STATE OF NEW MEXICO
WATER QUALITY CONTROL COMMISSION

IN THE MATTER OF THE PETITION FOR ALTERNATIVE ABATEMENT STANDARDS FOR THE FORMER ST. ANTHONY MINE, CIBOLA COUNTY, NEW MEXICO

No. WQCC 16-05 (A)

NEW MEXICO ENVIRONMENT DEPARTMENT'S STATEMENT OF INTENT TO PRESENT TECHNICAL TESTIMONY

Pursuant to the Water Quality Control Commission ("Commission") Adjudicatory Procedures, 20.1.3 NMAC, the New Mexico Environment Department ("Department") submits this Statement of Intent to Present Technical Testimony at the public hearing in this matter, scheduled to be held on July 11, 2017. The hearing will address the Petition for Alternative Abatement Standards ("Petition") for the former St. Anthony Mine in Cibola County, New Mexico. The Petition was filed by United Nuclear Corporation ("UNC") on December 19, 2016.

In accordance with 20.1.3.17.E NMAC, the Department states as follows:

1. Name of person filing Statement of Intent:

The entity filing the Statement of Intent is the Ground Water Quality Bureau of the Water Protection Division of the New Mexico Environment Department.

2. Statement of position:

The Department does not oppose the Petition and recommends that the Commission grant the Petition.

3. Name and affiliation of Department's witness:

Kurt Vollbrecht
Manager, Mining Environmental Compliance Section
Ground Water Quality Bureau
New Mexico Environment Department
Santa Fe, New Mexico

The Department reserves the right to call additional witnesses in rebuttal.

4. Estimated Length of Testimony:

Mr. Vollbrecht's direct testimony is estimated to take approximately 30 minutes.

5. List of exhibits to be offered at the hearing:

The Ground Water Quality Bureau intends to offer the following exhibits into evidence at the hearing:

NMED Exhibit 1:	Written Testimony of Kurt Vollbrecht
NMED Exhibit 2:	Resume of Kurt Vollbrecht
NMED Exhibit 3:	Map Showing Ore Body in Vicinity of St. Anthony Mine
NMED Exhibit 4:	January 9, 2002 Letter from NMED to UNC Requiring Abatement Plan
NMED Exhibit 5:	June 27, 2017 Letter from Mining and Minerals Division in Support of Alternative Abatement Standards
NMED Exhibit 6:	"Bibo, Moquino and Seboyeta Public Water Systems Source Water Protection Issues," by Dennis McQuillan
NMED Exhibit 7:	Resume of Dennis McQuillan
NMED Exhibit 8:	April 26, 2017 Letter from Office of the State Engineer re: Institutional Controls per 20.6.2 NMAC

The Department may introduce additional exhibits as evidence for purpose of cross-examination or in rebuttal. The Department may also use additional demonstrative exhibits at the hearing, such as photographs, maps, charts, graphs, and PowerPoint slides, without introducing them into evidence.

6. Summary of Testimony:

The written direct testimony of the Department's witness, Mr. Kurt Vollbrecht, is submitted as Exhibit 1. Mr. Vollbrecht will testify about the applicable criteria for evaluation of petitions for alternate abatement standards, his review and evaluation of the Petition, and how UNC has met the requirements under the New Mexico Water Quality Act, NMSA 1978, §§ 74-6-1 through -17 (as amended through 2013), and the Commission's Water Quality Regulations, 20.6.2 NMAC.

Respectfully submitted,

NEW MEXICO ENVIRONMENT DEPARTMENT

/s/ Annie Maxfield
Annie Maxfield, Assistant General Counsel
Office of General Counsel
New Mexico Environment Department
121 Tijeras Ave. NE, Suite 1000
Albuquerque, New Mexico 87102
Telephone: (505) 222-9592

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing Statement of Intent to Present Technical Testimony was served on the following parties of record on June 29, 2017:

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Santa Fe, NM 87504
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/s/ Annie Maxfield
Annie Maxfield

STATE OF NEW MEXICO
WATER QUALITY CONTROL COMMISSION

IN THE MATTER OF THE PETITION
FOR ALTERNATIVE ABATEMENT STANDARDS
ST. ANTHONY MINE, CIBOLA COUNTY, NEW MEXICO NO. WQCC 16-05 (A)

WRITTEN TESTIMONY OF KURT VOLLBRECHT

My name is Kurt Vollbrecht, and I am the Program Manager of the Mining Environmental Compliance Section ("MECS") with the New Mexico Environment Department ("Department" or "NMED") Water Protection Division's Ground Water Quality Bureau ("GWQB"). I am presenting this testimony in the hearing concerning the Petition for Alternative Abatement Standards ("Petition") for the Jackpile sandstone aquifer at the St. Anthony Mine in Cibola County, New Mexico. United Nuclear Corporation ("UNC") filed its Petition on December 19, 2016.

I. QUALIFICATIONS

MECS is responsible for all permitting, spill response, abatement, and public participation activities associated with mining facilities in New Mexico in accordance with the New Mexico Water Quality Act, NMSA 1978, §§ 74-6-1 to -17, and the Ground and Surface Water Protection Regulations, 20.6.2 NMAC and 20.6.7 NMAC. I have held the position of Program Manager for three years and I oversee 12 supervisory and technical staff. In total, I have worked for NMED for over 18 years, holding a variety of technical and supervisory positions in NMED's Water Protection Division (and its predecessor divisions), including the last 11 years with MECS. I hold a Bachelor of Science degree in Geology from California State University, Hayward and a Master of Science degree in Geology from the New Mexico Institute of Mining and Technology.

A copy of my resume is marked as NMED Exhibit 2. It is accurate and current.

NMED Exhibit 1

II. GENERAL DESCRIPTION OF THE ST. ANTHONY MINE

The St. Anthony Mine is located within the Laguna Sub-District of the Grants Mining District. The Grants Mining District is an area of significant uranium reserves approximately 100 miles long and 25 miles wide encompassing portions of McKinley, Cibola, Sandoval and Bernalillo counties in west-central New Mexico. The St. Anthony Mine is in Cibola County, within Township 11 North, Range 4 and 5 West, approximately three miles east-southeast of the Village of Moquino and shares a border with Laguna Pueblo to the south. The property containing the St. Anthony Mine is owned by Cebolleta Land Grant and was leased to UNC for mining purposes. The neighboring property owners include Cebolleta Land Grant, Laguna Pueblo, and a private owner.

The St. Anthony Mine was operated by UNC from 1975 to 1981. During this time, conventional mining by UNC was conducted in two open pits and an underground mine. UNC's exploration drilling established that, in addition to an ore deposit of economic value, the zones of mineralization in the Jackpile sandstone extended beyond those areas that were considered economical to mine. In addition, the known extent of the ore deposit at St. Anthony was never fully mined. Additional economic ore deposits associated with the J. J. No. 1 mine remain to the northwest, upgradient from the St. Anthony Mine with respect to the direction of groundwater flow. NMED Exhibit 3.

III. DESCRIPTION OF JACKPILE SANDSTONE AQUIFER

The Jackpile sandstone consists of an 80- to 120-foot thick lens of medium to coarse grained sub-arkosic sandstone that is located at the top of the Brushy Basin Member of the Morrison Formation. It is overlain by the Dakota Sandstone which has an approximate 10-foot thick olive-gray shale at the base within the area of the St. Anthony Mine. The Dakota Sandstone

is not a water bearing unit within the area of the St. Anthony Mine. The Jackpile sandstone is underlain by mudstones and sandstones of the Brushy Basin Member of the Morrison Formation. The stratigraphic units generally dip shallowly to the northwest at approximately 1.5 degrees. As a result, the Jackpile sandstone is found at greater depths to the west and northwest of the St. Anthony Mine and outcrops at the surface to the southeast, including within Meyer Draw. Recharge occurs locally in the San Mateo Mountains to the northwest. Regional groundwater flow within the Morrison Formation, including the Jackpile sandstone, is to the southeast.

IV. HISTORY OF ABATEMENT ACTIVITIES AT THE SITE

Underground and open pit mining at the St. Anthony Mine was initiated prior to promulgation of the Water Quality Control Commission ("Commission") regulations, and ceased in 1981 when the groundwater discharge permit program was in its infancy. In 1995, NMED drafted a preliminary assessment report for the St. Anthony Mine. In 2001, NMED drafted a report that included water quality data and the results of various field investigations. On January 9, 2002, pursuant to Sections 20.6.2.1203.A(9), 20.6.2.4104, and 20.6.2.4106.A NMAC, NMED sent UNC an "Abatement Plan Required" letter based on available water quality data. NMED Exhibit 4. In November 2002, NMED issued a conditional approval of a Stage 1 Abatement Plan and UNC began site characterization. In September 2006, UNC submitted an initial Stage 1 report summarizing site characterization. Over the next two years, NMED required several addenda to the Stage 1 report, and in November 2008, UNC submitted a Stage 2 Abatement workplan. A Multiple Accounts Analysis ("MAA") process was initiated on May 14, 2009 with a meeting among various stakeholders including representatives from Laguna Pueblo, Cebolleta Land Grant, the Mining and Minerals Division ("MMD") of the New Mexico Energy Minerals and Natural Resources Department ("EMNRD"), the NMED Surface Water Quality Bureau, NMED GWQB,

Everest Holdings, Neutron Energy Incorporated, New Mexico Department of Game and Fish, and UNC. The MAA process is a process through which multiple stakeholders' objectives can be weighed and balanced to achieve consensus or near-consensus decision making. Over the next two-plus years the stakeholder group met to discuss, evaluate, and score various abatement alternatives. Based on the MAA process and results, and additional work conducted under the Stage 2 Site Characterization, UNC selected and proposed to NMED a preferred abatement option in a final Stage 2 Abatement Plan dated September 24, 2014. UNC submitted a modified final Stage 2 Abatement Plan to NMED dated February 9, 2015. The preferred abatement option includes a partial pit backfill and geochemical stabilization of pit sediments, which will result in the need for alternative abatement standards ("AAS") for groundwater in the Jackpile sandstone at the St. Anthony Mine.

The requirements of the New Mexico Mining Act, NMSA 1978, Sections 69-36-1 to -20, were a major factor for consideration during the MAA process and UNC's selection of a preferred abatement option. The Mining Act requires surface reclamation of mine sites to achieve a designated post-mining land use and self-sustaining ecosystem. In addition, in order to leave the large and small pits open, a pit waiver would need to be obtained in accordance with Mining Act regulations, 19.10.5.507.B NMAC. To obtain a pit waiver under the Mining Act and its associated regulations, UNC would need to demonstrate that the large and small pits would meet all applicable laws, regulations, and standards for air, surface water, and groundwater protection following closure; and that the open pit will not pose a current or future hazard to public health or safety. As discussed in a letter to NMED from the MMD director in support of the Petition, the requirements for a pit waiver would be difficult to achieve. NMED Exhibit 5.

V. PROPOSED ALTERNATIVE ABATEMENT STANDARDS

UNC has proposed AAS for the St. Anthony Mine of 12.4 mg/L for uranium, 2913 pCi/L for radium (combined radium-226 and radium-228), 10.7 mg/L for fluoride, 77,000 mg/L for sulfate, 113,000 mg/L for total dissolved solids ("TDS"), 5.05 mg/L for boron, and 908 mg/L for chloride. The AAS are requested in perpetuity to facilitate site closure and development, with institutional controls proposed to ensure that the Jackpile sandstone aquifer is not used as a potable water supply in the future.

VI. STATUTORY AND REGULATORY REQUIREMENTS FOR AAS PETITIONS

Alternative abatement standards fall within the Commission's authority to grant a variance from any regulation of the Commission, pursuant to NMSA 1978, Section 74-6-4(H), of the Water Quality Act. The Commission's abatement regulations provide that a responsible person may submit a petition for approval of AAS any time after submission of a Stage 2 abatement plan. NMED reviews petitions for AAS and makes a recommendation to the Commission regarding approval based on the criteria in 20.6.2.4103.F(1) NMAC:

> (a) compliance with the abatement standard(s) is/are not feasible, by the maximum use of technology within the economic capability of the responsible person; OR there is no reasonable relationship between the economic and social costs and benefits (including attainment of the standards set forth in Section 20.6.2.4103 NMAC) to be obtained;
>
> (b) the proposed alternative abatement standard(s) is/are technically achievable and cost-benefit justifiable; and
>
> (c) compliance with the proposed alternative abatement standards will not create a present or future hazard to public health or undue damage to property.

An AAS petition must provide the information required under Subsection 20.6.2.4103.F(2) of the abatement regulations, as well as that required for variance petitions under Subsection 20.6.2.1210.A NMAC. 20.6.2.1210.A NMAC requires that the petition:

(1) state the petitioner's name and address;

(2) state the date of the petition;

(3) describe the facility or activity for which the variance is sought;

(4) state the address or description of the property upon which the facility is located;

(5) describe the water body or watercourse affected by the discharge;

(6) identify the regulation of the commission from which the variance is sought;

(7) state in detail the extent to which the petitioner wishes to vary from the regulation;

(8) state why the petitioner believes that compliance with the regulation will impose an unreasonable burden upon his activity; and

(9) state the period of time for which the variance is desired.

Subsection 20.6.2.4103.F(2) NMAC requires that an AAS petition also specify the water contaminant(s) for which alternative standards(s) is/are proposed, the alternative standard(s) proposed, the three-dimensional body of water pollution for which approval is sought, and the extent to which the abatement standard(s) set forth in Section 20.6.2.4103 NMAC is/are now, and will in the future be, violated.

VII. THE PETITION MEETS THE REGULATORY REQUIREMENTS

I have reviewed the UNC AAS Petition and, based on my review, I conclude that the Petition meets the statutory and regulatory requirements under the Water Quality Act and the Commission's regulations, as discussed below.

A. Compliance with Abatement Standards is Not Feasible

UNC has demonstrated that compliance with the abatement standards in 20.6.2.4103.B is not feasible, pursuant to 20.6.2.4103.F(1)(a) NMAC. As discussed in the Petition, and in the Stage 2 Abatement Plan dated February 9, 2015, the presence of naturally occurring uranium mineralization within the Jackpile sandstone within the proposed AAS boundary results in it being infeasible to abate groundwater to meet the WQCC standards for the health-based constituents uranium and radium. Groundwater in the Jackpile sandstone upgradient and off-gradient of the St. Anthony Mine naturally exceeds groundwater standards for uranium and radium, as well as for other constituents in the AAS petition including fluoride, sulfate, and TDS. In addition, contaminant levels have increased significantly within the large pit lake due to evapoconcentration and geochemical processes, and this will continue until the pit is backfilled. The constituents with increased levels in the pit lake include uranium, radium, boron, chloride, sulfate, and TDS. The presence of uranium and associated minerals within the Jackpile sandstone will remain a source for elevated levels of contaminants of concern in groundwater in perpetuity, regardless of what efforts are made to address constituents that are elevated within the pit lake. Therefore, implementing treatment to abate contaminants that are present in the pit lake above standards would result in an aquifer system that is still unusable due to naturally occurring uranium mineralization within the Jackpile sandstone.

B. The Proposed AAS are Technically Achievable and Cost-Benefit Justifiable

The proposed AAS are based on UNC's geochemical modeling of the future water quality associated with the existing pit lake within the large pit. The geochemical modeling was reviewed by NMED aqueous geochemist Dr. Patrick Longmire which resulted in refinement of the model prior to NMED approval of the Stage 2 proposal. Current water quality was used to project water quality in the pit lake in the future based on mineral solubility, and geochemical and physical processes, including evapoconcentration. The AAS proposed represent a "worst-case" scenario with respect to water quality following backfill of the large pit, although it is highly unlikely that these high concentrations will be approached in groundwater within and downgradient of the large pit following backfill. Given the complex reactions that will likely take place in the pit backfill and the Jackpile sandstone downgradient of the large pit and the uncertainty associated with predicting these reactions, it is prudent to request alternative standards that represent the worst-case scenario following pit closure. As is discussed in section VII.C, below, there is no potential for downgradient mixing of the water within the Jackpile sandstone aquifer offsite, and even if these high concentrations are evident in the future, they will not pose a threat to human health. In addition, as previously discussed, the presence of naturally occurring uranium mineralization within the Jackpile sandstone within and hydrologically upgradient of the proposed AAS boundary results in it being economically infeasible to abate groundwater to meet the WQCC standards for the contaminants of concern.

Pursuant to Mining Act regulations, 19.10.5.507.B NMAC, the operator must demonstrate that closing the pit to achieve a self-sustaining ecosystem is not technically or economically feasible (i.e., the pit must be filled in if the demonstration cannot be made). Backfilling the large pit is both technically and economically feasible. In addition, as discussed in the letter from MMD

in support of the Petition, the specific conditions the Director of MMD must evaluate to grant a pit waiver as set forth in 19.10.5.507.B(1) and (2) NMAC likely cannot be met. Therefore, the proposed AAS are technically achievable and cost-benefit justifiable, as required by 20.6.2.4103.F(1)(b).

C. Compliance with the Proposed AAS Will Not Create a Present or Future Hazard to Public Health or Undue Damage to Property

In accordance with 20.6.2.4103.F(1)(c), UNC has demonstrated that compliance with the proposed AAS will not create a present or future hazard to public health or undue damage to property. Exposure to uranium, radium, and fluoride impacted groundwater will be prevented by the institutional controls outlined below. The following controls will eliminate the potential human exposure pathways and render the proposed AAS protective of public health:

1. Natural groundwater quality within the Jackpile sandstone is poor, and produces a very low yield. The land owner, Cebolleta Land Grant, seeks to return the land to its previous use of grazing and wildlife habitat, and has no foreseeable plans for future use of the Jackpile sandstone aquifer. UNC's hydrologic modeling indicates that the groundwater within the affected area will not travel offsite onto adjoining properties, but rather will be consumed via evapotranspiration within Meyer Draw. The hydrologic modeling was reviewed by NMED hydrologist Dr. Joseph Marcoline, which resulted in refinement of the model prior to NMED approval of the Stage 2 proposal. In addition, a report by NMED Chief Scientist Dennis McQuillan indicates the public water supply wells for the Villages of Moquino, Bibo, and Seboyeta located approximately five to eight miles to the west have not been impacted by the St. Anthony Mine and likely will not be impacted by backfilling the mine. NMED Exhibit 6. Mr. McQuillan's resume is included as NMED Exhibit 7.

2. If the AAS are approved by the Commission, the Department will petition the New Mexico Office of the State Engineer ("OSE") to issue an Order under 19.27.5.13.A NMAC prohibiting construction of a well in the affected water-bearing zone of the Jackpile sandstone. The Petition includes the necessary information and documentation for the Department to prepare its recommendation for the Order under 19.27.5.13.A NMAC if the Commission approves the Petition. As demonstrated in a letter dated April 26, 2017 a process has been defined between the two state agencies for implementation of a prohibition on well drilling as appropriate. NMED Exhibit 8. OSE has previously granted such Orders for aquifers or portions of aquifers to ensure protection of human health.

3. OSE regulations at contain provisions that prevent construction of a water supply well in contaminated groundwater. *See* 19.27.4.29 NMAC (requiring wells to be constructed to prevent contamination, inter-aquifer exchange of water, flood water contamination of aquifer, and infiltration of surface water); 19.27.4.29.D NMAC (requiring that all wells be set back from potential sources of contamination in accordance with NMED regulations and other applicable ordinances and regulations); 19.27.4.30.A NMAC (requiring annular seals when necessary to prevent flow of contaminated or low quality water); 19.27.4.30.A(4) NMAC (requiring annulus sealing and proper screening in wells which encounter non-potable, contaminated, or polluted water at any depth to prevent commingling of such water with any potable or uncontaminated water).

Because of the nature of the Jackpile sandstone aquifer as a mineralized system, it is apparent that no effort and no reasonable cost are likely to achieve to the standards in 20.6.2.3103 NMAC. Therefore, an arrangement whereby the administrative controls are fully in place and fully documented is both protective of human health and beneficial to intended future land use.

The AAS will allow NMED to administratively close out abatement for this area, and also allow for the backfill of the large pit pursuant to a closure plan approved pursuant to the Mining Act. Backfill will make the property available for a post-mining land use of grazing and wildlife habitat, providing an economic and social benefit to the land holder and surrounding community.

VIII. COMPLIANCE WITH 20.6.2.1210.A NMAC AND 20.6.2.4103.F(2)

Based on my review, the Petition sufficiently sets forth the required information in 20.6.2.1210.A NMAC for variance petitions. *See* Petition at pp. 5-6. The Petition further contains the required information under 20.6.2.4103.F(2) NMAC for AAS petitions as follows:

- The contaminants for which AAS are proposed are uranium, radium (combined radium-226 and radium-228), fluoride, boron, sulfate, chloride, and TDS.
- The three-dimensional body of water pollution for which approval is sought is defined as the Jackpile sandstone aquifer within the area defined by four corners of the affected property area including: the northwest corner at 35.17 degrees north and -107.32 degrees west; the northeast corner at 35.17 degrees north and -107.29 degrees west; the southeast corner at 35.15 degrees north and -107.29 degrees west; the southwest corner at 35.15 degrees north and -107.32 degrees west. This also defines the extent to which the standards of 20.6.2.4103 will be violated in the future.
- The standards of 20.6.2.4103 NMAC incorporate the standards in 20.6.2.3103 NMAC. Thus, the 20.6.2.4103 NMAC standards will be increased as follows:
    - The uranium standard of 0.03 mg/l will be increased to 12.4 mg/l
    - The radium standard of 30 pCi/l (combined radium-226 and radium-228) will be increased to 2913 pCi/l
    - The fluoride standard of 1.6 mg/l will be increased to 10.7 mg/l

- The boron standard of 0.75 mg/l will be increased to 5.05 mg/l
- The chloride standard of 250.0 mg/l will be increased to 908 mg/l
- The sulfate standard of 600 mg/l will be increased to 77,000 mg//
- The TDS standard of 1000 mg/l will be increased to 113,000 mg/l

IX. COMMUNITY OUTREACH

In addition to the extensive MAA process involving multiple stakeholders as previously noted, NMED held a public meeting at the Cebolleta Land Grant Community Center on June 12, 2017. The meeting was advertised via publication in the local newspaper, posting of notice in well-traveled areas in and around the Cebolleta Land Grant, and mailings to residents for whom NMED had addresses. The intent of the meeting was to present the findings of the NMED study related to potential for impacts to the public water systems in the area, provide information to members of the community regarding the St. Anthony AAS petition, and answer any questions community members have regarding the Petition. Around 10 community members attended the meeting and expressed their support for the Petition and their desire to see the large pit backfilled so that the area could be returned to grazing land.

This concludes my testimony.

I, Kurt Vollbrecht, swear under penalty of perjury that the foregoing is true and correct.

Kurt Vollbrecht
Ground Water Quality Bureau
New Mexico Environment Department
Santa Fe, New Mexico

Kurt M. Vollbrecht
E-mail: kurt.vollbrecht@state.nm.us

Education

M. S. in Geology, August, 1997, **New Mexico Institute of Mining and Technology**, Socorro, NM

B. S. in Geology, June, 1994, **California State University, Hayward (CSUH)**

Professional Experience

Program Manager, NMED Mining Environmental Compliance Section, NMED GWQB, 3/12-12/12 and 7/13-present: Manager of the Mining Environmental Compliance Section, including developing regulations, policies, and guidelines for mine related discharges; review and approval of discharge permits; assigning, directing, and tracking the work of current MECS technical staff and Team Leaders on permit development and enforcement actions; coordination with the United States Environmental Protection Agency regarding National Priorities List sites; conducting meetings with permittees, public members, and senior management.

NMED Mining Environmental Compliance Section Operational and Closure Team Leader, NMED GWQB 12/12-3/14: Responsible for evaluating, drafting and ensuring consistency and compliance with Ground Water Discharge Permits, specific to hard rock mine sites in New Mexico for protection of groundwater pursuant to the NM Water Quality Act and WQCC Regulations. Supervision of several NMED technical staff including Tyrone Mine, Chino Mine and Continental Mine permit leads, AOC, and uranium mine permit lead.

Mining Act Team Leader, NMED GWQB, 9/05-3/12: Responsible for coordination with the Mining and Minerals Division (MMD) in implementation of the NM Mining Act and providing comments and environmental determinations to MMD pursuant to the NM Mining Act. Evaluate and ensure compliance with Ground Water Discharge Permits specific to hard rock mine sites in New Mexico for protection of ground water pursuant to the NM Water Quality Act and WQCC Regulations. Evaluate reclamation practices and water quality issues at hard rock mine sites pursuant to the NM Mining Act. Supervise 3 technical staff.

Industrial Waste Team Leader, NMED GWQB, 7/04-9/05: Lead facility-type team by identifying, prioritizing, and implementing ways to improve program effectiveness in regulating facilities including development of policies, guidelines, templates and regulations. Provide technical and regulatory guidance to staff to ensure compliance with domestic, agricultural, and industrial Ground Water Discharge Permits for protection of groundwater pursuant to the NM Water Quality Act and WQCC Regulations. Supervise 3 technical staff.

Geoscientist A, NMED GWQB, 7/00-7/04: Evaluate and ensure compliance with domestic, agricultural, and industrial Ground Water Discharge Permits for protection of groundwater pursuant to the NM Water Quality Act and WQCC Regulations. Supervise 3 technical staff as above. Assistant to Domestic Waste Team Leader for oversight of 600+ domestic waste discharge permits.

Water Resource Specialist, NMED GWQB, 10/98 – 7/00: Technical staff member responsible for review of a large, diverse caseload including domestic, agricultural, mining, and industrial Ground Water Discharge Permits. Duties include technical review of existing Ground Water Discharge Permits, review of new, renewal, and modification applications for Ground Water Discharge Permits, and evaluation of technical submittals to ensure compliance with NM Water Quality Act and WQCC Regulations.

Exploration Field Geologist: Havilah Mining, Houston, Texas. 9/97 - 6/98, Mapping of potential ore body in southwest Texas, on-sight supervision of drilling program, core logging, splitting, and sample

preparation for assay. On-site supervision of an exploratory placer operation in Sonora, Mexico. Duties included field mapping of veins and placer deposits, selection of sample locations to properly characterize potential deposit, overseeing operation of sluice and mineral separation equipment. *Supervisor:* Al Wadsworth, Consulting Geologist.

Masters Research: New Mexico Tech, Socorro, NM. 9/94 - 9/97, In-depth study of Precambrian rocks including: detailed field mapping, structural analysis, petrographic study, microprobe analysis, and $^{40}Ar/^{39}Ar$ and U/Pb dating of igneous and metamorphic rocks. *Supervisor:* Dr. Laurel Goodwin.

Assistant Manager: 6/85 – 6/93, Buss Automotive Parts, Oakland, CA.

Teaching Experience

Teaching Assistant, Geologic Field Courses:
New Mexico Tech, assisted students in detailed mapping of structurally complex Precambrian rocks in northern New Mexico. *Supervisors:* Drs. Steve Ralser and Maureen Wilks. Summer, 1996 and 1997.

CSUH advanced field course with emphasis on field mapping and study of Cascade Range volcanoes and associated deposits. *Supervisor:* Dr. Elwood R. Brooks. Summer, 1995.

CSUH summer field course including mapping of Devonian-Pennsylvanian miogeoclinal rocks in eastern Nevada, Mesozoic sedimentary rocks of the northern Colorado Plateau, and folded Mesozoic strata in the Gros Ventre River Valley, Wyoming, structural analysis of mesoscopic features, Grand Teton Range, Wyoming, and tape and compass mapping of a Paleozoic dike complex, northern Sierra Nevada. *Supervisor:* Dr. Elwood R. Brooks. Summer, 1994.

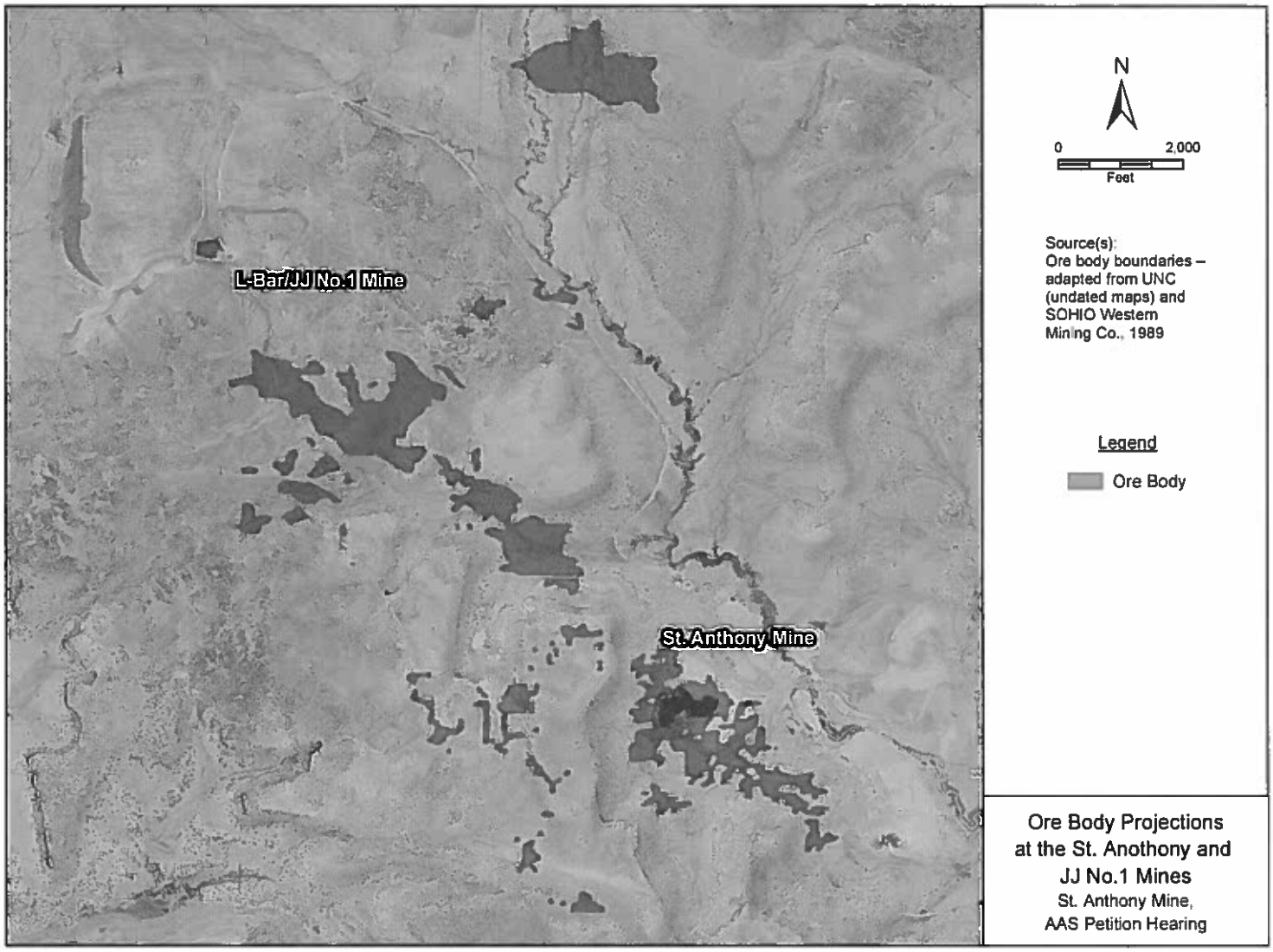
Lab Instructor, Igneous and Metamorphic Petrology, Structural Geology, New Mexico Tech. *Supervisor:* Dr. Laurel Goodwin. 9/94 - 5/97.

Instructor, Beginning Rock Climbing, New Mexico Tech. Responsible for safety and instruction of a large group (20-25 students). 9/96 - 5/97.

Teaching Assistant, Igneous and Metamorphic Petrology, CSUH. *Supervisor:* Dr. Nancy Fegan. 1/94 - 3/94.

Awards and Scholarships

New Mexico Bureau of Mines and Mineral Resources Research Grant, 1997; Leon Redbone Scholarship, 1996; Geological Society of America Penrose Grant, 1995; New Mexico Tech Graduate Research Grant, 1995; Livermore Lithophiles Brunton Compass Award (outstanding field student), 1993; CSUH Dept. Scholarship, 1993.



Ore Body Projections at the St. Anothony and JJ No.1 Mines

St. Anthony Mine, AAS Petition Hearing

NMED Exhibit 3

State of New Mexico
ENVIRONMENT DEPARTMENT
Ground Water Quality Bureau
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PETER MAGGIORE
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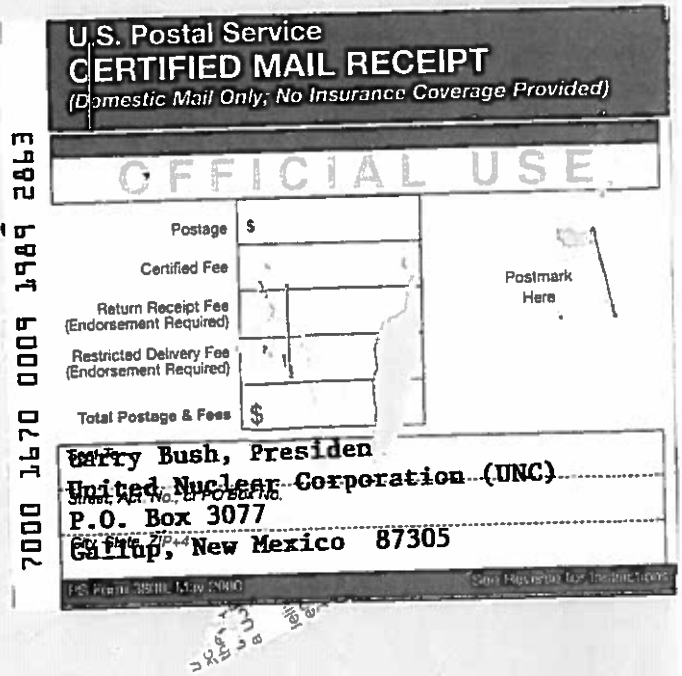


CERTIFIED MAIL – RETURN RE

January 9, 2002

Larry Bush, President
United Nuclear Corporation (UNC)
P.O. Box 3077
Gallup, NM 87305
505-722-6651

Re: Abatement Plan Required at St. Anthony Mine Site

Dear Mr. Bush:

Pursuant to the New Mexico Water Quality Control Commission (WQCC) Regulations Sections 20.6.2.1203.A(9), 20.6.2.4104 and 20.6.2.4106.A NMAC, the New Mexico Environment Department (NMED) hereby notifies UNC that it is a "responsible person" as defined in WQCC regulation 20.6.2.7.KK NMAC and requires that UNC submit an abatement plan for the St. Anthony Mine site, located approximately 10 miles northeast of Laguna, New Mexico. Site inspections and water quality sampling conducted during 1977, 1978, 1985 and 2000 indicate that standards set forth in WQCC regulation 20.6.2.4103 NMAC have been exceeded. Within 60 days of receipt of this letter, UNC shall submit to NMED an abatement plan proposal for a Stage 1 Abatement Plan to characterize ground and surface water contamination at the St. Anthony Mine site.

The Stage 1 Abatement Plan purpose is to define site conditions and provide the data necessary to select and design an effective abatement alternative. WQCC regulation 20.6.2.4106.C NMAC describes the information that may be required for a Stage 1 Abatement Plan. UNC's abatement plan proposal must include the definition of extent and magnitude of ground and surface water contamination as well as characterization of the hydrogeology of the site.

For your reference, a current copy (effective December 1, 2001) of the WQCC Regulations, 20.6.2 NMAC is enclosed.

Please contact Kevin Myers at 505-476-3506 with any questions.

Sincerely,

Marcy Leavitt, Chief
Ground Water Quality Bureau

Enclosure (UNC only)

cc: Mary Ann Menetrey, Program Manager, GWQB-MECS
Doug Bland, Director, MMD
District I, Albuquerque NMED field office
Rebecca de Neri Zagal, ONRT Albuquerque
Leanne C. Padilla-Moore, President of Moquino MDWCA
Barbara Bernacik, Pueblo of Laguna
Daniel Gonzales, Cebolleta Land Grant

State of New Mexico
Energy, Minerals and Natural Resources Department

Susana Martinez
Governor

Ken McQueen
Cabinet Secretary

Matthias Sayer
Deputy Cabinet Secretary

Fernando Martinez, Division Director
Mining and Minerals Division

June 27, 2017

Secretary Butch Tongate
New Mexico Environment Department
Office of the Secretary
P.O. Box 5469
Santa Fe, NM 87502-5469

Re: EMNRD Support for Granting Petition WQCC 16-05 (A) to United Nuclear Corporation, St. Anthony Mine, Cibola County, New Mexico

Dear Secretary Tongate,

The Energy, Minerals and Natural Resources Department ("EMNRD") Mining and Minerals Division ("MMD") submits this letter in support of granting Petition WQCC 16-05 (A) in the matter of Alternative Abatement Standards ("AAS") for the former St. Anthony Mine, Cibola County, New Mexico.

Overview of MMD Jurisdiction Over St. Anthony Mine

The St. Anthony Mine ("Mine") is subject to the New Mexico Mining Act and promulgated regulations under 19.10 NMAC. The Mine qualifies as an existing mining operation under 19.10.5 NMAC, and MMD has been working with the operator, United Nuclear Corporation ("UNC"), for several years to obtain closure and reclamation of this Mine. MMD has also been working in close coordination with the New Mexico Environment Department ("NMED") during this time as both agencies have jurisdiction over the Mine.

MMD's Preferred Alternative for Mine Reclamation

An interim closeout plan for the Mine was approved by MMD in 2013, however this interim plan does not address reclamation of the open pits because a final decision had not yet been made regarding selection of a proposed abatement option for the Mine. As discussed in *Petition for Alternative Abatement Standards* (December 16, 2016) submitted by UNC, and as established through MMD's participation in the Multiple Accounts Analysis process described in the Petition, and as explained below, MMD's preferred alternative for reclamation, of the Mine, pursuant to the requirements of the New Mexico Mining Act, is to partially backfill or backfill the open pit, which would require granting of AASs by the Water Quality Control Commission. Depending on the

NMED Exhibit 5

outcome of this Petition, MMD will require UNC to submit an updated closeout plan for the Mine within 90-days after the WQCC's ruling.

However, in order for UNC to implement the preferred alternative under the Mining Act for pit backfill, AASs are required because backfilling the large open pit will eliminate evaporation and subsequently result in the loss of groundwater containment and result in impacts to groundwater above standards downgradient of the large pit. NMED's *Response to Petition For Alternative Abatement Standards* ("Response") states that the Petitioner has demonstrated that achievement of the abatement standards at 20.6.2.4103 NMAC is not technically feasible and that other reclamation options evaluated are prohibitively expensive and/or have a negative environmental impact. Further, the Response states that the Petitioner has demonstrated that the proposed AASs will be achievable upon backfilling of the large pit and reclamation of the Mine. The granting of achievable AASs for groundwater at the Mine are critical in order for UNC to proceed with site closure under a pit backfill scenario, returning the Mine to a self-sustaining ecosystem, and meeting the requirements for closure under the NM Mining Act 69-36-1 through 20 NMSA 1978.

Reclamation of the open pit to a condition that allows for re-establishment of a self-sustaining ecosystem following closure is a requirement of 19.10.5.507 NMAC. In order for UNC to obtain a waiver from this requirement, and thereby allow the pits to remain open, UNC must demonstrate that the open pits: meet all applicable laws, regulations, and standards for air, surface water, and ground water protection following closure; and that the open pit will not pose a current or future hazard to public health or safety (19.10.5.507.B NMAC). It is unlikely that the Mine will meet these conditions in its present condition, therefore granting of a pit waiver pursuant to the Mining Act is unlikely to be a viable option for the Mine. As such, backfilling of the pit represents the most viable option for reclamation, although this option requires the granting of AASs.

Support To Grant Petition WQCC 16-5 (A)

In summary, MMD supports Petition WQCC 16-5 (A) and recommends that the Commission grant the petition in full.

Respectfully submitted,

Fernando Martinez, Director
Mining and Minerals Division
Energy, Minerals and Natural Resources Department
1220 S. St. Francis Drive
Santa Fe, NM 87505

Bibo, Moquino and Seboyeta Public Water Systems
Source Water Protection Issues

Dennis McQuillan
Chief Scientist
New Mexico Environment Department
June 29, 2017

Executive Summary

The Villages of Bibo, Moquino and Seboyeta ("the Villages") are located in an area of historical uranium mining and milling. There has long been concern about the possibility that the Villages' water supply wells in the area, especially those used by Moquino, could be contaminated by undisturbed uranium minerals, or by contaminants released during mining and milling. As sources of public drinking water, the Villages' wells have been subject to chemical testing as far back as in the mid 1960's.

Natural geologic conditions provide the Villages' water-supply wells with a high degree of protection from contamination. Water wells currently used by the Villages all pump water from one or more sandstone aquifers that underlie approximately 400 feet of shale. The downward seepage of any contaminants discharged onto or near the surface of the ground, such as domestic wastewater or uranium mill tailings waste, will be impeded by the shale. Additionally, naturally occurring contaminants that may dissolve directly into groundwater, or that were released into groundwater by mining operations, are likely to migrate to the southeast away from the Village drinking water wells.

Five decades of monitoring confirm that these natural geologic conditions have, thus far, protected the Village water supply wells from the potential sources of contamination that exist in the region. Village water supply wells have been routinely tested for nitrate, heavy metals and radiological parameters for decades. Chemical test results show no evidence of groundwater contamination from uranium mining and milling, or from human or animal waste.

Introduction

The Villages of Bibo (also known in the past as Seboyetita), Moquino and Seboyeta are located within the Cebolleta Land Grant in northeastern Cibola County, New Mexico (Figure 1). Each of the Villages presently operates public water supply systems that utilize one or more wells. The Villages are in a region that contains uranium mineralization that has been mined and milled, with Moquino's water wells being closest to the areas mining and milling (Figure 1). Protecting Moquino's drinking water wells from potential contamination by uranium and other mineral constituents has long been of concern to the Moquino Community, to the New Mexico Environment Department (NMED), and to environmental advocacy organizations. The purpose of this report is to present existing information and identify issues of concern to protecting Village water supply wells. This report was prepared using published reports, monitoring data, and existing records contained in NMED and N.M. Office of the State Engineer files. No

attempt was made to verify the information found through additional sampling, measurements, or other field work.

Geology and Hydrology

The Villages are located in the southeastern area of the San Juan structural basin of Colorado, New Mexico, Arizona and Utah. Regional geology and hydrogeology are described by Moench (1963), Schlee and Moench, (1963), Moench and Schlee (1967), Baldwin and Rankin (1995) and Intera (2014). Uranium resources in the region are described by Kittel et al., 1967, Rautman et al., 1980, and McLemore and Chenowith (1989). The following summary of conditions in the area of the Villages draws heavily from these reports.

Seboyeta and Seboyetita Creeks flow to the south and southeast through the Villages and converge into the Rio Moquino, a tributary of the Rio Puerco and Rio Grande watersheds, (Figure 1). The Rio Moquino has been designated by the NMED Surface Water Quality Bureau as impaired by total nitrogen, total phosphorous, and temperature (NMED 2007, 2010).

A stratigraphic column for geologic units exposed in the area of the Villages is provided in Figure 2. The Mancos Shale is exposed at the ground surface or underlying Quaternary alluvium or colluvium in and around the Village area. The Gallup Sandstone, the Crevasse Canyon Formation, the Point Lookout Sandstone, and basalt lava flows overlie the Mancos Shale on mesa slopes and mesa tops north and west of the Villages.

Groundwater occurs in various sandstones within and underlying the Mancos Shale. These sandstones include, in descending order, the Tres Hermanos sandstone beds within the Mancos Shale, the Dakota Formation (sandstone), the Jackpile sandstone of the Brushy Basin Member and Westwater Canyon Member of the Morrison Formation. In the Village area, the Jackpile sandstone member is probably in hydraulic communication with the overlying Dakota sandstone, and these sandstones were considered by Baldwin and Rankin (1995) to be part of the same aquifer. The deeper Westwater Canyon aquifer is isolated from groundwater in the overlying Dakota and Jackpile sandstones by fine grained sediment in the Brushy Basin member of the Morrison Formation. In the Village area, wells drilled into the Dakota, Jackpile and Westwater Canyon aquifers have yielded water for domestic, stock and industrial supply. Based on the relatively shallow reported depth of the old Moquino well, 300 to 350 feet, and on anecdotal reports of shallow private domestic wells within the Villages, it is possible that the Tres Hermanos also has been used for water supply in the Village area.

The Villages are located in the area of the Laguna subdistrict of the Grants uranium district. Uranium deposits in the Jackpile Sandstone and Brushy Basin Members of the Jurassic Morrison Formation were mined from 1951 to 1983, producing approximately 100,500,000 pounds of U_3O_8 (McLemore and Chenowith, 1989). The JJ-1 (L-Bar) deposit, located approximately 3 miles east of Moquino, is estimated to contain almost 12,000,000 pounds of U_3O_8 in remaining reserves (ibid).

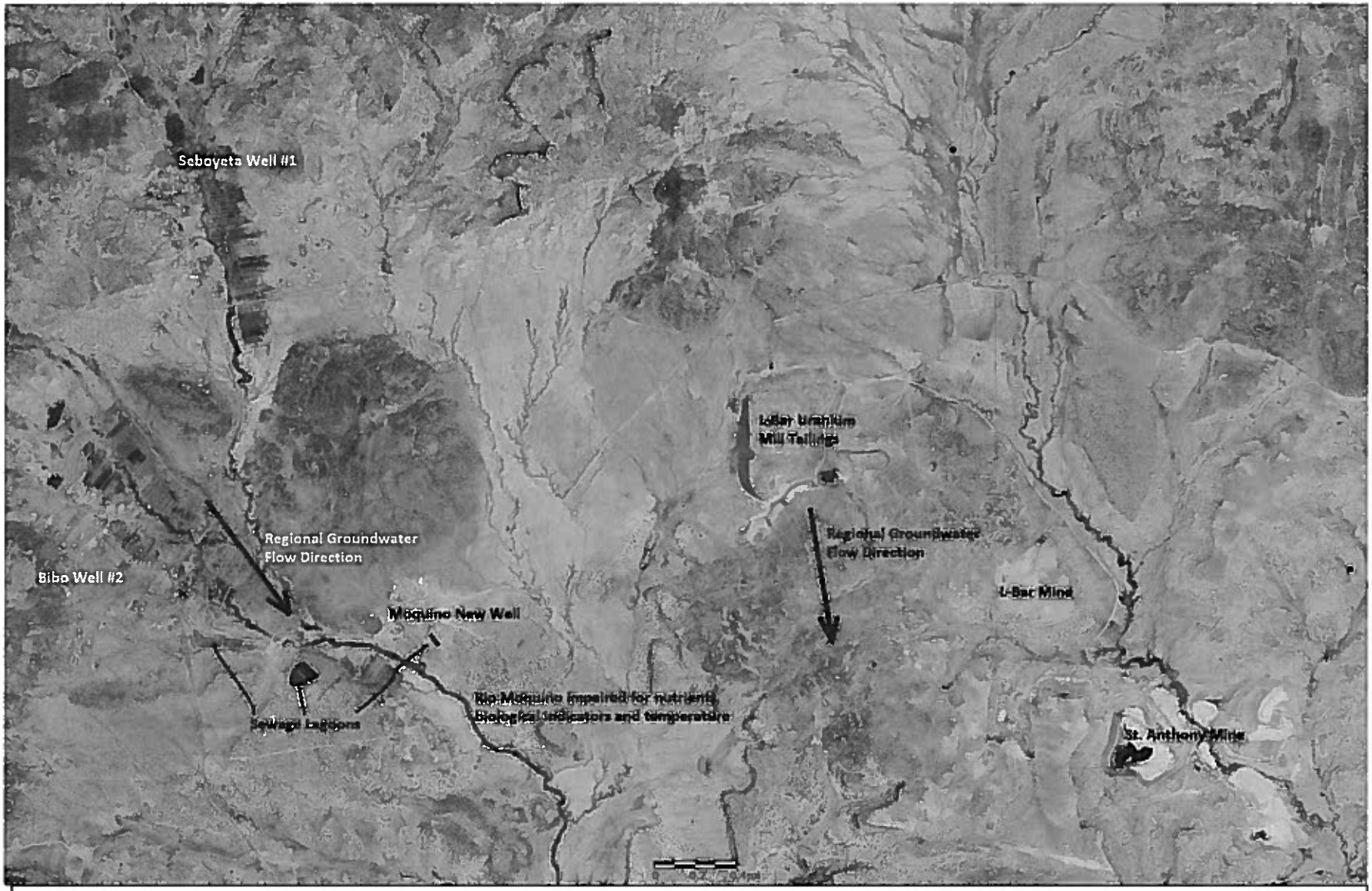


Figure 1. Aerial image showing water supply wells for Bibo, Moquino and Seboyeta, regional groundwater flow direction, and potential sources of contamination including wastewater lagoons, Rio Moquino impaired stream, former uranium mining and milling facilities.

Figure 2. Stratigraphic Column for Geologic Units Exposed in the Village Area. (From Schlee and Moench, 1963)

Eolian and alluvial deposits
Unconsolidated sand and silt

Colluvial deposits
Talus, landslide blocks, and sheets of debris

Basalt undifferentiated
Olivine basalt; forms plugs, and flows on high mesas and buttes; includes bedded and massive agglomerate, lapilli tuff, and fine ash. Possibly in part as old as unit Tb in Seboyeta quadrangle

Hosta Tongue of Point Lookout Sandstone
Pale-olive to very pale orange, fine- to medium-grained, firmly cemented sandstone. Upper 20 feet thinly interbedded with shale. About 100 feet thick

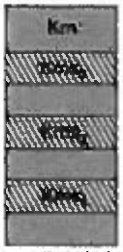
Gibson Coal Member of Crevasse Canyon Formation
Interbedded yellowish-gray, fine-grained, poorly cemented sandstone, dark-gray shale, and coal. About 300 feet thick

Dalton Sandstone Member of Crevasse Canyon Formation
Two sandstones separated by siltstone. Upper sandstone moderate orange pink to very pale orange, fine- to very fine-grained, well-cemented; about 20 feet thick. Middle siltstone about 45 feet thick. Lower sandstone grayish-orange to yellowish-gray, fine-grained, well-cemented; about 60 feet thick

Mulatto Tongue of Mancos Shale
Gray shale and subordinate yellowish-gray, friable to well-cemented sandstone. 350 to 400 feet thick

Dilco Coal Member of Crevasse Canyon Formation
Interbedded pale-orange to light brown sandstone and siltstone, and grayish-brown shale. About 85 feet thick

Gallup Sandstone
Very pale orange to grayish-orange, fine-grained, well-cemented sandstone. About 80 feet thick



Mancos Shale
Km, *gray, friable shale with sparse beds of yellowish-gray, friable sandstone. Main body about 750 feet thick. Lower units about 30, 50, and 20 feet thick in descending order.*
Kms_3, *grayish-orange to yellowish-gray, fine- to medium-grained, well-cemented sandstone; grades downward to siltstone and shale. About 60 feet thick.*
Kms_2, *grayish-orange to pale yellowish-brown, fine- to medium-grained, well-cemented sandstone; divided in middle by zone of siltstone and calcarenite; contains abundant brown-weathering pods of calcareous sandstone as much as 5 feet thick; lower part grades downward to siltstone and shale. About 25 to 30 feet thick.*
Kms_1, *yellowish-gray to pale yellowish-brown, fine- to medium-grained, well-cemented sandstone. About 30 feet thick*

Dakota Sandstone
Tan, orange, and white, fine- to medium-grained, very well cemented sandstone interbedded with subordinate black shale; quartz pebble conglomerate common at base. About 50 feet thick

UNCONFORMITY

Morrison Formation
Jmj, *Jackpile sandstone (economic use); yellowish-gray to white, fine- to coarse-grained, friable sandstone and sparse thin beds of grayish-green mudstone. 0 to 200 feet thick in subsurface.*
Jmb_1, *mudstone unit of Brushy Basin Member; grayish-green to light greenish-gray, friable, sandy, bentonitic; sparse thin beds of massive, clay-rich sandstone and light-gray, dense, massive limestone. Incompletely exposed; about 295 feet thick, including Jmb_2, in subsurface at Jackpile mine.*
Jmb_2, *sandstone unit of Brushy Basin Member; grayish-yellow to very pale orange, fine- to coarse-grained, friable to well-cemented sandstone. Forms lenses generally less than 20 feet thick*

Village Water Systems

The locations of public water supply wells are shown in Figure 1. As required by the federal Safe Drinking Water Act (SDWA), and earlier federal laws and regulations, all three Village water systems have been subject to water-quality testing requirements for decades.

Bibo

The Bibo Mutual Domestic Water Association (MDWA) serves a population of approximately 232 persons and is supplied by a main well #1, and back up well #2. Well #1 was drilled to a depth of 600 feet with a static water level of 223 feet. Examples of SDWA water-quality test results for the Bibo public water supply system are given in Table 1. Test results show no evidence of contamination from uranium mining and milling, or from human or animal waste.

Table 1. Water Quality Data Examples for Bibo Water-Supply System.
MCL, maximum contaminant level. ND, not detected. SMCL, secondary maximum contaminant level. SC, specific conductance. TDS, total dissolved solids.

Parameter	MCL/ SMCL*	Bibo	Bibo Composite	Bibo Well #2	Treated Water
Sampling Date	--	1965-67	1975-79	1/25/06	4/29/15
Calcium, mg/L	--	68	7.6	--	--
Magnesium, mg/L	---	34	2.5	--	--
Sodium, mg/L	--	35	239	--	--
Potassium, mg/L	--	2.3	1.95	--	--
Chloride, mg/L	250	31	19	--	--
Sulfate, mg/L	250	94	170	--	--
Bicarbonate, mg/L	--	246	388	--	--
Carbonate, mg/L	--	ND	11	--	--
Fluoride, mg/L	4	0.75	0.93	--	--
$NO_3 + NO_2$ as N, mg/L	10	--	0.18	--	--
Arsenic, ug/L	10	--	ND < 17	--	--
Uranium, ug/L	30	--	--	ND < 1	ND < 1
Radium^{226} pCi/L	5	--	--	ND	0.86
Radium^{228} pCi/L	--	--	--	ND	0.59
Iron, ug/L	300	0.14	ND < 0.2	--	--
Manganese, ug/L	50	ND	ND < 50	--	--
Selenium ug/L	50	--	ND < 5	--	--
SC, µmho/cm	--	--	--	--	--
TDS, mg/L	500	488	906	--	--
pH, units	6.5-8.5	--	8.57	--	--

* MCLs for fluoride, $NO_3 + NO_2$, arsenic, selenium and uranium are enforceable human health standards.
SMCLs for chloride, sulfate, iron, manganese, TDS and pH are non-enforceable recommended limits for the aesthetic qualities of drinking water.

Moquino

The Moquino water system serves a population of approximately 260 persons and is presently supplied by one well. The "old" Moquino well was reportedly drilled in 1944 to a depth of 300 to 350 feet, and was used as a source of potable water for the community prior to being replaced by the "new" well (known as Well #1) in 1977. The old well (known as Well #2) has been in an inoperable condition for many years. Based on the Well Record filed with the State Engineer Office, the new well was drilled in 1977 to a total depth of 550 feet and was screened from 400 feet to 550 feet (Figure 3). Groundwater was reportedly encountered at a depth of 390 feet during drilling and rose to a static level of 200 feet. The top of the screened interval of the new well coincides with the projected top of the Jackpile Sandstone (Intera, 2014), and penetrates 150 feet of a projected 198-foot thickness. The Jackpile Sandstone is a productive aquifer in this region and also contains extensive uranium deposits. The new well also may produce water from the Dakota Sandstone that overlies the Jackpile Sandstone. Examples of SDWA water-quality test results for the Moquino public water supply system are given in Table 2. Test results show no evidence of contamination from uranium mining and milling, or from human or animal waste.

Moquino's new well also is tested independently by the U.S. Department of Energy (DOE) triennially for uranium, selenium, chloride, sulfate, nitrate plus nitrite, and total dissolved solids. This testing independent of SDWA requirements was imposed by the N.M. Water Quality Control Commission (WQCC) pursuant to Alternative (groundwater) Abatement Standards that the WQCC approved for the L-Bar uranium mill and tailings impoundment in 2003. The DOE is the custodian of the site pursuant to Title II of the federal Uranium Mill Tailings Radiation Control Act (UMTRCA) and the Alternative Abatement Standards approved by the WQCC are incorporated into DOE's Long Term Surveillance Plan for the site (DOE, 2004). Time trend graphs of DOE test results for the Moquino well are provided in Appendix A.

Seboyeta

The Seboyeta water system serves a population of approximately 238 persons, and is supplied by one well. Seboyeta Well #1 was reportedly drilled to a depth of 950 feet with a static water level at 460 feet. Examples of SDWA water-quality test results for the Seboyeta public water supply system are given in Table 3. Test results show no evidence of contamination from uranium mining and milling, or from human or animal waste.

Figure 3. Well Log for Moquino "New" Well.

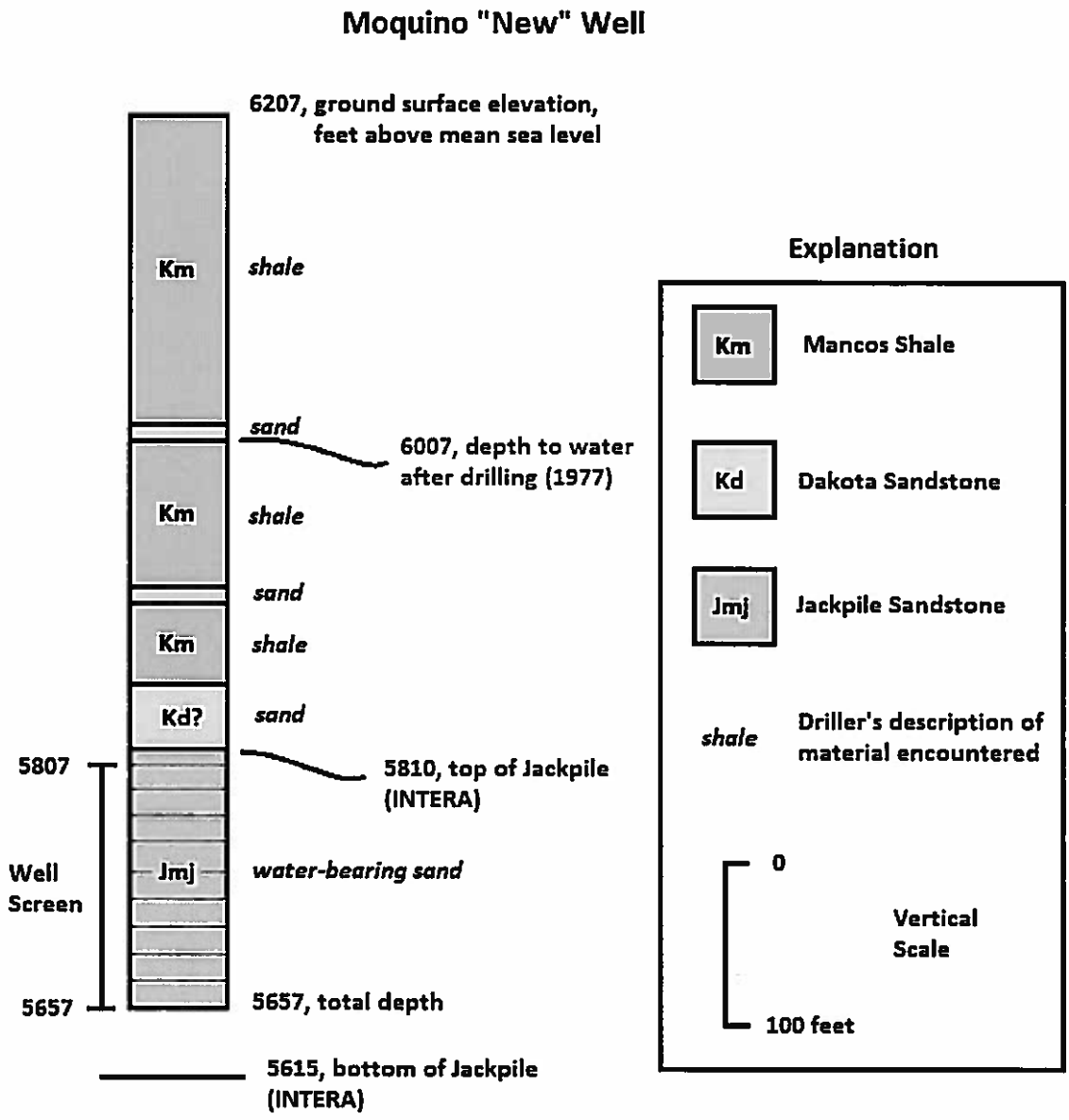


Table 2. Water Quality Data Examples for Moquino Public Water-Supply System. MCL, maximum contaminant level. ND, not detected. SMCL, secondary maximum contaminant level. SC, specific conductance. TDS, total dissolved solids.

Parameter	MCL/ SMCL*	Moquino Old Well	Moquino New Well	Moquino New Well	Treated Water
Sampling Date	--	1965-67	1975-79	6/16/2006	5/11/16
Calcium, mg/L	--	4	4	--	--
Magnesium, mg/L	--	2.4	0.7	--	--
Sodium, mg/L	--	135	146.1	--	--
Potassium, mg/L	--	1.2	0.59	--	--
Chloride, mg/L	250	4.7	5.4	--	--
Sulfate, mg/L	250	4.4	68.2	--	--
Bicarbonate, mg/L	--	292.8	282.3	--	--
Carbonate, mg/L	--	8.4	12.1	--	--
Fluoride, mg/L	4	0.65	0.8	--	--
$NO_3 + NO_2$ as N, mg/L	10	ND	0.3	--	--
Arsenic, ug/L	10	--	< 7	--	--
Uranium, ug/L	30	--	--	ND < 1	ND < 1
$Radium^{226}$ pCi/L	5	0.11	ND < 0.05	0.31	0.48
$Radium^{228}$ pCi/L	--	--	ND	0.27	0.2
Iron, ug/L	300	ND	ND < 200	--	--
Manganese, ug/L	50	ND	ND < 50	--	--
Selenium ug/L	50	--	ND < 7	--	--
SC, µmho/cm	--	625	634	--	--
TDS, mg/L	500	440	472	--	--
pH, units	6.5-8.5	--	8.55	--	--

* MCLs for fluoride, $NO_3 + NO_2$, arsenic, selenium and uranium are enforceable human health standards.
SMCLs for chloride, sulfate, iron, manganese, TDS and pH are non-enforceable recommended limits for the aesthetic qualities of drinking water.

Table 3. Water Quality Data Examples for Seboyeta Public Water-Supply System. MCL, maximum contaminant level. ND, not detected. SMCL, secondary maximum contaminant level. SC, specific conductance. TDS, total dissolved solids.

Parameter	MCL/ SMCL*	Seboyeta	Seboyeta Spring #1	Seboyeta Composite	Seboyeta Well #1
Sampling Date	--	1965-67	1975-79	1975-79	4/29/15
Calcium, mg/L	--	4.8	31	12	--
Magnesium, mg/L	--	4	10	4	--
Sodium, mg/L	--	94	64	82	--
Potassium, mg/L	--	1.6	3	2	--
Chloride, mg/L	250	24	7	ND < 3	--
Sulfate, mg/L	250	14	44	25	--
Bicarbonate, mg/L	--	251	228	242	--
Carbonate, mg/L	--	ND	8	ND	--
Fluoride, mg/L	4	0.4	0.5	0.41	--
$NO_3 + NO_2$ as N, mg/L	10	ND	0.03	0.09	--
Arsenic, ug/L	10	--	11	ND < 5	--
Uranium, ug/L	30	--	--	--	ND < 1
$Radium^{226}$ pCi/L	5	--	--	ND < 0.05	1.01
$Radium^{228}$ pCi/L	--	--	--	ND	0.37
Iron, ug/L	300	--	350	ND < 31	--
Manganese, ug/L	50	ND	ND < 0.06	ND < 50	--
Selenium ug/L	50	--	33	ND < 4	--
SC, µmho/cm	--	--	--	--	--
TDS, mg/L	500	273	293	303	--
pH, units	6.5-8.5	--	8.48	7.92	--

* MCLs for fluoride, $NO_3 + NO_2$, arsenic, selenium and uranium are enforceable human health standards.
SMCLs for chloride, sulfate, iron, manganese, TDS and pH are non-enforceable recommended limits for the aesthetic qualities of drinking water.

Potential Sources of Contamination

Within the area of the water supply wells used by the Villages, the following features have the potential to release contaminants onto or below the surface of the ground.

- Rio Moquino impaired stream
- Domestic wastewater infrastructure (onsite systems and centralized collection and treatment works)
- Naturally occurring arsenic, selenium, uranium and other minerals
- Open-pit and underground mine workings
- L-Bar uranium mill tailings pile
- Cemeteries

Rio Moquino Impaired Stream

The section of the Rio Moquino that has been designated by the NMED Surface Water Quality Bureau as impaired by total nitrogen, total phosphorous, and temperature (NMED 2007, 2010) is shown in Figure 1. Six of six sampling stations on the Rio Moquino contained total nitrogen exceeding the target level, while one of six stations exceeded the target level for total phosphorous. Loss of riparian habitat, rangeland grazing, and mining were identified as potential sources of nutrient impairment (NMED, 2010).

Domestic Wastewater Infrastructure

The Villages were originally developed with privies and onsite wastewater systems (cesspools and septic systems). Centralized wastewater collection and treatment infrastructure was subsequently installed, and has been upgraded and permitted by the NMED Ground Water Quality Bureau. Most, but not all, homes in the Villages are now connected to public wastewater infrastructure.

Naturally Occurring Mineralization and Uranium Reserves

Uranium ore bodies and other geologic minerals have the potential to leach contaminants into groundwater and water-supply wells, even if they have not been disturbed by mining activities. Uranium resource maps of the region suggest that mineralized zones exist within the Jackpile sandstone immediately south of the Villages of Bibo and Moquino (McLemore and Chenowith, 1989). The Jackpile sandstone is an aquifer that bears water to one or more of the Village drinking water wells. Additionally, naturally occurring minerals such as arsenic and sulfate have been detected at elevated concentrations in some wells and springs in the region.

Uranium Mining

The Jackpile sandstone member of the Morrison Formation was mined for uranium approximately 3+ miles east of the Villages' water supply wells, with Moquino's well closest to the mines. As discussed above, the Jackpile sandstone also is an aquifer in this region. Mine workings have released radionuclides and other minerals into the aquifer, causing groundwater contamination in the vicinity of the mines. Chemical analyses of mine water produced from the JJ #1 mine and from the St. Anthony open pit and shaft during their operational periods are given in Table 4. The mine waters ranged from sodium sulfate to sodium bicarbonate-sulfate, and all contained high levels of uranium and radium^{226}. Some mine waters also contained high levels of sulfate and total dissolved solids.

Table 4. Chemical Analyses of Seboyeta Area Uranium Mine Water. (Goad et al., 1980) ND, not detected. SC, specific conductance. TDS, total dissolved solids.

Parameter	**JJ #1 Settling Pond**	**JJ #1 Settling Pond**	**St. Anthony Pit**	**St. Anthony Pit**	**St. Anthony Shaft**	**St. Anthony Shaft**
Sampling Date	11/27/78	11/8/79	10/26/77	11/16/78	11/28/78	11/8/79
Calcium, mg/L	9	11	--	168	38	13
Magnesium, mg/L	--	6	--	--	--	5
Sodium, mg/L	294	297	724	642	361	362
Potassium, mg/L	7	4	--	5	4	8
Chloride, mg/L	15	23	24	20	34	22
Sulfate, mg/L	209	252	2151	2038	530	272
Bicarbonate, mg/L	--	571	--	285	398	420
Carbonate, mg/L	--	--	--	--	--	--
Fluoride, mg/L	--	--	--	--	--	--
$NO_3 + NO_2$ as N, mg/L	1.5	2.7	--	2.2	5.8	1.7
Arsenic, ug/L	ND	22	5	ND	7.2	8
Uranium, ug/L	11,100	31,500	2,500	5,510	1,010	5,370
Radium^{226} pCi/L	98	310	180	90	40	450
Radium^{228} pCi/L	--	--	ND	--	--	--
Pb^{210} pCi/L	--	--	17	--	--	--
Iron, ug/L	--	350	--	--	--	--
Manganese, ug/L	--	--	--	--	--	--
Selenium ug/L	ND	7	19	ND	25	ND
SC, µmho/cm	1294	1360	4549	3998	1823	1269
TDS, mg/L	952	893	1378	2493	1272	887
pH, units	--	8.3	8.18	--	--	7.57

Uranium Mill Tailings Impoundment

The L-Bar uranium mill operated from 1977 to 1981 and processed 2.1 million tons of ore using acid leach technology. Uranium mill waste was discharged into an unlined tailings impoundment (Figure 4) located on top of the Mancos Shale. Chemical analyses of mill tailings liquor during the period of operation (Table 5) show very high concentrations of uranium, arsenic, sulfate, total dissolved solids and a very acidic pH of approximately 1.

The mill tailings impoundment is about 2 miles east of Moquino's wells. Other Village wells are located further to the west. Tailings contaminants percolated into the first Tres Hermanos sandstone aquifer within the shale. There is no evidence, however, that mill tailings contaminants migrated through the shale into the underlying sandstone aquifers.

Figure 4. L-Bar Uranium Mill Tailings Impoundment, circa late 1970s.

Table 5. Chemical Analyses of L-Bar Uranium Mill Tailings Pond Liquor. (Goad et al., 1980) SC, specific conductance. TDS, total dissolved solids.

Parameter	Tailings Pond	Tailings Pond	Tailings Pond
Sampling Date	11/15/77	11/27/78	11/8/79
Calcium, mg/L	--	--	352
Magnesium, mg/L	--	--	1275
Sodium, mg/L	1203	1663	927
Potassium, mg/L	--	182	96
Chloride, mg/L	530	660	371
Sulfate, mg/L	304	57,824	36,865
Bicarbonate, mg/L	--	--	--
Carbonate, mg/L	--	--	--
Fluoride, mg/L	--	--	--
$NO_3 + NO_2$ as N, mg/L	--	6.0	2.2
Arsenic, ug/L	1,108	1,594	1,110
Uranium, ug/L	1,100	23,300	4,230
$Radium^{226}$ pCi/L	180	98	25
$Radium^{228}$ pCi/L	38	--	--
Pb^{210} pCi/L	1800	--	--
Iron, ug/L	--	--	--
Manganese, ug/L	--	--	--
Selenium ug/L	330	65	4,181
SC, µmho/cm	71,820	89,376	71,523
TDS, mg/L	32,056	46,104	39,760
pH, units	0.96	--	0.98

Cemeteries

Cemeteries in Bibo and Moquino are located approximately 0.15 and 0.45 mile from the public water supply wells that serve those Villages. Arsenic was used in embalming fluids in the 19th and early 20th centuries, and decomposing corpses have the potential to release nitrate into soil and groundwater. SDWA testing of Bibo and Moquino water supply wells has not detected elevated arsenic or nitrate that might indicate contamination from cemetery leachate.

Discussion and Conclusions

Natural geologic conditions continue to provide the Village water-supply wells with a high degree of protection from contamination. These conditions include:

- Approximately 400 feet of Mancos Shale overlies the deeper sandstone aquifers that bear water to the Villages' supply wells, and impedes the downward seepage of contaminants discharged onto or near the surface of the ground. These discharges include onsite and centralized wastewater infrastructure, and uranium mill tailings.

- The regional hydraulic gradient and direction of groundwater flow are to the southeast. Contaminants that naturally dissolve into groundwater from undisturbed mineral deposits, and contaminants released into groundwater during mining operations, should flow to the southeast, away from Village water supply wells. It is highly unlikely under present conditions that pumping of Village water supply wells could alter the hydraulic gradient sufficiently enough to pull contaminants in from down-gradient and off-gradient directions.

Five decades of monitoring confirm that these natural geologic conditions have, thus far, protected the Village water supply wells from the potential and actual sources of contamination that exist in the region. Village water supply wells have been routinely tested for nitrate, heavy metals and radiological parameters for decades. Chemical test results show no evidence of contamination from uranium mining and milling, or by human or animal waste. The DOE testing provides independent verification that Moquino's well water complies with drinking water standards for radionuclides, metals, chloride, sulfate and other constituents that could originate from historical uranium mining and milling operations. DOE test results also show that the monitored parameters have not increased in Moquino's drinking water well since monitoring began in 2005.

Recommendations

1. Neither the SDWA or DOE monitoring programs include the full suite of major anions and cations. It is recommended that the Village drinking water wells be tested for major ions at least once every three years. Major ion data could be used for geochemical groundwater modeling, and could provide early detection if contaminants from domestic wastewater or mining/milling begin to migrate towards the drinking water wells.

2. It is recommended that the drinking water monitoring data from both SDWA and DOE be reviewed, plotted and interpreted together. Historical plots for important constituents like sulfate, TDS, metals and radionuclides should be prepared using all data available.

3. It is recommended that the public water systems develop a collective Source Water Protection Plan to monitor and protect the quality and sustainability of their drinking water wells.

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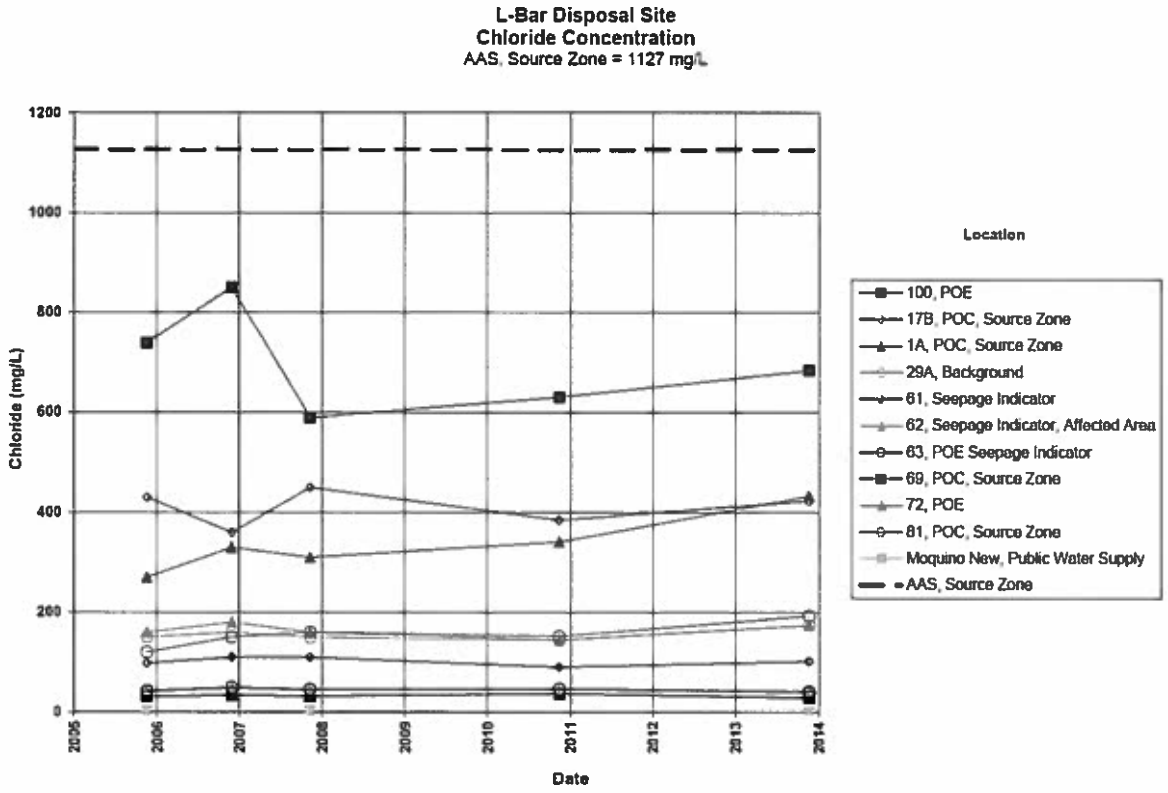
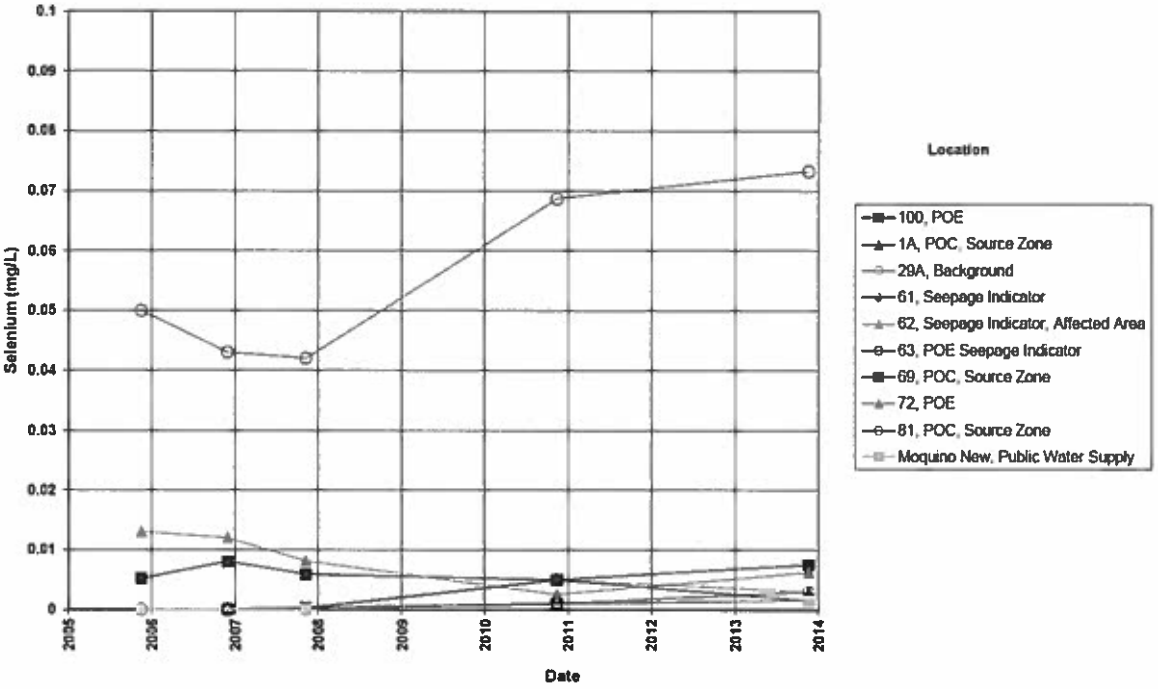
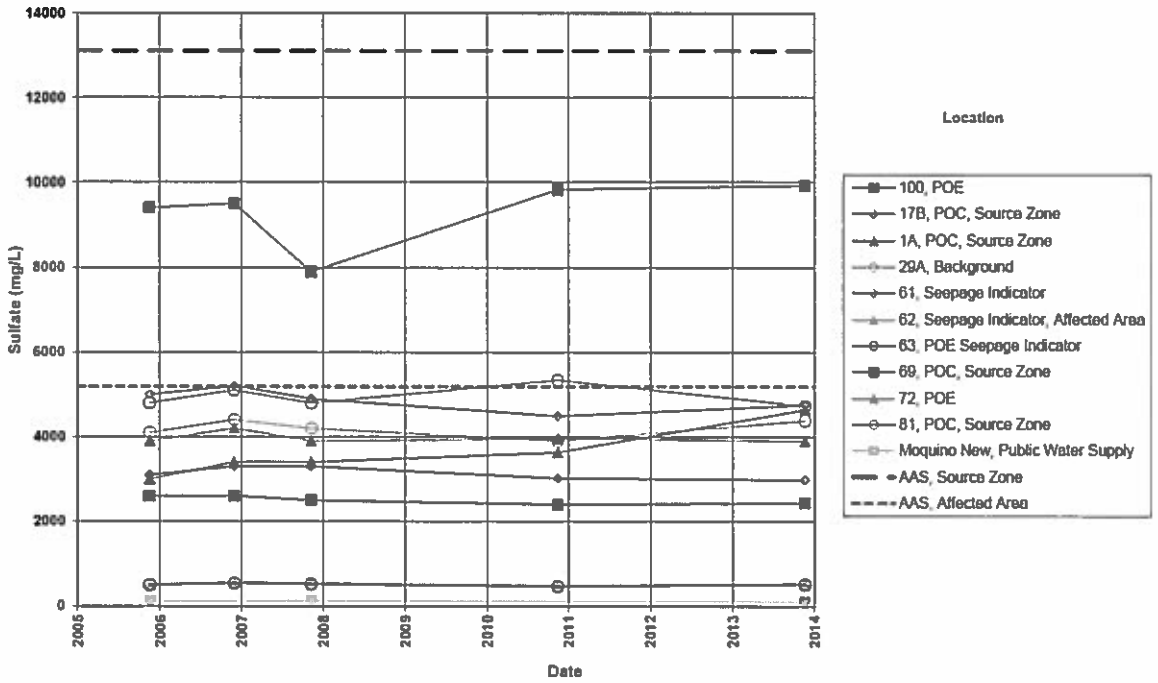
Appendix A – Groundwater Contaminant Concentration Time Trend Graphs for Chloride, Selenium, Sulfate, Total Dissolved Solids and Uranium (from DOE, 2014). Data for the Moquino public water supply well is in yellow squares.



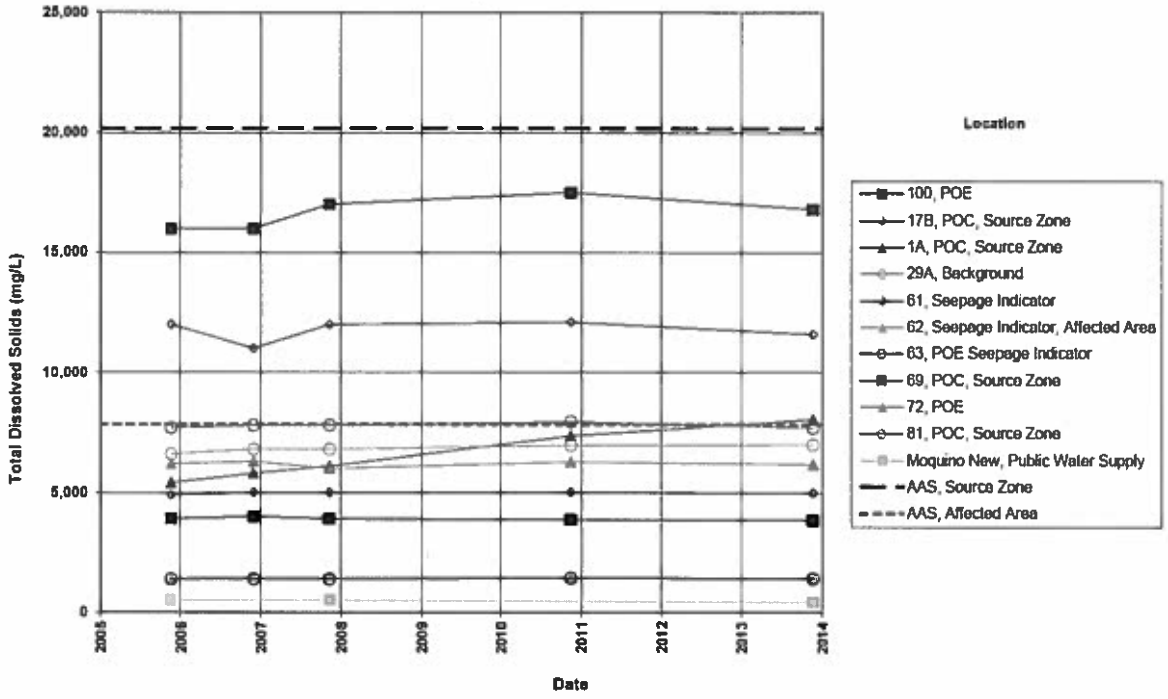
L-Bar Disposal Site
Selenium Concentration
ACL and AAS, Source Zone = 2.0 mg/L



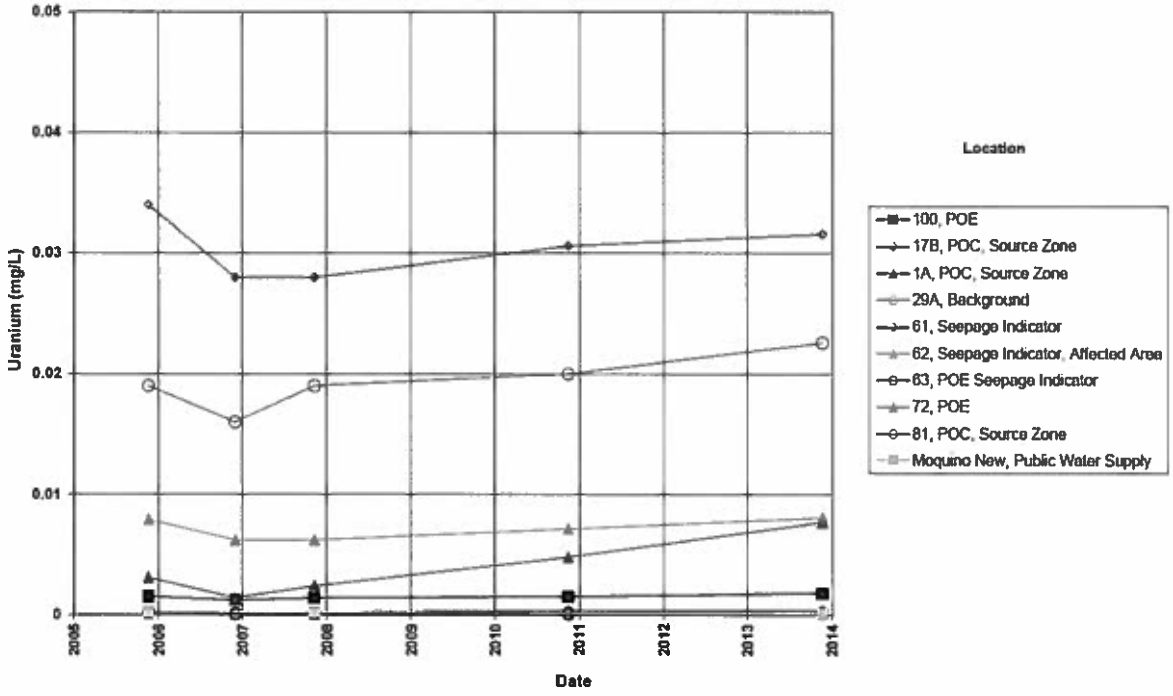
L-Bar Disposal Site
Sulfate Concentration
AAS, Source Zone = 13,110 mg/L
AAS, Affected Area = 5185 mg/L



L-Bar Disposal Site
Total Dissolved Solids Concentration
AAS, Source Zone = 20,165 mg/L
AAS, Affected Area = 7846 mg/L



L-Bar Disposal Site
Uranium Concentration
ACL and AAS, Source Zone = 13.0 mg/L



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EDUCATION

University of New Mexico: Bachelor of Science; Geology, 1978; distributed minor in chemistry, mathematics and physics

Short Courses and Certifications: OSHA 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER); Incident Command System; Health Homes Specialist Credential (National Environmental Health Association), Red Cross first aid and CPR/AED; geochemistry; management and supervision

WORK EXPERIENCE

New Mexico Environment Department: March 1979 to June 2005 and October 2005 to present; Environmental Scientist, Water Resource Specialist, Geologist, Health Program Manager, Natural Science Manager, Chief Scientist

Consultant, Educator and Freelance Writer: 1987 to 2005; Sites in Arizona, Colorado, New Mexico, Ireland, Nova Scotia, Scotland and Wales

DUTIES AND ACCOMPLISHMENTS

Surveillance, Investigation, Incident Response: regional environmental surveillance and mapping; 200+ site investigations; spill response; emergency response actions for hazardous materials releases, wildfires and drinking-water outages.

Negotiation, Design and Oversight of Corrective Actions: public sewer and/or safe drinking water service provided to rural communities with contaminated domestic wells; source control/removal actions; free-product recovery systems; aquifer pump-and-treat systems; sparge-and-vent systems; in-situ bioremediation systems, drinking-water treatment systems on contaminated public supply wells.

Research: ground-water quality and public health; laboratory and in-situ biodenitrification; natural attenuation of nitrate, gasoline, chlorinated solvents and high explosives; natural and anthropogenic sources of perchlorate; pharmaceutical residues in ground and surface water; stable isotope geochemistry of ground-water pollution; natural uranium in the Espanola Basin; effect of septic-tank lot size on ground-water nitrate.

Program Development: creation of the "Water Fair" free well-testing program; promulgation and revision of numerical and narrative water-quality standards; development of comprehensive regulations to abate water pollution; design and implementation of databases and Geographic Information System; development of regulations to allow beneficial reuse of domestic gray water; development of a program to eliminate substandard onsite wastewater systems owned by indigent households.

Management and Supervision: hiring, training, supervision and mentoring of staff; preparation of job hazard analyses; development and implementation of hazard communication and safety plans; management of program budgets; acquisition and management of state and federal grants and appropriations; job hazard analysis; program audits to identify and correct inconsistencies.

Stakeholder Outreach and Involvement: negotiated rulemaking committees; training and technical assistance to the regulated community and general public; guest lectures and seminars at state universities; public presentations; conference papers; news media interviews; cooperation and partnerships with universities, activist groups, federal, tribal, county and municipal agencies.

Expert Testimony: U.S. Congress; N.M. State Legislature; N.M. District Courts; Federal District Court; N.M. Environmental Improvement Board; N.M. Water Quality Control Commission; judicially qualified as an expert in state and federal district courts.

EQUIPMENT USED

Vapor Testing Instruments: flame ionization detectors; photo-ionization detectors; combustible gas and O_2 meters.

Radiation Detection Instruments: Hand-held alpha, beta, gamma and x-ray monitor; gamma scintillometer.

Water Testing Instruments: pH meters; conductivity/temperature/salinity/dissolved oxygen meters; ion-specific electrodes; colorimeters; spectrophotometers.

Other Equipment: water level/free petroleum product sounders; continuous water-level recorders; pressure transducers; portable well pumps; electromagnetic induction (terrain conductivity) meter; hollow-stem auger; portable X-ray fluorescence spectrophotometer.

RECENT PUBLICATION EXAMPLES

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April 26, 2017

New Mexico Environment Department (NMED)
Attn: Michelle Hunter
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RE: NMED petitions to implement institutional controls per 20.6.2 NMAC

Greetings Ms. Hunter:

The NMED and Office of the State Engineer (OSE) have a long history of agency cooperation on statewide projects potentially affecting water quantity or water quality dating back many decades.

The respective bureaus within NMED work as expert witnesses and support Water Quality Control Commission (WQCC) petitioners who is seeking approval of alternative abatement standards for remediation of a contaminated site. The institutional controls needed to help prevent the contamination from moving during this period include the OSE placing restrictions on drilling or completing wells within a certain water bearing zone.

When an NMED bureau initially contacts the OSE that a petitioner will be requesting drilling restrictions, the OSE is then given the opportunity to review the WQCC hearing notice to ensure the proposal has provided adequate public notice. After the hearing, if the petitioner has gained WQCC approval, the NMED provides formal written request to the State Engineer to implement institutional controls. This can include restricting the drilling and completion of wells within the area of contamination, for perpetuity or a scheduled time determined either by NMED or the WQCC, or alternatively, issue a health advisory to those that do drill wells in an affected area. The OSE will then issue an order restricting the activity within the area of contamination and the area is added to the agency permit mapping system and also to maps on the OSE website alerting the public of the restriction.

We will continue these efforts with formal requests from NMED for specific areas of the state designated by NMED in order to protect the health and well being of the public.

NMED Exhibit 8

Please let me know if further discussion would be helpful.

Sincerely,

John T. Romero, P.E.
Director, Water Rights Division

Email cc:

Bruce Yurdin, Director Water Protection Division
Ali Furmall, Manager of Remediation Oversight Section
Lara Katz, NMED Asst. General Counsel
Annie Maxfield, NMED Asst. General Counsel
Jerri L. Pohl, OSE Statewide Projects