GROUND WATER QUALITY PROTECTION AND MONITORING PROGRAMS IN ALBUQUERQUE

Douglas Earp
Geohydrologist
Environmental Health Department
City of Albuquerque

Albuquerque and surrounding communities have a combined population in excess of 500,000 people. Municipal, public, and private wells in these communities extract water from the underlying alluvial aquifer system. The alluvial aquifer is the only source of potable water throughout most of the Albuquerque-Belen basin and is consequently an irreplaceable resource.

Federal, state, county, and local governments share responsibility to protect the ground water resource, to develop a thorough understanding of interactions between ground water and surface water within the basin, and to monitor chemical quality of water at the wellhead and at strategic points within the system. These responsibilities have historically been addressed, with various levels of effort, through a diverse assortment of programs and activities. Efforts are currently underway to develop a comprehensive regional water resource management program. Ground water quality monitoring will constitute a vital part of the program.

This paper contains an overview of many existing and planned programs and activities which relate to the protection of the ground water resource. This discussion is presented from the perspective of the City of Albuquerque, the major user of the ground water resource. Federal, state, and county programs are also discussed to present a comprehensive picture of related programs and activities.

HYDROGEOLOGIC SETTING

Albuquerque is located near the center of the Albuquerque-Belen basin. The basin is about 90 miles long, is 25 to 40 miles wide and encompasses approximately 2700 square miles. The basin is bounded on the east and west by a series of generally north-south trending faults which separate unconsolidated, relatively transmissive sedimentary deposits within the basin (technically termed a graben) from consolidated, relatively impermeable rocks on either side. Total depth of sediments filling the graben exceeds 20,000 feet in some places. Faults along sides of the basin converge to form the San Acacia Constric-

tion, the southern end of the basin. The north end of the basin is less clearly defined, but roughly corresponds to the southern flank of the Jemez Caldera and Santa Ana Mesa.

The Albuquerque-Belen basin is generally arid. Mean annual precipitation varies from 8 to 24 inches depending on altitude and proximity to major topographic features.

Principal surface water features include the Rio Grande, Rio Puerco, and Jemez River. In addition, valley areas near the Rio Grande are served by an elaborate network of irrigation canals and drains. Numerous arroyos enter the basin from adjacent mountains and flood-control canals direct runoff toward the Rio Grande. Each of these natural and man-made features has an effect on the dynamics of ground water flow in the basin. Interactions between surface water and ground water are complex and often not well understood.

The basin fill consists of unconsolidated sediments (interbedded alluvial and flood plain deposits) and volcanics. These sediments are saturated through most of their thickness and constitute the principle aquifer of the area. Hydraulic properties of the basin-fill deposits vary considerably, both vertically and areally. Chemical characteristics of ground water contained in these deposits also vary spatially.

Recharge to the aquifer occurs as underflow from the north, infiltration from the Rio Grande, arroyos, and other major surface water features and from irrigation activities within the inner valley. Relative importance of these recharge components varies on seasonal and long-term bases.

Movement of water within the aquifer is controlled by hydraulic properties of the basin-fill materials and by the hydraulic head distribution within the aquifer. The historical direction of regional ground water flow, under undisturbed conditions, was toward the south. The flow direction has changed in many areas owing to irrigation and drainage activities, pumping by domestic wells and, particularly in recent decades, to pumping by high-capacity municipal wells. Strong vertical gradients and flow components are present in many areas.

Ground water levels and flow directions also vary on a seasonal basis. For example, water levels in irrigated portions of the inner valley generally rise during the irrigation season (late spring and summer). Conversely, water levels near municipal well fields drop during the summer months due to peak demand during that time of year. Water levels near municipal wells recover somewhat during the winter months whereas water levels in agricultural areas generally drop.

The complexity of the geologic setting and the seasonal and longer-term changes in natural and induced recharge, irrigation activities, and pumping by municipal wells have

profound implications for ground water quality monitoring. Regional-scale monitoring is necessary to determine natural variability in chemical characteristics of ground water and to monitor long-term changes. Preliminary site-specific monitoring is typically required to ascertain local components of flow (vertical and horizontal) prior to final design of local ground water quality monitoring programs and effective contaminant-removal programs. References listed at the end of this paper give more detailed information about the geology and hydrology of the basin.

PREVENTION PROGRAMS AND ACTIVITIES

Prevention of future contamination is of great importance and is a method by which tax dollars can be effectively used to protect the ground water resource. Prevention programs are receiving increased attention at all levels of government. The following summary emphasizes activities at the local level.

Three agencies within Albuquerque city government are involved in ground water protection programs. The Public Works Department (PWD) operates the municipal water-supply system and the wastewater-treatment system. They consequently have primary responsibility for ensuring a perpetual supply of potable drinking water and for minimizing potential adverse environmental impacts related to wastewater collection and treatment. The Albuquerque Environmental Health Department (AEHD) is responsible for regulating eleven non-municipal public-water-supply systems within the city (e.g. the University of New Mexico, several hospitals, several mobile home parks, and others) to ensure that they provide safe water to their customers. AEHD also regulates the installation of on-site liquid waste disposal systems within the city limits. The Planning Department has primary responsibility for developing long-term plans (comprehensive plan, area plans, sector plans) and zoning recommendations, which adequately address concerns related to ground water protection. Since there are overlapping responsibilities, concerns and areas of expertise within these three departments, there is an ongoing need for active communication and cooperation among management and staff.

Underground Storage Tank (UST) Program

The AEHD has recently become actively involved in the remediation of leaking underground storage tanks (LUSTs) in Albuquerque. This involvement is formalized through a Memorandum of Understanding between the city and the New Mexico Environmental Improvement Division (NMEID). The Public Works Department is funding a full-time hydrogeologist position, administratively located within the Environmental Health

Department, to carry out LUST-related activities. The state will also provide some funding assistance and will follow-up on cost recovery against responsible parties.

Registration of underground storage tanks is mandated under Section 9002 of the Resource Conservation and Recovery Act (RCRA). Over 2,400 underground storage tanks located within Bernalillo County have been registered with NMEID. Approximately 700 of these tanks are located in the inner valley area where the water table is shallow and soils are acidic. Using Environmental Protection Agency (EPA) estimates that 5 to 10% of existing tanks are leaking, 35 to 70 inner-valley tanks may pose an immediate threat to ground water.

Initially, the AEHD Underground Storage Tank program will develop nine LUST cases in the Albuquerque area based on a priority rating system. Once a case is technically developed, it will be turned over to NMEID for enforcement by the Health and Environment Office of General Counsel. The city will continue to monitor remediation activities at the sites to assure timely, effective cleanup.

The city has also taken lead responsibility for identifying tanks which were not reported during the registration process. These primarily include abandoned tanks at locations that have changed ownership or have been converted to other uses. Such tanks pose a significant potential threat to ground water in that most are old and many still contained liquids including gasoline, diesel, and dry-cleaning solvents when they were abandoned. To date, 219 potential abandoned tank sites have been identified, primarily through visual surveys along major streets. The status of 159 sites has been determined through more in-depth surveys. Relevant information will be turned over to the NMEID for further action.

Small Quantity Generator (SQG) and Technical Assistance Program

The 1984 Amendments to the Resource Conservation and Recovery Act (RCRA) brought small quantity generators of hazardous waste (generators of 100 to 1,000 kilograms of hazardous waste per month) under federal regulation. Prior to enactment of this legislation, an estimated 590,000 kilograms (1.3 million pounds) of hazardous waste were being improperly disposed of each year by Albuquerque area businesses. Proper management and disposal of these wastes greatly reduces the potential for contamination of ground water resources.

To this end, the Albuquerque Environmental Health Department in 1985 began conducting an education and on-site technical assistance/consultation program for small quantity generators of hazardous waste. The program, which is unique for local governments, has been carried out with funding assistance from EPA. Program activities have

included mass mailings of information on new regulations, free seminars on hazardous waste regulations and proper management of hazardous wastes, a one-time hazardous waste collection project and an on-going, on-site technical assistance/consultation program for local businesses. Although quantification is not possible at this time, the improper disposal of hazardous wastes has been significantly reduced through this program.

The Albuquerque Fire Department has a 24-hour hazardous material emergency response capability through which spilled materials are cleaned up, contained and held for proper disposal by the responsible party. AEHD provides technical support upon request from the Fire Department.

Wellhead Protection Program

The Safe Drinking Water Act Amendments of 1986 (Section 1428) provide for the optional development of state/local Wellhead Protection Programs. Protected areas are to include surface and subsurface areas (surrounding a well or wellfield which supplies a public water system) through which contaminants are likely to migrate and eventually reach a well or water supply. The ultimate objective of the program is to control or eliminate potential contaminant sources which are located within the protected areas.

Congress authorized up to $20 million in technical assistance grants to develop state/local programs. However, the House Appropriations Committee failed to allocate money for the program. The future of the program and of New Mexico's and Albuquerque's participation is uncertain at this time.

Sole Source Aquifer Demonstration Program

The Safe Drinking Water Act Amendments of 1986 (Section 1427) also provide for the optional development of Sole Source Aquifer Demonstration Programs. Under these programs, protection of critical aquifers will be achieved through development and implementation of comprehensive ground water management plans for critical areas. Albuquerque will likely develop and implement a comprehensive ground water management plan for the metropolitan area without formally participating in the federal program.

New Mexico Water Quality Control Commission Regulations

New Mexico Water Quality Control Commission Regulations effectively regulate new or newly modified facilities, which may potentially discharge to ground water, by means of the discharge permit program. This program, which is implemented at the state level, has effectively minimized potential contamination related to industrial, agricultural, and waste disposal and treatment activities since 1977.

Other Programs

A complete summary of federal, state, and local regulatory programs related to protection of water resources is included elsewhere in these proceedings in a paper by Maxine Goad (see *Historical Overview of New Mexico Ground Water Quality Protection Programs*).

GROUND WATER MONITORING PROGRAM

Ground water quality monitoring in the Albuquerque area has historically been random and irregular and has been performed by various public and private entities. Water quality data are similarly scattered and are generally not accessible in any single data base. Efforts are currently underway to develop a comprehensive regional ground water quality monitoring program and a central data base for all water quality data (including historical).

City Monitoring Activities

Within Albuquerque city government, responsibility for ground water quality monitoring is shared by the AEHD and the Public Works Department (PWD).

The AEHD presently conducts routine sampling at four dedicated ground water quality monitoring wells -- three at the inactive Los Angeles landfill and one near the inactive Yale landfill. The Los Angeles landfill wells are sampled quarterly for an extensive suite of inorganic and organic chemical constituents.

The Public Works Department currently monitors chemical quality of the municipal water supply as required under the Safe Drinking Water Act. Sampling is performed at selected points within the distribution system. Results consequently represent quality of mixed water from several wells rather than from discrete wells. The Public Works Department also routinely monitors chemical quality of water from four nested-pairs of monitoring wells located adjacent to sludge drying beds at the wastewater treatment plant.

The city currently maintains a computer data base containing water quality data for over 1500 private wells in Bernalillo County, which were sampled between 1960 and 1976.

Bernalillo County Monitoring Activities

Ground water monitoring by the Bernalillo County Environmental Health Department is generally limited by budget constraints to sampling private wells for nitrate and coliform bacteria. Sampling is usually performed at the request of homeowners and mortgage companies. For the last five years, the County Environmental Health Department has also been resampling fifteen private wells near the mouth of Tijeras Canyon on

an annual basis in an effort to monitor long-term trends in nitrate concentrations. The county is also cooperating with the NMEID in a nitrate sampling program in the east mountain area, recently funded a study of septage disposal practices and options, and is investigating the possibility of establishing assessment districts as a means for providing community water supplies to outlying communities that are currently served only by private wells.

State Monitoring Activities

State ground water monitoring activities in New Mexico and portions of the Albuquerque metropolitan area are addressed in other papers being presented at this conference (see paper by Dennis McQuillan entitled *Ground Water Contamination in New Mexico 1927-1986* and paper by Bruce Gallaher entitled *Water Quality Problems in Albuquerque's South Valley*). State efforts have included detailed studies of the Albuquerque South Valley (over 370 water quality analyses), participation in the San Jose Superfund-site investigation, numerous LUST contamination investigations, monitoring at facilities to verify compliance with ground water discharge permit limitations, and other general and site-specific investigations. NMEID periodically sponsors "Water Fairs" at which water samples brought in by private well owners are analyzed on-site for a few key indicator chemical parameters. Follow-up sampling by NMEID personnel is performed at wells which showed anomalous results during the initial screening.

Federal Monitoring Activities

The U.S. Geological Survey (USGS) data files (in STORET and WATSTOR) contain water quality data for 265 wells in the Albuquerque metropolitan area dating back to the mid-1940s. The USGS and the Albuquerque Public Works Department are involved in development and performance of several cooperative agreements for work related to evaluation of ground water and surface water resources. Included are projects to:

- Monitor ground water levels in 41 wells scattered throughout the basin. Four wells are equipped with continuous recording devices, 30 are monitored monthly and 7 are monitored twice each year.
- Quantify effects of urbanization on hydrologic processes (ground water and surface water).
- Evaluate surface water and ground water resources of the area and estimate impacts of future demand.
- Develop data bases for water-quality data and geophysical well-log data, which are compatible with the Albuquerque Geographic Information System (AGIS).

The Bureau of Indian Affairs (BIA) recently began monitoring chemical quality of ground water and surface water entering Isleta Pueblo. Data will be used to identify and assess potential contamination entering Pueblo lands from the north. A paper by Jane Wells of BIA entitled *Southwestern Indian Water Resource Management: Issues and Strategies for Assuring Clean Water* is included in these proceedings.

Kirtland Air Force Base monitors water quality in wells which serve the water supply system at the base. An extensive suite of chemical data are available for seventeen wells dating back, depending on the well, to 1959.

FUTURE DIRECTIONS

Additional Monitoring Wells

Ground water monitoring activities in Albuquerque will be significantly expanded in the next two years. The city council has appropriated $142,500 for construction of monitoring wells during the current fiscal year. In addition, the city anticipates receiving some federal LUST Trust funds for construction of additional wells at sites where tank leaks have caused ground water contamination. An undetermined amount of Superfund money is also slated for drilling activities in the Albuquerque area by NMEID.

Taken together, these additional wells will provide valuable information regarding ground water quality near four former landfills, several municipal well fields, one or more industrial facilities, and several LUST sites. In addition, some wells will be designed to provide information of a more general (non-site-specific) nature regarding water quality variations on a regional scale. Inner valley areas having a shallow water table and major aquifer recharge areas will be given top priority in these efforts. Nested wells/piezometers will provide information regarding vertical flow and water quality variations in the vertical dimension.

Other existing wells that are suitable for sampling include USGS's multi-level piezometer nests along Montano Road in the north valley and along Rio Bravo Blvd. in the south valley. Sampling of some of these piezometers is anticipated as a means of determining vertical and regional water quality variations.

Most new wells will be sampled quarterly for the first year, semi-annually during the second year, and on an annual basis thereafter. Chemical analyses will include major inorganic constituents (including ions and trace metals) and selected organic constituents.

Possible uses of water quality data generated through these monitoring efforts include:

- identification of previously undetected contamination problems
- providing background and site-specific data for use by state regulatory agencies in enforcement actions
- siting of new municipal (and other) water supply wells
- supporting sound land-use-management decisions
- guidance to the citizenry and elected officials regarding funding needs and priorities
- guidance to private sector for facility siting
- guidance regarding prioritization of extension of water and sewer facilities
- projecting effects of growth and increased water use on ground water quality

Comprehensive Water Resource Management Plan

Geologic, hydrologic and chemical information gained during construction of new wells and during monitoring of new and existing wells will be used to assist in development of a comprehensive, long-term, regional ground water quality monitoring and management program. This program will be funded primarily through the Public Works Department and will likely be designed by a consultant working in close cooperation with Albuquerque Public Works, Environmental Health, and Planning Departments, and with the U.S. Geological Survey. A more extensive discussion of this program is included in another paper included in these proceedings entitled *Albuquerque's Water Resource Management Program* by William H. Otto.

Albuquerque Geographic Information System (AGIS)

Effective management of water quality data will receive major emphasis during development and implementation of the regional ground water monitoring network. All available water quality data should be assembled in a single location and should be made readily available to all potential users. This is not a simple task, owing to the multiplicity of data sources, formats, and end users.

The City of Albuquerque and the USGS are currently evaluating a geographic information system called ARC/INFO for this purpose. The city manifestation of ARC/INFO is the Albuquerque Geographic Information System (AGIS). AGIS is fully compatible with other ARC/INFO systems such as the one utilized by the USGS.

Geographic information currently resident in the ARC module of ARC/INFO (and AGIS) includes street networks, land parcels (for portions of the city), soil distributions, surface water drainage networks, water table elevations and others. Information which will be added to the system in the near future includes locations of water supply wells, monitoring wells, underground storage tanks, landfills, hazardous waste generators,

facilities holding ground water discharge permits, areas of known ground water contamination, and other relevant data. AGIS will readily allow production of maps and overlays of this information, singly or in combination with any other information residing in the system. For example, it will be possible to produce maps showing proximity of potential contamination sources to public or private wells or, conversely, to illustrate proximity of wells to the locations of contaminant spills and releases.

The INFO portion of ARC/INFO (and AGIS) is a powerful and extensive data base, and will provide access to data for any specified point, line or area within the area of coverage. For example, INFO will ultimately contain water quality data for individual wells. Data will be retrievable for any specified combination of chemical parameters, for any specified well or wells located within a designated area, or for virtually any combination of wells and/or chemical parameters.

Taken together, the geographic and data-base features of ARC/INFO (and AGIS) will provide an extremely powerful and useful tool for organizing, analyzing and utilizing geographic information. The area of coverage and the amount and quality of information contained in the system will continue to grow as needs and applications expand.

Information Exchange

It is important that ground water quality data be made available to multiple users. It is equally important that technical and managerial staff of various government agencies keep abreast of related activities being performed by other entities, and that they receive timely updates and interpretations of results.

One important forum for this type of information exchange is the Middle Rio Grande Aquifer Water Quality Steering Committee. Committee members include representatives of virtually all government agencies and institutions which are involved in ground water protection and monitoring in the Albuquerque-Belen basin. Meetings are held six or seven times each year and typically include three or four informal technical presentations on topics of mutual interest.

Other important forums for information exchange include meetings of the New Mexico Chapter of the American Water Resource Association, the New Mexico Hazardous Waste Management Society and the New Mexico Geologic Society.

SUMMARY

Federal, state, county, and local governments share responsibility for protecting the ground water resource upon which Albuquerque and surrounding communities depend for their water supply. Most ground water protection programs originate at the federal and state levels. Albuquerque is actively involved in local implementation of several programs.

Ground water quality monitoring in the Albuquerque area has historically been performed independently by various agencies at all levels of government. Efforts are currently underway to plan, coordinate, and expand monitoring activities through development of a comprehensive regional ground water quality monitoring program. Plans are also being made to consolidate ground water quality data in an integrated database/ geographic-information-system in an effort to facilitate data access, analysis, and presentation. These programs will be vital components of a larger water-resource management plan for the Albuquerque area.

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