WATER FOR INDUSTRY IN NEW MEXICO'S FUTURE

William J. Stone, Hydrogeologist
New Mexico Bureau of Mines
and Mineral Resources

INTRODUCTION

The mild arid climate which attracts people to the Southwest is also the most limiting factor for the region's growth. Unlike the Southeast, water resources are limited in this arid setting. Although some people can relocate in New Mexico for reasons of climate alone, others cannot unless suitable jobs are available. Manufacturing industries, a principle source of jobs elsewhere, are limited in New Mexico to nonwater-intensive activities. The mineral-resource extraction industry affords additional jobs, but because such activity is water-intensive it depends on the availability of water supplies.

Establishment of a new extractive facility is costly. The Hidalgo Smelter, constructed south of Lordsburg in late 1977 by Phelps-Dodge Corporation to handle copper concentrate from their Tyrone Mine, reportedly cost $320 million; because of its isolated location, the construction of a $10 million townsite was also necessary (Kotovsky, 1978). One of several factors the company considered before making such an investment was the availability of a reliable supply of suitable quality water.

The purpose of this report is to review the role played by water in New Mexico industries. More specifically, present and future water problems and conflicts are examined. Based on these considerations, several implications for future water-resource efforts in the state are noted. In this report, New Mexico industry is divided into two categories: extractive and non-extractive.

EXTRACTIVE INDUSTRY

Extractive industries are those involved with the mining, milling, smelting, or other processing of mineral resources. In New Mexico, the extractive industry centers on the production of coal, copper, industrial minerals (aggregate, clay, stone, etc.), lead, molybdenum, petroleum, potash (and other soluble salts), precious metals, uranium, and zinc (Fig. 1).

Projected water requirements of the extractive industry may be approached in three ways. In terms of the estimated volume of new water required for use in the year 2000, the processing of fossil fuels (coal, carbon black, gas) ranks first, the copper industry ranks second, and the potash industry ranks third (Table 1). By volume of this water which may be depleted (in the year 2000) the first and second ranks remain the same, but the uranium industry moves into the third position (Table 2). If such depletion is viewed in terms of the percentage of new water exhausted in 2000, fossil-fuel processing remains in the first position, the uranium industry moves to the second position, and the copper industry drops to third (Table 3).

The rankings change little for the year 2020. The molybdenum industry jumps into second place and the copper industry drops to third

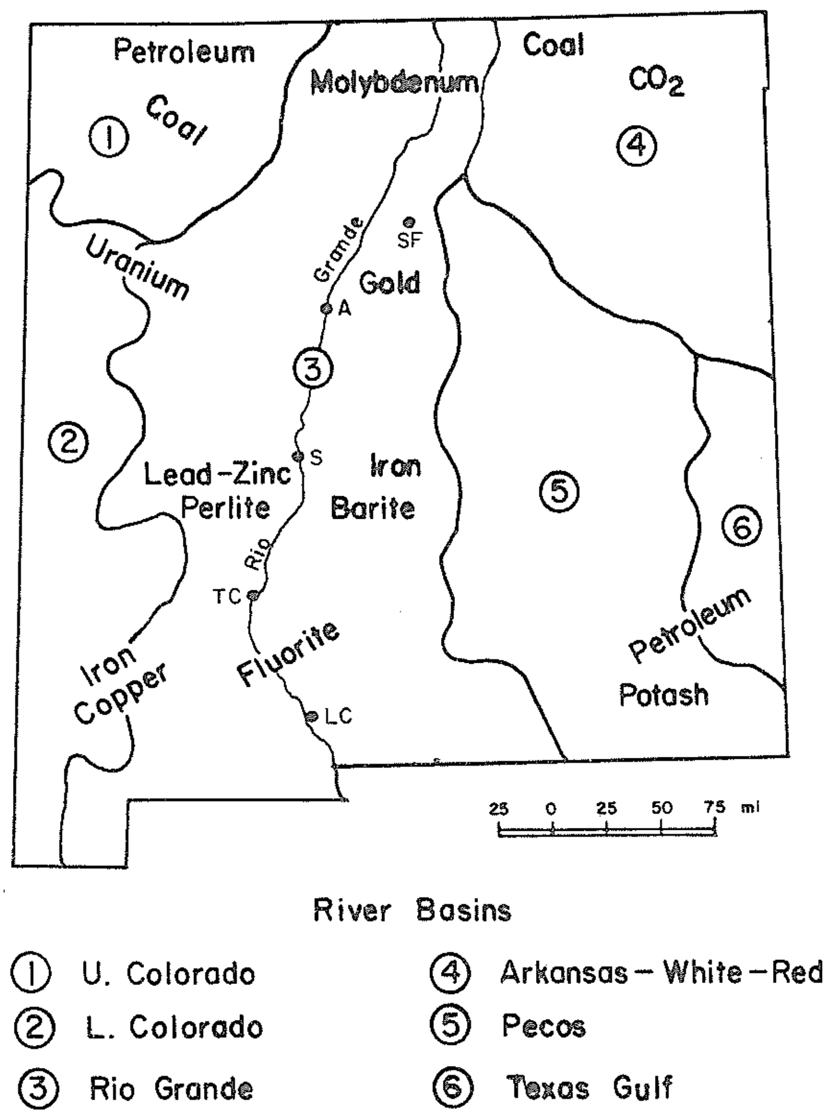

Figure I. Mineral resources and river basins in New Mexico (Sorensen and others, 1973).

Table 1. Ranking of New Mexico's mineral industries by water requirements (modified from Sorensen and others, 1973).

Resource	2000 (ac-ft new water)	2020 (ac-ft new water)
Fossil fuels (proc.)	117,270	154,180
Copper	52,770	76,280 (3)*
Potash	42,410	56,510 (5)*
Uranium	36,890	68,900
Molybdenum	33,980	82,830 (2)*
Petroleum (sec. rec.)	18,000	20,000
Industrial Mins.	4,330	6,860 (8)*
Lead-zinc	4,060	7,750 (7)*
Petroleum (drlg.)	2,670	4,500

*New rank in year 2020

Table 2. Ranking of New Mexico's mineral industries by volume of new water depleted (modified from Sorensen and others, 1973).

Resource	2000 (ac-ft depleted)	2020 (ac-ft depleted)
Fossil fuels (proc.)	108,420	143,260
Copper	37,110	57,220
Uranium	27,670	55,190
Potash	21,210	31,090 (5)*
Molybdenum	18,690	49,700 (4)*
Lead-zinc	2,030	4,650
Industrial minerals	1,400	2,860
Petroleum (drlg.)	270	450
Petroleum (sec. rec.)	0	0

*New rank in year 2020

Table 3. Ranking of New Mexico's mineral industries by percent depletion of new water (modified from Sorensen and others, 1973).

Resource	2000 (% depletion)	2020 (% depletion)
Fossil fuels (proc.)	92	93
Uranium	75	80
Copper	70	75
Molybdenum	55	60
Lead-zinc	50	60
Potash	50	55
Industrial minerals	32	42
Petroleum (drlg.)	10	10
Petroleum (sec. rec.)	--	--

place in water requirements. There is no change in the positions of the industries for volume or percentage of water depleted.

Inasmuch as the fossil-fuel processing (especially coal) uranium, and copper industries are the most water-intensive in the state, and have the greatest potential for growth, they will be the focus of the remainder of the discussion of the extractive industry.

Coal

Major coal extraction occurs in the San Juan Basin of northwest New Mexico. Production there is expected to nearly triple in the next 10 years (Table 4).

In the San Juan Basin, coal is extracted mainly by strip mining. Most of this coal is used in mine-mouth electric-power generation. Water is required for various mining, reclamation, and power-plant functions (Table 4). Present water needs are met by surface water (San Juan River).

As strippable reserves are diminished, underground mining and in-situ extraction techniques (gasification, liquefaction) may replace stripping; these methods will require dewatering of the coal and adjacent strata. Should surface gasification plants or coal-slurry pipelines be constructed, additional water will be required.

Future water needs may be met partly by surface water, as at present, and partly by ground water. Ground water may be obtained from: 1) underground coal-mine dewatering; 2) deep wells on the mine sites; 3) well fields tapping Tertiary strata in adjacent areas to the northeast; and 4) uranium-mine dewatering in the Grants Mineral Belt,

Table 4. Role of water and production trends for coal, uranium, and copper mining in New Mexico. Parentheses indicate future water concerns.

Resource and Role of Water	Recent Production Trends/Location	Anticipated Production Trends/Location
COAL	1979-18 mt up 31% from 1978 production	1985-47 mt/yr 1990-50 mt/yr
drilling dust control washing cooling boiler feed revegetation (dewatering) (gasification) (liquefaction) (slurry)	San Juan Basin	San Juan Basin and to south
URANIUM	1966-1978= 47% of all U_3O_8 in nation	to increase four-fold in next 10 yrs
drilling dust control transport milling dewatering (in-situ mining)	San Juan Basin	San Juan Basin and to south
COPPER	1979 production up from 1978 production	will continue to increase gradually
drilling dust control transport milling smelting cooling (dewatering) (in-situ leaching)	SW part of state	SW and NE parts of state

along the southern edge of the basin. The latter two would require transporting the water considerable distances.

The problem with relying on surface water as a source is that New Mexico's share of the San Juan River is fully appropriated. Should existing water rights be purchased, necessary transport to the more distant parts of the coal belt would be costly. Drilling for deep ground water on site, drilling wells and transporting ground water from nearby Tertiary strata, and taking delivery of excess ground water from the uranium mines would also be expensive. More water may be required than is available from the uranium mines alone and some combination of these alternatives is necessary.

Two major conflicts are recognized. First, energy development will be competing with irrigated agriculture for a fixed amount of surface water. Industry may be able to afford the more expensive ground water alternatives, but agriculture can not. Such alternatives should be little more expensive than buying surface water and transporting it by truck or pipeline. The other conflict involves the area of Indian water rights. The amounts of surface and ground water to be reserved for Indian use and the administration of this water is far from clear at present.

Uranium

Major uranium extraction occurs in the Grants mineral belt at the southern edge of the San Juan Basin, northwest New Mexico. Uranium production was expected to quadruple in the next 10 years, but the moratorium on nuclear power plant construction has severely reduced production. Several New Mexico mines have closed.

Most uranium is extracted by conventional underground methods. Water is required for various mining and milling functions (Table 4). In most places present water needs are met by water encountered in mining; in others, water is transported short distances.

As mining moves into areas of lower-grade and deeper ores, in-situ methods (solution mining) may become more prevalent. Mobil Corporation is currently operating a pilot project to evaluate such methods near Crownpoint.

The main water problem in mining is dewatering. Removal of large volumes of water are necessary because the principal ore-bearing zone is also a regional aquifer. Several water-resource impact problems are also associated with uranium extraction. First, oxidation at the face of mine workings makes radionuclides soluble and mine waters are thus enriched with these constituents. With proper collection and treatment of mine waters there need be no environmental damage. Second, mill tailings are disposed of in ponds and dumps; again, with care, there need be no impact. Third, abandoned mines may release radionuclides to area ground water. Recent work has shown that the chemical conditions that develop around such sites may naturally limit migration of undesirable constituents to a short distance from the abandoned mine shaft (Stone and others, in review).

In addition to dewatering, in-situ operations will be troubled by problems of controlling the mining solution. The major water-resource-impact problem in in-situ mining will be the cleanup of underground cells after leaching ceases. Experience in other areas of such mining will be most helpful in this matter.

The main conflict centers around water-level declines produced by dewatering for conventional mining. Lyford and others (1980) showed that water-level declines will be greatest near the mines, but the edge of the cone of depression resulting from a high level of uranium-mine dewatering could reach the San Juan River by the year 2000. Such declines could reduce the availability of deep ground water for coal development. Ironically, dewatering also provides an alternative source of ground water for coal development. As in the case of coal, Indian water rights are also an issue in uranium extraction.

Copper

Major activity associated with copper extraction centers in the southwest part of the state. New mines are planned near Hillsboro and Pecos. Although specific figures are unavailable, copper production is expected to increase gradually over the next 10 years.

Most copper is extracted by open-pit methods. Water is required for various mining, milling, and smelting uses (Table 4). Leaching of copper from abandoned mine dumps and specially designed heaps is also a common practice. Underground or in-situ leaching in areas of low-grade, high-volume ores may become more common. Recent attempts to implement this method at Cerillos failed largely because of public concern for the environment.

On the average, approximately 100,000 gallons of water are used to produce a ton of copper -- more than for producing a ton of any other major metal (Mussey, 1961). Of this amount, 70,000 gal are used in mining and concentrating the ore and 30,000 gal are used in refining the copper. Slightly more than half this average is used in areas where water is scarce or expensive. According to Mussey (1961), 18 percent of the water required is used consumptively; highest consumptive use is in the West.

The major water problem in copper extraction is supply. Locating a suitable source of water reasonably near a minable copper deposit is by no means assured in the arid setting of New Mexico. Water needs may be met by developing new supplies or by purchasing existing supplies.

The main conflict is competition for water with agricultural, municipal, and recreational users. Table 1 shows the copper industry to rank second in projected water requirements and Table 2 shows it to rank second in volume of water depleted. In view of these large amounts of water, other uses may be restricted or totally excluded in areas where copper is produced.

NON-EXTRACTIVE INDUSTRY

Non-extractive industries are those which manufacture goods or provide a service.

Manufacturing

Although a recent study shows New Mexico dropped from fifth to seventeenth place among the continental United States in terms of the attractiveness of its business climate (Albuquerque Tribune, 1981), manufacturing will continue to employ a significant segment of the population. The manufacturing industry in New Mexico is concentrated in major municipalities. Products are small by industrial standards and include such things as clothing, electronic parts, jewelry, and medical supplies. Fabrication of such goods is not water intensive and water is used mainly for employee comforts. Water is generally obtained from public supplies available from the municipality in which the industry is located. Similarly, any water problems or conflicts associated with manufacturing are largely the concern of the municipality involved.

Waste Disposal

The service industries are similar to the manufacturing industries in that they are not water intensive, they seldom threaten water resources, and they are generally located in major municipalities. An important exception is the waste-disposal industry. As used here, this includes the operation of sites for disposal of toxic waste. Such waste may be radioactive or otherwise toxic. Radioactive waste may be low-level radioactive materials, discarded by hospitals or universities, or high-level radioactive waste.

Unlike the extractive industry, water supply is not a problem. In fact, water requirements are very low by comparison. The major problem is rather one of assuring isolation of the hazardous waste, especially as regards area water resources. Depending on location, activity by other industries may be restricted by the presence of a toxic-waste-disposal site. For example, potash mining and oil exploration would be curtailed in the vicinity of the proposed Waste Isolation Pilot Project (WIPP) site in southeast New Mexico.

IMPLICATIONS FOR FUTURE WORK

The foregoing sketch of water problems and conflicts associated with industry in New Mexico suggests a number of topics for future water resource work. Research in the areas of conservation, management, regulation, and alternative supplies is clearly warranted. Conservation studies might result in reduction of the large depletion percentages shown in Table 3. The use of more saline water by industry and economical ways of desalting water for industrial use, such as by solar stills, are also topics deserving further attention. Competitive-use conflicts might be resolved through improved water-resource management schemes. The possible consequences of the anticipated water-use transfers should be examined. Although existing regulations for protecting water resources are probably accurate, enforcement/implementation of these regulations may need enhancement. Additional regulations may be required to ensure conservation or to minimize consumptive use. Although reports are available on the regional hydrogeologic conditions for most areas of industrial activity in the state, additional site-specific studies would be useful in the cases of the extractive and waste-disposal industries. The growth of the manufacturing industry will be closely linked to the growth of the major municipalities. Thus, any work that strengthens their water-resource position, also strengthens the position of the manufacturing industry.

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