

ALBUQUERQUE'S WATER RESOURCES MANAGEMENT PLAN

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INTRODUCTION

The city of Albuquerque thanks the Water Resources Research Institute for its invitation to be on the conference agenda. The primary concern of the Water Resources Management Plan is to ensure an adequate water supply for the city of Albuquerque.

Albuquerque does not now have a Water Resources Management Plan; however, we have recently initiated a project to develop a plan. It is this project, the development of a comprehensive, long-range water resources management plan, that I will discuss with you today.

The city has over the years developed and implemented plans for its ground water supply and distribution of that supply. With a great deal of foresight, the city contracted for San Juan-Chama Diversion Project water. In accordance with a master plan, the water system has been expanded in an orderly and economical manner to meet the water supply needs of the city. The city believes it is now time to renew and expand its planning efforts to meet future water supply requirements. The source of supply is the key element in those planning efforts.

BACKGROUND

Before discussing the plan, I will provide some background information on Albuquerque's water supply system. Albuquerque's water utility has grown from its inception in 1885 to a water system that today has 121,000 service connections serving 438,000 people. One of Albuquerque's major assets is its abundant water resources. The city's supply is derived from an underground basin of water located along the Rio Grande. The water is currently withdrawn utilizing 81 wells which have a total production capacity of 240 million gallons per day. Our peak day of record was 185 million gallons which occurred this past summer. The total production for 1986 was 34 billion gallons.

We expect the water system will serve a population of 525,000 in ten years. By year 2025, we forecast that the system will serve 875,000 people, double today's service

population. That growth, to year 2025 and beyond, can only occur with appropriate planning and development of the water supply source.

OBJECTIVES OF THE WATER RESOURCES MANAGEMENT PLAN

The primary objectives of the development of a long-range water resources plan are to (1) obtain a comprehensive geohydrological understanding of the ground water resource, (2) assess the potential for alternate sources of supply, (3) prepare a groundwater quality management program, (4) evaluate legal and institutional matters related to a water resources plan, (5) prepare a master plan for ground water well and surface water supply (if required), and (6) prepare a long range plan for the development and management of water resources for the city's water supply system.

These objectives are in response to Albuquerque's water supply mission, system planning, design and operational requirements, and existing problems. The city of Albuquerque has the responsibility for supplying, in perpetuity, potable water to present and future customers. The city must ensure that an adequate supply of water will always exist and that the city has a legal right to use the water. Albuquerque is obligated to deliver water meeting Safe Drinking Water Act standards and to provide an adequate, reliable and economical supply.

To fulfill this mission, the city must have the knowledge and tools to plan, design, operate, and maintain the water supply system. Implementation and enforcement of regulations to prevent degradation of its ground water source must be pursued. In addition, we need to develop policy and a plan of action to acquire and develop our water resources.

A greater understanding of aquifer characteristics is necessary to prepare a long-range well location and production plan, develop optimal well design and construction criteria, and for evaluation of well problems. We must develop ongoing monitoring and analysis programs to appraise the withdrawal of ground water and its effect on the resource, and learn the variations in factors that influence the quantity and quality of the water resource. Ground water models must be refined to predict more accurately the consequences of ground water withdrawal strategies.

Pollution of the ground water supply is a major concern. The effects of contamination have been widely reported in the local news media. Health risks and economic consequences of inaction must be assessed. The city needs to develop a ground water quality management plan for the prevention and mitigation of ground water degradation.

The need for the Water Resources Management Plan can be emphasized by the following questions.

1. What is the sustained yield of the ground water system? What share of that yield is available to the city?
2. What is the quality of the ground water areally and at depth? Will saline water intrusion or subsidence occur as a result of long-term withdrawals of the ground water?
3. What is the extent, type and location of existing contamination of the ground water system, and what effects will that contamination have on existing and future ground water withdrawal strategies?
4. Besides ground water, what alternative water resources are available for city use?

These few basic questions and lack of answers thereto, typify our current limitations in carrying out long-range water supply system planning. An abundant amount of water resources information has been produced to date, and voluminous data are available. However, that information has not been assimilated and utilized for the purpose of developing a water supply plan. It is now necessary to collect, interpret, and evaluate that data. This will provide additional information essential to formulating a comprehensive technical understanding of the resources and development of appropriate planning strategies.

WATER PLAN

The city has created a preliminary work plan for development of a comprehensive Water Resources Management Plan. The approach involves at least a dozen overlapping work elements, as follows:

1. Management objectives
2. Population and demand forecasts
3. Ground water use
4. Alternate sources of water
5. Geology
6. Hydrology
7. Pollution
8. Monitoring
9. Data management

10. Model development and calibration
11. Legal and institutional constraints
12. Applied research

Management Objectives

The project objectives previously outlined are also the principal management objectives. Upon initiation of the project, the project team will evaluate the city's established goals and objectives and will develop detailed plan objectives. Subsequently, a final work plan which includes methodology and scheduling will be formulated.

Population and Demand Forecasts

The objective is to develop reliable estimates of future service populations, their location, and water use requirements. Once water resource availability is determined, it will be necessary to develop policies related to the ultimate service population, service area, bulk sales, and region issues.

Initially, forecast horizons will be selected and demand scenarios prepared for those horizons. Those scenarios will be used to test the ground water system's yield capabilities and for comparison with overall feasible resources.

If preliminary examinations of feasible water resource availability show probable resource limitations, more detailed population and demand studies will be performed. This data will be used for precision modeling, conceptual system configuration, and other phases of work.

Ground Water Use

This element will involve various studies and evaluations to predict the longevity of the ground water resource and to establish criteria and strategies for production of ground water to ensure a sustained supply without negative impacts. The U.S. Geological Survey has developed a three-dimensional model of transient ground water flow for the Albuquerque-Belen basin. The city will use the model, with some modifications, to perform preliminary simulation studies. Also, a next-generation model will be developed for more accurate yield predictions and study of well and well field withdrawal strategies.

Alternate Sources of Water

The objective is to determine feasible sources of water supply other than local Rio Grande basin ground water. Heretofore, Albuquerque has relied entirely on the ground water beneath the city for its water supply. Pollution, water-rights issues, and the possibility that future demand may exceed the amount of water we may safely take from

the ground create a need for an understanding of the location, amount, and cost of water that the city might obtain from other sources.

Alternate sources of water that may be investigated include (1) Rio Grande basin surface water, (2) other basin surface water, (3) ground water from other nearby basins, (4) other imported water, (5) storm runoff, (6) sewage effluent, and (7) conservation.

Geology

The objective is to define the water-bearing and water-yielding properties of the rocks of the Albuquerque basin and the larger Rio Grande drainage basin that impact upon Albuquerque's immediate and potential water resource. Specific objectives include:

1. Definition of the Albuquerque basin in three dimensions;
2. Preparation of a detailed geologic map of the Albuquerque basin;
3. Preparation of maps that show the physical and chemical properties of the rocks that control water behavior both on the surface and in the ground;
4. Creation of a data management program that will allow the city to update maps easily, build numerical models of water-resource systems, and predict the character of the rocks that new wells will tap, and thereby determine their design and yield; and,
5. Characterization of the features of the Rio Grande drainage basin that may have a direct effect on Albuquerque's water supply.

To carry out these activities, the city will make use of existing data as well as gather new data. Ideas concerning the stratigraphic sequence from a variety of sources will be integrated into one fixed, but flexible, conceptual model of the Albuquerque basin and its location on the Rio Grande drainage basin.

Hydrology

The objectives of this element are to (1) quantify the hydrologic cycle as it applies to the Rio Grande drainage basin and the Albuquerque basin, and (2) characterize processes that operate in the basins. Specific objectives include:

1. Quantification of the surface water resources of the major drainage basins tributary to the Rio Grande, and of the Rio Grande drainage basin above San Acacia;
2. Characterization of the movement of ground water from recharge to discharge areas under pristine conditions and present pumping conditions;
3. Identification of recharge areas and rates, and the volume of water that each contributes;
4. Definition of the interrelationships among the flow of the Rio Grande, diversions from the Rio Grande, the drains, and the ground water resources;

5. Quantification of ground water discharge to streams, evapotranspiration, and wells;
6. Quantification of ground water underflow;
7. Quantification of the amount of water that can be pumped from wells;
8. Investigation of:
 - A. the shape of the water table and the distribution of head,
 - B. the seasonal and annual variation of the water table and of head,
 - C. the hydrologic features of each stratigraphic unit,
 - D. soil-moisture distribution and variation in the vadose zone,
 - E. recharge areas and rates,
 - F. stream flow and diversion,
 - G. ground water discharge to streams, evapotranspiration, and wells, and
 - H. the chemistry of water under pristine and present conditions; and,
9. Preparation of detailed hydrologic budgets.

When the city thoroughly understands the hydrologic budget of the Rio Grande drainage basin and its tributaries, and the ground water budget of the Albuquerque basin, it will know the ground water resources with which it has to work.

Pollution

The objective is to prevent pollution from diminishing the ground water resource. Specific objectives include:

1. Determination of present and potential sources of pollution (its sources, extent, and amount);
2. Cleanup of pollution before it can reach city wells;
3. Development of standards and procedures that will minimize pollution potential; and
4. Development of cleanup procedures for anticipated pollution problems.

Monitoring

The objective is to characterize changes in the water-resources system and the factors that influence it. A specific objective of the monitoring element is the development and implementation of an ongoing routine program to measure parameters that account for changes in the water resource.

Parameters the city expects to measure include:

1. Those associated with city wells such as depth to water, pumpage, and properties of the water pumped;
2. Land-use changes;

3. Stream flow and storm runoff;
4. Ground water levels in the Albuquerque Basin;
5. Climatic features such as precipitation, evapotranspiration, and air temperature;
6. Chemical constituents of surface and ground water; and
7. Soil-moisture variations.

Data Management Element

The objective is to create a data management system that will contain all data. Specific objectives include:

1. Creation of a universally available data catalog;
2. Establishment of a procedure for adding new data as it becomes available;
3. Automatic production of basic data reports; and
4. Development of automated procedures for detecting problems.

Model Development and Calibration

The objective is to develop calibrated numerical models. Specific objectives include the development of models to:

1. Emulate pristine conditions;
2. Generate present conditions; and
3. Predict the (a) consequences of changing the ground water system, (b) optimum yield of the system and of individual wells, (c) effects of pollution and of proposed remedial efforts, and (d) short-term behavior of a single well or group of wells in a well field.

Legal and Institutional Constraints

The objective is to make the city aware of and immediately responsive to legal or institutional factors that affect or might affect its capacity to deliver water. Specific objectives include:

1. Cataloging water rights in the Rio Grande basin;
2. Summarizing relevant principles in acts, statutes, court decisions, adjudications, and State Engineer findings and orders that relate to water rights;
3. Cataloging acts and statutes, rules and regulations, case histories, court decisions, and other relevant documents that apply to water resources use and pollution, and to summarize provisions that apply to operations of the city;
4. Developing a procedure to insure that the city will stay abreast of statutory and regulatory changes;
5. Establishing guidelines and procedures for city participation in the formulation of new legislation or rules and regulations;

6. Establishing the city's authority to preserve the water resource; and
7. Determining the city's position on resource management issues such as those created by the 1986 amendments to the Safe Drinking Water Act.

Applied Research

The applied research element consists of independent studies designed to solve specific city problems. Immediate problems include:

1. The feasibility of using San Juan-Chama water for artificial ground water recharge;
2. How to optimize well development and rehabilitation;
3. What standards and criteria to use in designing new wells; and
4. Consequences of iron bacteria in wells.

CONCLUSION

In conclusion, I will describe briefly the initial steps in the plan development. The city has appropriated \$2.3 million toward the effort and is in the process of retaining a consulting firm for the project. We have entered into cooperative agreements with the U.S. Geological Survey to perform certain geo-hydrological tasks, and we anticipate additional cooperative arrangements.

The consultant contract work will begin about March 1988. The first project task will be for the consultant, in conjunction with the city, to prepare detailed project methodology, schedules, cost estimates and manpower allocations. An iterative, phased work plan is most probably in order.

In Phase I, as now envisioned, preliminary work will be performed as follows:

1. Evaluate the alluvial-aquifer system underlying the Albuquerque area to determine the sustainable yield of the underground basin;
2. Identify and assess potential alternate sources of supply, including Rio Grande Basin surface water, imported water, reclaimed wastewater, conservation measures, and other resources;
3. Evaluate the feasibility of artificial ground water recharge with San Juan-Chama Diversion Project water;
4. Develop a ground water quality management program; and
5. Compile and interpret existing information on the geological and hydrological characteristics of the ground water system.

It is anticipated that the Phase I work will be performed in an 18 month time period, and that the total project will require five years. Data collection and analysis will continue indefinitely in order to maintain a dynamic water resources management system.

The project is a major undertaking and is, at the least, of a regional nature. We will be reaching out to obtain expertise, on a contractual or advisory basis, from the State's water resources professional community; that is, we will enlist experts like yourselves.

Thank you for the opportunity to describe the city of Albuquerque's Water Resources Management Plan project. We are excited about this effort and the opportunity it presents to develop and maintain a water resources management system that maximizes use of the resource while minimizing harmful actions.

Thank you.