COMMENT

ARIZONA'S COMING DILEMMA: WATER SUPPLY AND POPULATION GROWTH†

The arid Southwest is experiencing tremendous population growth and economic development. An examination of population and density statistics lends itself to the superficial conclusion that this area can sustain many times the development it has already undergone. This paper explores the present and future supply and demand of water resources in order to determine whether water supply will set an upper limit on this growth. The paper sets forth the current law governing water rights in relation to its effect on water consumption and growth patterns. It focuses on the prospects for maintaining consumption and the present growth rates by increasing the water supply, or, in the alternative, by altering the current water rights system to prevent the exhaustion of water resources, putting a brake on increasing consumption and restoring equilibrium between supply and demand.

> [P]ure water is becoming a critical commodity whose abundance is about to set an upper limit of economic evolution in a few parts of the nation and inevitably will do so rather widely within half a century or less.[1]

In 1960 it was estimated on the basis of median range assumptions for birth rate that the population of the United States in 1970 would be 207 million.[2] The accompanying state-by-state breakdown forecast a population of 1.78 million for Arizona in 1970, using the higher of two projections of interstate migration.[3] The national estimate missed the 1970 Census figure of 204.8 million by one per cent, but the Arizona estimate missed the actual figure of 1.771 million by only one-half of one percent.[4] When the accompanying estimates[5] for

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1. A. PIPER, HAS THE U.S. ENOUGH WATER? 22 (U.S. Geological Survey Water Supply Paper No. 1797, 1965).

2. SEN. SELECT COMM. ON NATIONAL WATER RESOURCES, 86TH CONG., 2D SESS., WATER RESOURCES ACTIVITIES IN THE UNITED STATES 2 (Comm. Print No. 5, 1959-60) [hereinafter cited as WATER RESOURCES ACTIVITIES].

3. *Id.* at 6-7. The high migration assumption forecasts interstate movement for 1958-1980 equal to the measured migration from 1940-1958. The lower migration assumption was that movement 1958-1980 would equal one-half that of 1940-1958.

4. The error in the U.S. figure for 1970 is 1.074 percent; the error in the Arizona figure for 1970 is .508 percent. U.S. BUREAU OF THE CENSUS, DEP'T OF

Arizona's future population are adjusted by the error, calculations of population project 2.377 million for 1980, and 3.636 million for 2000.

The population boom in this part of the empty Southwest could be viewed from the perspective of the advocates of raw space demography as a solution in itself to the American population problem of overcrowding.[6] Superficially, the statistics reinforce the idea of vast growth potential. While Arizona's population grew thirty-six percent in the last decade, its population per square mile increased from 11.5 to only 15.6. In comparison, while the country as a whole grew only fourteen percent, density increased from 50.6 to 57.5 persons per square mile, a larger increase than Arizona.[7] There is plenty of empty land in Arizona, but the statistics are falsely optimistic. The growth potential in raw space belies the question of a sufficient water supply to support such growth.

I

ARIZONA'S WATER SUPPLY

A. Present Sources

1. Surface Water

The Colorado River is the major source of surface water for Arizona and the adjoining areas of the Lower Colorado Basin, which also includes the Las Vegas area of Nevada, and the Imperial and Coachella (Salton Sea) Valleys of southeastern California.[8] The Colorado averages a flow of around ten million acre-feet (AF)[9] per year at Lees Ferry in northern Arizona.[10] Out of this quantity, one million AF are

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COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES 5, 12 (92d ed. 1971). This suggests that although the birth rate assumption was slightly high, when the error it caused is deducted, the interstate migration assumption was close to accurate.

5. See WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 5 at 6-7.

6. *See, e.g.*, Wattenberg, *The Nonsense Explosion*, NEW REPUBLIC, April 4 & 11, 1970, at 18; Wallich, *The Population Problem*, NEWSWEEK, June 29, 1970, at 70; Jermann, *Zero Population Growth—Do We Need It Now?*, AMERICA, May 22, 1971, at 538-40.

7. U.S. BUREAU OF THE CENSUS, *supra* note 4, at 13.

8. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 5 at viii. The Imperial and Coachella Valleys do not drain into the Colorado River; they are below sea level. Their historic claims and current rights to Colorado River water make them part of the basin as described and treated by the Senate Select Committee.

9. An acre-foot is the quantity of water required to cover an acre of land one foot deep (326,000 gallons).

10. J. HUMLUM, WATER DEVELOPMENT AND WATER PLANNING IN THE SOUTHWESTERN UNITED STATES 113 (1969). A Senate Committee print gives the average discharge as 13.2 million AF per year. One figure measures the median flow; the other the flow half of the time. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 4 at 9.

pledged by the federal government to the five Indian reservations along the river.[11] An additional one million AF are lost to evaporation along the way,[12] and one and a half million AF are promised by treaty with Mexico to flow across the border to the Gulf of California.[13] The United States Supreme Court considered the division of the remaining seven and a half million AF in *Arizona v. California.*[14] The settlement of that long-standing dispute gave California, Arizona and Nevada rights to the remainder at rates of 4.4: 2.8: 0.3 million AF, respectively.[15] The Court also decided the rights of the parties in case of surplus.[16]

While Arizona was granted rights to 2.8 million AF by the settlement, it was not yet using that quantity of Colorado River water.[17] However, the congressionally authorized Central Arizona Project,[18] now under construction, will eventually deliver 1.8 million AF from the Colorado to a reservoir near Phoenix, which will fully exploit Arizona's share of Colorado River water.

Much of the Arizona water supply comes from the Salt River Project, a system of reservoirs and canals diverting virtually all the water from this major tributary of the Gila River, which drains much of the central plateau-highlands of Arizona.[19] However, as Table I[20] makes clear, Arizona has nowhere near a sufficient supply of surface water to meet the total demand.

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11. Arizona v. California, 373 U.S. 546, 596 (1963).

12. J. HUMLUM, *supra* note 10, at 113.

13. Treaty with Mexico respecting utilization of waters of the Colorado and Tijuana Rivers and of the Rio Grande, Feb. 3, 1944, art. 10, para. (a), 59 Stat. 1219 (1945), T.S. No. 994 (effective Nov. 8, 1945). The guarantees contained in this treaty have subsequently been declared a national objective in the Colorado River Basin Project Act of 1968, Pub. L. No. 90-537, tit. II, § 202, 82 Stat. 887 (codified at 43 U.S.C. § 1512 (1970)).

14. 373 U.S. 546 (1963).

15. *Id.* at 565.

16. *Id.* While Arizona was given rights to one-half of any surplus, such a surplus is more hope than prediction; in the decade before the decision the Colorado flowed at below the litigated volume. J. HUMLUM, *supra* note 10, at 113.

The apportionment of shortages has been clarified by the Colorado River Basin Project Act, 43 U.S.C. § 1521(b) (1970), which provides that diversions for the Central Arizona Project shall be limited to allow satisfaction of presently perfected rights without regard to priority in time or state.

17. At the time of the decision Arizona could not use its share, because California was then under contract with the Bureau of Reclamation to receive 5.36 million AF. 373 U.S. at 562.

18. This is part of the Colorado River Basin Project Act of 1968, Pub. L. No. 90-537, tit. III, 82 Stat. 885 (codified at 43 U.S.C. §§ 1521-28 (1970)). A map and description of the project can be found in J. HUMLUM, *supra* note 10, at 111.

19. The project is described in J. HUMLUM, *supra* note 10, at 103-09. It was authorized pursuant to the Reclamation Act of 1902, ch. 1093, 32 Stat. 388.

20. See text accompanying note 24 *infra.*

2. *Groundwater*

The lion's share of Arizona's water supply comes from the productive groundwater supplies that have been developed since the nineteen-thirties.[21] The southwestern three-fifths of the state is described geologically as a basin and range province—an area of broad, flat valleys separated by abrupt mountain ranges standing from two to seven thousand feet above the valleys and trending along a northwest-to-southeast axis. The composition of the basins is largely alluvium[22] from the surrounding ranges, varying in depth with the shape of the underlying bedrock—from hundreds to thousands of feet. While there is a great deal of regional variation, the entire area is generally rich in productive aquifers.[23]

TABLE I[24]

	water used	used in agriculture	groundwater pumped	surface water Colorado R.	surface water Salt R.
1957—	6.6	6.1	4.5	1.3	0.8
1962—	7.34	—	4.5[25]	1.7	1.14

(in million acre-feet per year)

Arizona gets approximately 65 percent of its annual water supply from groundwater pumping (see Table I). The State Land Department estimates an annual overdraft of three million AF, although there

21. U.S. GEOLOGICAL SURVEY & ARIZONA STATE LAND DEP'T, 1967 ANNUAL REPORT ON GROUND WATER IN ARIZONA 42 (Water Resources Report No. 36) [hereinafter cited as 1967 ANNUAL REPORT ON GROUND WATER].

22. Alluvium is defined as "[c]lay, silt, sand, gravel, or similar detrital material deposited by running water esp. during recent geologic time, the deposits ordinarily occurring on the floodplains of streams or . . . at places where streams issuing from mountains lose velocity and deposit their contained sediment on a valley floor." WEBSTER'S THIRD NEW INT'L DICTIONARY (unabr. ed. 1961).

23. An aquifer is defined as "[a] water bearing bed or stratum of permeable rock, sand or gravel capable of yielding considerable quantities of water to wells." WEBSTER'S THIRD NEW INT'L DICTIONARY (unabr. ed. 1961). In this paper the term "groundwater" is used to describe any water found within an aquifer. The legal rubric "percolating water" is used as a synonym for "groundwater." *See* 56 AM. JUR. *Waters* § 111 (1947).

For a basic description of groundwater geology, see generally Thomas & Leopold, *Groundwater in North America*, SCIENCE, March 6, 1964, at 1001, and C. MCGUINNESS, THE ROLE OF GROUNDWATER IN THE NATIONAL WATER SITUATION 21-28 (U.S. Geological Survey Water Supply Paper No. 1800 (1963)).

For a description of Arizona geology and the geography of its groundwater system see U.S. GEOLOGICAL SURVEY & ARIZONA STATE LAND DEP'T, 1963 ANNUAL REPORT ON GROUND WATER IN ARIZONA 39-42, 48 (Water Resources Report No. 15) [hereinafter cited as 1963 ANNUAL REPORT ON GROUND WATER].

24. The 1957 data is from U.S. GEOLOGICAL SURVEY & ARIZONA STATE LAND DEP'T, 1958 ANNUAL REPORT ON GROUND WATER IN ARIZONA 10, 12, 54 (Water Resources Report No. 5) [hereinafter cited as 1958 ANNUAL REPORT ON GROUND WATER]; the 1962 data is from 1963 ANNUAL REPORT ON GROUND WATER, *supra* note 23, at 27, 131.

25. The amount of groundwater pumped in 1962 is no greater than in 1957 because predictions of voluminous runoff from winter rains for the spring of 1962 led to

are no quantitative methods for determining natural recharge.[26] When the projected population growth for 1980 is added, the state will annually overdraft around three and a half million AF.[27] These statistics make it clear that the Central Arizona Project water can only slightly mitigate the overdrafting of groundwater.[28]

The overdraft has long been felt, but its effects will be experienced more severely in the near future. Data gathered by the United States Geological Survey indicate that in many irrigated areas, well levels have dropped as much as one hundred feet within the last decade. At some points the groundwater tables, or aquifers, have been depleted to depths of 300 to 450 feet.[29] Water has been recovered from as deep as 2000-2500 feet at a test well,[30] but the possibility of the uniform presence of a great volume of water is misleading. In the first place, the greater the depth from which the water is mined means, in many places, the likelihood of a high salt or mineral content, which requires purification before domestic use and a shift to more salt-tolerant crops. Secondly, although the depth of Arizona's aquifers has not been determined, it is generally assumed that the rough bowl-shape of the bedrock creates a deposit whose average depth is much less than its deepest point. And finally, drilling to such depths requires much more costly methods which are beyond the budget of individual and small corporate water pumpers.[31]

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the large-scale use of Salt River Project stored surface water during the beginning of the growing season. The predicted runoff surplus did not materialize, and as a result, reservoir levels were very low during the summer of 1962. 1963 ANNUAL REPORT ON GROUND WATER, *supra* note 23, at 131.

26. See C. MCGUINNESS, *supra* note 23, at 112-13. Natural recharge in some basins cannot yet be measured, and estimation is accomplished only by inference from geological data on porosity and other factors. The accuracy of such estimates is also unknown. Thomas & Leopold, *supra* note 23, at 1004. The 1963 ANNUAL REPORT ON GROUND WATER, *supra* note 23, indicates that some wells in areas near major canals have suffered little or no lowering in contrast to nearby wells that cannot benefit from such recharge. *Id.* at 102. In addition, it is estimated that about ten percent of Arizona's rainfall becomes runoff, and that half of that (or five percent) becomes recharge. *Id.* at 39. However, an examination of rainfall distribution shows that rain is least in the heavily irrigated areas. *Id.* at 15.

27. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 6 at 6-8.

28. The extraction of Central Arizona Project water from the Colorado River will further deteriorate the quality of water flowing into Mexico, a problem that the Mexican government claims has already caused millions of dollars of damage to Mexican farming. L.A. Times, June 14, 1972, pt. I, at 19, col. 1. A fuller discussion of this political issue can be found in Turner, *Colorado River Salinity Concerns Mexican Chief*, Arizona Daily Star, June 14, 1972, § C, at 5, col. 1, and in Arizona Daily Star, June 16, 1972, § A, at 1, col. 3.

29. 1958 ANNUAL REPORT ON GROUND WATER, *supra* note 24, at 31-32, 47, 54; 1963 ANNUAL REPORT ON GROUND WATER, *supra* note 23, at 88, 102, 105.

30. C. MCGUINNESS, *supra* note 23, at 155.

31. This point is soon to be reached in Kern County in the Central Valley of California. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 6 at 14.

While very little is known about groundwater movement, and even less is known about the porosity and holding capacity of specific areas, it is known that water in Arizona's alluvial basins percolates generally in the direction and approximately at the gradient of its drainage. By this so-called underflow, some lower basins are continuously recharged from upper basins,[32] although the rates of such recharges are unknown.[33]

A relatively recent discovery is that the normal course of percolation in Arizona drainages has been changed in places by the development of cones of depression[34] around which capillary or artesian pressure is generated so that the flow within a radius of two to ten miles is toward the center of the cone.[35] Heavy users overlying a cone of depression, therefore, benefit from the distorted percolation at the expense of their nearby neighbors, a phenomenon similar to the decrease or exhaustion of surface flows due to heavy pumping upstream in the underlying aquifer. Pumping will invariably alter the water table in the immediate vicinity. These principles of aquifer hydrology make it clear that certain private pumpers benefit from the effects of natural percolation and recharge at the expense of others.

Arizona's water resources have long been overtaxed, and water planners have agreed for an equally lengthy period that the state is borrowing against the future in overdrafting its groundwater. What no one agrees about is how to eliminate the discrepancy between demand and supply. The popular approach has been to search for new sources of water.

B. Possible Future Sources

1. Desalinization

Arizona's nearest salt water source is the Gulf of California, only forty miles from Yuma, but 200 miles from Tucson and 300 miles from

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In Lea County (southeastern New Mexico), it has been determined that agricultural pumping will become uneconomical when two-thirds of the aquifer has been depleted. *Id.* at 233-34. "The irrigated acreage in the state declined between 1955 and 1957 in part because of the increased cost of pumping water from greater depths." Mann, *Law and Politics of Ground Water in Arizona*, 2 ARIZ. L. REV. 241, 265 (1960).

32. 1963 ANNUAL REPORT ON GROUND WATER, *supra* note 23, at 39. For cases that deal with the interrelationship between ground and surface water, see City of Lodi v. East Bay Municipal Util. Dist., 7 Cal. 2d 316, 60 P.2d 439 (1936) (defendant, while building a reservoir upstream, was required to release the flow necessary to maintain recharge of plaintiff's groundwater sources). *See also* United States v. Fallbrook Public Util. Dist., 165 F. Supp. 806, 847 (S.D. Cal. 1958); Hudson v. Dailey, 156 Cal. 617, 628, 105 P. 748 (1909).

33. Thomas & Leopold, *supra* note 23, at 1004.

34. This is an area of severe aquifer depletion which describes an inverted cone around the point of extraction.

35. 1963 ANNUAL REPORT ON GROUND WATER, *supra* note 23, at 86, 95.

Phoenix. Thus, no matter how cheaply salt water can be converted, the transportation costs will at least equal those of transporting fresh water from the Colorado River.[36] Existing technology could produce desalted water costing about four times what is currently paid by the consumer.[37] The domestic user could afford to pay more, but such a price would most probably be out of the range of water-hungry irrigators.[38] This suggests that limitations imposed by water cost, as well as water supply, could force a decline in the importance of agriculture in the future of the Southwest. Such a price for converted water would be uncompetitive with ground and diverted surface water. The potential importance of desalinization should not be dismissed, but barring severe shortage, or a change in the economics of agriculture, it will play a lesser role in water resources planning.[39]

2. *Increased Storage*

An examination of the climate of southwest Arizona reveals that it is in the area of the greatest evaporation potential in the country. Due to its low altitude, the area immediately around the Colorado River suffers the severest evaporation losses; estimated reservoir depletion along the Colorado appears to be greater than ten percent of the assured supply. When compared to the 8.1 percent average evaporation for the entire West, and the two to three percent evaporation in the East, the Colorado River is the worst place to store wa-

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36. Estimates have run as high as a transportation cost of three to four times the conversion costs. W. THORNE, LAND & WATER USE 220 (Am. Ass'n for the Advancement of Science Pub. No. 73, 1963).

37. [T]he cost approaches but has not yet reached the target of $1 per thousand gallons. . . . It is reasonable to expect that cost at point of production ultimately can be diminished to and below the target. However, considering the quantity of energy required for separating water from dissolved salts, and, further, considering costs at which energy reasonably can be produced and applied to the separation, the writer considers it highly unlikely that the overall cost of desalting ocean water can, in the foreseeable future, be diminished by an order of magnitude below the target—that is, to as little as 10 cents per thousand gallons. Actual use of desalted ocean water will involve an additional increment of cost—that of pumping from the desalting plant to the place of use against the head necessary for effective distribution.

A. PIPER, *supra* note 1, at 22.

38. C. MCGUINNESS, *supra* note 23, at 100. *See also* WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 30 at 52.

39. Another source of salt water currently under consideration is the water that would be produced as a by-product of geothermal power generation in the Salton Trough, which extends from the Imperial Valley into Mexico. The State of California estimates that several million acre-feet per year could be produced. This water is brackish, however, and would require desalinization. It is also in great demand as a supplement to Southern California's water supply. GEOTHERMAL RESOURCES BOARD, CALIFORNIA STATE RESOURCES AGENCY, THE ECONOMIC POTENTIAL OF GEOTHERMAL RESOURCES IN CALIFORNIA 7 (1970).

ter.[40] Few feasible large-storage locations remain unused on the lower Colorado River now that plans to build the Bridge (Havasupai) Canyon Dam in the Grand Canyon and the Marble Canyon Dam upstream have been defeated.[41] The other areas in Arizona suitable for large reservoirs and with a significant water flow—the Verde, the Salt, and the Gila Rivers—have been developed for the Salt River and Central Arizona Projects.

Methods of coating the surface of reservoirs with a microscopically thin layer of a tasteless, odorless, alcohol-based evaporation preventive have been developed. Such a method is not prohibitively expensive, but it will not eliminate evaporation. While this method will become a factor in cost-benefit analysis of surface water storage, it does not promise to be much more than a minor contribution to the problem of inadequate water supply.[42]

While surface storage, the current solution, has only limited further potential, the possibility of groundwater recharge from surface water diversions has often been suggested.[43] The idea is technologically feasible; recharge pumping and spreading is currently carried on in Orange, Los Angeles and other coastal counties in Southern California. It saves evaporation losses and reservoir costs, and replenishes ground water systems. Recharge pumping can prevent: pumping costs from becoming prohibitive; the subsidence of depleted water-bearing soils with the resulting diminution in the capacity of the aquifer;[44] and the intrusion of salt water, either from adjacent ocean aquifers[45] or

40. A. PIPER, *supra* note 1, at 4, plate 2. A reservoir system must be designed taking into account the fact that larger storage capacity per unit increases evaporation and other losses as a percentage of usable storage until a point of diminishing returns is reached. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 3 at 16.

41. Compare the Lower Colorado River Basin Project Act, S. 1658, 88th Cong., 2d Sess. § 104(a) (1963) *reprinted in* S. REP. No. 1330, 80th Cong., 2d Sess. (1964) with the Colorado River Basin Project Act of 1968, Pub. L. No. 90-537, tit. III, 82 Stat. 885 (codified at 43 U.S.C. §§ 1521-28 (1970)).

42. Aandahl, *The Nation's Water Resources*, 48 J. AM. WATER WORKS ASS'N 931, 936 (1956).

43. C. MCGUINNESS, *supra* note 23, at 104; A. PIPER, *supra* note 1, at 24; Thomas & Leopold, *supra* note 23, at 1004. City of Los Angeles v. City of Glendale, 23 Cal. 2d 68, 142 P.2d 289 (1943), upheld the right of the city of Los Angeles to underground water imported from the Owens Valley, which it deliberately spread over gravel pits for underground flow to the groundwater reservoirs it mined. The court held it would be too harsh to compel the city to build surface reservoirs just to maintain its right to the water it imported. *Id.* at 77, 142 P.2d at 294.

44. Subsidence of a depleted aquifer in the western Central Valley of California has caused the diminution of a four million AF-capacity aquifer to a capacity of two million AF. Thomas & Leopold, *supra* note 23, at 1004.

45. This has caused the salinization of 25,000 acres of groundwater table and spurred some of the current recharge programs in Southern California. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 6 at 14. *See* CALIFORNIA DEP'T OF RESOURCES, BULL. NO. 63, SEAWATER INTRUSION IN CALIFORNIA (1958).

from fossil salt water percolating upward into depleted inland aquifers.[46]

The source of the supply for a recharge program might limit its efficacy to no more than a middle-range solution. Recharge water could come from excess surface flow, present surface storage (thus reducing evaporation losses), and presently untapped aquifers (which could be pumped at rates approximating or slightly overdrafting natural recharge). It is difficult to estimate how much water could be generated by such a program, but it might substantially reduce the current overdraft. Even if, in the long run, new sources are required, the sensibleness of a recharge program and the concomitant modification of common law water rights should appeal to the water resource planner.[47]

3. *Inter-regional Water Diversion*

In 1964 the Los Angeles Water Department issued plans for a proposed Northwestern Water Compact. Water would be diverted from the Snake River in southern Idaho, pumped to storage centers in northeastern Nevada, and then released to flow by gravity in pipe by one of two suggested routes into Lake Mead.[48] The proposal was greeted by firm opposition from Northwestern governors at a 1964 governors' conference, but some expressed the fear that California's numerical power in Congress might force them to the bargaining table.[49] The legal dimensions of such a program are beyond the scope of this paper.[50] Promotion of the plan is presently in eclipse as Southern California unveils the culmination of the Pacific Southwest Water Plan—the aqueduct from central California's river delta region to Los Angeles. But the governors' reaction to the plan was perhaps one of the first times public figures have seriously questioned both the economic wisdom and the long-range social policy of continued population and economic expansion in the arid Southwest.[51]

See also California Water Service Co. v. Edward Sidebotham & Son, 224 Cal. App. 2d 715, 37 Cal. Rptr. 1 (1964) (filed in 1945!).

46. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 6 at 14.

47. See text accompanying note 134 *infra.*

48. J. HUMLUM, *supra* note 10, at 121.

49. *Id.*

50. *See generally* Weatherford, *Legal Aspects of Interregional Water Diversion,* 15 U.C.L.A.L. REV. 1299 (1968); King, *Interstate Water Compacts,* in WATER RESOURCES AND THE LAW 353 (U. of Mich. Law School, Legislative Research Center ed. 1958).

51. This inter-regional conflict is reflected in the provision of the Colorado River Basin Project Act of 1968 that places a ten-year moratorium on studies by the Department of the Interior dealing with importation of water into the Colorado River basin from sources outside its natural drainage. Pub. L. No. 90-537, tit. II, § 201, 82 Stat. 886 (codified at 43 U.S.C. § 1511 (1970)).

In late 1970 the Governor of Arizona remarked that "[t]he area between Phoenix and Tucson could sustain five to ten million people if we develop it right with green belts and the like."[52] He added that the water for such a metropolis would come from Canada.

In 1967 the Ralph M. Parson Co., a private, transcontinental engineering and construction firm, issued its revised and more alluring version of what it calls NAWAPA—the North American Water and Power Alliance.[53] The plan proposes harnessing the immense water resources of Alaska and British Columbia, which would be pumped into huge reservoirs built in the trenches of the Columbia and Fraser Rivers just west of the crest of the Rockies. From there a small fraction of the water would be diverted through the Continental Divide to flow through the Sasketchewan and other Canadian river systems to irrigate the Canadian prairie provinces and provide, by canal, a steady flow for the Great Lakes. Most of the water would be pumped to Idaho, where it would be divided and pumped for gravitational flow into the needy systems of the American West—the Missouri, the Sacramento, and the Colorado for service to Southern California, Arizona, and Mexico. This system would deliver 180 million AF per year, 136 million AF to the United States and the rest to Canada and Mexico, and would cost $100 billion to build, $.5 billion in annual maintenance, and take thirty years to complete.

Arizona's surface water is fully exploited, its groundwater is overtaxed, and new sources are either uneconomical or would require an enormous investment and not be ready for decades. The proposals of new sources should be examined not only for their merits as engineering projects, but for their underlying assumption—that increasing water demand for both population and economic development is not only good, but inevitable. There is another approach.

II

LEGAL PROBLEMS IN WATER RESOURCE CONSERVATION

Arizona has always been considered an arid state.[54] Its water supply problems must be considered in the light of the governing water law, much of which is derived from legal developments in the well-watered East.[55] The law as a tool has been put to work for the policy

52. Comments after a speech made Oct. 18, 1970, by the Hon. Jack Williams, reported in Arizona Daily Star, Oct. 19, 1970, § A, at 12, col. 1.

53. J. HUMLUM, *supra* note 10, at 122-26.

54. *See* Reclamation Act of 1902, ch. 1093, 32 Stat. 388.

55. The important exception that recognizes Arizona's aridity is ARIZ. CONST. art. 17, § 1, which provides: "The common law doctrine of riparian water rights shall not obtain or be of any force or effect in the state."

of rendering the state productive. The law now promotes the maximum use of water resources, to the point of exhaustion. It does not have to.

A. Traditional Groundwater Law

A simplified summary of groundwater law should be sufficient to demonstrate the difficulty of establishing an effective conservation program, and the impossibility of setting up a recharge program, without changes in the law.

Arizona inherited the legal distinction between surface water and groundwater, and its corollary—that underground streams flowing in definite channels are treated as surface water, not groundwater.[56] Underground streams are subject to appropriation, while underground water moving through the soil[57] is not.[58] Although there clearly are underground stream channels, the flow of such and similar but less pronounced flows shades so gradually into standard percolation as to defy the legal distinction.[59]

> We might add that society and its knowledge developed these anomalous distinctions between surface and groundwaters completely overlooking the hydrological cycle. But the distinctions are too well engrained with stare decisis to change today.[60]

In most states percolating water is appurtenant to the land under which it runs or lies, a property right that has been limited, by case law or statute, to "reasonable use."[61] With groundwater as with surface watercourses, overlying owners—those whose right to the water is limited to use on the land to which the water is appurtenant[62]—may have correlative rights against each other. Thus, when there

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56. *See* Pima Farms Co. v. Proctor, 30 Ariz. 96, 245 P. 369 (1926).

57. See text accompanying note 32 *supra.*

58. For the consequences of this distinction, see text accompanying notes 66-67 *infra.*

59. Thomas & Leopold, *supra* note 23, at 1003; Piper & Thomas, *Hydrology and Water Law: What Is Their Future Common Ground?*, in WATER RESOURCES AND THE LAW 7, 10-11 (U. of Mich. Law School, Legislative Research Center 1958).

60. Brasher v. Gibson, 2 Ariz. App. 91, 406 P.2d 441, 448 (1965) (action by riparian owner to enjoin diversion of water from public slough).

61. 1 WATERS & WATER RIGHTS § 17.2 (R. Clark ed. 1967) [hereinafter cited as 1 WATER RIGHTS]. *See* Bassett v. Salisbury Mfg. Co., 43 N.H. 569, 573, 82 Am. Dec. 179 (1862).

62. *E.g.*, Sloss-Sheffield Steel & I. Co. v. Wilkes, 231 Ala. 511, 165 So. 764 (1936); Schenk v. Ann Arbor, 196 Mich. 75, 163 N.W. 109 (1917); Evans v. City of Seattle, 182 Wash. 450, 47 P.2d 984 (1935). *See* City of Pasadena v. City of Alhambra, 33 Cal. 2d 908, 925, 207 P.2d 17, 28 (1949), in which the California Supreme Court described the overlying right as analogous to a riparian right. *See also* Rank v. Krug, 142 F. Supp. 1, 105 (S.D. Cal. 1956).

is a supply shortage, each can enforce a pro rata reduction in the delivery to which his fellow landowner-users are entitled.[63] In *Bristor v. Cheatham*[64] the Arizona Supreme Court rejected the applicability of correlative rights to groundwater, and held that reasonable use is the only limitation on groundwater rights in Arizona.[65]

A right of prior appropriation is obtained by beneficial use prior in time to other similar claims. Water so taken can be put to beneficial use on land other than that to which the water is appurtenant, and the right to the amount of appropriated water can be enforced to prevent diminution by any subsequent appropriator.[66] The Arizona Supreme Court strictly construed the state statutes to conclude additionally that the legislature had not applied such appropriative rights to groundwater.[67]

Generally, appropriative rights are subordinate to overlying rights where they co-exist, *i.e.* a landowner can only appropriate water that is surplus flow or groundwater to which no overlyer has a claim.[68] In *City of Pasadena v. City of Alhambra*[69] severe groundwater depletion necessitated a reduction of "mining." The court stated that the proper overlying use was superior to the appropriator's right, and the latter must yield when shortage reduces the "surplus" to which his right attaches.[70] Such a limitation on water rights was precluded in Arizona by *Bristor v. Cheatham*,[71] leaving no superior right to enforce to curtail the overdraft.

This state of the law leaves the private pumper helpless to prevent a neighbor from benefitting from the distorted percolation around a cone of depression, and helpless to prevent the drying up of his well due to heavy pumping at a deeper well "upstream" in the underflow of percolating groundwater. If a recharge program were in operation, persons paying nothing could benefit from the recharge if any one of various hydrological situations obtained beneath their land.

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63. 5 WATERS AND WATER RIGHTS § 441 (R. Clark ed. 1972) [hereinafter cited as 5 WATER RIGHTS]. *See* Katz v. Walkinshaw, 141 Cal. 116, 74 P. 766 (1903).

64. 75 Ariz. 227, 255 P.2d 173 (1953).

65. *Id.* at 236, 255 P.2d at 178-79.

66. 1 WATER RIGHTS, *supra* note 61, at § 51.9. For a list of the statutory appropriation systems governing groundwater, see 5 WATER RIGHTS, *supra* note 63, at § 441. *See also* City of Pasadena v. City of Alhambra, 33 Cal. 2d 908, 925-27, 207 P.2d 17, 28-29 (1949).

67. 75 Ariz. at 234-36, 255 P.2d at 175-77.

68. Rank v. Krug, 142 F. Supp. 1, 110-11 (S.D. Cal. 1956); Peabody v. City of Vallejo, 2 Cal. 2d 351, 367-73, 40 P.2d 486, 491-94 (1935).

69. 33 Cal. 2d 908, 207 P.2d 17 (1949).

70. *Id.* at 926, 207 P.2d at 28-29.

71. 75 Ariz. 227, 255 P.2d 173 (1953). *Compare* WASH. REV. CODE ANN. §§ 90.44.010 *et seq.* (1962), which allows designation of criticial areas and authorizes limitations on withdrawals in conformity with priority of existing appropriative rights.

Because the private enforcement of both correlative rights and rights of prior appropriation have been ruled not to apply to Arizona's groundwaters, the responsibility for groundwater management has devolved upon the State. Even the court in *Bristor v. Cheatham*[72] recognized that if it did not change the law by imposing the correlative rights doctrine, the police power of the State might be the only remaining source of power to prevent exhaustion of the state's groundwaters.

B. The Arizona Groundwater Act

> In most places the chief problem in scientific reservoir management will be to adapt the present cultural pattern to it. . . Efficient reservoir management would require that withdrawals be from wells so spaced in location, depth and times and rates of pumping as to take maximum advantage of the storage and flow characteristics of the reservoir. . . .[73]

The effort of the Arizona Legislature to alter the present cultural pattern is embodied in the Groundwater Act.[74] The Act enables the state land department to declare areas of severe overdraft "Critical Groundwater Areas" when it has been shown that the area does not have a "reasonably safe supply for irrigation of the cultivated lands in the basin at the then current rates of withdrawal."[75] The Act prohibits the issuance of a drilling permit except for replacement or repair of an existing well in any Critical Groundwater Area.[76] However, the Act confers no authority to diminish the then-existing overdraft.[77]

The no-new-permit requirement has been weakened by judicial interpretation. In *State ex rel. Lassen v. Harpham*[78] the State sought to enjoin the construction of forty-two new wells in a designated Critical Groundwater Area. The injunction was denied because the wells had been "substantially commenced" within the meaning of the statute before the area was designated a critical area.[79] The driller had invested $28,000 in starting bore holes at all the well sites, but the hold-

72. 75 Ariz. at 234-35, 255 P.2d at 177-78.

73. Thomas & Leopold, *supra* note 23, at 1005.

74. ARIZ. REV. STAT. ANN. §§ 45-301 *et seq.* (1956). The drilling permit scheme [*id.* § 45-306] requires pumpers to keep logs, the data from which is compiled by the U.S. Geological Survey and the Arizona State Land Dep't. See, *e.g.*, notes 21, 23 & 24 *supra.*

75. ARIZ. REV. STAT. ANN. § 45-301(1) (1956).

76. A replacement permit will be granted when the aquifer has been depleted so that the well must be deepened in order to continue pumping at current rates of beneficial use. ARIZ. REV. STAT. ANN. § 45-316 (1956).

77. Southwest Engineering Co. v. Ernst, 79 Ariz. 403, 291 P.2d 764 (1955); C. MCGUINNESS, *supra* note 23, at 161.

78. 2 Ariz. App. 478, 410 P.2d 100 (1966).

79. *Id.* at 491, 410 P.2d at 111. *See also* ARIZ. REV. STAT. ANN. § 45-313(c) (1956).

ing still debilitated the statute. The court declared that no bad faith could be presumed from the defendant's having begun drilling with knowledge that the area would soon be designated a Critical Groundwater Area, provided that the wells were completed within a year after the designation. The Groundwater Act requires notice and hearings before an area is restricted,[80] and no permit is required for drilling until the area is declared critical.[81] The court admitted the likelihood that a rush of in-under-the-wire drilling would commence whenever an area was considered for restriction, but held that the legislature sanctioned such drilling.[82]

In *State ex rel. Morrison v. Anway*[83] the Arizona Supreme Court upheld a summary judgment against an attempt by the State to prohibit diversion of water pumped from a Critical Groundwater Area to lands not in irrigation at the statutory time prior to designation. Because the land from under which the water was being pumped lay fallow, the court expanded the doctrine of reasonable use to include such diversion to previously non-irrigated land. This holding permits the landowner to continue to appropriate water for new uses unrelated to the land to which the appropriative right attaches, and thus maximizes continued overdraft.

Maintaining water users' rights at the maximum overdraft established in a Critical Groundwater Area seems to be State policy. The transfer of a groundwater right to new use was also allowed in *Jarvis v. State Land Dep't.*[84] Irrigators mining the aquifer in the valley to the west of Tucson enjoined the State Land Department from leasing the city water department right-of-way for a pipeline across State land to deliver water pumped from a Critical Groundwater Area outside the designated area.[85] But a subsequent proceeding regarding alleged violations clarified the scope of the injunction.[86] The court held that if and when any user ceased irrigation or the city purchased any existing water rights in the adjacent valley, the city could pump such water out of the Critical Groundwater Area for municipal needs.[87] By allowing

80. ARIZ. REV. STAT. ANN. §§ 45-309, 45-310 (1956).

81. Pumpers and prospective pumpers are required to record their wells or their intention to drill a well with the state land department [*id.* §§ 45-304, 45-305 (1956)], but these records are for statistical purposes only.

82. 2 Ariz. App. at 489-90, 410 P.2d at 109-10.

83. 87 Ariz. 206, 349 P.2d 774 (1960).

84. 106 Ariz. 506, 479 P.2d 169 (1970), *enforcing* 104 Ariz. 527, 456 P.2d 385 (1969).

85. The city sought to estop the plaintiffs from asserting their rights on the ground that plaintiffs knew that the city had acquired well sites in the Critical Groundwater Area and had expended $2.8 million on pipeline construction. 104 Ariz. at 531, 456 P.2d at 389.

86. 106 Ariz. at 506, 479 P.2d at 169 (1970).

87. *Id.* at 511, 479 P.2d at 174.

the city to assume any abandoned water right, the court managed to balance the city's need for water and its valuable investment against the beneficial use rights of the irrigators and the statutory mandate against expanding the overdraft. This novel holding may play an important role in the continued urbanization of southern Arizona. As the extent of irrigation decreases in restricted areas due to increased pumping costs or encroaching subdivisions, a municipality may appropriate the abandoned right for municipal needs and continue the overdraft.

The Groundwater Act, passed reluctantly by the Arizona Legislature,[88] has been at best ineffective at controlling depletion in major water-use areas. Because it becomes applicable only when the aquifer has been severely depleted, rather than effecting any real preservation of groundwater, the law has served only to protect and perfect existing rights to water against diminution by new users.[89] It reflects a policy that the development of water resources will not be curtailed until it conflicts with the pre-existing rights of a failing aquifer. While the statute has prevented accelerating depletion in some areas, it has only maintained the current overdraft unabated.

Thus have *Bristor* and the Groundwater Act helped precipitate Arizona's dilemma. The need for new sources appears inescapable under the influence of the current law and the policy it sanctions. Unless water consumption can be curtailed, Arizona will be forced to cease growth or face exhausting its aquifers.

C. Limitations of Water Rights

A program to diminish overdraft and conserve groundwater would require a new or greatly limited system of water rights. A program of groundwater recharge, or an outright diminution in allowed water usage, would require the abolition or modification of common law rights to prevent the beneficial use of any recharged water without compensation to the recharger. Such a system might be subject to challenge as a taking of property without compensation under either the United States or the Arizona Constitutions.

1. Constitutional Issues

A number of states have enacted or considered permit systems

88. Mann, *supra* note 31, at 249-64.

89. The dissent in Southwest Engineering Co. v. Ernst, 79 Ariz. 403, 424-25, 291 P.2d 764, 779 (1955), argued that if the purpose of the Groundwater Act was to conserve and protect the water resources of the State, and if the legislature had found that mining greatly exceeded recharge, to allow present uses to continue unabated was an unreasonable, and therefore unconstitutional, legislative classification that could only frustrate the purpose of the Act.

that modify existing common law water rights.[90] It has been held in various courts that the replacement of a common law riparian right by beneficial use permits is not unconstitutional as a taking without compensation.[91] The constitutional test requiring a reasonable relationship between the state objective and the means employed is met by a permit system. The prevention of waste and other water abuses is logically a permissible state objective.[92]

More problematic is the constitutionality of a system that *diminishes* existing rights. Most specified-term permits have provisions for compensation when a right is terminated by the state acting on behalf of a preferred user. But the Florida Model Code contains one provision that might be contestable.[93] It does not provide for compensation when a right is terminated upon expiration of the permit. This provision could stand or fall with the statutory or administrative reasons that justify termination; for example, if it were terminated by reason of abandonment or failure to develop beneficial use, compensation would not be required.

The issue crucial to this discussion is whether a permit could be terminated or diminished because of water shortage or overdraft, as part of a conservation program. In *Williams v. City of Wichita*,[94] the Kansas Supreme Court said: "Legislation limiting the right to use [of groundwater] is in itself no more objectionable than legislation

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90. *E.g.*, IDAHO CODE ANN. §§ 42-226 to 42-239 (Supp. 1971); IOWA CODE ANN. §§ 455A.1-.39 (1971); WASH. REV. CODE ANN. §§ 90.44.010 *et seq.* (1962); Florida Model Water Code, soon to be issued in book form, portions of which are reprinted in Maloney & Ausness, *A Modern Proposal for State Regulation of Consumptive Uses of Water*, 22 HAST. L.J. 523 (1971); and Model Water Use Act, in WATER RESOURCES AND THE LAW 533 (U. of Michigan Law School, Legislative Research Center ed. 1958).

91. *See, e.g.*, State *ex rel.* Emery v. Knapp, 167 Kan. 546, 207 P.2d 440 (1949), in which the Kansas Supreme Court held that legislation to prevent waste of water and establish a permit system did not constitute a taking, as a riparian owner has no vested right in unused water flow; Baumann v. Smrha, 145 F. Supp. 617 (D. Kan. 1956), which upheld the same Kansas statute against Federal constitutional attack. *See also* Murphy v. Kerr, 296 F. 536 (D.N.M. 1923); Katz v. Walkinshaw, 141 Cal. 116, 74 P. 766 (1903).

92. *See* Maloney & Ausness, *supra* note 90.

93. *Id.* at 531-33. The Idaho Supreme Court in State *ex rel.* Tappan v. Smith, 92 Idaho 451, 444 P.2d 412 (1968), upheld the action of the state reclamation engineer in enjoining a landowner from withdrawing water from a well pursuant to IDAHO CODE ANN. § 42-237a(g) (Supp. 1971). This system functions to diminish existing rights only as an administrative enforcement of the rights of prior appropriation that prevail in Idaho. The appellant landowner made no unconstitutional-as-taking attack on the statute.

94. 190 Kan. 317, 374 P.2d 578 (1962). The case upheld the Kansas Water Appropriation Act of 1945 that established a permit system for underground water rights because it defined existing uses as vested rights not vulnerable to impairment.

forbidding the use of property for certain purposes."[95] While the broad language seems to validate limiting groundwater withdrawals, the cases have only applied this standard to systems replacing riparian with appropriative rights, or diminishing appropriative rights upon attack by riparian owners, or establishing a beneficial use limit to the ownership of migratory waters.[96] This reasoning might not extend so far as to allow a state to forbid continued water use, but it should sanction limiting or reducing water use as a proper exercise of the state's police power.

The opposite conclusion has also been drawn. *Bristor v. Cheatham*[97] has been analyzed to support the following conclusion:

> The correlative rights rule, allowing for the proportional division of water *actually available* each year, might conceivably have been enforced by a complex legislative code, but the court rejected it and chose the reasonable use rule instead. It is now doubtful whether the Arizona legislature can constitutionally define reasonable use strictly enough to stop the rapid drain of limited ground water supplies. Therefore, it is likely that only by state condemnation and the payment of just compensation can the virtual mining of the aquifers be controlled.[98]

This conclusion is disputable: the correlative rights doctrine does not have to be taken literally, since the amount of water actually available is still unmeasured. A pro rata assessment of the amount of water *pumped* could serve as well as a basis for proportional reduction.[99] Further, the constitutional standard defining how far regulation can go without constituting a taking that prevails in Arizona indicates that the State legislature should have the authority to define reasonable

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95. *Id.* at 339, 374 P.2d at 595, *citing* Euclid v. Ambler Realty Co., 272 U.S. 365 (1926).

96. *E.g.*, California-Oregon Power Co. v. Beaver Portland Cement Co., 73 F.2d 555 (9th Cir. 1934), *aff'd on other grounds*, 295 U.S. 142 (1935); Williams v. City of Wichita, 190 Kan. 317, 374 P.2d 578 (1962); In re Hood River, 114 Ore. 112, 227 P. 1065 (1924); Knight v. Grimes, 80 S.D. 517, 127 N.W.2d 708 (1964); Texas Water Rights Comm'n v. Wright, 464 S.W.2d 642 (Tex. 1971).

97. 75 Ariz. 227, 255 P.2d 173 (1953).

98. Note, *Percolating Waters—Ownership Rule Restated in Arizona*, 26 ROCKY MT. L. REV. 104, 107 (1954).

99. *See* California Water Service Co. v. Edward Sidebotham & Son, 224 Cal. App. 2d 715, 37 Cal. Rptr. 1 (1964). The California Water Replenishment District Act, CAL. WATER CODE §§ 60000 *et seq.* (West 1966), does not provide any mechanism for reducing the groundwater overdraft, nor does it allow the exercise of eminent domain over "water or water rights already devoted to beneficial use." *Id.* § 60230(8). It does, however, provide a Replenishment District with the power to levy a production tax on groundwater pumped to finance a replenishment program [*id.* § 60317], and the power to levy a real property tax [*id.* § 60252]. The former tax is used by the Orange County Replenishment District, while the latter is used by the Los Angeles Metropolitan Water District.

use strictly. In *Southwest Engineering Co. v. Ernst*[100] the court said:

> It can thus be seen that a conflict occurs between appellant and the state by reason of the interest of the public in the preservation from destruction of a resource essential to the sustenance of life. Where the public interest is thus significantly involved, the preferment of that interest over the property interest of the individual even to the extent of its destruction is a distinguishing characteristic of the exercise of the police power.[101]

This statement of principle arguably endorses the strictest of legislation.

Professor Sax argues[102] that the issue of governmental taking through exercise of the police power should be redefined to reflect its historical origin, which lay in requiring the government to pay when it took private property for a public use. Public use did not mean public regulation, such as laws enacted to improve health or prevent injury. It meant the use and ownership of the previously private property for a public enterprise. Thus a police power exercise can be identified as a taking if the government assumes control of the economic resources involved to further a government enterprise. The classic examples of taking land for highways, schools, and public works fit this description. But exercise of the police power in a controversy over land or resource use in which the government is not a participant, in which its only role is as mediator between conflicting *private* demands, requires no compensation to any owner even if the value of his property is completely destroyed. If *Ernst* is read to have endorsed this analysis of the problem, limitations on groundwater rights would not be a taking to further any government enterprise, but rather, government mediation between the conflicting demands of private users of a failing resource.[103]

Federal law in this area derives largely from *Pennsylvania Coal Co. v. Mahon*.[104] Justice Holmes ruled that an important "fact for consideration in determining [the limits of the police power] is the extent of the diminution [in property value]."[105] Holmes felt that if regulation went too far, it amounted to a taking.[106] Holmes' view was modified in *Goldblatt v. Town of Hempstead*[107] by the Court's conclusion that "[a]lthough a comparison of values before and after

100. 79 Ariz. 403, 291 P.2d 764 (1955).

101. *Id.* at 409, 291 P.2d at 768.

102. Sax, *Takings and The Police Power*, 74 YALE L.J. 36 (1964).

103. ARIZ. CONST. art. 2, § 4, dealing with takings and the police power, was treated as virtually identical in Southwest Engineering Co. v. Ernst, 79 Ariz. 403, 409, 291 P.2d 764, 768 (1955).

104. 260 U.S. 393 (1922).

105. *Id.* at 413.

106. *Id.* at 415.

107. 369 U.S. 590 (1962).

is relevant, . . . it is by no means conclusive."[108] Goldblatt had argued that the value of his property was completely destroyed, but the Court found no taking in the zoning that outlawed his land use. Two recent cases, *Armstrong v. United States*[109] and *Consolidated Rock Products Co. v. Los Angeles*,[110] treat the diminution in value test too ambiguously to conclude whether it is the law or not. In *Consolidated Rock Products*, the Court dismissed for lack of a federal question the appeal on a record that clearly showed that the owner's land had been rendered valueless by the ordinance involved.[111]

Even if the diminution of value test still carries some weight it should not preclude the Arizona Legislature from restricting "reasonable use."[112] A legislative definition of reasonable use strict enough to *stop* the overdraft, *i.e.*, cut water use in half, arguably does not hit irrigators hard enough to constitute a taking even if the diminution-of-value theory is held to apply. This conclusion is reinforced if the doctrine of domestic as preferred use is applied.[113] A milder definition that merely diminishes the rate of overdraft should be constitutional under any test.

2. *Permit System Variations*

There are a number of variations of permit systems that deserve consideration. First, the Critical Groundwater Area designation could be

108. *Id.* at 594.

109. 364 U.S. 40 (1960) (contractor/supplier's liens on property under contract with United States constituted compensable property interests).

110. 371 U.S. 36 (1962), *dismissing per curiam appeal from* 57 Cal. 2d 515, 370 P.2d 342, 20 Cal. Rptr. 638 (1962) (plaintiff's land, valuable *only* as rock and gravel pit, was not "taken" by a residential-only zoning classification). This case and *Armstrong* can be reconciled using Professor Sax's theory. *See* Sax, *supra* note 102, at 43-45.

111. 371 U.S. at 36.

112. If the diminution-of-value test were strictly applied, the court would have to take evidence on the economics of agricultural production to deal with the issue that the termination of a percentage of the appropriator's right might make it uneconomical for him to continue to farm the rest of his land.

113. The doctrine holds that in time of shortage, owners of rights for mining or agricultural use must limit their use while the preferred use continues unabated. *See, e.g.*, Metropolitan Water Dist. of S. California v. Marquardt, 59 Cal. 2d 159, 379 P.2d 28, 28 Cal. Rptr. 724 (1963); CAL. WATER CODE § 106 (West 1966); IDAHO CONST. art. 15, § 3.

In Arizona this doctrine may be implied from the fact that the Arizona Ground Water Code, ARIZ. REV. STAT. ANN. § 45-313 (1956), prohibits the drilling only of irrigation wells in Critical Groundwater Areas. *See* Jarvis v. State Land Dep't, 106 Ariz. 506, 510, 479 P.2d 169, 173 (1970). Even in the absence of an express doctrine, a stated legislative goal to preserve the state's groundwater for the long-term benefit of domestic users would validate a statutory discrimination between domestic and agricultural use. See the discussion of Miller v. Schoene, 276 U.S. 272 (1928), in Southwest Engineering Co. v. Ernst, 79 Ariz. 403, 410-11, 291 P.2d 764, 768-69 (1955). See note 115 and accompanying text *infra*.

put to broader use to prevent more exhaustive mining of already overburdened but not yet critical aquifers. The language in *Southwest Engineering Co. v. Ernst*[114] declaring the Act constitutional is more sweeping than coverage of the Act itself. Second, an attempt could be made to prohibit the development of presently untapped aquifers. A restrictive reading of *Ernst*, and its citation to *Miller v. Schoene*,[115] seem to preclude the application of the police power to destroy property rights unless other property deemed more important is saved. A legislative determination that the untapped or lightly used aquifers of Arizona must be protected because they constitute the future supply for developed regions should meet this test. And language in the beneficial use permit system cases supports regulation or prohibition of development. The emphasis in these holdings has been that water rights are in no way absolute; they obtain only to the amount of water that has been used, and do not extend to unused or undeveloped supplies flowing through or under the owner's land.[116] This issue may soon be tested—a recently defeated initiative in Boulder, Colorado, and an initiative recently passed in Livermore, California, would prevent further housing development within the city limits by refusal to issue building permits when the municipal sewer and water systems are burdened to capacity. This licensing situtation is closely analogous to a water-pumping permit scheme. The Boulder initiative, which was closer to an outright prohibition on further development, was defeated, so that issue has not yet undergone a court test. The Livermore initiative is expected to be challenged in court.[117] By prohibiting the issuance of building permits whenever the school, water or sewage systems are over-burdened, it will allow the voters to choose the level of development they want at a bond election that will occur *before* growth has made the bond issues necessary. If the courts uphold the ordinance,

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114. 79 Ariz. 403, 411-12, 291 P.2d 764, 769-70 (1955).

115. 276 U.S. 272 (1928) (privately-owned cedar trees destroyed without compensation because they were host to a rust that threatened to decimate Virginia's apple industry).

116. Williams v. City of Wichita, 190 Kan. 317, 374 P.2d 578 (1962).

117. San Francisco Chronicle, Apr. 13, 1972, at 1, col. 2. The initiative is vulnerable to attack as void for vagueness, and on the ground that prohibiting residential building permits is an unreasonable classification if the purpose is to prevent the overburdening of municipal sewer and water systems, since industry and commerce contribute to the problem and are not regulated. Memorandum from the Livermore City Attorney to the Livermore City Council on the SAVE Initiative, Feb. 4, 1972 (copy on file with *Ecology Law Quarterly*). A law restricting only agricultural water uses should not be vulnerable to attack on the second ground if Arizona recognizes the principle of domestic as preferred use. See note 113 and accompanying text *supra*. Significantly, the Livermore initiative was not discussed as a taking without compensation.

For a perspective on the interrelation of residential and water resource development, see Note, *Subdivision Planning Through Water Regulation in New Mexico*, 12 NATURAL RES. J. 286 (1972).

the case will be good precedent for the proposition that a property right does not extend to an undeveloped or unimproved resource which is only a potential use.[118]

A third means by which the development of unused land and its water supply can be discouraged or stopped is through the strict regulation of state land sales and leases, and federal land grants. Further development of irrigated agriculture in the Imperial Valley has been stopped in part by the Department of the Interior's refusal to perfect patent claims to public lands in the area. Under the Desert Land Act,[119] private title can be perfected to certain lands that are naturally non-productive. But two Desert Land Act entrymen were denied their patents in *In re Ritter and Bunn.*[120] The Department of the Interior noted that California was at the time already using 5.1 million AF of Colorado River water when it had been allotted only 4.4 million AF. Even though petitioners had complied with all the requirements necessary to receive a patent, it was ruled that "it would be contrary to the public interest . . . to increase the pressure on the inadequate water supply . . . by classifying the lands involved in these applications and other similar public lands as available for disposition under the desert land law."[121] While much of Arizona's federal and state-held desert land does have some underground water resources, this should not make the *Ritter* policy inapplicable. It is submitted that these untapped aquifers will and should constitute the future water supplies for developed areas when supplies are depleted, or a recharge program is begun.[122]

A fourth measure that could spur efficient use while serving as the basis for a groundwater recharge/storage program, is a tax on withdrawals. Such a tax could help finance a recharge system,[123] and would be its own measure of where and how much replenishment should be apportioned. Such a tax system would to some extent slight the hydrological complexities of the aquifer until precise methods for

118. See note 115 and accompanying text *supra.*

119. 43 U.S.C. §§ 321 *et seq.* (1970). Of similar effect is the Carey Act, 43 U.S.C. §§ 641-48 (1970), originally enacted in 1877 [Act of Aug. 18, 1877, ch. 301, § 4, 28 Stat. 422], and made applicable to Arizona in 1909 [35 Stat. 638 (codified at 43 U.S.C. § 646 (1970))], which authorizes the Secretary of the Interior to carry out the policy of settling the arid states by granting free to each western state up to one million acres of public land if the state will cause it to be irrigated and reclaimed within ten years.

120. 72 Interior Dec. 111 (1965).

121. *Id.* at 112.

122. The city of Tucson has already acquired leases and rights in a number of neighboring valleys, among them those rights involved in Jarvis v. State Land Dep't, 104 Ariz. 527, 456 P.2d 385 (1969).

123. This system is used in Orange County, California. See note 99 *supra.*

mapping flow, recharge, and the effects of withdrawal are developed. The designation of an aquifer as the unit for measuring burden and benefit is, however, not an unreasonable state classification in furtherance of a permissible policy: "Public welfare may be so profoundly affected by a falling water table as to justify taxing the water pumper to pay for its replenishment."[124]

Severance taxes have been upheld as constitutional in relation to gas and oil resources in *Gulf Refining Co. v. McFarland.*[125] The analogy between mineral resources and groundwater is geologically quite accurate. An analogy between mineral resources law and water law might prove to be a fruitful line of reasoning for extending constitutional state control over the mining of groundwater. Thus far, however, the only application of mineral law to water resources has had the opposite effect of maintaining and stimulating water development. The severe groundwater depletion problem in the High Plains area of West Texas, where 25 to 43 percent of the cost of acreage lies in the value of the groundwater beneath, led to the adoption of a tax allowance to water pumpers on a cost-depletion basis, in *United States v. Shurbet.*[126] The court was careful to make it clear that its holding applied only to the "Ogallala formation" on the High Plains.[127] The underlying rationale, however, makes it applicable anywhere that the aquifer capacity is measured or deemed preciously limited.[128] If water became valuable enough, or could be considered as scarce or important as other natural resources, then it could come

> [u]nder the rule that oil and gas under land are not susceptible of private ownership, but fall within the domain of the natural resources of the state until severed from the soil and reduced to possession, . . . [and] their extraction and use are subject to regulation, or even complete restriction or suppression, by the state.[129]

Unfortunately, it is hard to find a holding as broad as the language. Most of the cases declaring regulation of oil and gas extraction constitutional deal only with measures designed to eliminate waste,[130] or to prevent the inequitable extraction from a common pool.[131] Courts have up-

124. State *ex rel.* Lassen v. Harpham, 2 Ariz. App. 478, 410 P.2d 100, 104 (1966), *citing* ECONOMICS AND PUBLIC POLICY IN WATER RESOURCE DEVELOPMENT 311 (S. Smith & E. Castle eds. 1964).

125. 264 U.S. 573 (1924), *aff'g* 154 La. 251, 97 So. 433 (1923).

126. 347 F.2d 103 (5th Cir. 1965).

127. *Id.* at 109.

128. See Note, *Ground Water—Depletion of a Wasting Asset,* 19 Sw. L.J. 791 (1965).

129. Annot., 78 A.L.R. 834, 836 (1932), *citing* Herkness v. Irion, 11 F.2d 386 (E.D. La. 1926), *rev'd,* 278 U.S. 92 (1928).

130. *E.g.,* Champlin Refining Co. v. State Corporation Comm'n, 286 U.S. 210 (1932).

131. *E.g.,* Walls v. Midland Carbon Co., 254 U.S. 300 (1920).

held regulation that prevented withdrawal of resources from another's property, and that pooled separately owned tracts of land to proration the resources beneath them all;[132] but such regulation is in effect no more confiscatory than its water resource analogy—the enforcement of correlative rights. It has been held that the state can regulate rates of withdrawal,[133] but again, this measure was enacted in order to maintain a pumping pressure that would prevent waste in extraction, not in order ultimately to conserve supply. As in the area of water resources legislation, the language in the cases is a good deal broader than the scope of the legislation whose constitutionality is being affirmed.

The breadth of the language does indicate, however, that legislation enacting a permit system of groundwater rights should be constitutional.

CONCLUSION

The Groundwater Act has served not to conserve the State's water resources, but to secure the rights of those whose beneficial use was established before the statute.

In Southern California, where recharge now accounts for about ten percent of the water that some districts purchase, private individual and corporate water pumpers can be mining the same aquifer that the district's customers are paying to recharge.[134] While data on the beneficial effects of such recharge pumping are unavailable, there is bound to be some resulting improvement in the nearby portions of the aquifer. There is the possibility that a well near the area of saline water intrusion could be saved by recharge efforts for which the pumper pays nothing. Unless the law of reasonable use is changed, some pumpers will acquire rights to imported water for which they pay nothing.

A policy designed to restore an equilibrium between water supply and demand could focus on diminishing current rights; or estab-

132. Northern Natural Gas Co. v. State Corp. Comm'n, 188 Kan. 355, 362 P.2d 599 (1961), *rehearing denied* 364 P.2d 668 (1961); Alexander v. Holt, 116 So. 2d 532 (La. App. 1959).

133. Champlin Refining Co. v. State Corp. Comm'n, 286 U.S. 210 (1932).

134. J. HUMLUM, *supra* note 10, at 141, n.1; Krieger, *The Law of the Underground*, 34 CIVIL ENGINEERING 52 (1964). California (like Texas, the next-heaviest groundwater-pumping state) does not require a permit for private extraction. However, since the passage of the 1955 Groundwater Replenishment Act, CAL. WATER CODE §§ 60000 *et seq.* (West 1966), groundwater pumpers within specifically designated Groundwater Replenishment Districts can be fined for failure to file a production report [*id.* § 60336] and are subject to taxes to cover the cost of goundwater replenishment within their district. Thus the class of pumpers who benefit from recharge for which they do not pay is reduced to those outside a designated Replenishment District who benefit hydrologically from recharge within the District. In most areas of California, moreover, no appropriative right vests without compliance with the applicable permit scheme. Rank v. Krug, 142 F. Supp. 1, 122-23 (S.D. Cal. 1956).

lishing a recharge program—and preventing some pumpers from benefitting without paying; or both. But implementing such a policy will require overhauling groundwater law, which currently promotes maximum use[135] and frustrates comprehensive planning.

The discussion above reveals that there are no constitutional obstacles to enacting such a policy, and that there are a number of permit system variations that could effectively promote the technically attractive recharge program and/or diminish the overdraft.

It is clear that such policies run counter to the thrust of current governmental thinking. The State of Arizona is not seriously promoting any of these feasible and legal measures. Even though depletion is serious, Arizona will not run dry soon.

Some writers have maintained that no steps will be taken until the demand/supply ratio reaches crisis proportions.[136] In Southern California, where salt water intrusion threatens thousands of acres of depleted aquifer, no substantial steps have been taken to alter common law groundwater rights, and only recently has there been large-scale cooperation in developing a recharge program[137] or limiting any but the most severe overdraft. Litigation has mitigated some crises by diminishing local overdrafts,[138] but no middle-range steps such as those discussed above have been acted upon. The primary reason that such steps have been ignored is the reliance by these arid areas in their long-term planning on the solution to their past problems—new supplies.[139] It is questionable whether this is a desirable public policy.

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135. Another aspect of the promotion of water resource development that would have to be changed is the ease with which one can obtain water rights in Arizona. Outside of a Critical Groundwater Area, all a party has to do to acquire beneficial use rights to groundwater in Arizona is to obtain a permit from the Arizona Corporation Commission, which issues permits upon a "certificate of convenience and necessity"—"convenience" meaning that there is water available for pumping, and "necessity" meaning that the pumper has prospective buyers or users of the water. Straayer, *Public Problems and Non-decision Making: A Study of the Tucson Water System*, 10 NATURAL RES. J. 545, 550 (1970). *See also* ARIZ. CONST. art. 15.

136. *E.g.*, Ingram, *Patterns of Politics in Water Resources Development*, 11 NATURAL RES. J. 102 (1971); Straayer, *supra* note 135, at 546-47.

137. See note 99 *supra*.

138. California Water Service Co. v. Edward Sidebotham & Son, Inc., 224 Cal. App. 2d 715, 37 Cal. Rptr. 1 (1964); City of Pasadena v. City of Alhambra, 33 Cal. 2d 924, 207 P.2d 17(1949).

139. For example, when local supplies proved insufficient early this century, Los Angeles tapped the Owens Valley. Its stored resources have been largely drained, and the Owens aqueduct has been extended farther north into the Mono Lake basin. Since the metropolitan water district had its share of the Colorado River's water limited, it has developed and just completed the newest and farthest extension of its water supply with the acquisition, through the Pacific Southwest Water Plan, of Feather River water via the Delta canal. For a history of Los Angeles water supply expansion, see J. HUMLUM, *supra* note 10, at 29-32.

NAWAPA[140] frames the issue in the boldest of terms. If such a project is necessary to satisfy demand until 2050, does such a policy ignore cost-benefit considerations or the law of diminishing returns? And more fundamentally, is it wise to be committed to a policy of unhindered—or artificially stimulated—population development in arid and semi-arid regions?

The Senate Select Committee on National Water Resources made the following projections for water demand in the entire Colorado Basin:

TABLE II[141]

withdrawals		agricultrial	municipal	industrial	mining	power		total (MGD)	total (MAF/yr)
1954	—	26,403	187	44	58	—	=	26,692	29.9
1980	—	22,770	397	137	750	3,571	=	27,625	30.9
2000	—	19,965	647	671	734	8,035	=	30,052	33.7

(in million gallons per day—1.0 MGD = 1,120.15 AF/year)

Since the Colorado River is only capable of producing 7.5 million AF per year for the upper half of its basin and 7.5 million AF for the lower half, it is evident that an increasing percentage—already more than half—of the area's water will come from groundwater sources. While natural replenishment reduces the total overdraft noticeably, the area could be deemed over-developed as of 1954. The decreases in agricultural water use will be less than the added requirements of population growth and the accompanying demand for power. Groundwater supplies will be further taxed by estimates that increasing flows of the Colorado and its tributaries will be required for waste dilution and in demand for recreation and sport.[142] While total demand is not estimated to rise drastically, depletion rates will nevertheless increase. Table III illustrates the general basin pattern for use and estimated use:

TABLE III[143]

Tucson, Arizona

			ANNUAL USE	
		population	muni., indus.	agricultural
1950	—	132,000	33,100 AF	103,000 AF
1963	—	302,000	81,500 AF	177,500 AF
2000	—	1,500,000	358,900 AF	105,700 AF

140. The North American Water and Power Alliance. See note 53 and accompanying text *supra*.

141. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 32 at 39-40.

142. *Id.* at 47-48.

143. Straayer, *supra* note 135, at 549. J. HUMLUM, *supra* note 10, also cites figures which are not used because he limits his area by the political boundary of Pima County. Straayer's figures, and the data in the Arizona State Land Department Reports [see notes 21, 23 & 24 *supra*] are based on the geological unit of the upper Santa Cruz River basin, which includes substantial acreage of irrigated cropland just north of the Pima County line.

Tucson will soon receive 100,000 AF/year from the Colorado River via aqueduct for municipal use, its first surface water supply. But that boon will only be swallowed up by demand for more than 200,000 AF/year more. Thus the aquifer will be depleted by 100,000 AF/year more than at present. These estimates illustrate the apparent necessity for immediate acquisition of new water sources. But there is, along with the middle-range solution of a groundwater recharge program, the long-range possibility of limiting consumption by restricting growth in both irrigated agriculture and population.

Table II shows a decrease in agricultural water use. While in Arizona this may reflect decreasing acreage—due substantially to urban growth—the Senate Committee on National Water Resources estimates that under prevailing population growth rates, more acreage in the Colorado Basin will be under cultivation in 2000 than in 1954 (3,340,000 to 2,813,000 acres).[144] Thus the decreased water demand reflects the prospect that irrigation efficiency will have noticeably improved. These figures indicate that while 6.2 AF of water per acre were required to produce the average crop in 1954, it will only take 4.9 AF per acre in 1980 and 4.4 AF in 2000.[145]

The arid Southwest has obvious advantages as an agricultural area: rare frost; a winter growing season that allows crops to arrive at market off-season; fertile alluvial soil; and into the near future, relatively plentiful water. But the 6.2 AF of water per acre required in 1954 and the 4.4 AF it will take in 2000 compare with figures of 2.0 AF in 1954 and 1.6 AF in 2000 in the East. If a new source of diverted water or desalinization cannot deliver water as cheap as groundwater is today, or if the aquifers become too depleted for economical pumping, Arizona's agriculture may lose its economic appeal.

The experience of the High Plains area of West Texas is illustrative of the fate of groundwater-dependent agriculture. The area has well-defined productive aquifers whose potential yield has been determined. The area has some 200 million AF storage. Seven million AF are pumped annually, and there is a measured recharge of 50,000 AF/year. At this rate the area will be dry in twenty years—thirty years from the publishing date of the survey.[146] The High Plains has recognized that its agricultural days are numbered. While the situation in Arizona is not nearly as severe, similar implications can be drawn from the drain that irrigation puts on Arizona's water resources.

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144. WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 12 at Table 11.

145. *Id.* at Tables 39-41.

146. *See* United States v. Shurbet, 347 F.2d 103 (5th Cir. 1965); Note, *Ground Water—Depletion of a Wasting Asset*, 19 Sw. L.J. 791 (1965).

It has been estimated that in 1960 just less than half of the groundwater pumped in the immediate vicinity of Tucson, Arizona, went into agriculture that supported around 1,500 people.[147] That same water supply could support a city of 200,000 domestic users. Such statistics have led to serious suggestions that irrigated agriculture be abandoned in the Southwest.[148] Statistically, agricultural use need only be cut in half to eliminate the estimated annual overdraft.

Without agriculture, Arizona could support a population as large as the middle-range birth rate/high migration projection calls for without needing to develop new water sources.[149] A rough equilibrium between the two water uses could be reached by means of slower population growth and a significant but gradual decrease in agriculture—which would stabilize water consumption at a much smaller and not so crucial overdraft. Such a policy could be significantly aided by a constitutionally valid water conservation and recharge program that altered the present system of perfecting and protecting maximum beneficial use and overdraft. It is beyond the scope of this Comment to do a detailed cost-benefit analysis of irrigation. Even without a change in public policy, the importance of agriculture will probably decline—from increased pumping costs in a depleted aquifer, from the urbanization of agricultural lands under the pressure of population growth, or from the prohibitive costs of desalinized or distant water. The law can serve to make gradual this economic prophecy.

A test of public willingness to support both continued growth and irrigated agriculture may develop out of the increasing burden of bonded debt into which municipal and State agencies will be forced in order to deliver distant water as cheaply as the failing local supply. But on its face the data indicate that the present rates of consumption cannot continue indefinitely without the help of new supplies, which may themselves be so priced as to provide a curb for consumption. Agriculture, whose huge consumption and low cost ceiling make it vulnerable to any adverse fluctuation in the economics of water supply, will be the first to feel the effects of change in public policy. Thus any comprehensive

147. Wilson, *Urbanization of the Arid Lands*, PROFESSIONAL GEOGRAPHER, Nov. 1960, at 5-7.

148. J. HUMLUM, *supra* note 10, at 193-94. "Wesley Steiner, executive director of the Arizona Water Commission, said Friday [before the Senate Appropriations Committee that] there is enough water in Arizona to support life only if the state cuts down on the use of irrigation in agriculture." Arizona Daily Star, Jan. 29, 1972, § A, at 1, col. 2.

It has been admitted that "[s]ince World War II, price-support programs have encouraged the continued use of [naturally non-productive] land for crops, and have acted as a deterrant to the application of effective soil and water conservation measures." WATER RESOURCES ACTIVITIES, *supra* note 2, Comm. Print No. 13 at 3-4.

149. See text accompanying notes 5 & 24 *supra*.

planning must face head-on the long-range policy decision on the future of agriculture in Arizona.

In this long-range policy decision, perhaps more so than in other fields, the law's role is that of a tool. Water law presently sanctions and protects the exhaustion of water resources, and prevents any remedy to overdraft other than the panacea of the past—the search for a new source. In the hands of the proper policy-makers, the law can brake the development/growth syndrome and introduce a rough equilibrium between withdrawal and natural and artificial replenishment of Arizona's groundwater. In the absence of change in the present water law and the consumption patterns it encourages, the need for NAWAPA may become a self-fulfilling prophecy.

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