Sandoval County Plans for Future Growth: Rio Puerco Desalination Plant

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, Karl, for the opportunity to be here today. For those who may not know, Sandoval County is located north of Albuquerque; it's about 3,200 square miles, and we are expecting the 2010 population number to be somewhere around 125,000 people (Note: 2010 census number came in at 131,561; representing a 10-year growth rate of 46.3 percent). Most of those people are concentrated in the City of Rio Rancho (2000 census value: 51,765; 2010 population: 87,521; a growth rate of 69.1 percent), which has been one of the fastest growing cities in the state and pulled the county into the position of being the fastest growing county in the state. The growth rate figures indicate a growth rate of 42 percent between 2000 and 2009, but in 2008 to 2009 that dropped off quite a bit. To get 42 percent, you'd be at almost 4 percent a year compounded; the 2008-2009 rate was down to about 1.5 percent and didn't even make the census list of the 100 fastest growing counties in the country. This means it went from #43 when based over a nine-year period to "not even on the list" in one year. That's not uncommon, the county that was the #1 fastest growing county in the country earlier in the decade was Flagler County in Florida but in the past couple of years, they weren't even on the list of 100, which obviously is a function of how the economics changed over the last two or three years.

So how does the county address this rate of growth? Although a bit unusual, this county doesn't really have a water system per se; we don't run a water utility at this time and probably will not in the near future. The county does have a subdivision regulation as does every other county. Appendix A of the subdivision regulations indicates that instead of the 40- or 50-year requirement for water supply to issue building permits for subdivisions, this area of the county requires a 100-year assured water supply. Some participants here today have done studies for developers to support the water supply numbers. I think it's a good policy to have a 100-year extended window to look at these things, especially in a faster growing county where you could potentially overextend your commitment. In 50 or 80 years, you could find yourself in an uncomfortable position.

Sandoval County's 100-year requirement applies to the southern part of the county, the lower 12 miles up from the Bernalillo County line, and extends from Highway 14 on the east side of the Sandias, westward to the lands of the Laguna Pueblo. This includes the parts of the county that grow the fastest. County policy does not apply to municipalities, so this does not apply in the City of Rio Rancho; they have their own requirements. It doesn't apply to federal or Native American lands, so its impact is limited, but it is in effect in those areas where there is the most potential growth.

Figure 1 data are from a Rio Rancho website showing single family residential growth from

1985 to 2009. The high growth period was that unbounded exuberance period of the mid part of this decade. And if you look at it on a year-to-year basis, you can see it a lot more clearly in Figure 2. I didn't have as many years of data from the City of Albuquerque; they have about three or four years on their website, but it looks similar.

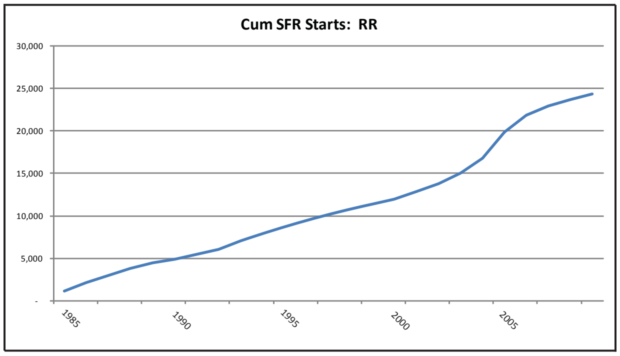

Figure 1. Cumulative residential starts for City of Rio Rancho

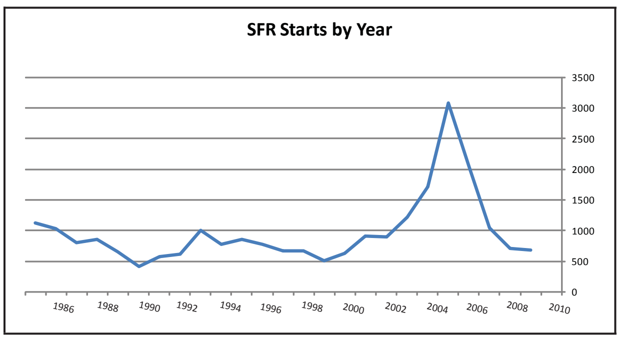

Figure 2. Residential starts for City of Rio Rancho

To be clear, a permit being issued to build a house doesn't mean the house gets built right away and there were other permits issued for multi-family developments. Consider also that permits for dwelling units are issued, but sometimes don't get built. The demand doesn't really show up right away but it is on-line to do that. Most of the growth in Sandoval County is in the south.

As we look forward, the third bullet in Figure 3 mentions the opportunity for growth; there is a lot of land that was previously owned by AMREP. Before Rio Rancho was incorporated in 1981, it was pretty much all owned by AMREP. They were in the business of developing and selling land. When Rio Rancho was incorporated, it was a small amount of land that ran from what is Southern Boulevard to Northern Boulevard, and it has expanded quite a bit since then. Currently it is 102 square miles. The area that AMREP had owned that is now not inside the city limits, is called Rio Rancho Estates. It is sparsely populated, has very little in the line of utilities or services, and is poised for growth. Given the current economy, we have time to take a sober look at what's going on. There are other areas considered for potential service by desalination that are not in the Estates. Some areas are adjoining ranch land and some are developments that were proposed in Bernalillo County (what was once Quail Ranch that became land annexed by the City of Rio Rancho). So there may be a demand for water being passed through the City of Rio Rancho to those areas. It remains to be seen how that will be addressed. As mentioned before, the slow-down in the growth has caused many of these permitted units to not have been started.

- Most growth in County is in South
- Concentrated in City of Rio Rancho
- Opportunity for growth in surround area
- Projections need period adjustment
- Rio West Master Plan approved by County Commission in 2006; is in Rio Puerco valley
  - Not started to date
  - Desal initiative was for this area/ development

Figure 3. Looking forward

Sandoval County worked with a developer for a planned community; the County approved the master plan for Rio West in 2006 and a desalination plant was proposed for that area. It is more than 11,600 acres of land in the Rio Puerco valley west of the Rio Rancho Estates. There is other mixed land; including some state land and some private land closer to the Bernalillo County line. That Rio West master plan indicated that work would start in 2008, but that has not happened yet. The number of housing units proposed in the master plan will also probably be scaled back quite a bit; the number of housing units was between 25,000 and 29,000 over a period until about 2031. (Note: The County and the developer have ended their joint efforts on this project. Continuing effort will be by the developer.)

Discussions with other community areas and developers were undertaken (Fig. 4). In some cases these communities do not currently exist, and the purpose was to determine how big a desalination facility should be planned. Obviously, you don't build a 25 or 30 million gallon a day plant on day one; (El Paso is different and they could do that) we couldn't because we didn't yet have customers with the demand for 25 million gallons per day. To decide how big to make this first unit, we performed an engineering evaluation, which came up with a five million gallon/day increment. The plan called for additional increments as demand developed. The trade-off was to either build a small less expensive plant or to build something larger that would allow expansion over time.

- In addition to Rio West, talks with others in the area to ascertain "need" for water
  - City of Rio Rancho
  - AMREP
  - Quail Ranch (before it became part of Rio Rancho)
  - King Brothers Ranch
  - Breezy Point
- Goal: How big plant should be? When?

Figure 4. Other developments in the area

What would happen if AMREP decided to develop the land they own? County tax records indicate there are about 40,000 lots in the Estates: some owned by AMREP, about half of which have been sold. These have been sold to people all over the country. When you try to provide utility service to these randomly distributed lots, it is very difficult because there is so much undeveloped and open space with often unknown ownership. We know what the property/tax records databases show, but we don't always know where those people are all the time. Folks regularly come to the County while visiting New Mexico to see the land that they found the deed for in Grandma's safety deposit box after she died. In many cases they didn't even know that they owned the property they ask: What is the land worth? Where will I get my water? When is the county going to drill my well? I am sure other Counties deal with similar issues and that Sandoval County is not unique in this regard.

If you build a five million gallon capacity today, there is only one potential buyer who could take five million gallons a day. In our case, that would be the City of Rio Rancho. We talk to the City quite a bit. We must sell water in large volumes to be able to pay off the debt incurred to build the plant in the first place. So it can become less about water and more about economics and finance.

What was it that the developer had done? The developer contracted Balleau Groundwater to do a study, which was a good idea. Having looked at that study before and after the wells were drilled, it appeared to me to be a good study. Balleau made estimates as to how deep you might have to go to get water. It recognized the fact that through the 11,000 acres of land, you have a lot of faulting: One of these is the Moquino Fault, which begins further up the County around La Jara and is associated with the Nacimiento Front (mountains to the west of the Valles Caldera, north of Cuba).

Based on these estimates to water depth, the developer filed for well permits with the state engineer; three of those locations were in Sandoval County and three were in Bernalillo County. We drilled two of those exploratory wells. The first one drilled was 3,840 ft deep. We found water at 3,700 feet and more water about 3,772 ft. The screened interval was from 3,598 to 3,809 ft. The water was contained in the San Andreas and Glorieta formations. The formation where we completed the well was the Yeso. The second well was drilled about 3,500 ft away. We hit water at about the same level, but we continued to drill to the granite. Total depth was 6,450 ft deep.

Our purpose was to find out if there was more water below and unfortunately we didn't find more water. In drilling through the Madera, we learned that it is very hard and therefore expensive when you are paying a day rate on a drilling rig. We were hoping to find fractures in the Madera. That did not happen. We were interested in fractures because it might help us answer the question that will come up about what to do with the concentrate stream from the desalination process. We do not know exactly what that answer is, but it is likely that injection will be evaluated as an option. Having drilled to the granite, we know more about the formations. Considerable additional study will be required to make a final case, should that injection option be pursued (approval of that option will have to be in accordance with the injection wells permitting processes/policies).

At 3,700 ft this water was quite saline. The reason to even go after this water is because of state statute 72-12-25. Basically that statute indicates that the state engineer doesn't control water that has more than 1,000 ppm total dissolved solids if the aquifer is more than 2,500 feet from the surface.

As it turned out, this water qualified. (Note: The statute was partially repealed in 2009. The statute now allows some uses of deep waters, but excludes water utilities. Issues of grandfathering might be entertained by the Office of the State Engineer (OSE), but are not clear to me at this time.)

Until the well encountered the water (3,700+ ft), we couldn't determine the water "quality"; we could have done with less than the 12,000 TDS (instead of just getting over the 1,000 TDS drinking water standard). The 12,000 TDS is about one third of the amount of solids/salinity contained in normal ocean water. The biggest difference between this water and ocean water is that this water is hard and ocean water is soft. We have high TDS, a fair amount of salt, and more arsenic than you want to think about. It has carbon dioxide and silica. All pose challenges to overcome to achieve an economical process. So it will require a fairly sophisticated treatment process to remove selectively the constituents from the water and ensure a good life span for our membranes: Also desirable is a good return in terms of percent recovery in the treatment process. (Note: The water quality test values were from four tests done at the first well only; second well quality testing has not been done at the time of this presentation, and should be of considerable importance going forward. Efforts of the land developer in April 2011 will include additional testing for water quality data.)

In October of 2008, we performed a 30-day flow test on the first well. We learned as much as we could from having only two wells instrumented. We flowed one and observed the response in the other well; after 30 days of flow we observed the recovery. These wells both flow artesian so we didn't have to put a pump in either one of them. You just open the valves. The first well flows 600-900 gallons/minute depending on what size orifice you want to use and how much risk you are willing to accept. If you close the valve, you have about 160 lbs of pressure at the head of the first well. The second one flows at about 125-150 gallons/minute, and when you close it in, you get about 200 lbs of pressure. You'll have to find someone with more experience than I to explain that but you don't get as much flow out of the second well (with higher pressures). The last step, the pilot testing, we did about a year ago (Fall of 2009), and I spoke about that effort at the 2009 water conference.

To support the test, we had a trailer-mounted pilot plant on site to determine a sequence of processes for treatment. Our prime contractor for this work is Universal Asset Management and one of their principle sub-contractors is CDM, which brought the trailer out to the site. This effort was funded with legislative money in the amount of about $700,000. Water flowed into the process trailer at 15 gallons/minute once we got the process balanced. We then ran it daily for about a month. The process begins with multi-stage solids removal so that we do two things: extend the life of the membranes and try to recover marketable products. If we can find markets to sell these constituents it (1) reduces the amount of injection that we have to do, and (2) there is the economic aspect of selling the removed materials. I never wondered how much you pay for a carton of salt in the store, but sell it in large enough quantities and you get numbers like $40 to $80 per ton for food grade salt. We have the potential to produce 250 tons a day of salt.

The water is going into the process at about 12,000 ppm (TDS) and the water coming out is about 300 ppm; observed recovery rate is about 82 percent. Whether that can be scaled up and maintained from a physical or economic point of view at production levels remains to be seen (you are making serious investments in both chemistry and energy to achieve 82 percent at production levels of 5+ mgd).

Figure 5 show the process trailer. In this photo, the well is hard to see. It is at the end of the black hoses, near the black barrels. The processed water comes out of the well, goes up on top of the trailer to the white container (that doesn't show very well in the photo) to allow the gases to be stripped from the water. It then flows down through this claricone (the large green funnel shaped device); lime (caustic) is added to get carbonate to precipitate out. Behind the claricone is a granular activated charcoal system (outside). The polishing system, kind of like a household water softener on steroids, is located inside the trailer.

Figure 5. Pilot plant

All of this occurs before you get to the membranes (Fig. 6), which are inside these large white tubes. There is a fifth tube on top you can't see but that is where the final stage membranes are. These are small membranes (pipe size); there is a "magnum" membrane coming on the market today. I haven't seen them installed but they are about a sixteen-inch diameter, so there is some really large membranes out there. I think the El Paso plant runs eight inches.

Figure 6. Membrane containers

In addition to the water arriving under artesian pressure, it is 150° F. This presents an opportunity for energy recovery. We can use the pressure of the free-flowing water, we realize that nobody guarantees us that we will have pressure forever. We don't know its source. The geologists here could probably tell you three or four different ways you could have that kind of pressure. We don't know which one or which combinations, we have. This means we must plan for a day when the pressure somehow diminishes or the temperature goes down and we can still have a process that works with those parameters.

Among issues in the process stream we have the dissolved CO_2 stripping (container on top of the trailer) and arsenic and radium are elements we'd like to take out early to reduce disposal volumes. In the beginning, we believed they could be a hazardous material for disposal, but since then we've learned that it probably won't be as big a deal. However, we still need to be careful with it and certainly it has to come out of the water before it meets potability standards.

I mentioned that we had a fair amount of arsenic, nearly 700 ppb. The standard is 10 ppb for drinking water, so we know we have to deal with that. The warm lime softening in that big green claricone (visible in the Pilot Plant image, Fig. 5) removes large masses of carbonate, the primary sources of the hardness in the water, and is a potential fouling agent for the membranes. Media filtration (GAC) is located behind the claricone. Further polishing of the water is done in a zeolite canister in the van.

To make the economics feasible, given the carbonate volumes we will be removing, we have contemplated a recalcination process onsite. Rather than importing railroad car sized quantities of lime to deal with the softening, we could make the lime onsite. At the end of these processes, water gets to the membranes. This is the 10,000 foot view of the sequence we are planning (Pilot Process, Fig. 7). How well it scales up from pilot size (at 15 gpm, to 3,500 gpm) will be a major factor in achieving cost objectives.

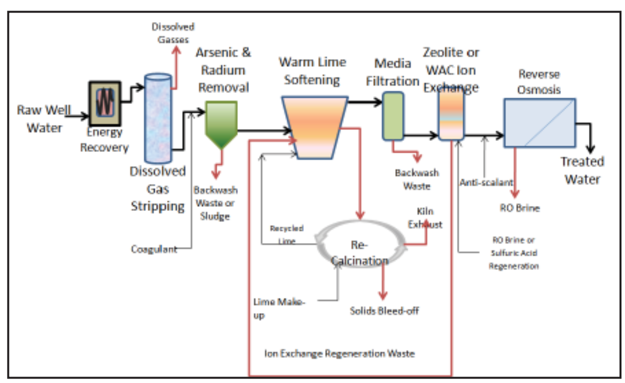

Figure 7. Pilot process

The next step was developing of the preliminary engineering report. We submitted it to the New Mexico Environment Department (NMED) and to the OSE. Their comments are being reviewed now.

Things we need to do before we commit a whole lot of money (in the $100+ million range), include gathering more information about aquifer characteristics. We harbor no illusions that this would be a fully sustainable source where we could get water recharged on a one-to-one basis matching everything we take out.

We obtained a sample from well EXP-6 during the early stages of well development and submitted this sample to University of Arizona in order to obtain the approximate age of the water in the sample. The laboratory reported a result for this sample of 29,000 years based on a Carbon-14 analysis. Given the Permian age of the aquifer (about 200 million years old), this result was surprising. Additional testing of samples from this well and EXP-5 are necessary to provide some degree of certainty regarding the age of the ground-water in these brackish water aquifers. Of further note is the limitation of Carbon-14 dating. Some sources state that 30,000 years is nearing the edge for Carbon-14 accuracy. (Note: This age data was from the first well only, and the tested sample was taken shortly after the initial flow testing. It is highly probable that subsequent testing may provide different results. In addition, the faulted nature of the area and the fact that the two wells showed markedly differing flow rates, leads to a lack of precision concerning some characteristics of the resource.)

The recovery, when the well was turned off, after the flow test (Fall 2008), was about 80 percent of what we observed as drawdown within 48 hours of shut down. The flow test rates 150 gallons/minute followed by a period of 250 gallons/minute from the 30-day test that we ran for making estimates of aquifer volumes and capacity. We need to know more about that, and we will need additional wells. The wells we drilled cost about $2 million each and that is a fairly expensive price for risk reduction and confirmation of data that we need to know. (Note: The recovery observations were based on pressure data from down-hole sensors, and not static levels of the water. Down-hole water pressures at the beginning of the testing were 1,504 psi. After 60-90 days of recovery, the pressure had recovered to 1,499 psi.)

Areas we need to know more about looking forward: impacts and interferences due to well locations and placement/spacing are to be determined. There is a lot of faulting in the area, which adds complexity. Any case to support assumptions on recharge and sustainability are tied to data that may be collected from more wells and additional flow testing. We understand that knowledge gained in this collection process may lead to conclusions other that "more water."

This year's conclusions are similar to the final thoughts from last year. We acknowledge that water is a limiting factor for growth in the county. There are many other costs that haven't been fully quantified in the estimates so far. More information on treatment costs is needed. More importantly, infrastructure for transporting and distributing this water is not included in the cost numbers so far. The County proposed to be a wholesaler of water: the customer builds his pipeline to take water from the desalination facility to his point of use/sale.

Other topics to be addressed will be by the developer concerning wastewater collection, sewers, and the potential reuse of wastewater effluents. This includes the possible reuse and treatment of effluent to potable standards. On a dollars per gallon basis, it is cheaper to treat wastewater to drinking water standards than it is to treat this 12,000 TDS water. We haven't figured what to do with the concentrate disposal. We know it will be expensive and would like to reduce its volume by marketing other by products.

Future considerations beyond this specific project include:

- Water statute- NM legislature partially repealed NMSA 72-12-25 (as noted above). Impacts of this action are not fully understood at this time.
- Eventually the customer will be asked to cover the costs to run this, and we recognize that. The bottom line is how much can you charge per 1,000 gallons of water? We think we can do this in the neighborhood of $6/1,000 gallons. Grant funding can reduce these costs by about $1/1,000 gallons for each 25 percent of the construction costs offset by grants. Interest on debt incurred to build the plant will be the largest expense over the life of the repayments.
- A group approached the County about co-locating a power plant at the desalination facility, which would have dropped the price by about $1/1,000 gallons, but we haven't heard much from them lately.

John Trever gave me permission to use this cartoon (Fig. 8); I thought it fits here. I'd be glad to answer any questions.

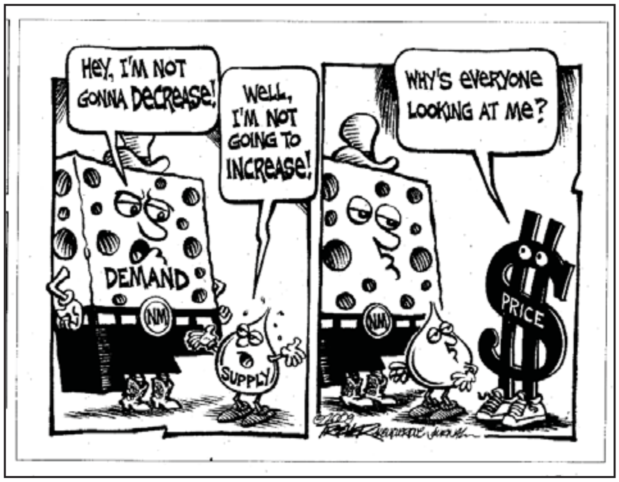

Figure 8 . Cartoon by John Trever