean Water Program, all funding available under the ARARA was provided or is being provided as grant funding. However, we are unable to provide strictly grants; they must be in combinations with loans. So we have made loans to the communities from our base program. If you have a loan of $2 million, you have to take 20 percent as a loan or if you have a grant, "x" percentage has to be in the form of a loan. We look at each community to make those calculations; it must reflect a backboard of affordability and not a standard projected percentage.

In New Mexico, under the Drinking Water Program, we had around $16 million to move out the door. We received project requests in excess of $230 million. Under the Clean Water Program, we have approximately $17-18 million available for funding and we received $670 million in requests. Between the two, we are just shy of $1 billion in requests. And $38 million doesn't really cover it. One of the benefits we found though, while we knew there were great and critical needs across New Mexico for water and wastewater infrastructure development and we had sort of an amorphous number in mind, was that we do have a billion dollars worth of needs. We now have a list of concrete, specifically identified projects and though they may not have received funding through the ARARA opportunity, we can work with those communities as we go into the future to develop ways to help them find financing, which is ultimately the way forward.

I would like to leave you with the fact that the ARARA exercise has shown us the need for communities to plan. One of the gaps that we have identified and that will need to be addressed in the near term is how do we find funding for those communities. They need to have preliminary engineering reports and they need to be further along in their environmental documents so that we can make them shovel ready. We hope that the Uniform Funding Application Process, which some of you may be familiar with, will be a mechanism that we can use in the future as we go along this road to help communities.

Again, let's prepare for the future by identifying appropriate projects and move forward to find funding that is increasingly limited. In particular, the State Revolving Loan Funds appear to be healthy into the future. In the federal fiscal year budget for 2010, it looks as if New Mexico is likely to receive 2 to 4 times the amount of general capitalization grants, so we will have low cost subsidized loan funding as we move into the future.

Thank you very much.

The Hidden Value of Science in Planning

Wes Danskin, U.S. Geological Survey

Wes is a research hydrologist with the U.S. Geological Survey in San Diego, CA. His areas of expertise include optimal water management, groundwater simulation, constrained optimization, hydrogeologic analysis of regional systems, integrated surface-water/groundwater interpretations, conflict resolution, and technical mediation of water issues. Wes has been the project chief on efforts in Texas, New Mexico, Nebraska, California, Hashemite Kingdom of Jordan, and Ethiopia. He received the USGS Excellence in Science award in 2008. Wes received a BA in geology from Carleton College and an MS in applied hydrogeology from Stanford University.

This is a talk on uncertainty, and I guess the main uncertainty I have for you guys is will you stay awake, and the main uncertainty I have for myself is will I remember what I'm going to say. This morning I listened to various speakers, and it seemed like the elephant in the room from my standpoint was that on one side you have areas of groundwater management, hydrologic areas, which are political things that humans have created, and on the other side are the natural formations. The elephant is the dynamic between the areas created by humans and those created by God. In my experience, God wins. "Don't fool with Mother Nature" was a notion that I was brought up with and my background is actually in environmental planning.

How many people in the audience would consider themselves planners? How many people would consider themselves engineers? I started out in environmental planning and worked with geology and groundwater and so forth. What I would like to do now is to weave those things together. I will finish with the idea that science itself has some hidden values that can help us merge the political realm with the hydrologic realm.

Science costs money, so it's easy to ignore it or put forth the minimum effort. One of the concerns that I heard when I was chair of a planning commission was, "Can we just get done with it and build something? More planning, more studies, enough already – you've spent most of the budget telling us what we might do or how we can't do something rather than getting to work." Fair enough, much of that is true. On the other hand, if you build without planning, there is a whole litany of mistakes that could have been avoided.

What I've found is that science has hidden value. On the face of it, science defines our world. For many engineers, science is helpful because we learn how to define things and they become part of our familiar experience. We start from there and we go on to accomplish a lot. But the other aspect of science that I have discovered is that science is very useful for uniting people, people who have different agendas, different perspectives, come from different cultures, and have different wants. I'll go through all of these and give you an example of how we've used these in a real study. And finally, science inspires. It's not a coincidence that most of the popular shows on TV are not the sitcoms, they

are National Geographic, Discovery, Myth Busters – shows that discuss the natural environment, about investigation, about pursuits, about things that people only know a little bit. People are inspired by these programs. We should not forget this when we want to build something and we want just enough science for that one accomplishment.

About the time I was born a book came out that was referred to as "Magic, Science, and Religion." It was written as an anthropology text, and it said that as cultures go forward, life is uncertain for all people at all times to different degrees. When life is very uncertain, it forms the basis for myth or magic because the process is not understood. After awhile, it becomes codified, and that forms parts of religion, and after a time it becomes so routine that it migrates into science.

In most cultures there is a blurring between science and religion. In Africa, the Ethiopians are primarily orthodox Christians, some Muslim, but they also have shamanism as part of their culture. Some might argue the same is true in the United States. Not understanding our world leads to fears that encourage beliefs in mythology like believing that thunderstorms and hurricanes come about because we have misbehaved. Today you can get on your iPhone and see what the weather is going to be like; those earlier fears are no longer as powerful over us as they once were.

One thing I encourage you to do concerns the fearfulness that is pervasive with climate change and increasing climate variability. That is not a matter of dispute anymore. A couple of weeks ago I was in Kenya and it was amazing to me that issues concerning water were on the front page daily. The Kenyans are going through difficult times similar to the Iraqis. An Iraqi friend of mine had not been in Baghdad for 30 years and he recently went back as part of a water study team. He was so sad when I talked to him about his trip last week. He is a very stoic person, but his eyes showed his sorrow when I asked him about Baghdad, and he said, "The water is not there." He was visiting during the time of high floods, and he could see islands in the Tigris and that has never been the case. The water is being trapped in other areas like Turkey, Syria, and Iran. If you were going to make a water management area, you would need a larger area than just Iraq. The question is: "What did God make the area?" The drainage for the Tigris and Euphrates go well outside Iraq. To manage water in Iraq, you must look further afield. Sandia Labs is working on a project that was mentioned earlier regarding the snowpack and whether there really is a water problem in Iraq. Turkey says there is a drought, and Iraq wants to share the drought equally. Or maybe it is just a political drought. This is an example of where science can be used to unite people.

Most people are honest and trustworthy and they bring to the table their beliefs. Of course what one person brings to the table may be somewhat different from what someone else brings. It's not that they are trying to be duplicitous, untrustworthy, or lie, although that does occur but is rare in my experience. More often it is that they see the elephant from two different sides.

For example, I was involved in a study of the Owens Valley in California, which was made famous in the film "Chinatown." You may recall in the movie, Jack Nicholson in Chinatown, Los Angeles wanted water at the turn of 1900s and turned to Owens Valley for it, which is located on the eastern side of the Sierras. They got the water to Los Angeles and that's the story. Just before environmental reporting was required, additional water was taken by pumping groundwater. This caused a conflict between the Los Angeles Department of Water and Power and the local county of Inyo. As it was presented to me at that time, Los Angeles claimed to be pumping from a deep aquifer, so the pumping couldn't affect plants. The county people, however, clearly saw that the pumping was affecting plants and causing the "rings of death" around the wells where plants were dead or dying. As the story unfolds, you learn that there were grazing issues going on near the wells, which were located near irrigated land. There was a long history of the land being irrigated, and then not irrigated, over-grazed, not grazed. And to compound the situation, there were other things going on like the 1976 drought. So which was causing what? The plant people would say of course the wells are causing the problems. Los Angeles DWP would say no, they are pumping from a deep system that could not affect the shallow systems, and the problems were due to grazing and drought.

What we did was to use science to understand. We developed a groundwater flow model. After about five years, not five months, we gained an understanding of the wells, and it turned out that everyone was right. Los Angeles DWP was correct as almost all the water being pumped from the wells was coming from the lower system. In fact 95 percent of it was – not 100 percent though. From the plant people's standpoint, that 5 percent

difference amounted to 25 percent of the water for the plants, and in most years it didn't matter, but in drought years it mattered a lot. And if one of those 25-year-old plants died or became severely impacted, they didn't recover. The germination process didn't recover because there weren't enough carbohydrates in the plant to flower and thus there were no seeds, and moonscapes followed. Both sides were correct, and after we understood that, the debates about the process stopped.

Science also can unite, although what needs to be said should come from an insider, and in your case, from people who actually live in New Mexico. At one point, I worked on the Middle Rio Grande and I am very encouraged to come back and see this part of the landscape. If you make an area that is large enough to include your enemies and you invite them to the table, eventually they will show up. As military people have said, keep your friends close and your enemies closer. That includes people you don't understand and people who have different agendas. Only then can you either resolve the questions or at least stop spending travel funds trying to keep track of what the other people are doing.

Another example is a situation we had in a upper basin/lower basin type setting where the upper basin consisted of sand and gravel, not unlike the Rio Grande deposits, and which flowed down to a hard-rock area where there wasn't much of an aquifer. However, that happened to be where Camp Pendleton Marine Corps Base is located, next to the ocean. Camp Pendleton is where we launch wars from and the First Marine Corps Division includes the first guys to go. The people in charge at Camp Pendleton were very concerned that they wouldn't have enough water if something happens. Meanwhile, this is in Southern California where the upper basin is urbanizing and more wells are being drilled. Those wells are causing declines in the surface water. Nearly, every place on the planet goes through the same thing because drilling wells results in less surface water. Now we had lawsuits going back and forth. So we organized a technical committee. That is the first thing I would suggest, and it should be broad-based. In this case we included the hydrologic boundary. We invited most of the players, although initially we weren't successful. We started with litigators from the two sides of Camp Pendleton and the water district as well as a technical advisory group.

Next, we enforced the rule that the attorneys meet in one room and the technical people meet in another. The technical people could not mention attorney-type language when we met. Water rights are a human-defined issue and those issues stay with the attorneys. Because we are engineers, geologists, and scientists, we allowed the attorneys to be in charge of us. We would ask if we could look at both surface and groundwater, and they would say ok. Over a period of years, again 5-10 years honestly, we ended up being good friends, and we knew everybody's personality; we knew their jokes before they made them.

The good news from this effort is that we ended up with a stipulated judgment that meant money was not going to be spent in court where discovery can cost from $1 to $5 million just to find out what your opponents have been doing. The rule that we honored was "science first." The attorneys and judges figured out how to follow that rule with the legal rules of the road. In the technical advisory committee meetings, everybody brought their data to the table and everything was free and common knowledge. It was tough to get to that point but when you're scared of going to court and losing, this is a better option.

I hope this success encourages you to bring together the people in the hydrologic area. To be fair, we did not include the local Native Americans, which doesn't make sense to me because they have silver bullets in court; they ought to be at the table, too. The way it was phrased to me was, "We have enough issues ourselves, we need to get ourselves on the right path and then we will include them." And in truth, part of the stipulated judgment said, "Ok, we know what we know, five years from now we need to revise." This notion seems to be a theme – we can thank the Soviets for that. We will revisit our plans every five years and what we don't know now, we may next time.

I love different cultures; in many ways, everybody is the same, and water is the same everywhere. In Arabic there is a phrase something like in English 'step-by-step.' In Arabic its 'habba-habba.' When I was in Kenya, I asked what this idea translated to in Swahili, and it is 'hatua kwa hatua.' All cultures know change takes time, and you make progress set by step. If you are going to start with a hydrologic regional area, you can't win all the battles the first day, but you can use science to define your system and unite people with seemingly very divergent interests.

Science allows for transparency. If you are not of the belief that everyone is honest, then you can at least allow science to make the landscape clearer. People's agendas are very hard to hide when you have the science in front of you. If someone doesn't understand, or if they understood but they try to hide it, that will be evident. Transparency comes along with defining the world.

Lastly, science is inspirational. As you go forward in this time of tight budgets, put in enough effort to gain the power of the people. The movie "Gladiator" is inspirational to me because my son is a warrior in the U.S. Navy. One of the phrases used in "Gladiator" is "win the crowd." I would encourage you to win the crowd. That's what National Geographic does, that's what Discovery does, that's what Jacques Cousteau did. As we move forward in our water planning by creating areas that make sense to God, we also go forward with enough inspiration to gather the political votes and win the dollars that will continue to carry us forward.

My last example deals with what we are trying to do in San Diego. I'm running a very large surface and groundwater project in an area where there is essentially no water. In an area that is desperate for water, we are going to take brackish groundwater, somehow desalt it, and then somehow quantify it. We will honor the system – we are actually extending the boundary to the Tijuana River that starts in the United States, flows into Mexico, and comes back into the United States. It is right to include it. Is was not included in the first five years because it was too politically dangerous and could consume too much time, but now it is actually part of what we are doing. I encouraged the engineers to investigate the whole system to the point where we will have the background to answer questions twenty or fifty years in the future. We are drilling wells not 800 feet deep, which is the zone from which they are extracting, but 2,000 feet deep where we have found more continental deposits that could be a potential source of water, maybe not in the next five years but at some point in the future. This kind of information is inspiring to the boards, it's inspiring to the engineers, and yes, it does cost money. But it is something that brings people to the table because they are excited about what is being found. In an era of uncertainty, it brings hope that we will have some degree of control over what initially was unknown.

During times of uncertainty, science can be our friend. Science can help us define our problems and lessen our fears of the future. Science can unite people with different goals by providing a common language and understanding. And perhaps most importantly, science can inspire, and encourage us to act.

Thank you much.

This article was transcribed directly from Mr. Danskin's talk and has not been reviewed or edited by the USGS.

The Land and Water Supply Connection: Does Water Limit Growth?

Susan Kelly, Utton Transboundary Resources Center, UNM

Susan is the interim director of the Utton Transboundary Resources Center and an adjunct faculty member at the University of New Mexico School of Law. The Utton Center promotes the equitable and sustainable management and use of transboundary resources by providing impartial expertise and scholarship. The Center publishes an annual edition for the legislature, entitled Water Matters! Susan is a frequent writer and speaker on water topics. She is active in a variety of projects in New Mexico. She represents the State on several binational water committees with Mexico. The Utton Center also administers the Joe Stell Ombudsman Program. Susan is an attorney licensed in the state of New Mexico and also a member of the American Institute of Certified Planners.

When I first started to think about this topic and mentioned it to several different people who work in this area, reactions were varied. Usually I would get a look of disbelief and the general response was – isn't it pretty obvious? At some point there will be limits to new water uses. I don't believe that we can hide from the reality of our water supply and in this talk I am going to discuss some of the indications of limits that we are aware of around the state. On the other hand, I don't believe that we can control growth even if people were to agree on this goal, which I doubt they ever would. It's not just a New Mexico problem, at the recent Western States Water Council meeting nearly every western state weighed in: Colorado, Arizona, Nevada, Texas, California, and Washington…too much growth and not enough water.

The question is what steps do we take now?

Our challenge and focus should be to address what is possible and within our control – managing our water resources and our growth to prevent future harm to people, protect rivers and ecosystems, and provide water for food production in the future.

To begin with, we need to think about how much water we have and what is our projected growth? I have struggled with this question; I looked at the regional water plans, growth projections, and projected demand for water. The numbers are elusive and subject to debate.

First, there are the population projections. New Mexico's population is projected to go from 1.8 million to 3.4 million by 2050. But there are many uncertainties regarding growth projections. They are simply estimates and these will change again based upon the cycle of economic and demographic changes that we are going through right now. And they may change in the future due to concerns about water supply or due to any number of factors.

Then there is the projected water supply. Although the regions in New Mexico are quite diverse and water resources can't be easily

generalized, several things are clear: renewable surface water supplies are already allocated to existing uses. These supplies are highly variable from year to year. And in many parts of the state, groundwater is being mined, or groundwater is being withdrawn from aquifers that are connected to streams that are subject to interstate compacts. And right now, even before any new growth, in an average year, if all water rights are exercised, there is a shortfall in supply.

Most regions have prepared some type of a water budget and even though there is variation in the methodology for developing these estimates, every region predicts a shortfall in future supply to meet projected demand.

The magnitude of the supply shortfall varies greatly from region to region and will depend on future drought and climate scenarios, the rate and location of population growth, the rate of increase in energy usage and its water demands, and our ability to adapt, manage, and conserve water. These factors are all uncertain.

If you take all of the regional plans together, and use estimates of current use and use the lower level range of population projections, the plans predict somewhere around a 70 percent increase in withdrawals over current water use for "new needs" by mid-century (these are needs that can be associated with growth – commercial, domestic, and public water supply; and uses 150 gpcd).

The increase varies greatly among regions. The situation is most extreme in the San Juan region, Jemez y Sangre, the Lower Pecos, the Lower Rio Grande, and the Middle Rio Grande with the projected Middle Rio Grande increase dwarfing the other regions, being about half of the total.

Given that concerns over this growth will be exacerbated by drought, climate change, and diminishing aquifers, it's hard to deny that we have limits to growth, especially if we take no action to change how we manage water.

The regional plans provide snapshots of the issues regarding future water supply. In the Lower Rio Grande, both surface water and groundwater are used and with the close proximity to the El Paso and Juarez metropolitan areas (with a population of almost 2 million), competition for water supplies is intense. Even under low growth scenarios, demand exceeds water rights by 2030 and there is a heavy reliance on transfers from agricultural water rights.

Santa Fe is aggressively trying to import water from other regions and get its SJC water online.

On the Canadian river system, water tables in the Ogallala and other aquifers have been dropping rapidly and in the southern plains there are declining aquifers and deteriorating water quality.

In the Estancia basin, groundwater mining has caused serious water level declines in the valley fill aquifer and water rights licenses, declarations and permits far exceed historical pumping.

Drought takes a serious toll around the state with some wells going dry- and communities that depend on aquifers high in the Sacramento Mountains experience serious water supply problems during drought years.

In the San Juan region, most of the existing use is surface water. The San Juan has been subject to shortage sharing agreements and with the prospect of climate change, this may become more pronounced.

Expensive new sources are being explored and pursued. Look at the brackish water projects proposed west of Albuquerque and in Sandoval County and in other regions of the state.

There are huge uncertainties with regard to these proposed supplies. And there are uncertainties associated with many of the sections of the water plans due in part to data gaps or data that is not reliable.

The regional water plans do provide various strategies for how to address future needs: conservation, desalination, transfers of water rights, removal of non-native phreatophytes, watershed restoration, and other measures, but it's clear that there's a huge amount of uncertainty (there's that word again) associated with most of the options both with regard to feasibility of implementation, effectiveness, and cost.

And of course there are huge uncertainties regarding water rights in nearly every part of the state.

The biggest problem or at least the problem that affects the largest number of people is in the Middle Rio Grande. The supply is somewhat set. We have obligations to abide by the Rio Grande Compact and all of the surface water is allocated. The streams are administered in such a way that any new use of water comes with the retirement of an existing use. And water rights are anything but settled in the Middle Rio Grande. Water rights

permits exceed typical supply in most years in part because we have not fully factored in senior Pueblo rights.

In the Middle Valley it is estimated that new uses (to serve domestic, commercial, and public water supply) will need at least an additional 120,000 acre feet in year 2050.

Conservation is the first line strategy and conservation can make a huge difference in stretching the water supply. Santa Fe is a leader among urban areas and the Albuquerque Bernalillo County Water Utility Authority has been effective in reaching its conservation goals thereby extending the time when it will need to seek new resources.

But if we rely solely on conservation to meet growth projections, the existing population will have to dramatically reduce outdoor use of water far beyond the levels we have currently seen. How do we do this without harming communities where thousands of homes have developed with significant amounts of irrigated landscaping?

What is an achievable level of conservation and how do we get there? Since most of the water in the state is used for agriculture (about 75 percent) many people eye transferring water from agriculture as our future safety net. But this raises many issues. First, cyclical drought and climate change may reduce surface water flows and reduce the amount available for agriculture.

Transfers from agriculture to urban have a big impact on the move-from community – its economy and quality of life and culture. Vacant land can affect the efficiency of the irrigation system and the same amount of water may have to be used to charge the ditches to serve less agricultural property. When water is moved from a farm, it can be developed or regrowth of vegetation can occur.

In the Middle Valley where the biggest projected shortfall is, agriculture is a lower percentage of use. To meet demand solely through agricultural water rights transfers would require drying up most of the existing agriculture, which would have a dramatic impact on regional communities, their character, and their economies.

Then, there may not be willing sellers. The acequia associations are trying to protect their communities, their members, their culture, and their senior priority water rights. The law may effectively make some agricultural water unavailable for transfer.

There are also known problems with making agriculture more efficient, although I feel that is a productive avenue to study and explore. We know the arguments. It's not helpful to make agriculture more water efficient, because the consumptive use remains the same and if a portion of the water right is moved, the depletions on the stream may actually increase. But continuing with sporadic transfers may be destroying the viability of some agricultural areas and may not be resulting in wet water savings. We need to better understand the hydrology and scenario planning is needed.

In the recent meetings on the State Water Plan, whether in Moriarity, Portales, Carlsbad, Tucumcari, or you name it, almost every community suggested that they plan to hang on to the water they have and not allow it to be exported to other regions. Moving water will be hard, expensive, and take time.

Water quality concerns are starting to dominate the conversation and in the future, water quality will play an important role in determining water quantity. All over the state there are concerns about water quality in the regional plans: PCBs, nitrates, chloride, and dissolved solids, which exceed New Mexico's groundwater standards; injection of rock-fracturing chemicals; leaking septic tanks.

Despite all of this doom and gloom, I think we can do what we need to do. So much has already been done by the Office of the State Engineer (OSE) and the Interstate Stream Commission. I applaud the Richardson administration and the OSE. They have negotiated settlement agreements, established a Water Cabinet, developed domestic well regulations, established the Strategic Water Reserve, made progress on the adjudications, streamlined the water availability analysis, restored habitat for endangered species, and kept us in compliance with our interstate compacts. In preparation of the State Water Plan and again in the recent meetings held to update the plan, they met with a hundreds of citizens and officials around the state to really understand the issues and priorities in each region.

As I said, I'm not a subscriber to the theory that we can stop growth but I do think that we can manage growth and have an obligation to do so. For the State to do this, they will need more resources. With significant investments in resource measurement and management, maximizing supplies, and conserving, we have the ability to protect ourselves and future generations against

the risks of hardships and suffering due to water shortages.

The future will need to be met from a variety of actions and we do have a number of actions we can take. First, we need to continually improve our understanding of water supply. In every area of the State, there is a need for improved, frequently updated information about how much water is available, how much is allocated and used, what are the implications of continuing or increasing the rate of withdrawal, and what are the implications of changing the use. We address these questions on a case by case basis as a permit is applied for or a water right is transferred, but understanding the long-term cumulative impacts of these decisions is important.

It seems pretty clear that conservation should be the highest priority strategy. In public water systems, we need to create stronger price incentives to encourage the transition from lawns to drought tolerant landscaping in a way that preserves the value and beauty of our cities.

We need to continue to think and explore big picture ideas: alternative reservoir storage to reduce evaporation, aquifer storage and recovery, desalination, and re-use.

Given the uncertainties with our water supply and projected growth and climate, we need to be careful about how we approve new growth so that people aren't building developments that may be without water someday. Here are some modest improvements that might be looked at:

- We need standardized statewide building codes that require the best available water conservation fixtures and low water use landscaping.

- Urban land use approvals should consider lot size and densities. Reducing the average lot size in Albuquerque from the current 6,500 square feet to 5,000 square feet could reduce outdoor water use in new subdivisions to less than 40 gpcd.

- We should look at the water availability process under the subdivision act. Right now if the analysis results in a finding of inadequate water supply, a county is under no obligation to deny the development approval. Some counties have hydrologists who work with the project and modify the proposed development based on the OSE input, but others don't have these resources. Either way, the county is not obligated to report back to the OSE after a finding of inadequacy. It seems like this is a loop that could be closed.

- Domestic wells are in litigation right now. But the OSE has the means to limit their use based on the regulations developed in 2006. They should proceed (and probably are doing so) with developing the information to identify critical management areas where these wells may be affecting streams or causing unacceptable water level declines and not wait for the legal issues to be finally resolved.

- Consistency in plans – counties and towns should at a minimum be required to acknowledge the regional water plans and state that they are consistent or describe why they are not.

I know that some people disregard planning as a frustrating activity with lots of messy public meetings, resulting in documents that no one abides by, or feel that planning is just about making plans for stealing another region's water.

But at its best, I believe that comprehensive basin-wide planning supported by research and sound science – truly engaging the public in the debate – should be the basis for resolving how we approach these issues. Projects should be identified and followed by study and implementation. Given what we know and don't know about our water supply, it is irresponsible not to invest in planning and use planning to direct activities toward the most feasible and cost effective alternatives.

After the comprehensive basin planning is completed, the legislature may have leeway to create a different structure for the negotiated settlement of water rights in areas like the Middle Rio Grande, which are not being adjudicated – maybe a structure like the Montana Reserved Water Rights Commission.

I want to end with a quote from U.S. District Judge Paul Magnuson from a legal decision in the southeastern part of the country – now I know this is a lawyer writing and not nearly as informed as it would be if it was say, an Engineer, but nevertheless it's pretty common sense language that is somewhat hard to argue with. It concern's the Atlanta situation and their water woes, but his message goes to the heart of the topic and I think provides direction to us.

"Too often, state, local, and even national government actors do not consider the long-term consequences of their decisions. Local governments allow unchecked growth because it increases revenue, but these same governments do not sufficiently plan for the resources such unchecked growth will require. Nor do individual citizens consider frequently enough their consumption of our scarce resources, absent a crisis situation such as that experienced in the ACF basin in the last few years. The problems faced in the ACF basin will continue to be repeated throughout this country, as the population grows and more undeveloped land is developed. Only by cooperating, planning, and conserving can we avoid the situation that gave rise to this litigation."

Cooperation, planning and conserving…versus litigation. Or another way to put it, do we want to plan ahead and prevent crises or do we wait for a crisis when it may be too late for some less draconian measure before we change?

I say we go the route of research, data, science, planning, settlement, and implementation. And while we work through this, be careful about how we grow.

Scenario Planning: Making Strategic Decisions in Uncertain Times

Timothy Thomure, HDR Engineering, Tucson

Tim has over 15 years of experience managing and implementing projects related to water supply, water quality, strategic planning, and regulatory compliance. He received his bachelor's degree from the University of Illinois and is scheduled to receive a master of engineering degree from the University of Arizona in December. Tim is currently a project manager with HDR Engineering and is a member of HDR's Water Supply Practice Group. Prior to joining HDR, Tim spent five years in the mining industry and nine years in the public sector as a program manager and water resources planner. Tim has long been an active member of the AZ Water Association and currently serves on the Board of Trustees of the Arizona Section of the WateReuse Association. Tim's presentation focuses on managing critical uncertainties in water resources planning through the use of the Scenario Planning technique.

After growing at unprecedented rates, many communities in the arid West need to rethink some of their most basic planning assumptions—assumptions about what the future may look like. Similarly, water professionals and decision makers in the arid West are now facing water-resource and supply challenges that were not envisioned a decade ago, including the uncertainties associated with global climate change. Scenario Planning is a technique that can assist water planners in managing uncertainty.

Based on a recent article by the speakers (Marra and Thomure, 2009), this presentation provided an overview of Scenario Planning as a potential tool to utilize for water resources planning. This presentation gave two water planning examples with significant uncertainties, although there are hundreds that could be brought into the conversation. Scenario Planning was defined, the process was reviewed, and the tangible outcomes were described. Quite often, one of the concerns expressed by people being exposed to Scenario Planning for the first time is: "That's great, however, you invest a lot of time to complete the process, but what is the outcome on the back end? What is the project or what is the path forward?" In the case of Tucson Water's long-range water plan (2004), the utility found it to be a very useful tool with some very tangible outcomes.

Water resources plans are developed by a myriad of agencies including the US army corps of engineers, state water planning agencies, and local municipalities. Other entities also engage in water planning efforts, such as the National Park Service. Regardless of the type of planning organization or its geographic location, the over-arching planning goal is sustainability. Simply put, sustainability is meeting the needs of today without compromising the ability to meet the needs of the future generations. But, how do we plan for a sustainable future in the face of significant uncertainty?

Examples of Planning Uncertainty

Climate change is obviously getting a lot of attention in the media. There is also a significant

amount of ongoing climate research and many projections of future conditions. However, we don't have all the answers and we don't know what the end points are going to be. We can collect date and observe trends, but we do not have a crystal ball with accurate predictions of future conditions. As water planners, we need to be aware that conditions are changing and that the range of climatic variability is growing. Rather than trying to decide which projection of future conditions is "right", knowing full well that whatever one we choose will most likely be wrong, we may be better served to plan for a range of possible future climatic conditions.

The future of effluent reuse is another water resource planning element with significant uncertainty. Many communities have developed reclaimed water systems to recycle municipal wastewater for turf irrigation or industrial uses. Over time, effluent reuse is expected to grow as other traditional water resources become exhausted. Water planners in many parts of the world have begun looking at the future (indirect or direct) potable use of effluent. There is no uncertainty that the technologies exist to safely recycle effluent into potable water. However, public acceptance of the potable reuse of effluent is highly uncertain and is likely to be decided on a community-by-community basis. Water planners need to consider the ramifications if their particular community embraces or reject potable effluent reuse.

Scenario Planning: Envisioning Multiple Futures

To better prepare for sustainable water future, water professionals are becoming increasingly aware of Scenario Planning as a tool to help manage uncertainty in turbulent times (Means et al, 2005). The method has been around for decades but became popular in the 1990s after Schwartz (1991) published The Art of the Long View. A more formal and in-depth presentation is provided by Van der Heijden (2005) in Scenarios: The Art of Strategic Conversation. According to Van der Heijden (2005), Scenario Planning assumes that the future is not predictable but it is nonetheless possible to come up with possible causal reasons why things happen the way they do. By analyzing the driving forces that motivate current events and extrapolating relevant trends into the future, one can strategically define a credible range of possible futures or scenarios. He notes that there is no one best answer but the Scenario Planning process can provide a means to developing a flexible strategic position from which to respond to change and irreducible uncertainty.

First Steps: Issues and Drivers

The first step is to identify one or more pivotal issues in order to prepare for a significant decision. For some utilities, the critical issue might be the increasing vulnerability of currently available water resources and how best to ensure supply reliability in future years. For others, it might be whether to prepare customers for the eventual indirect potable reuse of effluent and if so, when and how. Identifying the central issue can be accomplished through a brainstorming session involving a diverse group of staff members with the active involvement or tacit support of decision makers. The group should be prepared to enter into a vigorous vetting process – discussions can become contentious if there are strong opinions to work through. The objective is to arrive at consensus agreement on the central issue in order to move forward. In a subsequent session, the group generates a list of the driving forces that could have bearing on the central issue. Once the list is established, the driving forces are ranked to identify those considered extremely important and highly uncertain. These become the "critical uncertainties" in the next phase.

Scenario Definition: Critical Uncertainties and Stories of the Future

In subsequent meetings, the group determines which of these driving forces will be used to frame the scenario matrix. The matrix framework is constructed by placing the identified critical uncertainties on its defining axes. The boundaries of each future are thus defined by the polar extremes of the critical uncertainties. The planning group subsequently develops a sufficiently complete description of each unique future to give it substance—to make it real. This step is one of creativity and imagination. The participants should identify the potential issues that must be managed or overcome given the uncertainties involved. Each end-member future essentially becomes a different story or scenario. To develop a more flexible, multidimensional view of the future, each story/scenario is considered equally likely to occur.

Tangible Results: Pathways and Common Elements

The end-member future scenarios collectively establish a range of future possibilities. The group plots an independent pathway, a sequence of projects and programs, to realize each unique future based upon its specific characteristics and issues. Despite differences among the developed pathways, similarities and overlaps will occur; this commonality indicates which projects and programs would be most viable over time.

Summary

Instead of emphasizing what is known and predictable, Scenario Planning focuses on the critical uncertainties specific to a given major issue. Multiple scenarios are developed, each based on a unique combination of the identified critical uncertainties. The aim is not to capture every possible future but only those that can serve as end members which can define a credible range of future possibility. Each of those end-member futures are considered equally likely to occur to protect against perceptual bias and blind spots. By identifying and sequencing all the projects and initiatives that would be needed to realize each future scenario, a common implementation pathway can be developed. If all the individual pathways are stacked on top of each other, many projects and initiatives overlap in time—these are the common elements. The overall purpose of this approach is to identify the common elements that can strategically place an organization in a highly flexible, adaptable position when change occurs.

References

Marra, R. and T. Thomure, 2009. Scenario Planning: Making Strategic Decisions in Uncertain Times, Southwest Hydrology. 8(3).

Means, E., R. Patrick, L. Ospina, and N. West, 2005. Scenario planning: A tool to manage future water utility uncertainty, Journal AWWA. 97(10): 68-75.

Schwartz, P., 1991. The Art of the Long View, Doubleday, New York.

Tucson Water, 2004. Water Plan: 2000-2050.

Van der Heijden, K., 2005. Scenarios: The Art of Strategic Conversation, 2nd ed., John Wiley & Sons, New York.

Regional Water Planners Panel Discussion

Randy Kirkpatrick, San Juan Basin

Randy Kirkpatrick received a BS and an MA from New Mexico State University in agricultural education and public administration. Since the late 1980s, Randy has worked with water issues, and participated in the drafting of the original Regional Water Planning Template. In 1989 he became actively involved with the San Juan Water Commission, and in 1994 became the Executive Director for the Commission. Randy is Immediate Past President of the Colorado River Water Users Association and is currently serving as the Secretary/Treasurer of the New Mexico Water Resource Association. He serves as San Juan Water Commission representative on the following committees: Ad Hoc Committee for the New Mexico State/Regional Water Planning; Animas-La Plata Operation, Maintenance and Replacement Association; Animas-La Plata Project Construction Committee; Bureau of Reclamation Managing for Excellence; New Mexico First; New Mexico Water Dialogue; San Juan Basin Regional Water Planning; San Juan River Recovery Implementation Program; and Western Coalition of Arid States.

My history on regional and state water planning began before the tenuous development of the Regional Water Planning Template. During that process, I was fortunate to have time to survey many planning efforts in the West, which led to the original outline for the template. Twelve dedicated persons and I spent the next 13 months in the development of the original Regional Water Planning Template with the assistance of Interstate Stream Commission staff.

The current administration pushed for the very critical State Water Plan in about the same time allotment. It involved two broad public efforts, one in Socorro, as a Town Hall meeting that was well done, and the second in Albuquerque that was done without adequate time for participants to recognize truly the concept of complete planning. There were numerous regional meetings as well. While the result was an adequate first step in the form of a policy document to guide some Office of the State Engineer activities, it was not and is not what will lead the state to a truly sustainable water supply. No one means to be overly critical, but the financial and human resource demands for this effort are greater than has ever been dedicated to the process.

Our most recent update/review did not include a public exchange and simply followed a well designed program. The problems with the update were not due to the planning staff's effort but to the lack of resources available to develop a realistic plan. Good things will come from the effort, as in the first attempt, but the return on the investment is disproportionate when the investment is too small.

Planning must address a number of elements to reach its ultimate goal, which is a sustainable water supply for the citizens of New Mexico.

1. Hard data – The best data must be used primarily regarding supply/demand, with awareness of realistic strategies to achieve the balance among interests including the environment, health and well-being, and socio-economic stability.

2. Institutional bias – Institutions, particularly governmental agencies, assume and are granted authorities and develop processes that eventually become unwritten rules. These unwritten rules can become challenges to change. In some cases, they take on their own realm of importance to staff and leadership. Successful planning must overcome these and the inevitable "because we always did it that way."

3. Cultural resistance – Many are guilty of this, probably including myself. Agriculture has always done it one way, which is the basis for most of our water law. Cities have done it another way and feel their uses are more important. Environmental purists want it all to meet their beliefs, based on fact or feelings, and so it goes…

4. Legislative good intentions – Protectionism and politics can create unforeseen consequences, many relate to the two previous positions; some will or have been judicially corrected. It must be recognized that water is not optional on either side of most issues. Quoting Phil Mutz's first and best advice to me, "Be careful, you may get what you ask for."

5. Lack of authority – Water planning consists of more than one plan: the State Water Plan, Regional Water Plans, Water Development Plans (40 Year), Conservation Plans, and efforts related specifically to water quality. We need one comprehensive water plan that can be integrated into the other non-water plans that we all undertake with authority given locally, regionally, and statewide for the plans' elements.

6. Implementation – My bookshelves contain more than a half dozen water-related plans, most of which are not doing more than holding my bookshelves down. But with certain actions, they could become reality. Our first regional water plan in the San Juan Basin, prepared in 1981, led to the creation of an organization, a strategy, and funding, although no state funding. Let's look at the largest single result, other than my having a job.

SCOPE OF WORK

San Juan Basin Comprehensive Water Supply and Needs Study
and
Update to San Juan Regional Water Plan

Introduction

The purposes of the San Juan Basin Comprehensive Water Supply and Needs Study (Study) are to:

Water Supply

1. update the water supply analysis of the San Juan Regional Water Plan by extending historical data through 2008.

2. extend water supply projections through 2050 taking into consideration variability and statistical risks associated with climate change projections of water supply

3. estimate the water supply impacts of climate changes using existing climate model results.

4. estimate water supply variability and statistical risks of various supply scenarios through 2050 based on existing non-climate change studies, such as tree ring or other paleo climate studies results.

Water Needs

5. update water needs based on current data on irrigated acreage collected by the State of New Mexico
6. update the domestic water needs based upon current and forecasted population growth using United States Census Bureau and State of New Mexico demographer information
7. extend water needs for municipalities and industrial uses by adding historical uses through 2008 to the existing data set from the San Juan Basin Regional Water Plan
8. summarize and quantify existing water rights.
9. summarize water needs through 2050

Implementation

10. review and update the San Juan Regional Water Plan implementation strategies
11. prepare an implementation plan for meeting projected basin-wide water needs.

Climate Change and Water Supply

No study of climate change impacts to northwestern New Mexico, in particular the San Juan Basin, was identified in preparing this scope of work. Three studies examine climate change impacts to water supplies of the Rio Grand in New Mexico. They are:

1. WATBAL, a model that estimates changes in streamflow and water availability (Yates, 1997).
2. Rio Grande Hydro-Economic Model (RGHE) simulates six climate change scenarios (Ward, et al 2001).
3. Upper Rio Grande Water Operations Model (URGWOM).

Climate change impact study of the Rio Grande as part of UGWOM, a RiverWare based model of the river, was a New Mexico specific study that also considered climate change impacts to water supply. These model results are not deemed directly applicable to the San Juan Basin.

However, much of the water supply for the San Juan Basin in New Mexico originates in southern Colorado. Western Water Assessment (WWA), a collaborative effort of the Cooperative Institute for Research in Environmental Sciences at the University of Colorado and the National Oceanic and Atmospheric Administration's (NOAA) Earth System Research Laboratory (both in Boulder, Colorado) has conducted extensive research in climate change impacts to water supply, including that of southern Colorado.

WWA's research has relied on two principal global climate change models, the Canadian Model (Canadian Centre for Climate Modelling and Analysis, a subset of Environment Canada) and the Hadley Model (Met Office Hadley Centre, United Kingdom). Additionally, results of models by NOAA and Goddard Institute for Space Studies were used. This research would be the basis for this proposed study's analysis of climate change impacts to the water supply of the San Juan Basin.

Paleo-climate

Several paleo-climate studies have been conducted to assess the prehistoric water supplies of various regions of the United States. Most notably are studies completed by NOAA which included evaluation of tree rings within the San Juan Basin in Colorado. Results of NOAA paleo-climate changes will be used to assess impacts to the Animas and San Juan Rivers water supply.

Climate Change and San Juan Basin Supply

There are numerous methods to consider water supply changes associated with climate change. Initial WWA studies present information in terms of ranges of effects. Generally, in the San Juan Basin area the effects of climate change are:

1. An increase in precipitation in the San Juan Basin is reported by the Hadley Model and a mix of increases and decreases reported by the Canadian Model.
2. With increased temperatures, runoff will occur earlier than currently occurs and snowpack at lower elevations will decrease.
3. Less water will be available during peak demand summer months.
4. The irrigation season and peak demands will increase with increased temperatures.

The effects on the water supply of a specific water right holder could vary considerably. Earlier runoff may make storage more important and provide more opportunities for those entities with storage rights to capture water. Conversely, an extended irrigation season may delay the traditional start of the reservoir filling season as senior water rights continue to divert water for application to beneficial use through the autumn. Extended irrigations season may mean more crop production (i.e. 5 alfalfa crops instead of 4) which necessarily requires more water. If the rights are senior enough, this may result in less water for junior water rights holders.

TASK DESCRIPTIONS

Task 1 – Early Climate Change Assessment

An early climate change assessment will evaluate the climate change models and apply their findings directly to San Juan Basin supplies. This may be as simple as determining the percentage reduction or increase to the basin in aggregate. This task could be accomplished relatively quickly and provide some limited understanding of impacts anticipated from climate change on a basin-wide basis. This early assessment could not adequately evaluate the impacts to specific water rights.

Product: Memorandum report on basin-wide impacts to water supply from climate change as reported by existing models. (Completed)

Task 2 – Historical Data Collection and Extend Study Period

Starting with existing data sets from the San Juan Regional Water Plan, the project team will collect and extend streamflow gage data and other water use data through 2008 for use in projecting water supply and demands. Data will be collected on a monthly timestep for evaluating water rights vs. water supply under historical, climate change and paleo-climate change scenarios.

Product: Electronic files of extended data

Task 3 – Collection and Analysis of Monthly Climate Change Model Results

The results of two climate change models associated with the San Juan Basin will be collected and summarized to provide a more robust and comparative analysis. The goal will be to develop a reasonable monthly climate change estimate in water supply that could be used to project the basins supplies through 2050, using a replication of historical data. This may require the use of statistical comparisons of historical water supply data and climate changed water supply projections to develop a future projection. Because the climate change models report ranges of effects, the water supply average in 2050 will also reflect a range of responses.

The project team will collect monthly data effects of climate change and extrapolate the model results to the San Juan Basin Rivers (Animas, La Plata and San Juan). This analysis will not simulate storage or other human diversions but will use assumptions that the gages at the state line with Colorado are proportionally reduced. The exception will be the effects on the Animas River that will impact Animas-La Plata Project (ALP) water supplies. The effects of climate change on supplies at the Durango Pumping Plant will be extrapolated and applied to ALP supplies.

Product: Summary of Climate Change Model Impacts on Natural Water Supplies

Task 4 – Water Right Quantification

Using the San Juan Decree, the Cielo Report, New Mexico's WATERS database, and research of state water rights files, the water rights of the San Juan Basin will be compiled in a summary report. Because water rights are not always quantified in acre-feet, the project team will quantify the rights based on historical monthly usage or irrigated acreage described by the right. To avoid concerns or inaccurate perceptions that the San Juan Water Commission is trying to adjudicate rights, the non-municipal rights will be aggregated by subbasin and listed by type (i.e. agricultural, industrial, other). Municipal rights will be summarized in more detail and provided to the members of the Commission for review and concurrence. If confidentiality is needed, the Commission can direct that the municipal water rights quantification also be aggregated to avoid details of specific rights being published.

The purpose of quantifying water rights is to determine the seasonal variation effects of climate change based on priority of water rights.

Products: 1) a summary report of the water rights of the San Juan Basin

2) quantification of the rights on a monthly timestep

3) aggregation of agricultural rights by subbasins as defined by the San Juan Regional Water Plan

Task 5 – Population Projections and Extension of Demands through 2050

The 2000 U.S. Census Bureau data was used to develop population and water demand projections for the San Juan Regional Water Plan. This study will eventually use 2010 U.S. Census data to update the projections. This means that completion of this task will not be accomplished until the 2010 data is available in 2011. In the interim, the projections of population and water demands will be mathematically extended from 2044 (planning horizon for the San Juan Regional Water Plan) to 2050 using results from the San Juan Regional Water Plan in order to provide initial study results.

Products: 1) extension of water demands from 2044 to 2050.

2) re-assessment of population projections and demands incorporating 2010 census data.

Task 6 – Paleo-climate Changes

The results of NOAA paleo-climate study results will be collected and evaluated to assess the statistical frequencies of extreme and prolonged droughts in the San Juan Basin. Paleo-climate results are annual values and cannot be used to assess monthly timestep water supplies. However, the increased period of record will help assess the potential for severe droughts in the basin, including those that extend over several years.

Product: Section of report.

Task 7 – Comparison of Historical, Climate Change and Paleo-climate Results

Three scenarios of water supply will be compared with projected future demands at the year 2050. The comparisons will be made on a single-year basis representing the projected average monthly demands in 2050. The ranges of dry, normal and wet years for extension of historical data will be compared with

demands. These dry, normal and wet year comparisons will be modified by the results of climate change models to provide a statistical range of dry, normal and wet years. Paleo-climate statistics will be summarized but not used to compare with projects 2050 demands.

Product: Three sections of a report describing the results of comparing 2050 demands against historical supplies, climate change modified supplies and paleo-climate statistical supplies.

Task 8 – Implementation Plan

The implementation and drought contingency plans as included in the San Juan Regional Water Plan will be re-visited and discussed with stakeholders to determine their continued applicability to the conditions described by this study. As needed, additional implementation strategies will be developed and those that are no longer considered viable by the Commission will be deleted from inclusion in the plan.

Product: A section of the comprehensive water plan describing implementation strategies to meet projected demands.

Task 9 – Public and Stakeholder Outreach

Throughout the study at key milestones, the study purpose, methodology, and/or results will be presented to the public and to stakeholders. The purpose of this outreach will be to incorporate information from the public and/or stakeholders that may improve the study and provide better overall results. A secondary purpose will be to provide opportunities for the public and stakeholders to learn about the study and develop an understanding and acceptance of its process and findings. Re-establishment of the citizens advisory council used in preparation of the San Juan Regional Water Plan is a possible option of accomplishing this outreach.

Products: 1) Collection of stakeholder findings, minutes of meetings and other public input.

2) Participation in 10 stakeholder or public meetings over an 18 month period.

Task 10 – Preparation of draft and final Comprehensive Plan

Two drafts and one final version of the Comprehensive Water Plan will be developed. These documents will undergo review by the Commission and other stakeholders, as defined by the Commission.

Products: 1) a web based version of the draft and final master plans

2) 30 paper copies of each draft and final document

Regional Water Planners Panel Discussion

Tom Bates, Southwest Region

Tom has spent the last 18 years in city government, ten years as Town Manager in Silver City and eight years as Special Project Coordinator in Deming, always with an interest in water involvement. While in Deming, he served as the Southwest Region Water Manager and was responsible for the overall coordination of writing the Southwest Regional Water Plan. While in Silver City, his efforts included recycling, public transportation, and a no smoking in public facilities resolution. In Deming, Tom was responsible for the Peru Mill reclamation, the largest earth moving project in southwestern New Mexico that now serves as a model for the Southwest Region of the U.S. He was also responsible for the permitting and all but the final stages of the construction of the Deming/Luna County landfill. Tom's undergraduate degree is from Montana State and he has master's degrees from Western Kentucky University in public administration and government. He retired in January of this year, but still works on water issues for the City of Deming and Luna County as a water contractor.

As Karl said in my introduction, I was the Southwest Regional Planning Manager and, as such, I was responsible for coordinating the writing of the Southwest Region Water Plan. It is a process that took two to three years, and this was my first real exposure to many of the water studies done in the Southwest region of the state and to the water experts in the area. We hired Daniel B. Stephens and Associates and were guided through the process by Joanne Hilton and John Burkstaller. I think DB Stephens has done seven or eight of the regional water plans.

The experience was a good one; the regional water planning committee was open to anyone and everyone and initially it was somewhat contentious. Originally, the plan was to be done by the Black Range RC&D. At one point, they wanted more money but it was held up and I came late into the situation when there was some hostility. At our meetings, we had general rules about respecting the speaker while being hard on the issues. One thing we didn't do, and if I had to do it over again I would, was to limit the time a person could speak to two or three minutes so that everybody had a chance to speak. To some extent much of the discussion was, if not non-relevant, marginally relevant. The problem with that is that if somebody dominates the discussion, you can't shut them down while they argue about whether what they are talking about is relevant or not. And the other members feel like their time is being wasted. I do think that a short presentation is less contentious. I enjoyed one of our speakers who defined "input" as information that helps with the decision-making process. When you get input, the reaction is, "Aha, that's great." That may be an exaggeration, but I think that was one of the real lessons learned.

The plan draft was written and subsequently taken to all the communities where we received input. The input was then incorporated into the final plan. The plan generally was as good as the data that DB Stephens had. In some cases, data

were missing and we were told that they believed the data were correct with 60-80 percent confidence. To really update our plan correctly, we must do a bit more research.

We then briefed the plan to each of the county and municipal governments and they approved it with the promise that they would implement and enforce the plan and not simply put it on the shelf. In reality, the region has no structure, staff, or enforcement capabilities. We went so far as to require county water budgets but those are being ignored and I think the reason has been mentioned several times: new economic development, jobs, and getting reelected are all more important than cutting off somebody's water. I agree with what Angela Bordegaray said earlier that even though the plan is not being enforced in many areas, and certainly not in ours, it does increase awareness of the scarcity and the importance of water. In our region at least, people do realize that if we don't conserve our water, eventually we will run out of water.

We are now in a similar process in the Southwest Region for deciding what we should do with the 14,000 acre-feet of water that has been granted to the region annually by the Arizona Water Settlement Act. We are trying to make decisions using the best science available. I think the Southwest Regional Water Plan has given us confidence in how to go about this and from that perspective, the planning process has been very valuable. The work of Sandia National Laboratories in modeling river flow has been world class. The modelers are fantastic and the software is world class. Based on this work, we have a pretty good idea of our water situation.

Thank you.

Regional Water Planners Panel Discussion

Joe Quintana, Middle Rio Grande

Joseph Quintana is the Regional Planning Manager of the Mid-Region Council of Governments of New Mexico and is a member of the American Institute of Certified Planners. Joe has a master's degree in public administration, with a graduate certificate in natural resources, from the University of New Mexico. He works directly with local governments and has written numerous comprehensive plans and regulatory ordinances for municipalities and counties. Joe served as a principal staff person in developing the Regional Water Plan for the Middle Rio Grande area, was involved in the creation of the Estancia Basin Water Planning Committee, conducted the Middle Rio Grande Bosque Consortium, and assists the MRCOG Agriculture Collaborative.

Thank you. This discussion should bring today's topics full circle. We started this morning with the staff from the Office of the State Engineer talking about the state water planning process with reference to regional water planning. So, now we are looking at the state water plan from the regional water planning perspective. One of the challenges that we had when we were asked to be on this panel was to compare the process for developing the state water plan in 2003 and then again in 2009 when all of the regional water plans had been completed.

So let's look at how the two planning processes compare (Fig. 1). In 2003, a report that was put out a year earlier provided a framework for public input into the state water plan. So there was a lot of previous work that had been done before extensive citizen input was brought in. There were 29 public meetings statewide, not unlike what has been done this year when 22 public meetings were conducted statewide. Both of the public meeting series followed a similar process; and summaries or public comment synthesis reports are available. Prior to the planning effort in 2003, fact sheets were published and distributed widely, so there was a lot of information going out to the public before developing the state water plan.

2003 State Water Plan	2008-09 State Water Plan

▪ 2002 Framework for Public Input to a State Water Plan
▪ Public Input Process
  ▫ 29 Public Meetings Statewide
  ▫ Public Comment Synthesis Report
  ▫ Distribution of 10 fact sheets
  ▫ Town Hall Meeting in Albuquerque
▪ 2004 State Water Plan Implementation Report
▪ Ad Hoc Regional Water Planning Committee
▪ Seven Regional Water Plans completed and accepted by ISC
	▪ State Water Plan Progress Report issued June 2006
	▪ Public Input Process
	  ▫ 22 Public Meetings Statewide including the State-Tribal Water Institute
	  ▫ Summary data: regional water plans
	  ▫ Distribution of updated fact sheets
	  ▫ Meeting Notes for each meeting
	▪ Regional Water Planning Advisory Council
	▪ 16 Regional Water Plans completed and accepted by ISC

Figure 1. State Water Plans: Then and Now

In 2003, there were only 7 regional water plans that had been completed and accepted by the Interstate Stream Commission. So there weren't really enough regional water plans that could be compared and contrasted as a basis for the statewide plan. The state water plan at that time was more oriented towards the state water

assessment and statewide water resource needs. Regional water planning efforts at that time were discussed by an ad hoc regional water planning committee created by the Office of the State Engineer staff. That committee evolved and still operates today as the regional water planning advisory council. It is a group of regional water planners from the 16 regions, facilitated by staff from the Office of the State Engineer. The regional water planners talk and argue monthly but it has been a good input for the state staff to hear directly from the water planning regions. The state water plan for 2003 was a thick document. About two years later, there was a progress report that came out and reviewed what the state and regional water planners had accomplished. One thing that was different about the 2003 state water planning process was a "New Mexico First" Town Hall Meeting conducted in Albuquerque as an intense two-day conference where everybody was working on many water issues at one time.

What is different for the 2008-09 process is that there is already a state water plan in effect. We are asking questions about whether or not it is still applicable, what issues are new, and what accomplishments have been made. We are looking at the state water plan from a different perspective. The existing state water plan needs to be changed and updated and made more effective because plans don't hold up over time as circumstances change. The current process is starting with something that is already completed, whereas in 2003 there was basically a blank slate for the state water plan without much input from regional water plans.

Figure 2 is a map of the 16 water planning regions, you've seen this earlier and you will hear a little bit about what we did in the Middle Rio Grande Water Plan; Tom Bates will be talking about the Southwest New Mexico Regional Water Plan; and Randy Kirkpatrick will talk about the San Juan Regional Water Plan at the end. These regional water plans are quite different from each other. The socio-economic characteristics in those areas and the organizational structures for regional water planning are all very different.

For the Middle Rio Grande region (Fig. 3), our plan was accepted by the ISC in 2004 at the end of a six or seven year process. It was quite an undertaking because we had big players in the planning process, and major influential political jurisdictions were involved. One of the major constraints for our planning process was that early on a water budget had been calculated and we were looking at quite a significant annual water deficit, ranging from 55,000 acre-ft/year to even higher estimates. Our supply and demand are way out of balance. The Plan itself had 43 recommendations in 9 different categories. Some of the recommendations are being implemented, but there has not been any significant funding. Some funding has been provided by the State for implementation of regional water plans and some funding has been available for updates to plans over the years since they were completed. Much of the effort by the Office of the State Engineer was to just get all of the regional water plans completed by 2008.

Figure 2. Map of the 16 Water Planning Regions

- Accepted by the ISC on August 17, 2004
- Water budget: demand exceeds supply by about 55,000 acre-feet per year
- 43 Recommendations (9 categories)
- Plan implementation activities
  - Survey of local government water conservation activities
  - Development of a Model Water Conservation Program
  - MRCOG Water Resources Board: cooperative regional water planning and management
  - Bosque restoration (non-native tree thinning)
  - Application for funding regional toilet retrofit program

Figure 3. Middle Rio Grande Regional Water Plan

What we are able to accomplish in our water plan, as in most of them, is water conservation. You don't have to know exactly how much water you are using or how much water you have; it is just common sense in this area of the country that you would conserve water by using water as efficiently and effectively as possible. Those kinds of activities are the low-hanging fruit that we continue to go after.

First let me say something about our organizational structure. The Mid-Region Council of Governments has a regional Water Resources Board which was working in conjunction with the Middle Rio Grande Water Assembly in creating the plan. Both of those organizations are continuing to work on different aspects of the plan. The Water Resources Board is made up of the governmental jurisdictions within the planning area; so we reviewed what the cities, towns, villages, and counties were doing in terms of water conservation. A survey was conducted of all the local governments and a matrix was prepared to list all the recommendations in the Regional Water Plan; and to check which activities were being carried out by the local governments. We found that many communities were doing very little, but some were doing a lot. The Albuquerque/Bernalillo County Water Utility Authority is probably the gold standard for the most extensive water conservation activities. They are setting an example for the smaller jurisdictions.

The Council of Governments staff has developed a model water conservation program that was targeted for small municipalities. In that model, there are 10 steps for conducting a water conservation program. The model also proposed two ordinances: one that had to do with eliminating water waste and setting up a system for penalizing those who were wasting water or creating what we call fugitive water. The other ordinance developed a process for establishing an emergency water shortage plan where the local government could take actions to cut back on water use and impose water use restrictions community wide. There doesn't have to be a drought in effect because water systems can go down with just a pump breakdown. The objective is to get all of our local governments to adopt emergency water shortage plans.

The Water Resources Board meets four times a year as an advisory body to the Council of Governments' Board of Directors. They meet basically to keep up with water issues around the region; more like a forum to exchange information about water and find ways to implement the regional water plan. Running parallel to this is the Middle Rio Grande Water Assembly with their public information program. They have annual meetings; and this year's will be October 24 at UNM at Dane Smith Hall. It is a Saturday all day session.

So those are the activities that have been going on since the regional water plan was adopted. Without funding, we have been lucky to stay active. I don't know what the funding is for the Water Assembly but the Council of Governments Water Resources Board received no state water planning funds throughout this period. Basically it has been a volunteer effort with participation from the local governments.

There are other water resource activities that have been done by the Council of Governments. Bosque restoration in the Middle Rio Grande Valley has involved hundreds of acres of removal of non-native plants and trees. Those projects are ongoing and they are intended to result in the reduction in water loss in those areas as well as wildfire protection. The Water Resources Board is trying to do more regional oriented activities. One of the concerns recently expressed to the Board was the need to establish regional water conservation standards. We have a four-county area in the Council of Governments and it includes two regional water planning areas: the Middle Rio Grande and Estancia Basins. Some of these activities are easy to do. An example is that we are considering a standard time of day period such as 11:00 a.m. to 7:00 p.m. for restricting outdoor watering that is consistent throughout the area.

We are currently working on an application to submit to the Water Trust Board for funding to purchase and install toilets for a toilet retrofit program. Albuquerque and Rio Rancho have had toilet rebate programs and Albuquerque's is still active. A rebate program is for homeowners to replace an older toilet, say pre-1950, or one that uses more than an ultra-low flush toilet which is about 1.5 or 1.7 gallons per flush and receive a credit on their water bill. Bernalillo County however is actually contracting someone to locate homeowners in the county area who would qualify for replacement of a water hog toilet. Then they would work out an agreement to come in and pull and replace the old toilet. We have done some calculations, and the water savings can be significant. In our application to the Water Trust Board we are proposing to retrofit over 1000 toilets.

So whether we get the funding or not, Albuquerque and Bernalillo County are still replacing water wasting toilets; and what we want to do is spread that program out regionally so that we can get toilet retrofits in outlying rural areas. I will end here and answer questions later.

Flood Control in an Urban Area: Challenges for AMAFCA

John Kelly, Albuquerque Metro Area Flood Control Authority

Mr. Kelly is the executive engineer with the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA). After graduating from UNM in 1981 with a civil engineering degree and from NMSU in 1983 with an MBA, John's career has concentrated on flood control, starting with operations and maintenance work on the City flood control system, moving through a design and construction role while a staff engineer at AMAFCA, and now in a senior management role in the state's first and largest flood control district. AMAFCA is the leading flood control agency in the state with regard to implementation of storm water best management practices, aesthetic infrastructure designs, and providing multiple uses of its flood control facilities. AMAFCA is the highest bond-rated agency in the state, holding triple-A ratings from both Moody's and Standard & Poor's, the two leading bond rating agencies. One of John's first memories as a kid growing up in Albuquerque is the massive flood of 1963, which happened when he was 4½ years old and was the defining event for the organization for which he now works.

Thank you, Stephanie, for that introduction. We were created by the state legislature in 1963 as the Albuquerque Metropolitan Arroyo Flood Control Authority and to be the local sponsor for the Corps of Engineer's North and South Diversion Channels project. This project was sponsored by Senator Clint Anderson and initially, the sponsors didn't have a local agency to fund it. The city wasn't big enough to cover the limits of the project, the county didn't have the financial wherewithal, and so we were created by the state legislature. Like all New Mexico flood control authorities, our statute required that our first bond issue pass before the agency could come into being. The smart people at the time put that election off as long as they could. Lo and behold, two weeks before the election, we had one heck of a rain in Albuquerque. I do remember that night. My folks were having a dinner party and nobody could get there because Comanche Road was a raging river. We hopped in my dad's 1963 Galaxy 500 station wagon with all four brothers and drove over and looked at the Hahn Arroyo and saw that the culverts were washed out. We drove back to Comanche; it was still a raging river so we went back to the house and lit the Coleman lanterns because the power was out. You know what I remember most about this? Me and my four brothers ate pretty good that night because no one else could get there.

Needless to say, the bond issue passed. The Corps went to work on the North Diversion Channel and built a 9-mile continuously reinforced channel. That channel is designed for 44,000 cfs, which equates to about a 500-year-event; a 100-year-event is about 28,000 cfs. We saw 12,000 cfs back in 1980. The sister project was the South Diversion Channel, a riprap lined channel that heads up at the University of New Mexico pit and runs down to the river at the Tijeras Arroyo. A couple drop structures take care of the grade on this channel. Figure 1 shows a drop structure located just below I-25. I'm sure most of you passed it on your way here this morning. Since it was built, we have used our tax and authority to build about half of the surface drainage system in town.

Figure 1. South Diversion Channel Drop Structure

We share maintenance with the City of Albuquerque and Bernalillo County. We have 36 flood control dams, making us the largest non-federal dam owner in the state. We also have a system of supercritical trapezoidal concrete channels designed for hydraulic efficiency. This was a carry-over from the Corps of Engineers design on the North Diversion Channel; this design was followed through in the 1970s. I like to say that the most efficient thing in local government is our flood control system, just ask any kid who has been caught in there, if he survived. One of our real challenges, as we move into our storm water quality component under the EPA permit, is taking high velocity water and doing something with it to slow it down in order to remove trash, debris, and bacteria. We live in semi-arid grassland and the sediment loadings are incredible. That is one of the challenges we have when we slow water down, we are not just taking trash out, we are taking care of the sediment. That's good, because a lot of things adhere to the sediment.

The public challenged us to make those ugly concrete channels look prettier (Fig. 2), and then to allow us to use some of the 4,000 acres of right-of-way owned by AMAFCA. We were the first agency to use tinted concrete on a flood control channel in a nice earth tone color, and when this first came up the board almost didn't approve it. Back then concrete was about $70 a yard and tint was another $20 a yard. The board did not want to spend that much money to tint the concrete, grey was just fine in their opinion. But one of our engineers went back to the board with another argument, and said that tint was only 2 percent of the cost of the project, which convinced the board to go along with the tint. Thus most of our projects include tinted concrete. We use a lot of shotcrete applications, which gives a rough orange-peel finish and which does a couple things for us: the rough surface deters skateboarders and graffiti doesn't show up well on it. We also use a lot of riprap on channel sides where we have flatter slopes like along the bosques where slopes are lower and concrete lining isn't needed.

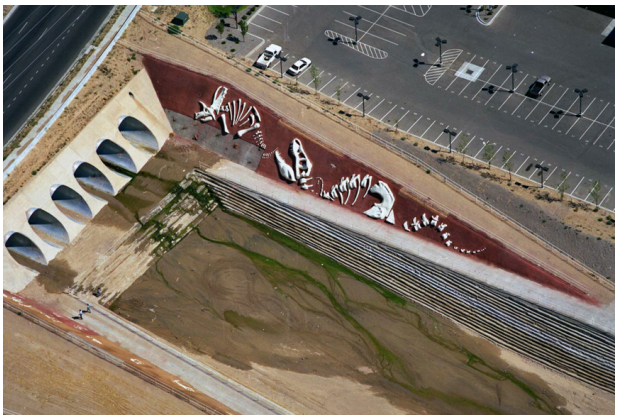

Figure 2. Calabacillas Arroyo at Coors Blvd.

We have also used soil cement extensively on our projects. Figure 3 shows Kinney Dam spillway designed by RTI. They did a great job on this project. The soil cement is alluvium right out of the bed of the arroyo, mixed with about 7 percent cement, enough water to hydrate it, and then it is placed with heavy earth-moving equipment. Those lifts on the spillway are 10 feet wide so we are making up in mass what we lack in rebar. The soil cement breaks at about 1,500 psi compared to 3,000 or 4,000 for concrete, and it looks like a nice set of sandstone layers.

Figure 3. Kinney Dam Spillway

We are the first agency in the state to landform a flood control dam. If you look at the crest of Las Ventanas Detention Dam, designed by Bohannon Houston, you see the crest varies horizontally and vertically. We don't have that long linear crest of the dam and it blends into the landscape better (Fig. 4). We have also varied the slopes by putting aesthetic fill beyond the structural fill so we can actually bring landscape in on a dam embankment (Fig. 2). We were able to build layers of geology into the Calabacillas Arroyo. On the West I-40 Diversion Channel project we have schools of salmon swimming upstream, if you can imagine that (Fig. 5). We are well known for the multi-use aspects of our facilities; we have bike trails up and down 60 percent of our flood control channels in town. It is a great independent transportation system off the highway grid. Our dams serve as anchors for parks, golf courses, and hang gliding areas all over town. At the Kinney Dam, we designed the dam with a two-stage pool, pre-sized for a future soccer field to be worked into the regional park complex. We also set the dam ramps at 20% slopes to meet future ADA requirements and to allow everyone access. With early coordination on the project, we enhanced its future multiple use.

Figure 4. Las Ventanas Detention Dam

Figure 5. West I-40 Diversion Channel

We are a co-permittee under the Albuquerque MS4 permit, which is the EPA storm water permit. We are partners with the City of Albuquerque, UNM, and the Department of Transportation. Our first mandates under the permit were to look at debris removal, characterize the trash going down the channel, and to look at bacteria in storm water. We were one of the last states to get permitted. The permit is in renewal right now. When we looked at debris in storm water in 1999, Don Dixon and crew got together and designed what we call the "shopping cart" and hung it off the Girard storm drain to see what we could catch. We caught a bunch of leaves.

Under the permit, we were required to conduct a gross pollutant study in which we characterized trash. We collected material from City pump station bar strains and we screened trash out of the arroyo system. We characterized the sample by volume. Figure 6 indicates what we found. Large natural materials and small natural materials (tumbleweeds, leaves, pine needles) made up 68 percent of the debris flow. Plastics made up 16 percent of the total, mostly those little water bottles we all like so much. Cigarette butts accounted for 6.4 percent and I think that was probably a function of the screen size that we used, but that surprised us all.

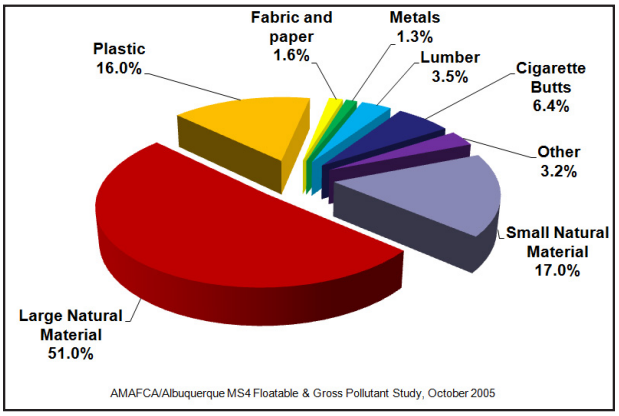

Figure 6. Gross Pollutant Study Debris Characterization by Volume

What we have done on debris removal? We had some good learning experiences with our existing system. Amole Dam, built in the mid-70s on the west side, fills with water, and drains down into the conservancy district's canal (Fig. 7). After the dam drains, you can typically see the accumulated trash, and we wondered why the trash was just sitting down there (Fig. 8). We took a better look at it and realized the ports were on an incline just like the baffle on a septic tank. So that was an easy solution for dams – just put inclined ports in the principle spillway outlet (Fig. 9). Our dams had a simple bar screen across the principle spillway pipe so we went in and modified quite a few of them with the inclined riser. Figure 10 shows a completed project at the South Baca Dam.

Figure 7. Amole Dam

Figure 8. Trash Collecet at Amole Dam

Figure 9. Inclined Port Spillway Tower at South Baca Dam

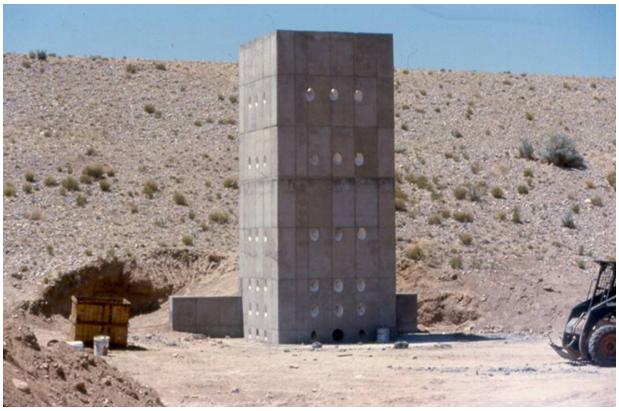

Figure 10. Completed Inclined Port Spillway Tower at South Baca Dam

I spoke earlier about our high-velocity system of channels. Peeling water off the side of a super-critical channel is a challenge. We have worked extensively with UNM's hydraulic laboratory and civil engineering department on this to the tune of $50,000 a year. I'm sorry we can't also do that with NMSU. We have looked at ways to peel water off the channel without adversely affecting the 100-year-design flow. The setup in Figure 11 has worked pretty well. Freeboard walls have been added on either side, we have sunk the channel, and diverted water off the side. On our first one of these, we had an inlet dead center in the channel but we saw some safety concerns with that and hopefully someone could swim by a storm water quality diversion like this. That pipe runs over into a debris removal structure, this was designed by Bohannon Houston. The pipe comes in and was designed for mechanical maintenance. Figure 12 shows a hanging baffle and a weir so water comes in on the left bank, goes under the baffle, and over the weir so we get a really good capture of the

sediments and floatables behind the baffle. That way relatively clean water will go down to the secondary environmental pump. We have modified this design in different ways in different locations.

Figure 11. North Pino Channel Debris Intake Structure

Figure 12. North Pino Arroyo Debris Removal Structure

Figure 13 shows the La Orilla outlet debris baffle; this is where it runs into the Rio Grande. This is a joint use facility with the MRG where we bleed storm water into it from Alameda Road all the way down almost to Montano. We designed this with the hanging baffle and the weir (the weir was already in the structure) and you can see how effective it is at removing trash before it gets into the river. A really easy way to do this is within a manhole (Fig. 14). In a typical storm drain manhole, one pipe going in and one pipe going out. We decided to put a sump in the manhole and a tee on the outlet pipes so the water has to come in, go under the tee, resulting in capturing the floatables. Then if someone forgets to maintain it (this thing is out of sight and out of mind), the water will go over the top of the tee and you have not compromised the flood control function. For this to work very well, however, you must use a vacuum truck for maintenance.

Figure 13. La Orilla Outlet Debris Baffle

Figure 14. By-Pass Manhole Debris Containment after One Year of Operation and Before Maintenance

In our Bear Canyon Arroyo (Fig 15), we looked at a system that the City Refuse Dept. could maintain. We placed screens across the arroyo as we had excess capacity in the channel because of upstream dams. The screens are set up so the City can come in with their normal refuse truck and empty the screens. These work fairly well but you end up taking to the dump 68 percent large and small natural vegetation.

We are now in our fourth generation of storm water retrofits. You will recall from Figure 12, the North Pino Arroyo Structure, that the system worked very well for floatables and sinkers but we had a lot of material that was suspended in the storm flow coming over the weir and running into the secondary pond. Jerry Lovato from our office had been to a storm water conference in Denver four years earlier and he came back with one heck of an idea. We used the coanda screen technology, which uses a wedge wire screen with a half-millimeter spacing between wedge wires. This screen allows little slivers of clean water to

be shaved off as the water flows down it (Fig 16). It works in a vertical or incline setting. You have moving water flowing down, sort of like a cheese grater in reverse because as it slices off slivers of clean water, the trash and debris continue rolling down the screen. Figure 17 shows the screen functioning as you can see the water coming over the weir and dropping into the first six inches of the screen. The half-millimeter spacing will take 1 cfs per square foot, which is a heck of a flow rate, and you can see the trash rolling down the screen here.

Figure 15. Bear Canyon Arroyo Debris Screen

Figure 16. Coanda Screen Installation over New Clean Water Gallery

Figure 17. North Pino Coanda Screen Operation

We have set up a similar but bigger project on the Vineyard Arroyo where the screen crosses the entire arroyo before flows make their way into the North Diversion Channel. The screen is sized for the 10-year-event coming down the arroyo (Fig. 18). Figure 19 shows what happens after a storm. The system has been on the ground for one full season, and you can see that water from a small storm came over just enough to come down and drop through the screen. You can see the debris washing down the stream and onto the screen. We have been critiqued by EPA about doing these end-of-pipe treatments, and they want to know why the program isn't up in the watershed, or why it isn't keeping the streets cleaner, or cleaning drop inlets more. The reason is that those are roles for the City, UNM, and the New Mexico Department of Transportation (DOT) in the storm water program; we are confined to the property and facilities we have.

Figure 18. Vineyard Arroyo SWQF Complete

Figure 19. Vineyard Arroyo SWQF After Storm

We must track fecal coliform. This is the only standard we do not meet for storm water. During a storm event, we have huge fecal loads, 80,000-100,000 colonies, but we meet the annual loading under TMDL regulations because of the clean trickle flow that runs down the diversion channel 24/7. EPA required us to look at the sources of fecal matter and we worked with the New Mexico Environment Department (NMED) and Bernalillo County on this. Two studies have been done: the first was done by the City using an antibiotic resistivity analysis and the other study was done by AMAFCA, NMED, and the County using DNA to source track. The pie chart on Figure 20 is a composite of the sampling they found showing the sources of fecal coliform in storm water. You will see that we have a huge canine source, a huge avian source as well as cows, horses – we even have coyotes for .5 percent. These numbers varied depending on where the test was taken. If you tested further up toward the mountains, there was more of a canine and wild source.

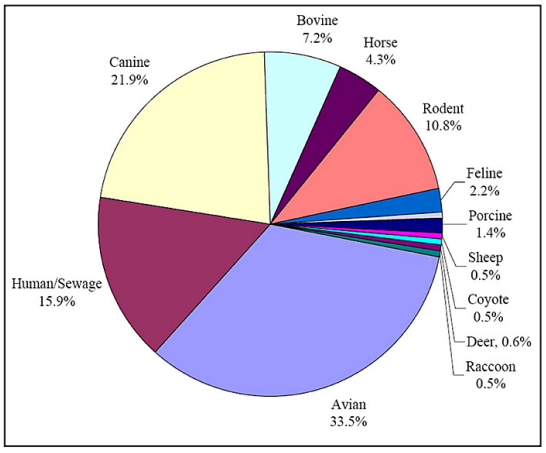

Figure 20. Middle Rio Grande Microbial Source Tracking NMED, AMAFCA, & Bernalillo County

We were surprised at the amount of human sewage that was showing up. Some of it was attributed to leaking septic tanks and some of it is attributed to how the testers typed the human sewage. For example, they went down to the sewage treatment plant, pulled samples off the grid chamber, typed those, and then matched them up to storm water. But what else flows into your sewage treatment plant? Restaurant floor washings go into the sewage system, but they can also be taken outside in a bucket and dumped into the parking lot, which eventually washes into the gutter and into storm drain system. So it may have been somewhat overstated in the study just by the way it was typed.

We do several things to take care of bacteria as well as heavy metals. Many storm water pollutants are bound to sediments and our sediment removal program removes a lot of that right out of the system. Many of our projects have constructed wetland areas that slow the water down. Figure 21 show sediment removal at the North Diversion Channel. Figure 22 shows the long vegetated swale we created going through the entire inlet to the North Diversion Channel. If we slow water down and get some UV on it, you will knock the fecals out. We have done the same at our North Pino Pond where we have built a secondary environmental pond that serves as an extended detention pond. It allows us to slow the water down, drop out more sediments, and allows the sun to work on the bacteria. It works pretty well. We planted the pond with wetland vegetation to take up some of the nutrients and it does a good job. However, mallards live there and they contribute fecal matter to a storm water quality pond. It's one of those things where you try something and you get unintended consequences.

Figure 21. Sediment Removal at North Diversion Channel

Figure 22. Bear Canyon Inlet Bio-Swales

Our storm water quality education program is now a 7-way partnership with the City, County, CNM, SSCAFCA, AMAFCA, DOT, and UNM. We are contributing $80,000 a year for storm water quality education programs and really pushing people to pick up after their dogs. Mutt mitts are now a common feature at almost any city park and along most arroyos. Even with our efforts, we still have direct fecal inputs into the system from our homeless population. Nobody wants to deal with that, but we have had to in at least one spot.

Referring back to Figure 20, we see that human sewage is 16 percent and avian sources are 34 of the total. We developed a project in one location where we were able to knock both those out. We had been looking at a demonstration project to deal with the pigeon problems on our diversion channels, primary at the bridges. We went to the police department and said, "We've got a real problem at Indian School Bridge over the diversion channel, it has turned into a homeless campsite." This area is close to UNM but far enough away where nobody was bothering folks sleeping under the bridge. And if they are sleeping under the bridge, you can guess what they do first thing in the morning. We went in with an Avian Control Project. You have seen the bird spikes and spiders on buildings; we put those on the bridge piers and portions of the abutments. But what was really successful was what we call bird slides. An abutment seat is about 6 feet long and 2 feet deep, perfect for your cardboard and sleeping bag. Figure 23 shows what we did: we put in a stainless steel bird slide so pigeons couldn't roost. It was fun watching them fly in and hit that stainless steel. They were like deer walking on ice. They cannot land and they just slide off. About 5 homeless guys were quite unhappy with our project. Of course, all we did was move them, but they are not doing things in the channel anymore.

Figure 23. North Diversion Channel, Indian School Bridge Avian Control Project - Bird Spikes and Spiders

We are grappling with a couple current issues: one deals with two documented fish kills in the North Diversion Outfall, another deals with water quality data, part of the work of a UNM student who identified a few things in the river no one has ever studied.

One fish kill occurred in 1989 and the only documentation we had on the event was a letter in the file indicating we called the Department of Game and Fish. Two Staff members, Paul Cassidy and Jack Kelly, went out and determined it was a DO (dissolved oxygen) issue. There was a bunch of carp and a few other types of fish dead. It was due to mixing stratified water. A crew went out, buried all the dead fish, and nobody thought anything more about it. Then in 2004, we had another fish kill at the North Outfall. This occurred while the USGS and the U.S. Fish and Wildlife Service were out looking at the outfall as a potential nursery habitat for the silvery minnow. They were monitoring the outfall for dissolved oxygen and after a small storm, we had a fish kill. They monitored oxygen and after an evening storm, the DO drops down to nothing, crept back; another small storm hits and it dropped back down (Fig. 24). They did not find any silvery minnows but the experience made us take a whole other look at the North Outfall. The North Diversion Channel Outfall goes out to the balloon fiesta area and then turns and drains into the river north of Albuquerque. It also travels through the southern boundary of the Pueblo of Sandia. The

concrete channel goes under the railroad bridge, through the outfall area, and past the levee into the river. The fish kill was in the embayment area. We looked at this and decided the problem was the bathtub drain area where the channel drops five feet to go under the railroad bridge. The water in that area is known the get stagnant. The theory was that this water had been pushed down the channel displacing water in the embayment area. That's why the DO dropped and caused the fish kill. What did we do? We opened the existing drain in the bathtub area and instead of keeping it closed as we would normally, we opened it to keep water flowing through the sink of stagnant water. It also made sense to put another drain in. Figure 25 shows the new drain and we thought we had the problem solved.

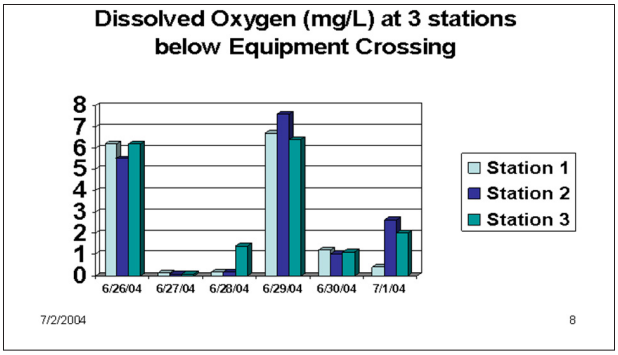

Figure 24. NDC Dissolved Oxygen over Time

Figure 25. North Diversion Channel "Bathtub" Drains

The event took place in 2004 and nothing happened in 2005 through 2006. In 2008, David Van Horn, a UNM graduate student in biology, presented his study on Middle Rio Grande water quality, a study designed to look at nutrient loadings in the Rio Grande. He had 4-way probes set up at Alameda and Rio Bravo and one of the results of the study was that we have a sag in DO.

Figure 26 shows the discharge into the Rio Grande and the North Diversion Channel discharge. The drop in DO relates to the flows in the North Diversion Channel; flows in the North Diversion Channel are followed by a subsequent spike in the Rio Grande, and then DO drops. What did we do? The USGS installed DO monitors in the pilot channel to start watching the pilot channel better. We installed a new DO monitor just upstream of the diversion channel because we wanted to see what was coming down the river; there are no gauges upstream. Then we did what all good engineers do, we did a study. A project to look at storm water quality facilities in the North Diversion Channel was actually in the works at the time. We broadened the project and included a big component to look at the Van Horn data and what was going on with DO.

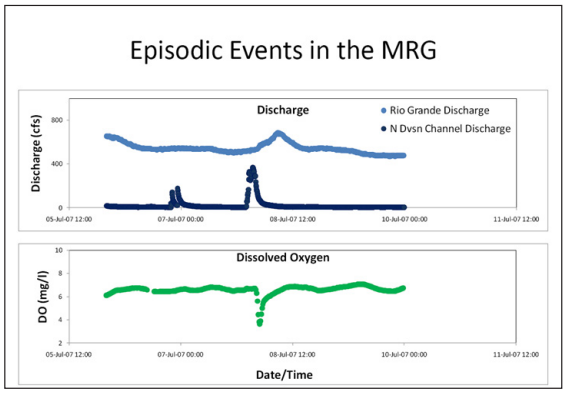

Figure 26. Van Horn Study

First we looked at the diversion channel and confirmed our storm water was full of oxygen, as it should be, as it rushes down the arroyo through drop inlets. Sure enough, the data shows DO at about 5 parts per million (Fig. 27). We looked at the embayment area again. The graph in Figure 28 provides the USGS results. You will note that we are all over the place with DO above 5, below 5. We then looked at the profile of the embayment area. Figure 29 provides the measured dissolved oxygen concentration; the top line reflects the top 18 inches of the pilot channel as we move through the channel from the river upstream and the lower line is the lower 18 inches. The lower 18 inches is deficient in DO. That's when we realized we did have a problem in the embayment.

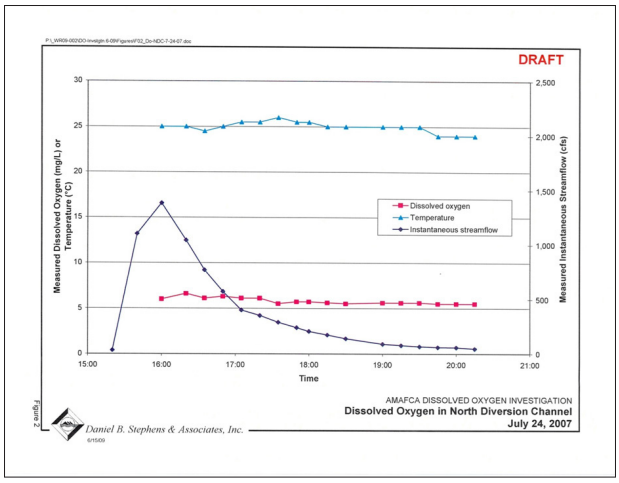

Figure 27. Dissolved Oxygen in North Diversion Channel July 24, 2007

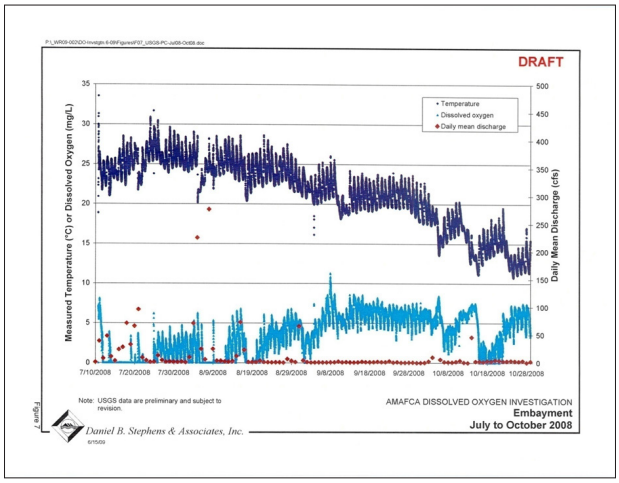

Figure 28. Embayment July to October 2008

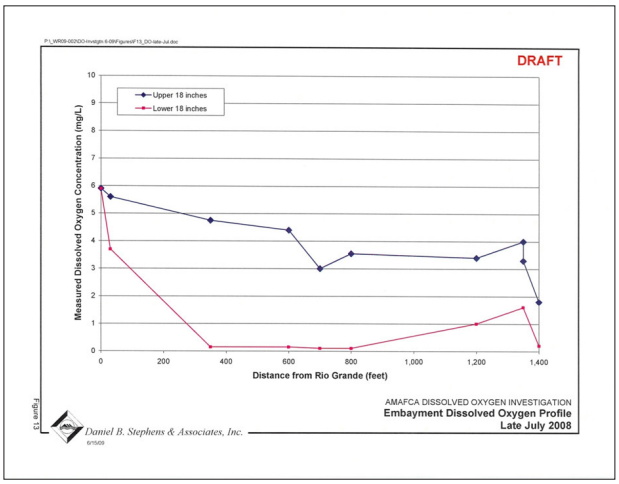

Figure 29. Embayment Dissolved Oxygen Profile Late July 2008

We looked again at the provisional water quality data from Van Horn (Fig. 30). The stream flow in the Rio Grande is the dark line and stream flow in the diversion channel is the lighter line. It's easy to see the response here. Following a storm, the diversion channel spikes followed by a spike at the Rio Grande at Alameda shortly after. You can see the data from a couple other storms that occurred over a five-day period. These results are what Van Horn found. But let's look at the next storm as shown in Figure 31. After the first storm, the DO dropped. We look at the second storm and the DO drops but there is no flow in the North Channel so something else is causing the sag and it is not necessarily the North Diversion Channel. Since Van Horn used 4-way probes, we looked at specific conductance as an indicator of salt in storm water. It should show up high from a natural arroyo system like the Jemez watershed, and it would be low for storm water in an embayment; rainfall has very low specific conductance. Look at Figure 32; you have a flow in the North Diversion Channel, with all that nice clean rainwater running down, and the specific conductance does drop (7/27/06). If we look over at the next storm, the specific conductance spiked (7/28/10), and that is the indicator that we had something coming down from upstream. We don't know if it was wash from the Jemez because we haven't checked or had gauges on those. Could it be from the Montoya's? Could it be from Rio Rancho?

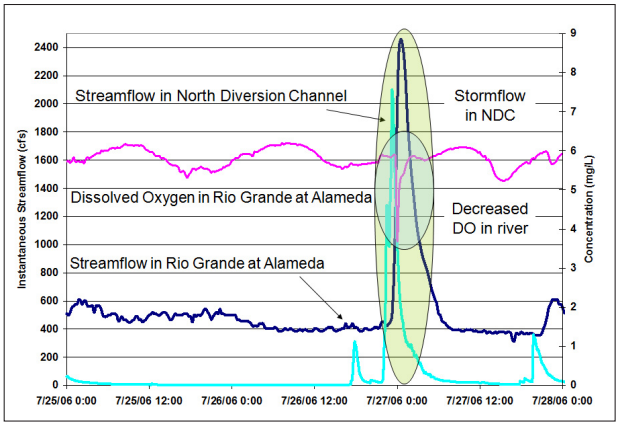

Figure 30.

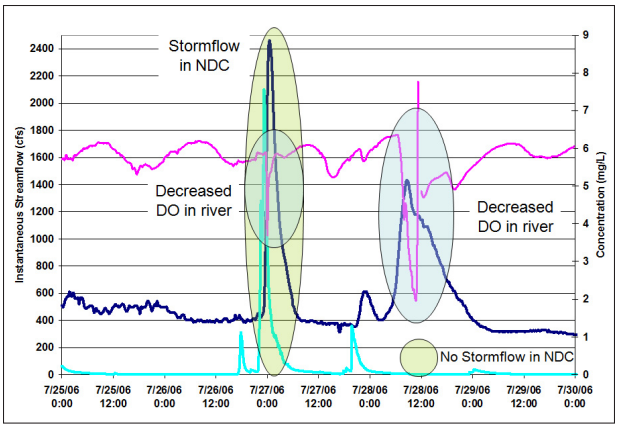

Figure 31.

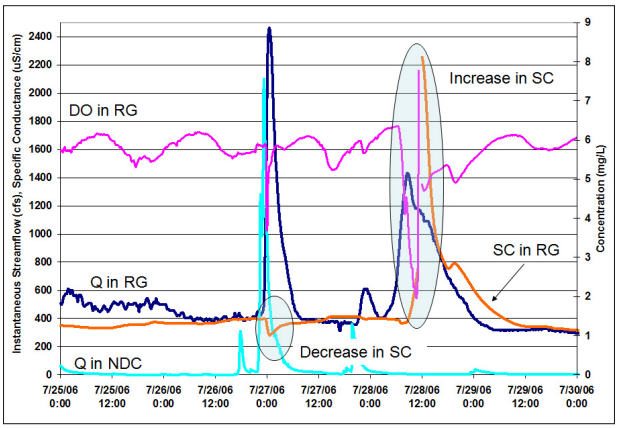

Figure 32.

So what have we done without more information? For one, we have engaged Van Horn to QAQC data so that we have a better validity in front of us and NMED. We have also worked with the Southern Sandoval County Arroyo Flood Control Authority and we have installed four continuous reading probes up at US 550, North Diversion Channel, at Alameda and at Rio Bravo. These probes are being monitored by the USGS and being paid for by AMAFCA and SSCAFCA. We hope that with better baseline data of QAQC/USGS data, we can get a better handle on what's causing DO sags in the river.

So what are we doing with the embayment given our issue of a sink of standing water that is causing sags? D.B. Stephens is looking at a few options; one is to bring a circulation channel through the Bosque and down through the pilot channel to keep circulation going there. The trouble is that the channel would have to be dug out deep enough to provide circulation at Rio Grande flows of 400-500 cfs. We have looked at mechanical aeration and also looked at filling it in. The real constraint is having the equipment crossing – that is what sets up the hydraulic control for the whole outfall. So we are looking at potentially filling in the upper two-thirds of that channel and leaving enough of the embayment area open so that it is naturally circulated from the river flow. We are looking at those possibilities right now and we have some permitting issues to work through. Hopefully we'll bring a project online in a year or so.

Let me finish here with another thought. AMAFCA's former mission was to "build flood control dams to where people won't get flooded." I like to tell people that we now are dealing with a diversion channel system that was designed in the 1950s, built in the 1960s, and designed with that hydraulic efficiency parameter foremost. The channel runs through the sovereign nation of Sandia Pueblo, through the critical habitat of two endangered species, and into the Rio Grande above the City's Drinking Water Project Diversion Dam. We are not in the flood control business anymore. One last thought: The ABCWUA Drinking Water Project Diversion Dam is 2¼ miles downstream from the North Diversion Channel Outfall.

Thank you.

NMED's Approach to Aquifer Storage and Recovery—Water Quality Issues

Robert George, New Mexico Environment Department

Robert is the Domestic Waste Team Leader of the New Mexico Environment Department Ground Water Quality Bureau where he coordinates the Bureau's permitting of domestic waste discharges, including wastewater irrigation reuse and aquifer recharge projects. Robert has over 20 years of experience in the fields of water supply and wastewater treatment, and has provided technical assistance to many of New Mexico's water and wastewater utilities. He is certified by the NM Water Quality Control Commission as a Level IV water and wastewater utility operator and holds an AAS in water utility operation.

I promise to keep my presentation relatively short this morning. I only prepared for 15 minutes, which I assumed was reflective of the interest level for a talk on regulations. This is really a breeze-through of where the Environment Department (NMED) is at with respect to aquifer storage and recovery, or aquifer recharge as we like to call it. It is intended for a fairly general audience so if I bore you, I apologize.

We are going to talk about the benefits of ASR, the water quality regulations as they pertain to it in New Mexico, and how NMED sees ASR proceeding. I will concentrate the most time on development in New Mexico. So let's talk about the benefits of ASR.

I hope everybody understands when I use the term ASR I am talking about aquifer storage and recovery, which is a technology that has been emergent for a number of years now, offering tremendous benefits for the replenishment of aquifers and for the storage of available surplus water. The ability to store surplus supplies in an aquifer for later recovery has a tremendous benefit in the West, potentially taking advantage of wet water supplies when water is actually there and banking it so that it is available in times when we need it. The source waters could come from a number of places including: surface water supplies (treated or untreated), potable water, or industrial wastewaters. The source may be reclaimed domestic wastewater, which is where I think a lot of the interest is. Reclaimed wastewater is a source in New Mexico that is being used increasingly for irrigation and other reuse applications in what NMED refers to as "above ground reuse." Aquifer storage and recovery using reclaimed wastewater has not yet started New Mexico, but we certainly anticipate it over the next few years.

The large storage capacity of aquifers is a great advantage and why people are interested in ASR. With such a tremendous ability to eliminate evaporative losses, this really represents a new management tool we haven't had before. From the quality standpoint, there is a significant advantage in having an environmental barrier in place to mitigate direct effects and provide additional

treatment and dilution. In ASR, the aquifer storage element represents this environmental barrier. It is becoming increasingly clear that under most circumstances, allowing recharged water to reside in the aquifer for extended periods offers water quality benefits. The overall benefit is most profound when considering unregulated contaminants (microconstituents) that are typical of reclaimed wastewater.

Let's talk about some of the downsides of ASR. There is an element to ASR that can be fairly energy-intensive. Particularly if you are pumping large quantities of water underground, the cost can be considerable compared to the alternatives (lakes and more traditional storage methods). It is not suitable for all formations and we can't do this everywhere. The formation must be well matched to storage and recovery of the water. There are many aquifers in New Mexico that are suitable and others that are not. There is at least the potential for leeching of contaminants as recharge water moves into areas that have not been previously saturated. This problem has been encountered at ASR projects in other states, although leaching often seems to be a relatively short-term effect, as one might expect. From a regulatory standpoint, a short-term leaching effect is a little confounding because the rules are written in such a way that you can't cause an exceedance of a standard. A leeching effect might be short-term and cause only a very localized problem. NMED has had to wrestle with devising effective regulatory strategies to deal with leaching effects that don't create a unnecessary barrier to ASR but that ensure that a system is protective of groundwater quality overall.

The technology used for ASR ranges from the simplest infiltration system, (you could view a septic tank leachfield system as a form of aquifer recharge) to complex multiple direct injection well systems. Simple infiltration systems that rely upon vadose zone treatment are going to play a large role in ASR in New Mexico, but there are also some fairly exotic approaches such as direct injection wells that introduce recharge water into the saturated zone. When using reclaiming domestic wastewater as the source, a very high level of treatment becomes necessary and this naturally increases the complications. NMED does expect that vadose zone treatment will be an element of infiltrative ASR projects here, but how to characterize the vadose zone treatment has not yet been established.

When the NMED Ground Water Quality Bureau (GWQB) issues a permit for a discharge that represents disposal, the standards in groundwater that must be protected are the standards set forth in 20.6.2.3103 NMAC. However, discharge permits issued for ASR projects will have to meet a higher standard of protection. This will involve protection to both the standards set forth in 20.6.2.3103 and to the state primary drinking water standards. The regulatory basis for this stems from the Underground Injection Control section in the Water Quality Control Commission Regulations (Section 20.6.2.5000 NMAC). GWQB is also focused on the control of pathogens for a variety of source waters and is concerned that the level of emergent (unregulated) contaminants at least be monitored.

Our current projects in development include:

- ABCWUA Bear Canyon Demonstration (operational)
- ABCWUA Large Scale Aquifer Recharge
- Rio Rancho Direct Injection
- Rio Rancho Mariposa Infiltration
- Rancho Viejo Development (SF County)

The Rio Rancho Direct Injection project features include a pilot project using potable water; the ultimate source water will be highly treated reclaimed wastewater; ongoing permitting with be with OSE, NMED, and EPA; and advanced water treatment methods will be explored (Fig. 1).

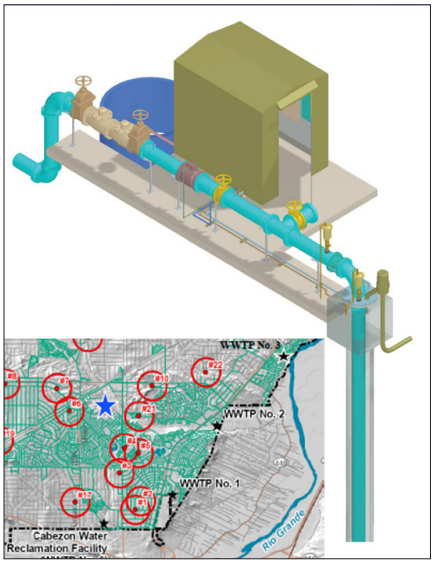

Figure 1. Rio Rancho Direct Injection

The Mariposa WRF Recharge System (Fig. 2) will use a reclaimed wastewater source and will include vadose zone treatment.

Thank you.

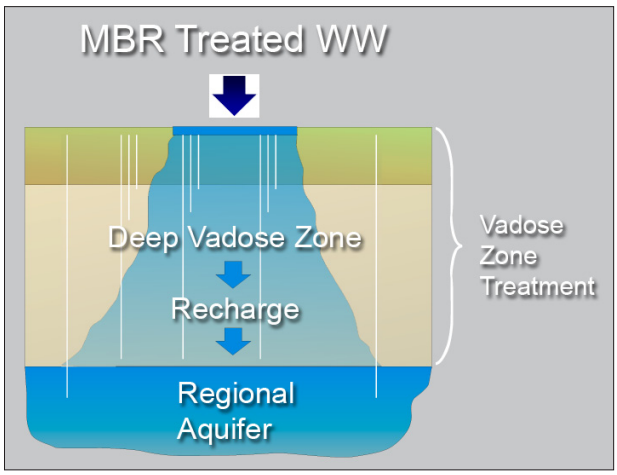

Figure 2. Mariposa WRF Recharge System

The Future of New Mexico's Deep Water

John R. D'Antonio Jr., New Mexico State Engineer

John, New Mexico State Engineer, is a registered professional engineer in New Mexico and Colorado, and has experience in hydraulic design, acequia rehabilitation, water resource management, and water policy development. Before he was appointed by Governor Bill Richardson to the state's chief water post, John was Cabinet Secretary of the New Mexico Environment Department in 2002. He served as the Director of the Water Resource Allocation Program for the Office of the State Engineer from 2001 to 2002 and served as the District I Supervisor in Albuquerque from 1998 to 2001. For 15 years, John worked with the U.S. Army Corps of Engineers as a hydraulic design engineer, as the Chief of the Hydrology, Hydraulics, Sedimentation, and Floodplain Management Program, and was the project manager for the Acequia Rehabilitation Program. A native New Mexican, John received a bachelor's degree in civil engineering from the University of New Mexico in 1979. He has been a member of the Governor's Blue Ribbon Task Force on Water Issues from 1998 to the present. In his post as State Engineer, John is the Secretary of the Interstate Stream Commission, Chairman of the Water Trust Board, Governor's Water Infrastructure Investment Team, and the Governor's Drought Task Force. He is also the New Mexico Commissioner to the Rio Grande, Costilla, and Upper Colorado river compacts.

Good morning. This is the best conference that I attend on a year-to-year basis. I think I have been speaking since 1998 off and on and the last few years pretty consistently. Today I am going to talk about the future of New Mexico's deep water. I'll provide an introduction, history, legislation, talk a bit about the state engineer's administrative procedures, Notices of Intent that have been filed – and there have been a number of those – technical considerations, our deep basin boundaries, and where we go from here.

A nonpotable deep aquifer is defined in 72-12-25 NMSA that was revised and amended during the 2009 legislature: nonpotable water has total dissolved solids greater than 1,000 ppm; and it must be deep – the top of the aquifer has to be at a depth of 2,500 feet or greater at any location at which a well is drilled; and the aquifer can only contain nonpotable water.

Let's talk a little bit about its history. Nonpotable deep well statutes were signed into law in 1967. Back then the driving force for the passage of statutes 72-12-25 through 28 was the oil and gas industry. Oil and gas operators in the southeastern part of the state in the Capitan Reef were concerned that they would be pulled into the Pecos Compact and that's the reason the laws were passed. In 1997, the first deep well was drilled under the statutes by Midway Ranch Ltd. in the Rio Puerco area west of Albuquerque.

Just this past year House Bill 19 amended section 72-12-25 to extend the state engineer's jurisdiction to non-exempt uses within declared nonpotable deep basins; the exempt uses are oil and gas, prospecting, mining, road construction, agriculture, electrical generation, industrial process, and geothermal uses. The amended legislation is only a page and a half and I want to read from section 1: "Declaration of a Basin -- Nonpotable Deep Aquifers - an undeclared deep water basin having reasonably ascertainable boundaries" –

which is a key phrase – "that consists of an aquifer, the top of which has a depth of 2,500 ft or more below the ground surface at any location at which a well is drilled, and which aquifer contains only nonpotable water, is subject to state engineer administration in accordance with section 72-12-25 through 72-12-28" and part B of that is "if the state engineer declares the type of the groundwater basin described in subsection A of this section, all appropriations of nonpotable water for…" – and it goes on to list several exclusions that I just mentioned.

House Bill 19 was passed during the 2009 Legislature and amends Section 72-12-25 NMSU 1978, removing certain limitations in existing law for the state engineer to administer deep nonpotable groundwater; it requires the state engineer to declare the basin; requires that the aquifer top is 2,500 feet below the ground surface; requires a water quality TDS greater than 1,000 ppm; and it is limited to municipal use. We haven't decided how we are going to declare those underground deep water basins yet. The other issue concerns the TDS greater than 1000 ppm.

Concerning our procedures and Notices of Intent, Table 1 (see end of paper) is a spreadsheet tracking notices filed as of April 29 of this year. The table reports the Notices of Intent, the date filed, the file number, number of wells, application, quantity of water, depth, and the number of wells that actually have been drilled. The summary at the bottom of the table indicates that notices were filed for appropriating 1.7 million ac-ft of brackish water annually and that wells vary from 2,500 to 12,000 feet in depth. The table indicates that only seven wells have been drilled, two of them are actually oil and gas wells. You'll note from the table the well completion dates and the county in which they reside. The first filing was in 1997 by Midway Ranch, Ltd. Some were filed in 2006, one in 2007, many in 2008, and as we started the 2009 legislative session, there were many filings. You'll also note from the table that in some instances, like the one with a filing for a quantity of 110,000 ac-ft, many are very speculative; the intent was to put a claim in with respect to those deep water sources. By the time the session was over, the last day in March, there were 607 proposed wells for over 1.7 million ac-ft/yr.

Figure 1 is our Notices of Intent map. The map is interesting as you can see that most notices for wells filed are near New Mexico population centers with the majority of the activity in the Middle Rio Grande. As you go up to the San Juan Basin there have been some filings, some around the Santa Fe area, Curry County, and Portales. The map's legend lists all the particular basins and the notices that have been filed. We have a few down in the Salt Basin, some around Tularosa and the Las Cruces area, and some in Lea County. So there is a statewide dispersion of filings but the vast majority are in the Middle Rio Grande area.

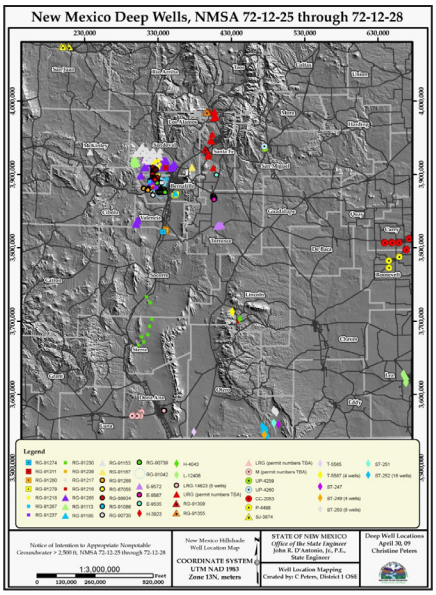

Figure 1. New Mexico Deep Wells, NMSA 72-12-25 through 72-12-28

For comparison and so that you can understand the magnitude of the numbers: the City of Albuquerque uses about 100,000 ac-ft/yr of groundwater, Las Cruces uses 18,500 ac-ft/yr, Rio Rancho uses 11,000 ac-ft/yr, City of Santa Fe uses about 10,000 ac-ft/yr, and statewide we use about 4 million ac-ft/yr, of which about 47 percent is groundwater, which is about 1.9 million ac-ft of water. The Rio Grande flow at Otowi is about 1 million ac-ft/yr. You can see the magnitude of these notices if they were all to come to fruition.

The challenges of deep well legislation include the many Notices of Intent filed for a lot of water. What is the legal significance of these Notices of Intent? Are they Notices of Intent to drill or to appropriate? Regarding the requirement for the state engineer to declare a basin – do we look at those of which there are about 39 or 40 existing basins or do we consider fewer basins defined as structural basins, and based on hydrogeologic knowledge? We have those concerns and we must develop a strategy for proceeding.

Current OSE administrative procedures require interested parties to submit a Notice of Intent before you drill, an exploratory permit application – and all wells need to be completed to artesian well specifications – and publication of a notice in the newspaper with an affidavit. After drilling, you must submit well records, water quality results, and meter readings on a quarterly basis. Although these are not permits with conditions, there are still requirements.

Looking at administrative procedures in the future, within the OSE Declared Deep Groundwater Basins, unless you qualify as an exempt party, you file a normal application to appropriate under the 72-12-3 statute, which is the statute you use for a water right appropriation. The exempt uses as mentioned earlier include: oil and gas exploration and production, prospecting, mining, road construction, agriculture, generation of electricity, use in industrial processes, or geothermal use. Which basically leaves municipal use as the only non-exempted use.

Concerning technical considerations; right now to be qualified under nonpotable deep well statutes, certain aquifer criteria must be met for depth, nonpotability, and hydraulic separation from the overlying aquifers. Statute 72-12-27 allows the New Mexico OSE to require submittal of pertinent data, and ongoing submittal on a quarterly basis for metered withdrawals and water chemistry. Wells must be constructed by New Mexico licensed well drillers from the surface to a depth that is appreciably into the first confining layer encountered below 2,500 ft. Figure 2 shows a geolograph on one of the Rio West rigs capable of recording penetration rate, weight of drill string, depth, and time. This machine helps indicate when the bit is worn and when to make replacement decisions.

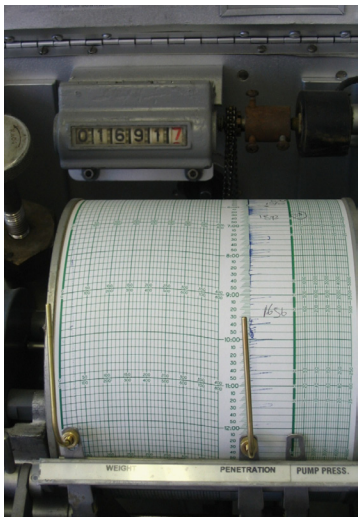

Figure 2. Technical Considerations for Deep Wells

The definition of an aquifer is a geologic formation, part of a formation, or group of formations capable of storing and transmitting water in economic quantities to wells. The information from previous deep drilling is important; we look at the logs of oil tests and sometimes that is the only information that is available. We also look at geologic maps and cross-sections. During and after deep well drilling, information obtained from various logs is used to determine top of aquifer and casing set depth. Logs are typically used in concert to interpret lithostratigraphic relationships. Hydrogeology at depth is typically unknown, so top of aquifer must be defined by stratigraphic contact. Well logs are required to demonstrate depth at which the casing is set and that a confining layer extending to below 2,500 ft overlies the deep aquifer.

Figure 3 is a cross section using information from oil test wells. This example is a plan view of the Rio West wells. We are looking down on the west basin and you will see the A to A' line, which is represented by this cross-sectional phase. We have information from some oil wells in the area that have been drilled about 10 miles apart but the information is still pretty sparse. With the distance being so far apart between data points, we have a lot of unknowns as we proceed forward.

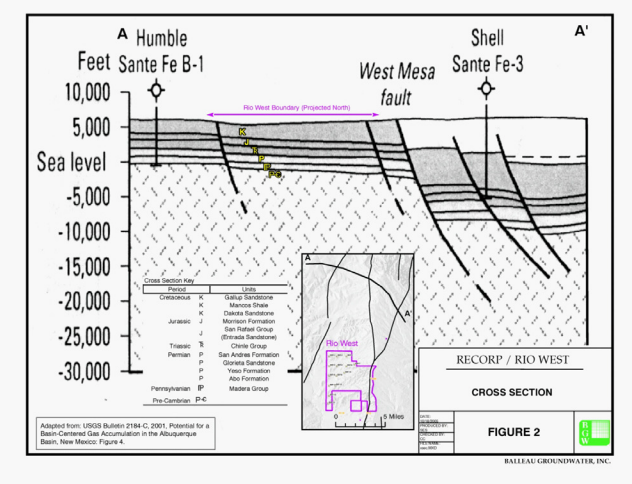

Figure 3. Information from Other Wells

Geologic maps and subsurface pre-drilling information is generally scanty and uncertain as to geology and depth, and the drilling process becomes a "wildcat" operation when trying to determine where the best place is to drill.

Figure 4 shows sample pages from a mud log with lithological cuttings and descriptions from Rio West Exploratory Well No. 6. This log showed a 1,500 ft shale confining sequence above the top of the sandstone/limestone aquifer starting at about 3,500 ft below ground. You can see the depth of 3,500 ft and as you go down, (referring to graph) the depth is increasing and you have a water producing zone in that particular area. Figure 5 is the last page of the mud log for that exploratory well and it also illustrates a well completion diagram. You can see where the cement goes down and cases the well; this is the well screen area, which is where the water would essentially come from after well completion.

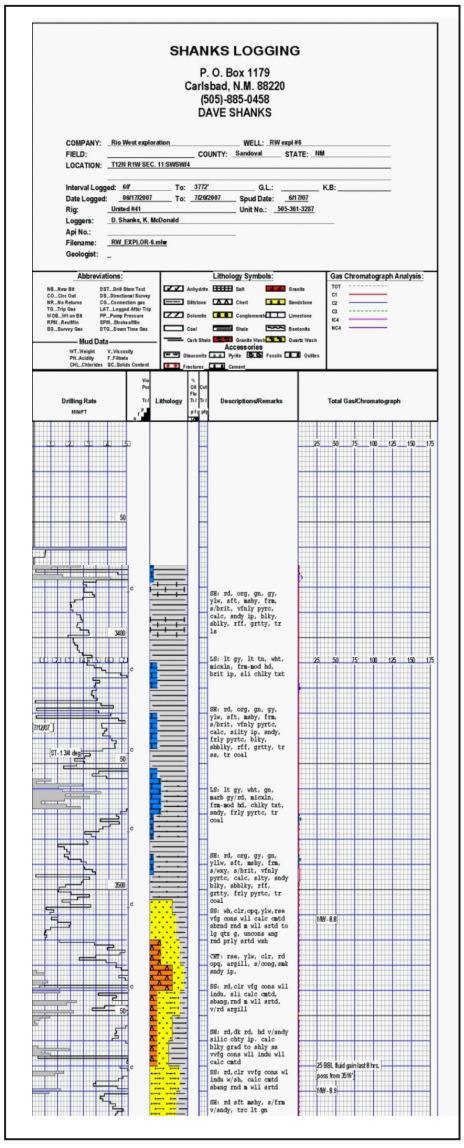

Figure 4. Drilling Mud Log & Lithologic Log

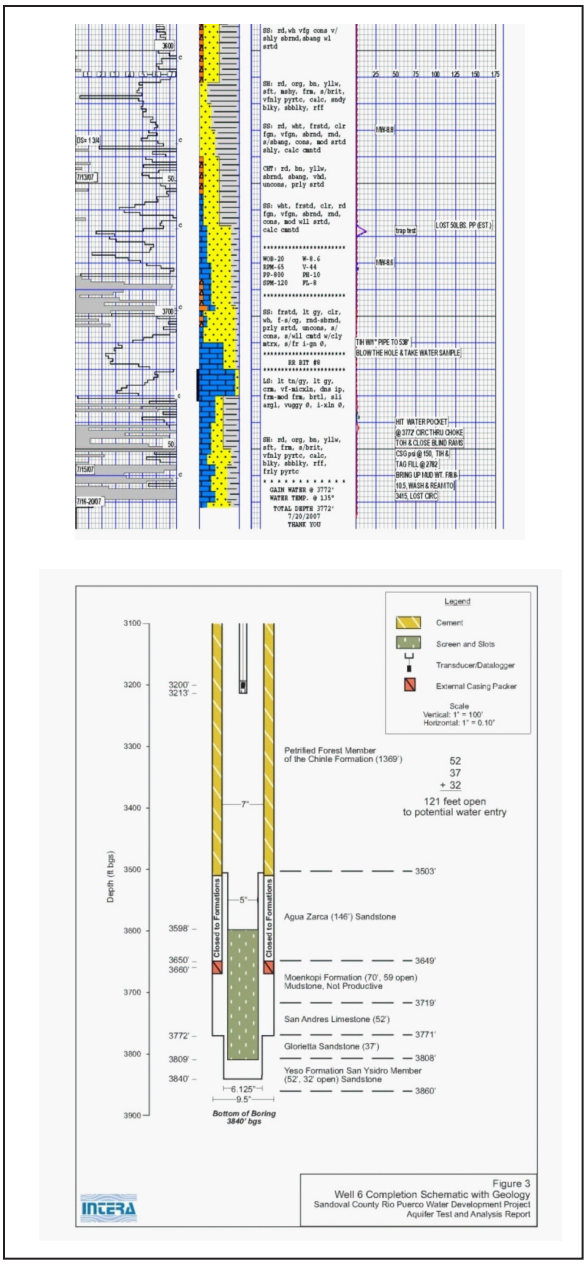

Figure 5. Well Completion Tapping Deep Aquifer

Water chemistry is important. Sampling typically follows completion of well construction, development, and test-pumping. Samples are analyzed by a certified laboratory for common cations and anions as part of a complete water chemistry analysis. This helps to identify the gross chemical make-up of the deep water. Specific analyses are done for radionuclides, arsenic, and other parameters of interest that may be requested in anticipation of cooperative agency concerns regarding use and treatment of well water as well as disposition of waste streams. The additional

analysis may also aid in establishing the hydraulic separation of the aquifer. Quarterly sampling and reporting of total dissolved solid levels as specified in statute 72-12-27 will be required once appropriations from the well actually start.

Brackish and saline water is defined as mildly brackish if the quality of water, the TDS level, is between 1,000 to 5,000 ml/L. The El Paso plant is using water with a TDS level between 1,000 and 4,000 ppm, which is pretty good quality water. We are seeing moderately brackish water wells on the west side of Albuquerque, those with 5,000 to 15,000 mg/L. Heavily brackish water contains 15,000 to 35,000 mg/L, while seawater and brine water contains greater than 35,000 mg/L.

In order to demonstrate that the deep aquifer contains only nonpotable water as required by 72-12-25, two things are necessary: 1) demonstration that representative samples of water from the aquifer at the location of the constructed deep well have TDS levels greater than 1,000 ppm and 2) demonstration that the aquifer is hydraulically disconnected from the overlying aquifers or surface water. Hydraulic separation means that the aquifer cannot have a hydraulic connection with overlying freshwater aquifers or surface water. Demonstration of aquifer separation would be supplied at the time the Notice of Intent to drill the well to appropriate nonpotable deep water is filed. Many lines of evidence may be considered to make the judgment as to the degree of hydraulic separation from other sources under OSE jurisdiction. As with the top of aquifer determination, these would be considered together. Figure 6 depicts the map and cross section showing the possible extent of the San Andres/Glorieta aquifer and fault displacement in the Rio West area. As you can see, we get into a lot of complexities when we are dealing with deep groundwater.

The well construction requirements specify that all deep wells will be considered artesian and will be required to meet the artesian specifications in the regulations. Following well construction, the well driller has 20 days in which to submit the well record. The OSE may require representative drill cuttings to be archived with the New Mexico Bureau of Geology and Mineral Resources core and cuttings archive.

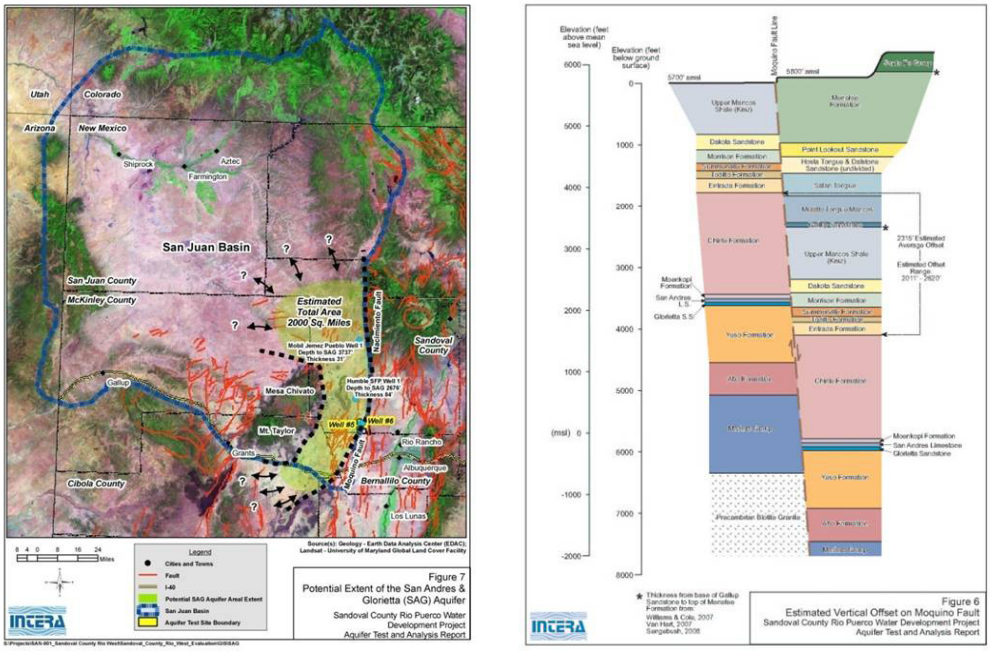

Figure 6. Map and Cross Section Showing the Possible Extent of San Andres/Glorieta Aquifer and Fault Displacement in the Rio West Area

A Plan of Operations must be submitted to the OSE but there is no filing fee associated with this. The plan contains general information on well ownership, well drillers, and well locations. As you move forward with the process, an exploratory well is drilled. Figure 7 shows the drilling of the Rio West well #6. The drill casing is staged at the right. The mud pit is beyond the rig in this photo. Figure 8 shows the trucks on site for cementing; the cement, interestingly enough, is dry and is mixed on site. Figure 9 shows the drilling mud being displaced out of the annulus by cement pumped into the casing. The mud pit was used only for waste on this job. Fresh drilling mud was added from surface tanks. Figure 10 shows that the Hubbard deep well was initially drilled on air/foam. Enough groundwater was discharged during drilling through the shallower strata that temporary effects to water levels in neighboring shallow wells were observed. The shallow aquifers penetrated by the deep well were cased and sealed off prior to drilling into the deep nonpotable aquifer.

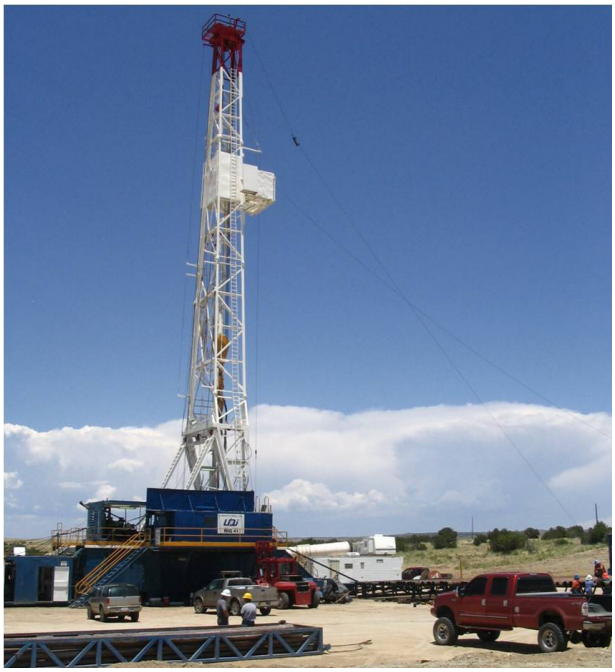

Figure 7. Drilling of the Rio West Well #6

Figure 8. Trucks on Well Site for Drilling

Figure 9. Drilling Muds being Displaced out of the Annulus

Figure 10. Hubbard Deep Well Initially Drilled on Air/ Form

Figure 11a is an interesting picture. The photo was taken in Dubai of the Burj Dubai, the world's tallest structure at 2,684 ft. The minimum length of our pipes is 2,500 ft (Figure 11b), so you can see how much pipe we are putting down into the ground. When put to scale, you can see that it is an enormous undertaking. In accordance with New Mexico regulations governing construction of artesian wells, the casing must be inspected by a representative of the OSE prior to installation and must meet API specifications or OSE approval. Figure 12 shows one of our onsite inspectors measuring casing wall thickness. Regulations require casing, cementing, plugging, and testing of artesian wells to be witnessed by an OSE representative. Note the threaded and coupled casing. Regulations specify the inside and outside diameter of the artesian casing and the number of threads per inch on threaded casing. Regulations also require the casing to be centered in the borehole. Typically this is done by using casing centralizers, installed at specified intervals along the casing to stand the casing back from the borehole wall. This allows cement to better surround the casing.

Figure 11a. The Burj Dubai, the World's Tallest Structure at 2,684 ft

Figure 11b. The Minimum Length of OSE Pipes Put in the Ground is 2,500 ft

Figure 12. An On-Site OSE Inspector Measuring Casing Wall Thickness

Figure 13 is a good photo of the cementing head. The wiper plug is in the head between the two lateral pipes. Cement is pumped through the lower pipe until the supply is exhausted, then the drill mud is pumped through the upper pipe, displacing the wiper plug downward. Figure 14 shows the cementing shoe that gets attached at or near the bottom of the casing. The wiper plug gets lodged into the opening, and the mud column behind (above) the plug gets shut inside the casing under pressure. Figure 15 depicts the activities on the mixer truck. Cement grout is sampled at the vortex mixer on the left. The control panel is monitored, and the mix is adjusted from the panel, including water, cement, and additives. Figure 16 shows grey cement starting to emerge from the annulus – some reddish mud is still visible. More cementing is necessary to achieve quality cement throughout the annulus. Another control on cementing is the wellhead safety. Figure 17 shows workers attaching the blowout preventer to the casing. And lastly, a pressure gage is used during pressure testing of the well casing to make sure there is a good seal. That is the last step in the OSE artesian well inspection process.

Figure 13. Photo of the Cementing Head.

Figure 14. Cementing Shoe

Figure 15. Activities on the Mixer Truck

Figure 16. Gray Cement Starting to Emerge from the Annulus

Figure 17. Attaching of the Blowout Preventer to the Casing

Regarding the proposed deep basin boundaries, we are referring to "reasonable ascertainable boundaries." When we look at hydrogeologic principles, we use existing knowledge; the geology and structure is also important but it is not the only factor; and there are major regional hydrologic divides between surface water and shallow groundwater that usually bound the deep basins. Figure 18 shows New Mexico's 39 groundwater basins, 40 if you separate the northern Rio Grande from the Middle Rio Grande, and where nonpotable groundwater may be found based on geophysical and well log data. We estimate that about 75 percent of the state may have nonpotable groundwater. Where shallow groundwater is nonpotable, deeper aquifers are also likely to contain nonpotable water. On the map, you can see the boundaries in yellow. The shallow groundwater flow regimes are the best available guide for delineating the groundwater flow regimes. The hydrologic connection between the deep aquifers and surface water or shallow groundwater is a matter of degree. It could be argued that most of the water, even though it is deep groundwater, it has a connection of some sort to an upper aquifer. The basin-fill aquifers already are underground water basins; the top of the aquifers is essentially a water table.

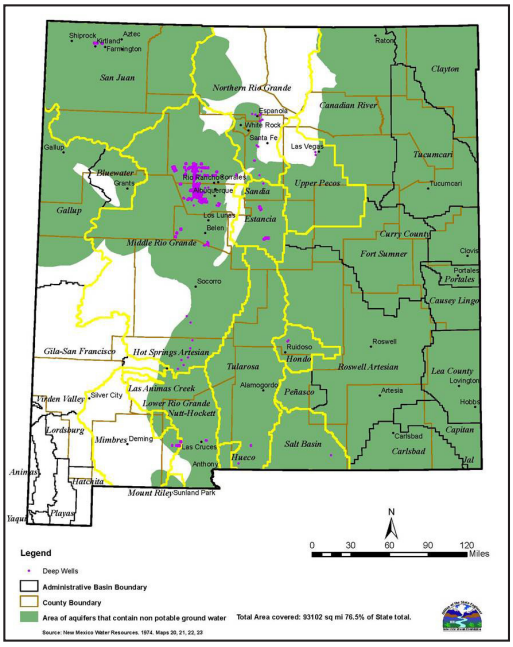

Figure 18. New Mexico's 39 Groundwater Basins

Figure 19's legend indicates the major aquifers: those in red are not considered major aquifers; the green are Basin and Range aquifers; and so on. You can see where our deep well Notices of Intent have been filed, a majority in the Middle Rio Grande. The map also indicates the proposed deep basin boundaries that OSE is looking at. This is a draft map and still a work in progress.

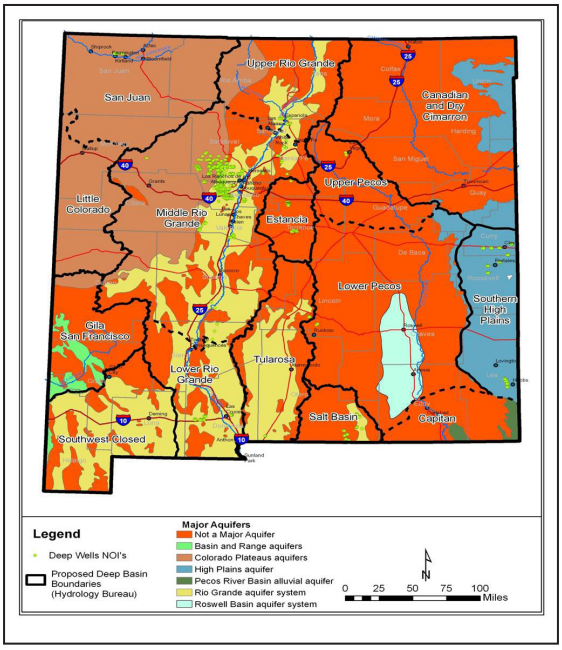

Figure 19. Legend of Major Aquifers.

Figure 20 provides some additional overlays looking at water level elevations with our proposed deep well basins. They are based primarily on regional hydrogeologic divides that generally coincide with the major rivers and stream systems within the state such as the Rio Grande, the Pecos, the Colorado, and Canadian. This is to ensure that we are looking at a strict interaction between surface and groundwater. The boundaries track declared underground basin boundaries and shallow groundwater contours relatively well. Topographic divides are modified where the hydrogeology indicates. An example is the southwest boundary of the Lower Rio Grande. The southwest corner of the state is really a groundwater basin. Going back to the 39 or 40 existing groundwater basins that we have already declared, and to meet the letter of the statute, we would have to declare deep underground water basins for all 40 declared basins. Preliminarily, we are looking at most 15 deep underground water basins with our hydrology bureaus input. I want to thank Mike Johnson the Hydrology Bureau Chief who has done a lot of work on this for the OSE. We continue to look at potential deep basin boundaries and at closed surface water sub-basins. Examples would be the San Augustine and Jornada sub-basins to be included with the dominant surface water system. If you look at the San Augustine Plains, they have been included in the Middle Rio Grande basin and the Jornada is in the Lower Rio Grande basin. We are connecting those two major water basins for administrative purposes. For the administrative division of major basins, sometimes we need to make those a little more convenient for our internal processes and our WATERS database. Thus the closed groundwater basins are declared as separate entities and still maintain protection of mined shallow groundwater. We look at those groundwater basins where we strictly have groundwater mining. In the Estancia Basin, the High Plains aquifer, and the Tularosa area, we really just have groundwater basins without surface water interactions and connections.

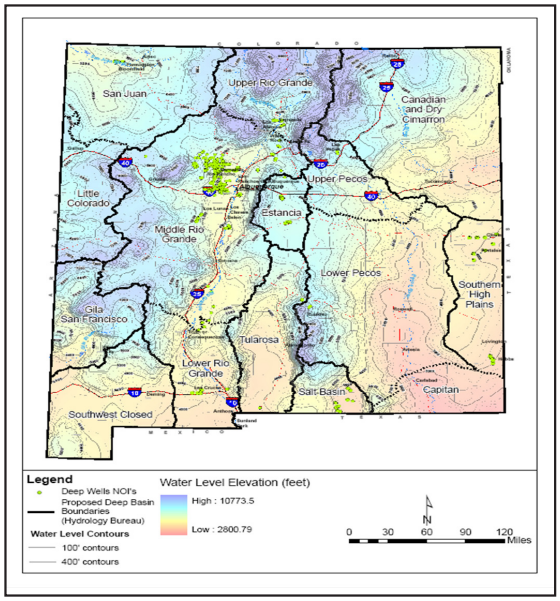

Figure 20. Additional Overlays Look at Water Level Elevations with OSE Proposed Deep Well Basins

We have many administrative concerns which include 1) protection of existing water rights of surface water and shallow groundwater and meeting interstate compact flows; 2) locations of existing Notices of Intent, which are being considered on a case-by-case basis; 3) optimizing

the public's understanding of the process once it is determined; and 4) the fact that deep aquifers may cross boundaries in certain areas like the San Juan and the Middle Rio Grande.

The important part of this presentation and the big question really is whether there is a hydraulic connection. Right now with OSE's deep basin administration, we can actually assume that all surface water is connected to the shallow groundwater, which in that case would mean that it is subject to OSE jurisdiction. If the sources are connected, there is no evidence to support the declaration of a separate aquifer. Thus, as per the law that was amended (72-12-25 as amended in 2009), we could decide not to declare groundwater basins in certain areas of the state. The OSE could reject applications for new appropriations under 72-12-3. In other words, in a fully appropriated surface water basin that is considered connected to the groundwater, then there are no new appropriations and we could reject applications on that basis. We could also reject Notices of Intent to drill, which are submitted pursuant to that same law that was amended. Again, if there are not two distinct aquifers, shallow and deep, then this statute does not apply, and we could reject those applications.

If there is a hydrologic connection, effects could be calculated and compared to reasonably conservative thresholds. There is a procedure that has been used in Colorado for what they call non-tributary groundwater. In 1985, Colorado's Senate Bill 5 provided a framework to guide the appropriation of groundwater in the Denver basin – if you are familiar with the Denver basin, you know there is a layered aquifer system consisting of four stacked layers that are all producing groundwater. These are separated and confined basins, and as you go below the four layers, there is another source of deep water. In 1986, the Colorado State Engineer adopted rules to carry out the provisions of that Act. The definition of non-tributary is that the measured effect on the surface water system must be below a statutory threshold for the groundwater in that location. Non-tributary groundwater may be used without developing a plan for mitigating effects to the surface water system; which means if it isn't considered tributary, you can pump that water, use it, and you will not affect the surface water supply due to an allowable threshold. The threshold in this particular case limits annual withdrawals to 1 percent of the amount of water that underlies the owned land. So if you look below the four layers into the deep aquifer knowing the area of the owned land and an estimate of the depth of aquifer below the 4 layers, you can calculate a volume. If you can stay within 1 percent extraction of that volume per year, you essentially have a 100-year water supply and staying below that threshold, you are able to use that water without having to offset the effects on the surface water supply. This is an interesting scenario and it is not uncommon with what we do with groundwater basins, such as critical management areas, where we limit the amount of water we take from those basins. Interestingly, there has only been a handful of these deep wells drilled so far. The deep wells in the Hondo basin (Hideout Wells) require offsets for projects that exceed thresholds. We are still in our infancy in establishing thresholds but quite frankly, it makes sense to say there are hydrologic connections and we need to account for cumulative effects.

Prior to 2009, the statute lacked clarity. An offshoot of this was that the State Engineer could recognize the right to drill a well and put water to beneficial use within a reasonable period of time pursuant to Notices of Intent that had been filed and published prior to the 2009 amendments. Also, if major surface water basins are determined to be hydraulically connected, that would leave only a few groundwater basins that could be declared as deep basins. I want to caution you that the shallow groundwater could also be hydraulically connected to the deeper groundwater in certain areas.

Our next steps Include: 1) declaring nonpotable deep water aquifers if technically defensible; 2) determining the legal significance of the Notices of Intent filed and published prior to 2009 (are they actually Notices to Drill or are they Notices to Appropriate?); 3) formalize procedures for filing applications to appropriate water from deep aquifers; 4) formalizing procedures to manage drilling and reporting of deep wells; 5) setting a well-defined process to facilitate development of deep nonpotable resources while protecting water rights and compacts; and 6) recognizing that the economics of development will limit irrational exuberance in using deep aquifer water in the near term.

The last item listed is probably the most important. There are economic limitations to development and to borrow from Alan Greenspan, there is "irrational exuberance" here. If you look at all the filings that occurred in 2009, I would call that irrational exuberance because in reality the

process is very expensive and time consuming. The OSE should have ample time to get a handle on the processes and we will establish procedures for utilizing this groundwater making sure the proper protections are in place for existing uses.

Thank you.

Table 1. Notices of Intent

Notices of Intent

NOI's for Deep Weels Filed Under Section 72-12-25 thru 72-12-28 NMSA

Notice of Intent file date	File number	Number of wells	Applicant (s)	Quant. (afa)/ combined	Depth (ft)	# of Wells Drilled	Well completion date	County
08/20/97	RG-67055	1	MIDWAY RANCH LTD PARTNERSHIP	400	2792	1	1997	Bernalillo
06/16/06	RG-88934	14	RECORP & MATACAN	16,000	3000 to 6000			Sandoval
02/22/07	RG-88934	7	RECORP& MATACAN PROPERTIES	8,000	3000 to 10000			Bernalillo
10/24/07	H-3923	1	THE HIDEOUT		3102 to 3600	1	Incomp.	Lincoln
10/13/07	H-4043	1	THE HIDEOUT	300	3500	1	2008	Lincoln
01/16/08	RG-88934	14	SANDOVAL, COUNTY, RECORP, BUTERA, CARINOS, & TESORO	16,000	3000 to 10000	2	2007	Sandoval
07/16/08	RG-90730	1	COMMONWEALTH UTILITIES CORP	110,000	5000			Bernalillo
07/23/08	RG-90739	35	ARTISCO OIL & GAS LLC	12,000	3500 to 10000	2	2007	Bernalillo
09/29/08	E-9535	1	ZORRO TRUST	500	3500			Santa Fe
10/29/08	RG-91042	46	WETLAND DEVCO LP	15,000	2500 to 10000			Bernalillo
11/26/08	RG-90186	17	KING BROTHERS RANCH	25,000	2500 to 10000			Sandoval
12/08/08	RG-91113	20	L BAR ENERGY LLC	10,000	3000 to 3500			Sandoval
12/30/08	RG-91167	2	DIAMOND TAIL LIMITED	100	2500 to 5000			Sandoval
01/02/09	RG-91153	11	SANDOVAL COUNTY	32,000	3000 to 10000			Sandoval
02/18/09	RG-90739	31	ATRISCO OIL & GAS LLC	15,000	3500 to 10000			Bernalillo
12/31/08	LRG-14623	5	CITY OF LAS CRUCES	5,000	5000 to 6000			Dona Ana
01/26/09	ST-247	1	SWEETWATER RISING LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Otero
1/26/09 & 2/6/09 & 3/5/09	T-5565	3	DOWN LOW LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500-10000			Otero
1/26/09 & 3/5/09	URG	3	HARMONY WELL INC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Sante Fe
01/26/09	URG	1	PHOENIX & AVRIEL LLC	15,000	2500 to 10000			Sante Fe
01/26/09 & 3/5/09	URG	3	ELDORADO MINES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Santa Fe

01/26/09 & 03/5/09	URG	3	SAN JUAN PEAKS LLC FOR THEBENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Santa Fe
01/26/09 & 03/5/09	URG	3	MONUMENT VALLEY LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Santa Fe
01/28/09 & 3/5/09	URG	3	GROUNDED & POLITE LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Sante Fe
01/28/09 & 3/4/09	RG-91195	3	GROUNDED & POLITE LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Bernalillo
02/16/09	RG -91218	10	SANDOVAL COUNTY & COMMISSIONER OF PUBLIC LANDS	19,000	3000 to 10000			Sandoval
02/16/09	RG-91217	4	THE NOT SO DEAD SEA LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Bernalillo
02/10/09	RG-91216	1	RIO PUERCO DEVELOPMENT	100,000	2500 to 6500			Bernalillo
02/18/09	RG-90739	24	ATRICSO OIL & GAS LLC	15,000	3500 to 10000			Bernalillo
02/19/09	URG	4	CAJA DEL RIO PARTNERSHIP	100,000	>2501			Santa Fe
02/24/09	RG-91230	6	NM RANCH PROPERTIES INC	3,000	2600 to 12000			Sierra
02/24/09	RG-91230	2	NM RANCH PROPERTIES INC	1,000	2600 to 12000			Socorro
02/24/09	E-9567	19	MORIARTY LAND & CATTLE INC	25,000	2500 to 10000			Torrance
02/24/09	RG-91236	3	ARMIJO LAND LLC	1,000	3000 to 10000			Bernalillo
02/24/09	RG-91237	6	PAINTED DESERT LLC	2,000	3000 to 12000			Bernalillo
02/27/09	UP-4259	1	MILLIKEN RANCH INC	10,000	3000			San Miguel
02/27/09	UP-260	1	MILLIKEN RANCH INC	10,000	3000			San Miguel
03/10/09	RG-91265	12	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	25,000	2500 to 10000			Valencia
03/10/09	E-9572	12	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	25,000	2500 to 10000			Torrance
03/10/09	SJ-3874	12	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	25,000	2500 to 10000			San Juan
3/10/09	L-12406	16	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	25,000	2500 to 10000			Lea
03/10/09	CC-2053	20	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	25,000	2500 to 10000			Curry
03/10/09	P-4498	12	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	25,000	2500 to 10000			Roosevelt
03/11/09	M	16	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	25,000	2500 to 10000			Dona Ana
3/12/09 & 4/28/09	RG-91265	13	SAN JUAN PEAKS LLC FOR THE BENEFIT OF THE CIMMISSIONER OF PUBLIC LANDS	65,000	2500 to 10000			Bernalillo

03/12/09	RG-91267	10	SAN JUAN PEAKS LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	50,000	2500 to 10000			Bernalillo
03/13/09	RG-91268	17	MONUMENT VALLEY LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	85,000	2500 to 10000			Bernalillo
03/13/09	RG-91280	2	KJJRJ LLC	10,000	2500 to 10000			Valencia
03/13/09	RG-91280	4	KJJRJ LLC	20,000	2500 to 10000			Valencia
03/13/09	RG-91274	2	HAT CREEK CATTLE CO LLC	10,000	2500 to 10000			Socorro
03/13/09 & 4/28/09	RG-91265	38	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	190,000	2500 to 10000			Sandoval
03/16/09	URG	3	CITY OF ESPANOLA	1,500	3000 to 3000			Rio Arriba
03/16/09	RG-91355	4	CITY OF ESPANOLA FOR THE BENEFIT OF THE COMISSIONER OF PUBLIC LANDS	2,000	3000 to 8000			Rio Arriba
3/13/09, 3/16/09 & 4/28/09	RG-91265	32	NATURAL BLUE RESOURCES LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	160,000	2500 to 100000			Sandoval
03/16/09	URG	1	BRADLEY A. AITKEN	25,000	2500			Santa Fe
03/16/09	ST-251	4	SCHAFER	16,000	2500 to 10000			Otero
03/16/09	T-5587	4	DUGGAR TRUST	6,500	2500 to 10000			Lincoln
03/16/09	ST-252	16	Y BAR RANCH LLC	64,000	2500 to 10000			Otero
03/16/09	ST-250	8	GEORGE & BARBARA RAUCH	32,000	2500 to 10000			Otero
03/16/09	ST-249	4	WAVERLY DUGGAR	16,000	2500 to 10000			Otero
03/17/09	RG-91279	5	MESA DEL SOL LLC	14,500	2600 to 12000			Bernalillo
03/19/09	RG-91309	3	SANTA FE CANYON RANCH LLC	2,000	2500 to 10000			Santa Fe
03/23/09	RG-91311	1	BREEZY POINT LLC FOR THE BENEFIT OF THE COMMISSIONER OF PUBLIC LANDS	15,000	2500 to 10000			Sandoval
04/02/09	RG-91153	25	SANDOVAL COUNTY	40,000	3000 to 10000			Sandoval
	Total	607		Total	1700,800			

Last updated 4/29/09 by C. Peters

The Future of Deep Water Permitting

Michelle Henrie, MHenrie | Land | Water | Law

Michelle Henrie is an attorney whose practice integrates water, land use, environment, energy, and natural resources. Michelle's law degree is from Vermont Law School. She has a master's degree from The University of Chicago as well as a BA from Utah State University. Michelle is a member of the Governor's Blue Ribbon Water Task Force; she is active with New Mexico First and the American Water Resources Association; and she is an accredited LEED professional.

It is great to be here, and I appreciate the invitation to participate. I am an attorney, and I do represent clients who are involved in filing some of the Notices of Intent that John D'Antonio mentioned. So, I need to make a disclaimer: I am not speaking on behalf of any client; I am just speaking as Michelle today, and again I appreciate the opportunity to be here.

Back in January and February of this year it was a perfect storm with all of the interest in deep water. The legislature was processing the deep water bill, then the issue landed in the newspaper (and I had the fortune or misfortune of being in the newspaper), and then things just exploded as people said, "Hey, what is going on here? I want to get in the game." As the momentum built, water blogs picked up the issues, and it just got crazier and crazier… until we ended up with notices of intent to drill and possibly appropriate millions of acre-feet of deep water. I think that during this crazy time, there was some confusion and some jumbling. Today I wanted to spend my time sorting out the issues and trying to clarify the different separate pieces involved in deep water projects.

And why do we care about the potential of deep water? For my clients who are water suppliers, they have a duty to look at potential sources of water. I always advocate for a diversified portfolio. In other words, if you are a community out in the Eastern Plains, you don't want to be solely reliant on Ogallala aquifer water, and yet what are your other options? If we have the potential of additional sources of water that possibly can be economically feasible, I think that water suppliers (and large water users) must consider whether this is a source that should be developed. That's why I'm such an advocate of deep water production, and so interested in desalination technology, and trying to figure out whether it is feasible…because if there is a chance in the world then we must explore it. We must. Not without considerations for the environment and safety and other water users and so forth. But we would be remiss to not at least consider it.

Again let's look at some of the different separate issues involved in deep water projects and see where there is feasibility and where there are questions. Let me give you a little context for my concerns. When I was in law school in

Vermont, I had a wonderful law professor who always cautioned us against a "mashed potatoes" approach. For example, when you are cooking dinner, if you have beautiful red beets from the farmers market and some nice organic potatoes, you have a few options for cooking them. One option is to throw everything in one a pot, boil it all up, and grind it with a potato masher. What do you get? Well, it looks like dog food. No matter how well it might taste, no matter its nutritional value, all you can say is "ick!" I think that is what happened earlier this year with the deep water hype that didn't separate out the different issues. All the issues were mashed together, and we ended up with a public perception that deep water development was an icky looking prospect that smelled bad too, and we should all just walk away. I disagree. So, let's try to separate out the issues.

So what are some of the issues? First and most critical we are talking about water. Water is so important to us, and I am so proud of us as New Mexicans because when I travel and talk to people in other states, they are not as water conscious as we are. For us, because water is so important, any time we are dealing with water, that fact is a separate issue in and of itself. However you feel about water, and whatever your concerns are about water, those same feelings and concerns are going to translate into deep water projects. We can't resolve all of those issues here today—maybe never—but let's do acknowledge them and move on.

Some of the other issues that we are going to talk about are ownership, jurisdictional, and regulatory issues. A second area for discussion is this whole question about drilling, producing, and getting the water from the ground to the surface, that is, drilling and production issues. A third area for discussion is treatment, desalination and related issues. For each of these areas of discussion, there are some unknowns. For example, what is really under the ground, how good it is, and how long it will last.

Let's start quickly with issue number one. Who owns deep saline water? In New Mexico, technically the state owns the water. If you have a water right or a domestic well right, you have the state's recognition that you may use water for a certain purpose in a certain place. You don't actually own the water. You just hold a "usufructory right"—a right to use it. What about deep water? There is a live question that affects ownership. Could deep water be more like oil and gas than water? If deep water is a "mineral," as opposed to "water," then its use follows the laws of mineral rights, not usufructory rights. This is a question that is percolating around. It has not been ruled on by courts. However, the legislature seems to think that deep water is "water," and that the State Engineer has the ability to assert jurisdiction over deep water.

As John mentioned, many Notices of Intent have been filed. What, exactly, has been legally "noticed"? Are these NOIs noticing an intent to drill a well? If so, is there a time period in which you need to drill the well? Does the notice eventually expire? The new deep water statute is not crystal clear on these points, and everything happened so fast that we are still figuring out the answers. You saw the map showing where NOIs have been filed. There are places where different people have filed NOIs right next door to each other. How are we going to administer these situations? Will it be Texas-style oil and gas where he who gets there first can take as much as he can get? The flip side is that the guy who invests the significant monies required to get this water deserves a secure investment that cannot legally be disrupted by the neighbor who sat on his hands and did nothing. One possible solution for addressing neighboring claims is "pooling" the resource as we do with oil and gas—although pooling has also been a fertile ground for lawsuits, so this approach is not without risk. This brings up the question of conflict. "Deep water" by definition does not comingle with the upper aquifers, so let's just focus only on deep water claimants. What if there are two different wells competing for the same aquifer water, and one of the wells starts to experience interference. Who resolves this dispute? Under the old deep water statute, these issues were resolved in court. When the State Engineer exercises jurisdiction over deep water—which he is now authorized to do—he gets to hear these fights. Lucky guy! So, on this issue of regulatory structure and the ownership of the water, there are a few loose ends but not insurmountable hurdles.

Issue number two is the perceived concern about drilling and production of deep water. We just saw a photo of a building in Dubai that is 2600 feet high. That's a tall building! On the other hand, it's not a particularly deep hole. We are drilling freshwater wells here in New Mexico at depths of 2500+ feet. We have very experienced hydrologists. We have experienced well drillers. There is significant knowledge based on oil and

gas drilling—and some of those wells are even deeper. Oil and gas wells, like deep water wells, must prevent commingling with the upper water aquifers. We know how to do this. We have a lot of experience here in New Mexico. Further, keep in mind that on the water side, deep water included, the State Engineer has well drilling regulations that must be complied with… and the State Engineer's office will be on site making sure. The truth is that drilling a deep water well is simply not a problem. We know how to do it. We have the equipment. We have been doing it for years but with a different target: freshwater or oil. The only change from what we already do is tht now we are going after water that is of poor (i.e., potentially corrosive) quality—and we may not know how poor until you get there. Again, these are not insurmountable obstacles. These are cost obstacles. Use a stainless steel casing. Not hard. Just expensive.

Issue number three involves perceived concerns relating to water treatment. Again, not hard. John mentioned the desalination plant in El Paso. That's a close-to-home example of what people are doing all over the world. The question is not whether we can desalinate water. The question is the best way to do it. What kind of treatment is most feasible overt the lifetime of the plant? What kind of treatment will best handle the water (and you may not know until you have a water sample)? The technology is out there. It might be expensive. Yes, byproducts need to be properly disposed of—and again, we have a regulated system here in New Mexico to handle disposal of produced water. Yes, the byproduct disposal cost will be passed down to the customers—just like they are for municipal wastewater treatment plants right now. Not hard. I think what may be harder is a quantification of the resource. If we are going to rely on this water for municipal uses, and if we are going to make the investment in developing this water, we want some certainty about how long it will last. Municipalities tend to think of in forty-year scopes: is the water going to be there for forty years?

My personal feeling is that what we need to consider deep water as part of our portfolio for conjunctive management. As we look to different sources of water in different periods of drought or different times of the year, it would be great to offer deep water as part of the management package. I'm not suggesting that deep water is a silver bullet. And I am not suggesting that we should suck the deep aquifers dry as fast as we can. I am suggesting that we consider deep water. Maybe not everywhere. Maybe not every community. But for some, it may be the right fit for now, and I would hate to see deep water development disregarded because of confusion about what is—and is not—problematic. In summary, I think there is merit to deep water exploration and development and I do appreciate the State Engineer's attention to these issues.

Thank you very much.

Deep Water Permitting: The Good, The Bad and The Just Plain Ugly

Ann Berkley Rodgers, Chestnut Law Offices

Ann joined Chestnut Law Offices in 1989. She received her Juris Doctor from the University of New Mexico School of Law in 1983. Prior to joining Chestnut Law Offices, Ann clerked for Chief Judge Santiago E. Campos, United States District Court for the District of New Mexico from November 1987 to August 1989. Prior to 1989, she was a Research Professor at UNM's School of Law working in water law, and research attorney for the Northern Pueblos Tributary Water Rights Association.

She has over 20 years of legal experience in Pueblo Indian water rights and has participated as an active attorney in several Pueblo water rights adjudications, including New Mexico ex rel. State Engineer v. Aamodt, State of New Mexico ex rel. State Engineer v. Abbott, and State of New Mexico, ex rel. State Engineer v. Kerr McGee, et al.

Introduction

I am a lawyer and we deal with words. Never give a lawyer anything written to review when a lawyer has a pen or pencil, even a crayon, in her hands – it will be edited when you get it back. Since we deal with words, I don't do PowerPoint presentations. I leave the pictures to others.

The firm I work with, Chestnut Law Offices, represents Pueblo governments, one of which is Acoma Pueblo. Acoma is nominally within the Rio Grande Groundwater Basin, as a tributary to the Rio Puerco. The Rio Puerco's contribution to the Rio Grande, and the aquifers underlying the alluvial aquifers of the Rio Grande is minimal: 4% of the annual flow, and at the surface most of this is sediment. The Rio Puerco delivers 78% of the total suspended sediment load of the Rio Grande.[1]

Acoma Pueblo is very concerned about water matters because it is located in a very water scarce region, and the little water there is has suffered severe depletion and contamination in the past due at least in part to the boom-bust cycle associated with uranium development in the area. Acoma cannot exist anywhere else, as a matter of federal law and of Acoma culture. Acoma is home to the oldest continuously inhabited site in North America. Its survival has always depended on wise use of all water resources. Now, this is more critical that ever before. Acoma does not plan to exist for decades; Acoma plans to exist for centuries - in the same location. For that reason even water that some would consider nonpotable, or too deep, must be taken into consideration when the Pueblo's water future is shaped.

[1] (USGS, 2009) U.S. Department of the Interior, U.S. Geological Survey. This page is http://esp.cr.usgs.gov/rio_puerco/puerco2/high_erosion.html, and is maintained by Richard Pelltier. Last modified: 15:04:23 on 15-Mar-2006.

Issues that Arise with the Deep Water Permitting Amendments of 2009

Acoma Pueblo takes the position that it is the government that controls all water on, running through, or under its land surface. Federal law protects the Pueblo from assertions of state jurisdiction over its lands and waters. The New Mexico Enabling Act states:

The people inhabiting this state do agree and declare that they forever disclaim all right and title to… all lands…owned or held by an Indian or Indian tribes, the right or title to which shall have been acquired through the United States or any prior sovereignty; and that until the title of such Indian or Indian tribes shall have been extinguished the same shall be and remain subject to the disposition and under the ABSOLUTE JURISDICTION AND CONTROL OF THE CONGRESS OF THE UNITED STATES.

There is some debate today about whether this was only a disclaimer of the state's proprietary interest, but that is of no consequence to what we are talking about today. In 1910, when this law was enacted by Congress, groundwater was generally under the control of the landowner as part of the land. New Mexico was the first state to regulate groundwater as something separate from the land itself and that was still 20 years away. We can quibble over whether Congress intended the Pueblos to have an owner's right based on the doctrine of the owner's absolute dominion, or the doctrine of correlative use which requires sharing among competing land owners.[2] In either context, there are important rights of the Pueblo to protect. So, the first things on my checklist when I review a proposed deep water well are:

1. Where is the well located on the surface? Is it near the Pueblo or areas of known recharge to Pueblo waters?

But, you say, if it isn't on Pueblo land, it isn't Pueblo water, right?

No. Water does not respect the boundaries drawn by people on a map. For example: One of the recharge areas for the Horace Spring which provides a large part of the surface water flowing through Acoma in the Rio San José is the Zuni uplift on the other side of El Malpais National Monument; another is the Dakota Sandstone aquifer which used to flow at the surface at Ojo de Gallo just west of the Malpais at San Rafael. Of course that flow is now non-existent – not because of surface water use, but because of increased groundwater pumping (mining) near Grants, New Mexico. Another source was the Rio San Jose and its alluvial aquifer itself – that flow is now close to non-existent because of Bluewater Dam and the groundwater pumping in the Bluewater-Toltec Irrigation District.

It is a shame that the legislature did not take this opportunity to require the Office of the State Engineer to enter into Memoranda of Agreement with Indian Tribes for management of these deep aquifers that potentially serve both the Tribes and the State. Collective management might take more time to put into place but it can forestall many greater debates and issues in the future.

2. What are the known facts about groundwater flow in the area? Will the proposed pumping affect water quantity or flow? What about water quality?

But, you say, this should not be important because these deep water aquifers must have an "hydraulic separation from overlying aquifers" to establish that it only contains non-potable water.

It is important. It is so important that it is almost a rhetorical question. "Hydraulic separation" sounds really good, but in the natural world it is quite rare. With groundwater, there is always uncertainty. For many centuries courts did not even try to regulate groundwater – there was too much that could not be known. There has been some movement. For example, in 1861 the Ohio Supreme Court refused to apply any law to groundwater issues:

> [T]he existence, origin, movement and course of such waters, and the causes which govern and direct their movements, are so secret, occult and concealed, that an attempt to administer any set of legal rules in respect to them would be involved in hopeless uncertainty, and would be, therefore, practically impossible.

[2] In Louisiana, the civil law of Spain and France is interpreted to reach essentially the same result as the absolute dominion rule, while the Roman law appears to apply something similar to the reasonable use rule. See 3 Water and Water Rights 2003 Repl. Vol. §20.02.

Frazier v. Brown, 12 Ohio St. 294, 311 (1861). In the early 1980s a hydrologist remarked on the importance of a strong research component to any effort to manage groundwater:[3]

> Hydrologically we operate largely in a sphere of ignorance, not because we lack understanding of the laws of nature as they relate to groundwater flow and quality, but because we lack the practical means to assess the extent of the resource … [we] have to learn to operate within the range of uncertainties which exist of a given data base.

There is not much difference in the substance of these two statements.

I often see hydrologists refer to a thick layer of clay as impermeable, and therefore, creating hydraulic separation between ground and surface water. Or hydrologists speak of aquitards as barriers, but these are not really barriers. An aquitard is considered to be impermeable because it has low permeability. It can store a large volume of water, but the water cannot pass through easily. Even so, given a certain set of facts, it does transmit water. Have you ever set a clay pot with a plant in it on a carpet? Give it about one month and there will be a permanent stain where the water from the clay pot has slowly, but ever so surely seeped from inside the pot to the rug. An aquitard is very similar to the clay pot. It slows the flow, but it does not stop it.

What water cannot seep through, it dissolves or erodes. There is mechanical erosion where the earth is physically broken down by water but does not change the chemical composition. Then there is chemical change where the water incorporates the earth to transform itself into some other liquid. Arsenic tea, anyone? Erosion is even greater where water meets the definition of "non-potable". Just think about what salt and water combined can do to steel. Then there are geological rifts where the earth under has moved so that water can move similar to a person in a maze.

For the Pueblo, where a century is a relative small part of its existence, the fact that these processes take a long time does not mean they should be ignored.

With wells, you also need to consider how much pressure a well is going to produce; the greater the pressure pulling the water in and up the well, the greater pressure to pull water from an adjacent aquifer or aquitard into the aquifer that is serving the well. This can be so great as to actually change the direction of groundwater flow, cutting off recharge, even if water is presently hydraulically separated.

An example is the Malpais area just west of Acoma. For many years learned geologists took the view that it blocked the flow of water. Tribal elders knew better. There are cracks in the malpais and wonderful watering holes. Traditionally, the depth to water in the watering holes was an indication of the availability of water from the Rio San Jose and some springs located on the Pueblo. Now it is taken as a given that water from the Zuni uplift region saturates the earth and flows into the Rio San Jose through springs.

The uncertainty surrounding groundwater management exists today and as a water lawyer I have to acknowledge its existence. That is why this second question is largely rhetorical. Absent unequivocal findings that the water that is proposed to be tapped (1) does not support aquifers that Acoma is using today, (2) is not recharge for Acoma present use (3) will not be needed for future use, (4) is not located under Pueblo land surface, in whole or in part, (5) will not further deplete existing groundwater sources of the Pueblo, I have to present the Pueblo with the opportunity to protest the application.

3. How do I file a protest for my client?

This is where the new law simply does not work, or perhaps it does its work too well. Different regimes are now in place depending on the type of use to be made of the "nonpotable" water. Under the old law this section was a limit on the State Engineer's ability to declare groundwater basins – the act that allows the State Engineer to exercise jurisdiction over groundwater.

> §72-12-25 (NMSA 1978) OLD VERSION:
>
> NO PAST OR FUTURE ORDER OF THE STATE ENGINEER declaring an underground water basin having

[3] Rodgers, A.B. and Utton, A. "The Ixtapa Draft Agreement Relating to the Use of Transboundary Groundwaters" 25 Nat. Res. J. 713, 732 (July, 1985)

> reasonably ascertainable boundaries SHALL INCLUDE WATER IN AN AQUIFER, THE TOP OF WHICH AQUIFER IS AT A DEPTH OF 2,500 FEET OR MORE BELOW THE GROUND SURFACE at any location at which a well is drilled and which aquifer contains non-potable water. "Nonpotable water" for the purpose of this act [72-12-25 to 72-12-28 NMSA 1978] means water containing not less than one thousand parts per million of dissolved solids.

With this limit on State Engineer jurisdiction, it was not unusual that protests were not to be filed with the State Engineer but with the state district court. §72-12-28 (NMSA 1978). There was no administrative jurisdiction to consider protests to a notice of intention to drill. §72-12-27 did authorize the State Engineer to require data to be filed with respect to a deep well, metering and water chemical analysis. The State Engineer had no authority to stop the drilling of the well.

Now, despite a nonpotable deep aquifer being subject to the State Engineer's jurisdiction, there are many uses that are governed by the old process, thereby removing any ability to challenge the notice of intent to drill through an administrative process. These uses are: oil and gas exploration and production, prospecting, mining, road construction, agriculture, generation of electricity, use in an industrial process or geothermal use. All other uses, such as municipal, domestic, etc., are subject to the existing administrative process for a regular groundwater permit application.[4] I wonder how many lobbyists had their hands on this bill before it was enacted by the legislature? I submit that there can be no rational basis for these distinctions between uses. What is special about generation of electricity, industrial uses, or agriculture so that they should be shielded from challenge during any administrative process.

I do question the purpose of altering the statute to allow the State Engineer to declare these deep well basins if there was no intent to require the largest of users to comply with an administrative process.

So, before I can file a claim, I now have to take into consideration what type of use is proposed for the "nonpotable" water. If one type of use, file in court. If another, file in the Office of the State Engineer.

For those uses where one must go into court, protests are limited to persons who can claim impairment of existing water rights due to the appropriation of nonpotable water. This could be construed to require fairly sophisticated hydrological work before any claim could be filed. The law applicable to a regular application for groundwater permit does not limit claims in this manner. In addition to those whose use may be impaired, under §72-12-3 an application can be challenged as being "contrary to the conservation of water within the State or detrimental to the public welfare" if the challenger can show that it will be substantially and specifically affected by the granting of the application. For Pueblos, where protection of their water rights is a public trust or federal trust duty, this can be a basis for challenging an application even where the hydrology is not sufficiently certain to support a claim of impairment.

Conclusion

It is important for the State to regulate water use and to work with other regulators such as Indian Tribes and other states to insure a water supply for the future.

At least these amendments address the ability of the State to regulate. The bad part is the legislature did not take advantage of the opportunity to acknowledge that water resources in New Mexico are not subject to state regulation alone, and to require collaborative, complementary regulation by Tribes and the State.

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[4] §72-12-25(B)(2009Supp.):

"If the State Engineer declares the type of underground basin described in Subsection A of this section, all appropriations of nonpotable water from that basin for

(1) oil and gas exploration and production, prospecting, mining, road construction, agriculture, generation of electricity, use in an industrial process or geothermal use shall remain subject to Sections 72-12-25 through 72-12-28; and

(2) all other uses shall be subject to 72-12-1 through 72-12-24."

It is also important that regulation is given to the State Engineer's Office, where there are supposed to be sufficient resources to analyze all the technical aspects of an application. However, it is just plain ugly to require two different processes for challenging or objecting to a deep well permit application or notice of intent to drill, giving greater protection to certain specific users over other users without rhyme or reason.

As desalinization and other water treatment becomes common place, what is technically nonpotable in the ground will become potable on the surface. While Deep Water will never be the source for all water users, just from a cost perspective if nothing else, it is going to be an important part of the water supply picture for New Mexico – at least until we run out of the energy to power the submersible pump.

There are problems with the new regime adopted by the last legislature. I hope the legislature and the State Engineer's Office will consider resolving those problems through additional legislation soon.

The Future of New Mexico's Deep Water Permitting

Guy Bralley, Sandoval County

Guy is the Water Resources Administrator for Sandoval County. He is engaged in project management for the County's water related projects, including the deep brackish water wells in the Rio Puerco area, located west of Rio Rancho Estates. Guy was previously with contractor services providers in support of the City of Rio Rancho and the Eldorado Area Water and Sanitation District (near Santa Fe). Prior to his water career, he served in the Air Force (1966-70) and Navy (1973-95). Following retirement from the Pentagon in 1995, Guy worked for Dynamics Research Corp as a consultant/ project manager to the Department of Defense and the Department of the Treasury for 3½ years, and 1½ years with Sikorsky Helicopter as VP of a joint venture with Lockheed Martin to support the H-60 maritime helicopter fleets worldwide. Guy has lived in Rio Rancho since 2000. He received a bachelor's degree in university studies from the University of New Mexico and master's degree in systems management from the University of Southern California.

Thank you very much. I want to thank everybody here for the opportunity to speak today, and I want to thank Isleta Pueblo for their fine facility and the hosting of this event. I represent Sandoval County and work with the development department as the water resources administrator. Before I started with the county, the county commissioners had decided to expend some money on the research and potential of what became the deep water wells that are located in the Rio Puerco.

I'm going to provide you an update on what we're doing at this point as well as during the past summer and early fall and then work backward to how we started. Figure 1 shows the well site as of about the middle of last month. All the good photos in John D'Antonio's presentation are our good looking wells, and all the ones that you didn't like, those were somebody else's.

Figure 1. Overview of Site

Figure 1 shows well site 6, where that big tall rig that John D'Antonio showed was two years ago. Two years ago we drilled the two wells, a year ago we did our flow tests for 30-days, and this figure shows our current pilot test. The purpose of the pilot test is to reduce the risk of going forward with a project that isn't going to be economically feasible, or that is incapable of meeting the needs of potability based on the water with which we start. We want to confirm that this selected process works; we want to determine what the costs and expenses might be, and until we know exactly what does work with this water, we won't be able to predict the associated expenses.

The end of the pilot test will be the basis for the Preliminary Engineering Report. We will then decide on whether the project is a "go" or "no-go." If we decide to continue with the project, the next step will be to design a plant. Obviously we would like to minimize costs for everybody's benefit so we will try to identify the economic potential of by-products. This water is 12,000 TDS (total dissolved solids), so we met OSE's standard for being non-potable but we have some concerns. A bit of background: on the way to the water that we obtained, which is basically 3,700-3,770 feet down, we didn't run into any potable water, or any other type of water, until we got below 3,700 feet. You have probably heard discussions and seen photos of the faulting in the area. We are located on one of the high parts of that fault system, and we actually drilled across one of the faults while drilling the first well. It caused some confusion for a while, but we figured it out. There is some separation between these formations and, we believe, the Santa Fe Group aquifers. To confirm how much water exists will require more testing than has been done so far. This pilot testing part of the project is funded by a legislative appropriation of $600,000.

Figure 2 shows the process trailer. The tank you see in the foreground powers the generator, which is the square box in front of the trailer. CDM is doing this work for us with a prime contractor (Universal Asset Management) from Missouri. The pilot plant has been on site since August. We have made the basic connections and are working on what I like to call "optimizing." Basically we are improving the balance of all the various factors required to deal with the contaminants in the water. We should have our findings and recommendations around December. We did some bench level testing earlier in the summer and evaluated four different ways to treat this water. We reported to the New Mexico Environment Department (NMED) on those options and recommended the one I will discuss in a minute. We received approval from NMED before we configured the pilot unit, which is basically a warm lime-softening process plus filtration and then Reverse Osmosis (RO) (Fig. 3).

Figure 2. Process Trailer

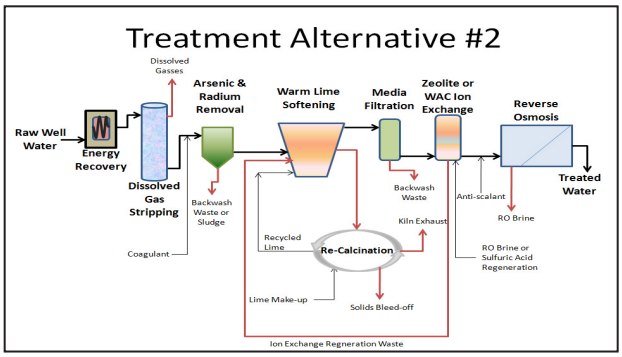

Figure 3. Treatment Alternative #2

It may be a little difficult to see from Figure 4, but you can open the valve on this pre-filter system until water comes out with no pump, it flows in artesian fashion. The first well is 160 psi on the surface when closed in; the second well does not flow as well as the first, but it has 200 psi (close in) pressure on top. We believe that both wells come from the same body of water and are connected underneath. When we flowed the first well, we had monitoring instruments on the second well and we detected a response and a drop in pressure at 3,200 feet (where those instruments were located). When we flow the well fast enough, we actually get a temperature rise in the water. At 3,200 feet, the water is 160°F; when it reaches the surface at

several hundreds of gallons per minute of flow it is about 150˚F. So from the very start we have a couple of plusses in our favor; one is we have an opportunity to recover energy from pressure and from temperature. Even if we don't really recover all of it, we can still use some in the process. That may help keep costs under control. It can also help in the process itself because some steps in the process work better with warmer or colder water. Membranes do not tolerate hot water so we must cool the water by the time it gets to the membranes to at least below 100˚F.

Figure 4. Pre-filter System (sand & anthracite)

Looking again at Figure 3, on the left we have energy recovery. Basically we want to see what we can recover. We have several investigations evaluating options for using that energy. The next step is to strip out the dissolved gases that are entrained in the water, for example, carbon dioxide. We recognize the issues associated with the carbon footprint and we do have naturally occurring carbon dioxide coming out of the well. We are looking at ways to collect the CO2 and possibly use it to feed algae as another potential renewable energy source.

The next step is to increase the pH up so we add some caustic solution and that's where we get the lime salt. We don't have the coagulant stage in the process right now, but eventually that stage will take out arsenic and radio-nuclides. We do have arsenic in abundance. We are at 70 times the drinking water standard on arsenic, and we recognize that after concentration, we will have a hazardous waste stream to deal with, and that's not the only one.

Next, lime softening is done in the big green "claricone" (Fig. 5), which you will see again in a minute. From there we go through media filtration using sand and anthracite (Fig. 4), and then through a zeolite bed that helps take out a little bit more of the hardness (Fig. 6), and lastly through the RO process (Figs. 7, 8). The large green claricone is where we drop out the hardness; we have about 1,800 ppm (CaCO3) with which to deal. The white pipes in the background of Figure 7 contain the RO membranes used during the first stage. The white pipes used during the last stages are a bit smaller and you can't see them very well in Figure 8.

Figure 5. General Overview Sep 09

Figure 6. Softening Tank (Ion Exchange)

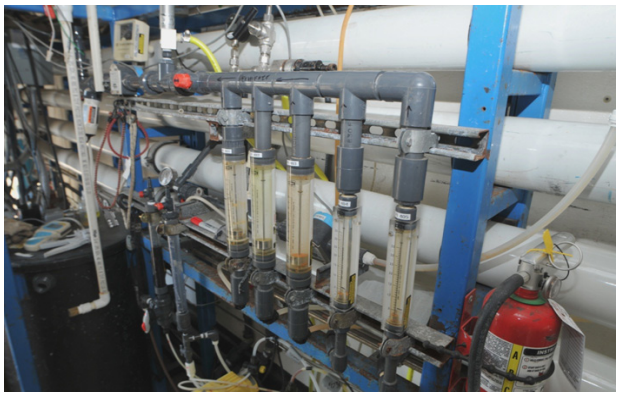

Figure 7. Rotometers, RO Membranes

Figure 8. Pilot Membranes

Today (mid-October), we are supposed to put in what we consider the final version of the second stage membranes and we will then have a better idea as to the kind of recovery we will get out of this process. The recovery rate as of yesterday is in the neighborhood of 83%, which is really kind of an eye-watering value; we don't know that we can afford that kind of number. We think that if we continue with our process, we may be able to get a higher recovery rate than 83%. The ultimate question is whether we can afford the costs of the energy and the chemistry. In the end – and I don't want to downplay it at all – we have a clear awareness that we have a disposal issue with the concentrate.

Phase 1 was the exploratory phase that included drilling and testing. We are now in Phase 2, pilot test and design. Phase 3 will be construction and Phase 4 will involve operations and maintenance.

We brought in a lot of folks for the exploratory phase, shortly after we drilled the wells and understood that we had some water. Among the people with whom we have been talking to from the start are representatives from Laguna Pueblo. I have been to the Pueblo and talked to the Laguna government twice myself, and we invite them to various meetings where we discuss what the possible uses are and which communities might be served with this water. I say "might" be served because we haven't made any (oral or written) agreements with anyone except for the original developer with which the county has an agreement (Master Plan has been approved by County Commissioners for Rio West Development). Beyond that, we had some meetings and said to the community developer, "Tell us what your dream would be, where would you really want to go." That way we could understand what size of a plant is appropriate. We have determined that 5 million gallon a day trains in the process is a good break-even point for cost curves. Thus we are looking at, nominally for money purposes, 25 million gallons per day at a point when you could have a demand for that much water, which could be 50 or 60 years away. We don't plan on being able to do this tomorrow, but we'd like to build and expand as demand dictates and whatever the technology allows.

We talked about the water itself: 12,000 TDS, 150°F. We did the flow tests and we understand that with two wells there is a limit to what you can learn. Being a consultant, I have learned that the last line in almost every report is "further study is warranted," which translates to "pay me some more money and I'll give you some more information." That is definitely true here. Other oil wells that exist in the area were data sources and we think we learned some things from them as well. The flow test was done for 30 days in October 2008, the OSE is inspecting the reports, and we are going forward with the pilot test.

In evaluating how much water might be in that aquifer, we came to a value of about 2,500,000 acre-feet based on some of the charts you saw in the state engineer's presentation.

Phase 3 construction will be dictated by what we learn in the pilot test and what process has the potential to work. Phase 4 will be operations and maintenance. As for our budget, we put $6 million into drilling and aquifer testing, about $2 million per well, and those two wells were only about 6 7/8" diameter at the bottom and built to OSE

standards. In the state engineer's presentation, you saw photos of the folks measuring the pipe and doing the cement work – that was the first well. We invited OSE staff to come back (as required) and look at the process and materials so that we will build to their standards. We have cemented to 3,000 feet, which is 500 feet below the point where OSE's jurisdiction (at the time) ran out. The second well was cemented to 3,200 feet with the upper casing and it is cemented again below that lower casing until you get to the area where the penetrations are to get the water inside the well casing.

We expect to be taking more visitors to the site soon. Monday we'll host some of the division directors from the county and after that we will probably have some opportunities to take folks from the press to the site. We did a media day at the end of the pump tests a year ago and we will likely do the same thing with this pilot test shortly.

Thank you.

Using New Mexico's AIS Management Plan and Legislation to Protect Our Aquatic Resources

Barbara Coulter, New Mexico Department of Game and Fish

Barbara is the Conservation Strategy Coordinator and the Aquatic Invasive Species Coordinator for the New Mexico Department of Game and Fish. She has a bachelor's degree in wildlife conservation and a master's in public administration.

Editor's note: The following paper represents an unedited version of the speaker's remarks at the conference.

Thank you everybody. My primary position within the Department of Game and Fish is conservation strategy coordinator. To give you some background, every state has a Conservation Plan, sometimes referred to as the State Wildlife Action Plan. Congress mandated that every state have a plan with a coordinator, and I am New Mexico's coordinator. I help implement the plan and do good things for wildlife. The cool thing about it is that the mandate also comes with state wildlife grants, and New Mexico gets about $1 million a year, which requires a 50 percent non-federal match, so I get to double $1 million into $2 million to do good things for species and conservation. As was mentioned yesterday concerning the state's budget, I now also get to be the state's Aquatic Invasive Species Coordinator, which is a gift. It is a massive undertaking and I just started in this position in late May, so I am barely at the six-month mark with this mission.

To start, I would be interested to see how many people here are from the Office of the State Engineer? One person. Alright how about from the Bureau of Reclamation? A couple of people. How many from the Army Corps of Engineers? A couple of people. I'm guessing Fish and Wildlife or State Parks staff are also involved. How many of you like to fish or boat or recreate in New Mexico's waters? I've hit just about everybody. Municipalities, too, are important and I know they are represented here as well. This means you all are on the frontline with me in slowing the spread of AIS, or aquatic invasive species, in New Mexico.

What is AIS? Essentially, it is any non-native plant, animal, or pathogen that can harm our economy, environment, or the health of plants, animals or humans. Rainbow trout is not exactly a native species, but it is not considered an aquatic invasive species because it provides recreational opportunity. I want to make that distinction right off the top, otherwise I will get in trouble with our Fisheries Division. In New Mexico, we have at least 100 non-native species. Our Agriculture Department takes care of all plant species that are non-native whereas Game and Fish has just been granted the responsibility for any and all aquatic invasive species and those are numerous.

To give you examples of a few AIS that are of concern: Asian Clams; Whirling Disease as it skews fish that are infested with it, skews their swimming pattern, and makes them, among other issues, much more vulnerable to retardation; non-native crayfish; Eurasian watermilfoil; and Didymo (rocksnot) found in the upper Pecos drain and in the Rio Hondo. I have to thank the New Mexico Environment Department and their folks who have been going out to test surface water quality and

collecting samples to give to Fish and Wildlife for confirmation of identification.

Other AIS of concern include the New Zealand mudsnail and what are referred to as Dreissenid Mussels, or Zebra mussels, which I will be focusing a majority of my time on because of their devastating effects (Fig. 1). We have native clams and mussels in New Mexico, but the way you can identify a Dreissenid mussel is that they have hairs that allow them to attach to boats, water treatment plants and grates, and almost any kind of material. That's what gives them away. We are also concerned with Quagga mussels, which are also devastating (Fig. 2).

Figure 1. Dreissenid Mussels

Figure 2. Quagga Mussel

How did these non-native species get here? Zebra and Quagga mussels arrived in the late 1980s and are believed to have come in through ballast water on ships from the Caspian Sea into the Great Lakes. Initially, we thought they would be confined to the Great Lakes, but they started spreading south and then east. We thought they wouldn't make it past the 100th meridian and we would be okay since we don't have the same kind of weather as in the east, but unfortunately we were proven wrong and they have spread faster than anyone thought they would.

In 1988, their distribution was fairly well defined, however they are very prolific. During optimal growing conditions, one adult female can release one million eggs, the fertilized eggs quickly mature, and the cycle continues. So how did they make it past the 100th meridian? The best and easiest way is via boats coming from different places and climates. The photo in Figure 3, I believe was taken at Abiquiu Lake. Figure 4 shows a veliger on 20 lb monofilament fishing line found on the boat in Figure 3. Unfortunately, recreationists and biologists are most guilty of spreading AIS because we go from water body to water body and we aren't decontaminating between trips because we aren't aware that we are harboring AIS. We are really good at spreading it ourselves. The juveniles or veligers drift for about 20 days as plankton before settling.

Figure 3. Mussels Rapidly Spread from one Lake to another Via Boats

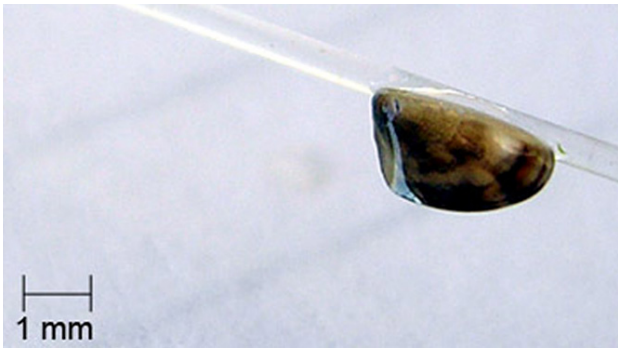

Figure 4. Veligor on a 20 lb Monofilament Fishing Line

What are the impacts and why are we concerned about these mussels? For one, we are worried about their impacts to native wildlife. The top left photo in Figure 5 shows habitat loss, shown as substrate covered in Zebra mussels; they will pile on top of each other or on top of anything. The bottom left and right photos show Zebra mussels attaching themselves to freshwater mussels not allowing them to open, which basically starves those native species. Their effects on native wildlife can be devastating.

Figure 5. Impacts to Native Wildlife

I'm sure many of you have seen the photo in Figure 6a of the propeller covered in mussels. Boats in particular that have been left in infested waters for multiple months carry the mussels and the longer the boats are in the infested waters, the higher the chance of them becoming infested and spreading more mussels (Fig. 6b-6d).

Figure 6a. Damage: Propeller Covered in Mussels

Figures 6b.

Figure 6c.

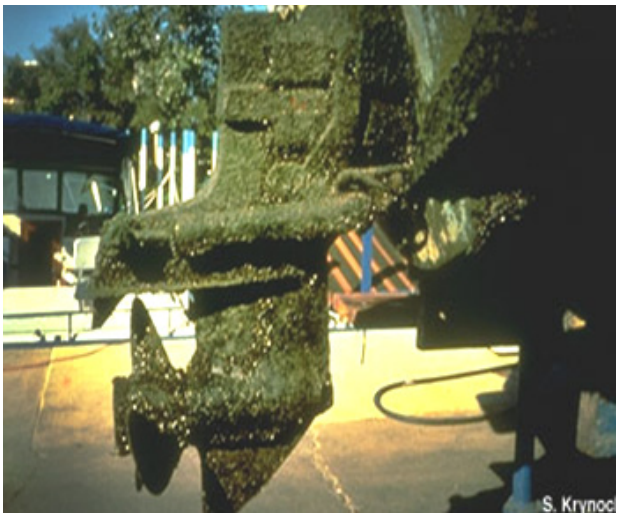

Figure 6d.

Water delivery systems can become contaminated with AIS. Mussels can attach to metal pipes and grow on top of themselves in the pipe or they can attach to glass and obstruct vision. The mussels can obstruct water control and delivery systems such as the trash rack and Penstock gate has shown in Figure 7. There is a trash rack in the Los Angeles municipal water district where they are very familiar with this issue as they spend millions of dollars on maintaining their equipment before it gets infested with Zebra mussels. The Bureau of Reclamation is having problems partially with clogged screens on water delivery structures. It is hard to imagine that this could occur, but it is happening. Waters that we thought were safe, given the biological range these species should be able to live within these species, are quickly proving in the West that they are expanding their range of water quality and water temperature in which they can survive. These mussels require some of the highest levels of calcium to build their shells so we thought calcium would be a limiting factor. We thought they wouldn't like salt water, or high temperatures, or certain pHs, and people were trying to use the chemistry of the water to understand their vulnerabilities. But they are proving us wrong and evolving very rapidly unfortunately.

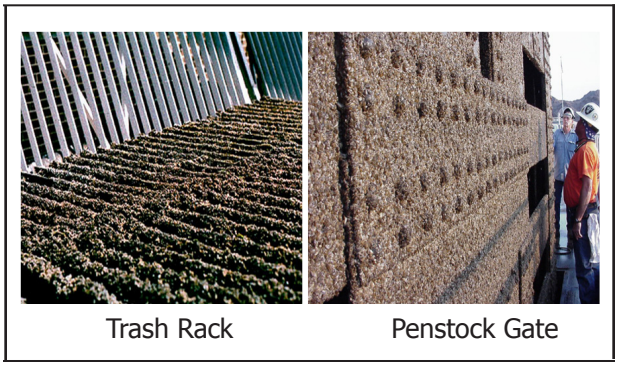

Figure 7. Damage: Obstruction of Water Control & Delivery Systems

Zebra mussels are very difficult to manage. Management, not eradication, is the name of the game and that is too bad. A lot of money is going into investigating how to better control and/or eradicate a source population of mussels. Unfortunately, nothing has proven very effective and the effort is very costly and intensive. We could drain all of our lakes, because no more water means no more mussels, but that would be a problem for other species as well, and every solution has a consequence or multiple consequences. As far as we know, we don't have any zebra mussels in New Mexico, and we are one of a few states remaining that is not infested with mussels. We are surrounded though by states with infestations. Texas has not confirmed that they have infested waters, but Oklahoma has infested waters, Colorado has infested waters, and Arizona does, so we are in a sense an island surrounded by infestations and we are trying to keep these mussels at bay as long as possible. If and when they do get here, it will be about management, not eradication, unless new technology is developed, but this in itself would cause huge infrastructure costs in just management. Figure 8 shows how quickly the problem spreads. In Parker Dam on the Colorado River you see that in three months, the substrate sample went from a few mussels to many. To check on the mussels, we float different items in the water, and later check what is growing on the item. So far we have no mussels on our substrate samplings. In Colorado, in just three months, it is just unbelievable what happened, but it is what is occurring.

Figure 8. Fast Increase in Population Density - Parker Dam, Colorado River

AIS economic costs in the U.S. are at least $109 million annually. Nevada's Park Service has spent $1.9 million in 2007 alone. Utah spends about $15 million annually; Idaho currently spends $56 million on trying to get rid of whirling disease. People in this field talk about homeland security and this effort should be under the Department of Homeland Security given how costly it can be. Essentially everyone in New Mexico will be impacted because our waters are connected. We don't have many isolated lakes, and if something upstream or from Colorado, since we are downstream, gets infested, there will be no way to keep the veligers from moving toward us. Their job is to move so they will be coming south into the

lower water systems. If they get into the San Juan-Chama system, they will get into Abiquiu, Cochiti, and so on until they arrive in Elephant Butte. This would be a nightmare worst case scenario, and it is something that I am hoping I won't be around for since Albuquerque gets a lot of their water from surface water and the costs will be transferred to the water users, and of course, irrigation is another concern.

House Bill 467 was unanimously passed in March 2009; before that, nobody had jurisdiction or authority over AIS in the state. By the end of May, I shifted my duties to start spearheading this effort. The Act relating to Game and Fish provided the authority for control and prevention of the spread of AIS in New Mexico and it was declared an emergency. Let me talk about a few things the act does. It is unlawful to knowingly transport AIS into the state and within New Mexico's borders. Most people do not know that they are spreading it, but if you have a boat that has been in Lake Mead, you know the storage tanks inside the boat are probably infested with veligers. When your boat gets into New Mexico's waters, it releases those veligers into our waters. Even if the outside of the boat seems clean, it does not mean that the boat is uninfested. To knowingly transport AIS is illegal and a misdemeanor.

The main part of the Act gave the director of New Mexico's Department of Game and fish, in consultation with our Energy, Minerals and Natural Resources Department and the New Mexico Department of Agriculture, the authority to designate AIS, designate what water bodies are infested, and to specify decontamination requirements. In addition, both Game and Fish and New Mexico State Parks are authorized to create regulations as necessary to implement and enforce HB 467 and that is partly because both agencies have law enforcement capacity.

We have four main targets in terms of how we are going to approach this issue. By the way, Game and Fish has very little authority over water or any water bodies in the state. Eagle's Nest Lake is the only lake that we have any major impact on, so the name of this game requires coordinated collaboration and funding. Right now I have been working diligently with the Army Corps of Engineers, Bureau of Reclamation, Fish and Wildlife Service, New Mexico State Parks, and most recently with the New Mexico Environment Department. Recently, I received a request from the Department of Transportation to instruct them on how to decontaminate their equipment when they go into different water bodies with their big machines. Their help will be wonderful.

First, education is the name of this game. We must get people to understand what AIS is and its impacts. They must understand what they can do to prevent and/or mitigate its spread in the state. Interdiction right now is voluntary. The Corps, State Parks, and Bureau of Reclamation provide voluntary boat inspections. If you decide you don't want to get your boat inspected because the line is too long or what have you, we really cannot stop you unless we are concerned about your boat because you are from an infected state. Otherwise inspections are voluntary. Interdiction and stopping infested boats from entering our water bodies is huge because most of our boat ramps are open 24/7 and are not manned. So if you have a dirty boat, you can bring it in at midnight and no one can stop you, and this is a huge problem. We must realize the effects this will have on our recreating public and tourism. We don't want to make going to our lakes a miserable experience, but we need to balance that with the significant threat, particularly with boats from other states that are considered high risk.

If a boat is infested, we need to provide a service to decontaminate it, which is a huge undertaking right now. We also must monitor our lakes and waters for veligers in order to get a heads up on whether an infestation exists. This requires collaboration across the board with state, federal, municipalities, private enterprises, boat marinas, and all the other players involved. Another issue is funding. This authority came with no funding so it is an unfunded mandate right now, which makes it really tough. What we need to do requires a lot of money and a lot of people.

We approach education through a variety of means. Our department and others have developed different print media including informational brochures and 50,000 rack cards placed in every state park. We have an AIS coloring book and we included information on the back of hunting and fishing regulations. We have billboards around the state instructing boaters to clean, drain, and dry boats and equipment. We use newspaper ad space to get the word out and we are trying to figure out how to best use that space. We are also working with a Minnesota group that has some funding for billboards and they want to help New Mexico. We are trying to get funding for billboards around Navajo Lake and Elephant Butte Reservoir. That

is not to say that the other lakes aren't important, but right now, Elephant Butte and Navajo Lake are two of the most high risk lakes given their boater numbers and their location.

We are also working with social media. You may have heard a radio spot last summer that I did in Santa Fe. We got great feedback and we are looking into doing more of those as well as public service announcements, particularly over holiday weekends when we get most of our boater traffic. We are focusing our efforts on boater traffic. There is a five-minute TV segment on New Mexico Wildlife, a TV program produced by the Department of Game and Fish. I will be working with the Chief of State Parks at Elephant Butte to film a one-minute infomercial on AIS. We'll be showing life jackets, boater safety, and AIS maintenance equipment to get the word out. We are going to have a presence at outdoor expos and other types of wildlife or recreation events. I will be presenting information as I'm doing here to lots of different entities to keep different agencies and individuals aware of what's going on. If they want to work with us, that would be great in getting the word out. The Army Corps of Engineers have a pretty cool video on YouTube on how to deal with AIS.

Interdiction is our second target and is the front line of defense and that means marina owners and managers. They must keep an eye out, talk with boat owners, and performing inspections. State Park staff and their officers will help train marina owners and while they are checking boater licenses, they can talk about AIS and make sure the public is informed. Volunteers, public support, and watercraft user support also are definitely important.

Our third target is risk management, which is essentially what this is all about – educating the public and educating boat owners to inspect and "filter" vessels at key launch ramps. If a boater is high risk, hopefully we will be more thorough with them, and if a boater is low risk, we'll let him or her on their way to enjoy our waters. We must engage stakeholders and here the really important thing is coordination across borders and jurisdictions. I am involved in some western and national efforts on this. It is really interesting because there are boats that slip through – basically in every state it is illegal to transport AIS – but it is still spreading because somebody is illegally transporting AIS, and we all are aware that it occurs. There is now an effort for when a "dirty boat" leaves a water body without being decontaminated, everybody keeps track of where that boat is. I will get emails on when and where a boat called "Sunshine" is moving from Lake Mead north to Idaho and where we think it is going next. I always chime in that I hope Sunshine goes north and not east. It's interesting to see people out there who are concerned citizens and who say they are worried and take part in tracking the boat's plate number. The law enforcement aspect is cool given their surveillance and monitoring techniques.

Currently, trained personnel, per the statute, is anyone who has completed the Fish and Wildlife's AIS watercraft inspection and decontamination training, level 1 or level 2. If you are level 1 trained, all you can do is inspect the boat. I am level 1 trained. If you are level 2 trained, you can actually dig in and decontaminate, and currently, about 140 people in the state are level 1 trained, mostly staff from State Parks and Game and Fish. We have seven people in the state who are level 2 trained and who can decontaminate a boat. Level 2 training requires that you go to Lake Mead, and I will be going there in two weeks so I can learn how to decontaminate a boat and I probably will decontaminate a boat at some point. We are looking at revising state statutes so that perhaps we can start training level 2 people here rather than sending them to Nevada, which is really not within our capacity. Currently, state statute also says that only trained personnel of Game and Fish or State Parks may affix a warning tag to equipment or conveyance where there is a presence of AIS, or if equipment or conveyance is leaving infested waters. Unfortunately, this really limits the Bureau of Reclamation and the Army Corps because they don't work with Game and Fish and so they can't tag a boat. We are looking to change that statute language as well to say that as long as you are trained you can tag a boat. Tagging a boat means it has to be decontaminated before it enters New Mexico's waters. Once we have a boat that is infested, after it has been inspected and tagged, it requires decontamination.

I'm sure some of you here heard about Navajo Lake and the infested houseboat that Lake Mead sent us in May. Figure 9 is a map of Navajo Lake State Park, and for those of you not familiar with it, the top part of the lake is in Colorado and under the jurisdiction of the Bureau of Reclamation, which is where multi-state coordination comes in. The photo on the right shows the bottom of that houseboat, and it came from Nevada through Arizona and

was literally about to get in our waters. It was on the ramp before the manager of that marina, at 7:30 that night, just happened to be on the ramp and stopped them to look at the bottom of the boat. He had gone through level 1 training so he knew what to look for and was certified to inspect. He was able to stop that boat, otherwise it would have been in the water and would have infested it.

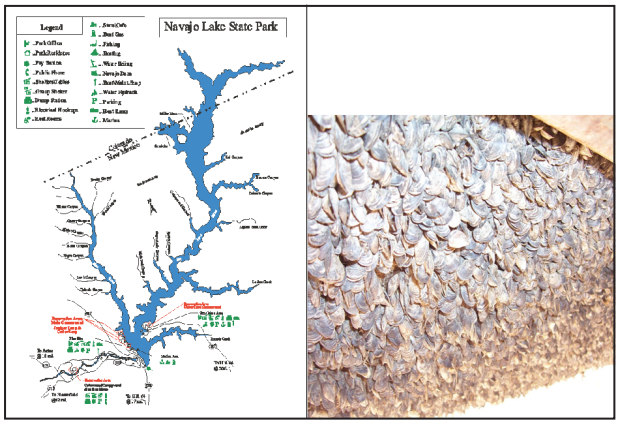

Figure 9. House Boat Found Contaminated Upon Inspection at Navajo Lake State Park

Figure 10 is a photo taken by Mickey Porter of the Army Corps of Engineers of James Sandoval who is with the Fish and Wildlife Service. James is decontaminating that houseboat using equipment borrowed from Colorado because we don't have decontamination equipment in the state yet. So you see that this is a multi-federal and multi-state coordinated effort. Game and Fish is required by statute to create requirements for decontamination. I believe those requirements were signed the day before we decontaminated this boat, which was very convenient. Our Website contains the requirements for decontamination of boats infested with Zebra and Quagga mussels. We can't say these are requirements across the board, they are very specific to species but we do have them for Zebra and Quagga mussels. Also, being released of liability prior to decontamination is a very important step because we use high pressure water between 300 and 350 psi at a minimum of 140° F when it hits the boat and comes out of the device a lot hotter than that. It is a fairly intensive process and if there are issues with the boat, we might not know about those issues until we are in the process of cleaning, and the boat could spring a leak, which happened on this houseboat. So it is very important that we sign a release form prior to touching a boat.

New Mexico Department of Game and Fish
Aquatic Invasive Species
Requirements for Decontaminating Warning
Tagged Conveyances and Equipment Infested with
Quagga or Zebra Mussels

Figure 10. Decontamination of a Houseboat

Our fourth target involves early detection and monitoring. We are monitoring our waters with both PCR and microscopy. Currently, we are sending samples to Denver to be tested and are trying to find local labs in New Mexico to do PCR testing for us to hopefully reduce some costs and the coordination efforts in mailing everything to Denver. We also use artificial substrate samplers where we just pull them up from the water and see what's going on.

In terms of collaboration, national, federal, state, and local stakeholders, there is the 100th Meridian Initiative, the point of which was not to allow Zebra or Quagga mussels to get past the 100th meridian. There are also western and national AIS taskforces. I have already mentioned our federal partners and many of the state partners, and local stakeholders such as sport fish organizations, New Mexico Bass, all those groups that are interested and involved. It is important that they stay that way as well as concerned citizens and private businesses.

The New Mexico Aquatic Invasive Species Advisory Council was formed two years ago and just recently met in July. The council was divided into five subcommittees: Inspection, Decontamination, and Enforcement is one large subcommittee; Research and Monitoring; Infested Waters Protocol (when that designation is made we need to have solid ground to stand on which will be based on Research and Monitoring); Information and Outreach (getting the word out through our

agencies that can pull resources and funds); and the Stakeholder Advisory, which is concerned citizens and marina owners giving us feedback (it is very easy for us to get stuck in regulations and how to make this work, and it is great to hear from bass fisherman exactly what kind of impact we will really make as we don't want to create horrible restrictions on people who are just trying to do the right thing).

Because we put together an Aquatic Nuisance Species Control Plan, we are eligible for an official wildlife grant and we received $34,677 that will go toward research, monitoring and outreach. It's not much and won't go very far, but it is something. We also have Boater Access funding available from Game and Fish and State Parks and it requires a 25 percent non-federal match so we are using that as well. In addition, we are working on compiling a list of all marinas, marina owners, conservation groups, RV entities, and anybody who could be interested or involved in this effort and who might want to contribute either to outreach efforts and get some free advertisement, or to donate toward the purchase of decontamination equipment. A mobile self-contained unit costs about $26,000. The permanent infrastructure for drive-through decontamination units costs around $200,000. We'd like to purchase some but they are not in our current budget. American Recovery and Reinvestment Act funds were utilized by the Corps to hire seven temporary park rangers and continued funding was requested for FY 10. We are scraping up funds when and where we can to increase our capacity.

Looking ahead, we need to continue with training efforts, get more people level 1 trained, get more people level 2 trained, or modify level 2 training requirements so people don't have to go to Nevada. We are also working on refining our monitoring and testing protocol that could be improved. We are developing an infested waters protocol and have some rough drafts of that floating around; when we have something more coherent, we will be sending it out for review. We also need constant and close coordination with basically everybody. One of our issues, and I don't know how we are going to address this anytime soon, is that decontamination is expensive. We need to set up a system where boat owners pay to decontaminate their boats as they do in most states. We must develop decontamination guidelines for other AIS; we need to put something together for Rocksnot and get that information on the web. We need to purchase decontamination equipment; hopefully we will have that at the start of the year.

Another issue is determining suitable decontamination sites. Because we are using hot water, and the process requires a lot of water leaving significant wastewater, we have to determine how best to dispose of that waste. This is tricky to say the least. And we also need to dispose of the solid waste such as mussel shells. Because we use PCR testing, we are testing for DNA of these aquatic Zebra mussels in the water, and if these shells get into the water, the DNA is in the water and thus we will think we have infested waters. It is really important to keep any DNA of these species out of the water. We don't want to decontaminate right on the beach, but we want to do the procedure close to where that boat was trying to get into the water. Hiring a full-time AIS coordinator is something I really hope we can do by next fiscal year.

Aquatic Wild is one of our educational outreach programs for school children and we are trying to incorporate AIS into early education for younger people. We will continue presentations and events, working on the billboards, and we very much need to expand our Web site. We are discussing doing an AIS hotline where a concerned citizen or anybody who is worried about a boat or any kind of equipment being infested can call and leave a message and we will follow up. The message could be done anonymously.

For more information, our current Website is http://www.wildlife.state.nm.us/publications/press_releases/documents/2009/040609ais.html, or you can contact me. I am happy to speak with you individually or give a presentation to any group or coordinate with any group. With that, I will take any questions.

They Are Going to Miss Me When I'm Gone: The Loss of Knowledge and Institutional Memory Due to Retirement

Karl Wood, New Mexico
Water Resources Research Institute

Karl has been director of the New Mexico Water Resources Research Institute since 2000. He joined the NMSU faculty in 1979. Prior to his tenure at the WRRI, Karl was assistant department head and range coordinator for NMSU's Department of Animal and Range Sciences. Much of his research over the years has been related to water resources and for 20 years, he was a member of the Range Improvement Task Force, which provides scientific expertise to help resolve disputes over management of water and other natural resources. Karl completed a BS in 1974 in forestry and range management and an MS in 1976 in range science with field emphasis on soils and range improvements both from the University of Nevada/Reno. In 1978, Karl received a PhD in range science with field emphasis on watershed management from Texas A&M. Karl has nearly 150 journal articles, research bulletins, special reports, and conference proceedings publications to his credit, mainly in the areas of range hydrology, range vegetation and soil assessment, and rangeland management, including reclamation of disturbed lands, range improvement techniques, grazing systems, and management of rare and endangered species.

You all know John Hawley, he knows every rock in New Mexico because he is the same age as the rocks, and John made the comment last year of "What are we going to do when all the water professionals are gone in the next few years?" And if you look at the average age in this group here, I think it is over 40, maybe over 50, and we are aging. So I was asked to put together a short presentation on who is going to replace us, and everybody immediately thought this was my swan song to say "Goodbye. I'm retiring and not coming back next year," but I hope to be back next year unless I'm fired, and maybe even the year after that. Eventually all of us are going to be replaced though.

The baby boomer population of 76 million began retirement last year. About 10,000 people will continue to join their ranks every day over the next two decades. About 10,000 people are going to retire every day. And 60 percent of the federal government, or 1.6 million white collar employees, and 90 percent of about 6,000 federal executives will be eligible for retirement in the next ten years. I thought that announcement would make the GS-7s clap. Almost one-third of the federal workforce is expected to retire or resign in the next five years. That is a big turnover.

As an interesting side note, who is going to benefit from an aging population? Well the cruise lines are looking forward to it, and the pharmaceutical companies definitely are, healthcare products and those companies who sell Rogaine and Viagra and those kinds of things, assisted living facility providers are going to gain from it, financial companies holding pension funds, doctors, especially those in orthopedic and physical therapy are going to benefit, and the only other one I can think of is the medical waste disposal companies, so it is not all bad for everybody.

To look at water, a 2008 study and publication by the U.S. Department of Labor predicted the job outlook from 2006 to 2016. They found that the number of hydrologists employed in 2006 is about 92,000, and we are going to need another 23,000 for a 23 percent increase by 2016. That is really good increase, if we have a workforce. Hydrology is growing much faster than the average job growth, and should be strongest in the private consulting firms. Driving this growth is the need to comply with regulations on flood control, clean air, groundwater decontamination, and the need to cope with demands on resources by a growing population.

Geoscientists now number about 31,000, and we are going to need another 22 percent. Geoscience is also growing much faster than the average, especially in energy, environmental protection, and land and water management. Surveyors, photogramists, and survey technicians are needed. There are not a lot of atmospheric scientists. It is argued that we don't need a lot of them and could do with an 11 percent decrease. I have a hard time believing that but maybe that's right.

The Department of Labor goes on to indicate that the need for agriculture and food scientists will increase by 9 percent, about an average growth rate, which is 7 to 8 percent. Eleven percent more engineers will be needed. Keep in mind engineers versus hydrologists, and you may say ask if there is a difference. The increased need for conservation scientists and foresters is only 5 percent, but that is the way it has been forever. The need for economists is 7%. That's reassuring, isn't it? I don't know where lawyers come in, but hopefully they are down there, too.

Where we are going to get the people to fill these jobs? One thing we can do is keep retirees working part-time, and there is a big effort nationwide in many fields to do that. You might want to provide them with additional training if you think they are trainable, offer job sharing, allow flexible time – these are things that are being tried and have worked.

The Ellis Huddleston model is one few people know about but me, but I observed it in the 1980s. Ellis Huddleston was the department head of Entomology, Plant Pathology, and Weed Sciences at New Mexico State University. He knew that there were many retirees moving into Las Cruces from other places. An example was a guy named George McNew who grew up in Alamogordo and had retired from Cornell University. He was one of the early organic chemists in the 1930s and 1940s. McNew had retired and was living in Las Cruces. Ellis came up with some ideas to put him and several others to work. He recruited professionals in the community who had retired from NMSU or elsewhere to be volunteer researchers. He asked them to research any problem. Ellis knew that often researchers have some things they'd like to work on but didn't have the time during their careers. Ellis gave them the opportunity. It couldn't be something like going to the moon because NMSU didn't have that much money, but if it had to do with determining why harvester ants eat wood then maybe that would work. He expected them to publish an article from their research project; he wanted to put his department on the map so he asked these researchers to publish. That was no problem, they had been publishing for 40 years. He offered them an office on campus – sometimes it was shared – a computer, web and email access, use of a vehicle if they needed to travel to the field, phone privileges, and travel to a professional meeting. After going to professional meetings for 40 years, these retirees were suddenly on their own dime. Ellis said he would send them to their professional meetings and asked them to speak while they were attending. They could see their old buddies and they loved the opportunity. He also gave them campus golf course and activity center privileges, invitations to guest lectures, meetings and classes on campus, and they loved that as well. Ellis gave them a few thousand dollars to conduct their research and total flexibility on time. You would not believe how much time these guys put down on this pet project with no pressure to publish and no pressure to get a raise or tenure; they just had to put out one publication, and they could do the things they loved to do. It worked really well. The benefits included large productivity at a very low cost, and happy retirees with a lasting dignity. We found that many people retire and go away bitter from public and private jobs, and the reason is that their dignity has been taken away. This gave them an opportunity to retain it. Would this model work in non-university settings? I don't know. I'd like to think it would.

We can also increase work visas for foreigners and bring more foreign educated water experts to our country. Or, we can educate and train more professionals. I think that is ultimately where we are going to get the bulk of our new researchers.

What education opportunities do New Mexicans have now to pick up the slack? We have six state universities, only four of them have water education programs: the University of New Mexico has water related graduate research and education programs in many different departments. It also has some special water programs; WRRI associate director Bobby Creel received a PhD in economics from UNM with a specialty in water. New Mexico Tech has about eight full-time faculty members, seven adjunct professors and sixteen different courses in hydrology including groundwater contamination. New Mexico Tech has a really good groundwater program, and it houses a New Mexico water certification program for people who have their bachelors or masters degree, go away to the work force and want to become certified. New Mexico Highlands has a master's of life science and biology degree with concentration in natural resources management. They graduate several masters students every year.

The program I want to talk mostly about is at New Mexico State University. We realized a few years ago that we have water researchers and educators all over campus, and there was no organization that brought them together. Most of the research today is interdisciplinary research; that is just the way we have gone in the last 20 years. NMSU formed an organization called the Water Science and Education Center. It is a virtual organization. There are eighty-five faculty members at NMSU who conduct water research and educate in that area. That was kind of shocking; that's more than at the other universities, Sandia National Lab, and Los Alamos National Lab put together. The 85 faculty and staff teach 85 graduate courses where water is in the title or in the course description and 112 undergraduate courses. The water-related programs are in 16 different departments across campus and this center brought them together.

What opportunities are on the horizon? Matt Larsen, Associate Director of the USGS last year said "…most hydrologists did not earn degrees in hydrology. In fact, only a handful of undergraduate and graduate hydrology programs exist across the country. It is far more common for hydrologists to come from the hard sciences or an engineering background with a specialty in water." So what does that mean? The national trend today in new programs is to develop a hydrologist with a specialization in multi-disciplinary areas. An example, the existing title we have is hydrogeologist. A hydrogeologist is a geologist first, one who works with water. The new title would be a geohydrologist, someone who is a hydrologist first with a background in geology.

NMSU recognized this trend and saw the opportunity given that so many faculty were teaching so many different courses. Researchers have developed a proposal that currently is going through the approval process. The proposal is for a master's program in water science and management with core courses and some flexibility. Another proposal is for a PhD program in water science and management with some core courses. Courses are in the disciplines of agriculture, engineering, arts and sciences, and environmental toxicology. The PhD could be earned in 34 credits with some electives. The major advantage of the proposed graduate programs is that they foster a multi-disciplinary research approach that broadens the ability for researchers to acquire grants. The big question in science is always, "Where is the next grant coming from?" These new graduate programs allow water professors and professors without PhDs to advise doctoral students, and that will be a real boost. It allows water professors in PhD-granting departments to advise students in one of two tracks, either the department specialty or the multi-disciplinary specialty. This should encourage more students to pursue a degree in water science and management.

We have many opportunities to help New Mexico develop our replacements. Maybe our personalities can't be replaced. Many years ago I was a pastor and I had a congregation of about 450 people and there were four or five people in the congregation who had a different kind of personality. My wife wouldn't let me call them kooks but that's what they were. I noticed that when they moved away, somebody always took their place. In our hydrology profession, we have some people who have a little different personality, but when they are gone, don't worry, there will be someone to take their place.

We will be replaced, and I include myself with the kooks. The major advantages of proposed graduate programs are that they foster a multi-disciplinary research approach that broadens the ability to acquire grants. In conclusion, smooth seas do not make skillful sailors; these programs are developing and coming along. Have faith, all of us can and will be replaced, and if that isn't enough, as Yogi Berra would say "the future ain't what it used to be."

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