EDITORS' NOTE

The student Comment entitled *Constitutional Limitations on State Severance Taxes* which appeared in the last issue of the *Journal*, 20 Nat. Res. J. 887 (1980), relied heavily on a previously completed article by Professors Browde and DuMars. M. Browde & C. DuMars, *State Taxation of Natural Resource Extraction and the Commerce Clause: Federalism's Modern Frontier*, which appears in the first issue of Volume 60, *Oregon Law Review* (1981). Because of unanticipated delays in the publication of that work, citation was made to an earlier unpublished version of their views prepared in collaboration with Professor Brown. Interested readers are referred to the *Oregon Law Review* article for the complete commerce clause analysis upon which our student Comment was based.

REASONABLE GROUNDWATER PUMPING LEVELS UNDER THE APPROPRIATION DOCTRINE: THE LAW AND UNDERLYING ECONOMIC GOALS

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INTRODUCTION

The extent to which well owners should be protected against declining water levels is an enduring issue of groundwater law.[1] The nature and treatment of the problem have been shaped over the years by the property right doctrine—absolute ownership, reasonable use, correlative rights, or prior appropriation—a state has applied to groundwater.[2] In appropriation doctrine states, the initially important question was whether the principle that priority in time gives priority in right would protect senior appropriators against interference with their historic diversion systems by later wells.[3] In most such states, it is now settled that seniors will be protected only in the maintenance of reasonable groundwater pumping levels.[4] The reasonable pumping level concept, however, has not been widely implemented. A National Water Commission study concluded: "No definitive guidelines exist as to what the measure of reasonableness is or how it will be applied."[5] Commentary upon the concept has ranged

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This article was supported primarily with funds provided by the Office of Water Research and Technology, United States Department of the Interior, as authorized under the Water Resources Research Act of 1964 and made available through the Idaho Water Resources Research Institute, University of Idaho. Part of the initial work was done under a research appointment in the Department of Agricultural Economics and Applied Statistics of the College of Agriculture, University of Idaho.

1. *See, e.g.*, Hutchins, *Protection in Means of Diversion of Ground-Water Supplies*, 29 CALIF. L. REV. 1 (1940); Moses, *Basic Groundwater Problems*, 14 ROCKY MT. MIN. L. INST. 501 (1968); Sorensen, *Groundwater–The Problem of Conservation and Interferences*, 42 NEB. L. REV. 765 (1963); Widman, *Groundwater–Hydrology and the Problem of Competing Well Owners*, 14 ROCKY MT. MIN. L. INST. 523 (1968); Note, *Protection of Ground-Water Diversions*, 5 UTAH L. REV. 181 (1956) [hereinafter cited as *Protection*]; Comment, *Who Pays When the Well Runs Dry?*, 37 U. COLO. L. REV. 402 (1965).

2. For criticism of the doctrinal approach to groundwater problems, see C. CORKER, GROUNDWATER LAW, MANAGEMENT AND ADMINISTRATION 112 (1971). This study, written for the National Water Commission, is the most comprehensive and thorough analysis of groundwater management problems available.

3. *See, e.g.*, Pima Farms Co. v. Proctor, 30 Ariz. 96, 245 P. 369 (1926); Noh v. Stoner, 53 Idaho 651, 26 P.2d 1112 (1933); Hanson v. Salt Lake City, 115 Utah 404, 205 P.2d 255 (1949).

4. *See* statutes in note 33 *infra*.

5. NATIONAL WATER COMMISSION, A SUMMARY DIGEST OF STATE WATER LAWS 56 (1973) [hereinafter cited as A SUMMARY DIGEST].

from strong support[6] to harsh criticism.[7] Thus, the currently important question is how, and even whether, the concept can be given workable specific content.

In 1970 the ratio of groundwater use to total water use in the western states ranged from a high of 62 percent in Arizona to a low of two percent in Montana.[8] The heavier groundwater use and more acute water level problems have tended to occur in nonappropriation doctrine states.[9] In the future, however, pressure for more intensive groundwater management is likely to grow throughout the West. Contributing factors will include (1) rising water demands associated with population growth, mineral development, instream flow maintenance, and water-based recreation;[10] (2) higher energy costs for groundwater pumping;[11] and (3) an apparent trend against federal construction of new dams to augment surface water supplies.[12] More intensive management efforts are likely to use existing frameworks, which include the reasonable pumping level concept in most appropriation states.

The primary objective of this article is to help fill the need for an-

6. *See, e.g.*, W. HUTCHINS, SELECTED PROBLEMS IN THE LAW OF WATER RIGHTS IN THE WEST 179 (1942) [hereinafter cited as SELECTED PROBLEMS]; *Protection, supra* note 1; Comment, *South Dakota's Artesian Pressure–Should It Be a Protected Means of Diversion?*, 16 S.D. L. REV. 481 (1971) [hereinafter cited as *South Dakota's Artesian Pressure*].

7. *See* Crosby, *A Layman's Guide to Groundwater Hydrology*, in C. CORKER, *supra* note 2, at 78.

8. The following percentages were reported for the eleven coterminous western-most states in U.S. DEP'T OF THE INTERIOR, WESTWIDE STUDY REPORT ON CRITICAL WATER PROBLEMS FACING THE ELEVEN WESTERN STATES 50 (1975) [hereinafter cited as WESTWIDE STUDY]:

Arizona	62	Oregon	16
New Mexico	50	Utah	16
California	38	Washington	12
Colorado	16	Wyoming	4
Idaho	16	Montana	2
Nevada	16		

Montana reported one area of groundwater level decline (Great Falls). Wyoming apparently had no areas of overdraft. GENERAL ACCOUNTING OFFICE, GROUND WATER: AN OVERVIEW 14-15 (Report to Congress by the Comptroller General 1977) [hereinafter cited as GAO].

9. *See* GAO, *supra* note 8, at 5-15; *see generally* 1 U.S. WATER RESOURCES COUNCIL, THE NATION'S WATER RESOURCES 1975-2000, SECOND NATIONAL WATER ASSESSMENT 18 (1978).

10. *See* WESTWIDE STUDY, *supra* note 8, at 54-62; *but cf.* 1 U.S. WATER RESOURCES COUNCIL, *supra* note 9, at 2 (predicting a decrease nationally in withdrawals for offstream use "due to more efficient use of water as a result of conservation efforts and better technology in recycling and similar procedures").

11. *See, e.g.*, Ellis & DuMars, *The Two-Tiered Market in Western Water*, 57 NEB. L. REV. 333, 355-56 (1978).

12. GAO, *supra* note 8, at 2.

alysis of the measure of reasonableness.[13] The introduction describes some hydrologic aspects of the pumping level issue, related groundwater management tools, and the diverse factual situations in which pumping level problems can arise. Key provisions of various reasonable pumping level statutes are then examined. Economic goals underlying the statutes are analyzed both in historical context and in relation to modern cost-benefit analysis. The article closes with a brief reference to other goals that may also affect the setting of reasonable pumping levels.

BACKGROUND

Hydrologic Aspects of the Problem[14]

An acquaintance with basic physical features of groundwater occurrence and withdrawal is needed to understand pumping level problems. Thus, some elements of groundwater hydrology and well hydraulics are set forth below.[15]

Underground formations that will yield groundwater in significant quantities are called aquifers.[16] Aquifers are either confined or unconfined. In an unconfined aquifer water is held under atmospheric pressure; in a confined (or artesian) aquifer the water is under greater pressure because an overlying impermeable formation restrains its movement. Water will stand in a well in an unconfined aquifer at a level corresponding approximately with the upper surface of the part of the ground that is saturated with water.[17] This level is called the

13. Space limitations preclude systematic treatment of such institutional and procedural questions as the role of the courts and administrative agencies in establishing pumping levels, the choice of enforcement mechanism as between damages and injunctive relief, and retroactive application of pumping level statutes to water rights that predate adoption of the appropriation doctrine.

14. The following summary, except as otherwise noted, is based upon Crosby, *supra* note 7, at 38-49, 56-70; Muckel, *Pumping Ground Water So As to Avoid Overdraft*, in U.S. DEP'T OF AGRICULTURE, THE YEARBOOK OF AGRICULTURE 1955, H.R. DOC. NO. 32, 84th Cong., 1st Sess. 294-99; D. TODD, GROUND WATER HYDROLOGY 17, 26-29, 149-51 (1959).

15. For comprehensive discussions of groundwater hydrology see D. TODD, *supra* note 14; W. WALTON, GROUNDWATER RESOURCE EVALUATION (1970).

16. Underground streams are rather rare. Far more common is percolating groundwater, which saturates the interstices of sand, gravel, and other permeable rock materials. *See* NATIONAL WATER COMMISSION, WATER POLICIES FOR THE FUTURE 230 (1973) [hereinafter cited as WATER POLICIES].

Hydrologists have criticized efforts in the law to distinguish between underground streams and percolating water. C. CORKER, *supra* note 2, at 147. They argue that physical reality requires a single doctrine for all groundwater, as well as recognition of the interconnection between groundwater and surface water. *See, e.g.*, D. TODD, *supra* note 14, at 300. Modern groundwater law is moving toward this view. *See* pages 20 through 23 *infra*.

17. Due to capillary action the zone of saturation actually extends somewhat above the water table.

water table. Water will rise in a well in a confined aquifer to the level of an imaginary surface called the piezometric surface. This level is a function of the amount of artesian pressure under which the water is confined. If the pressure is great enough, a flowing well results.

When water is withdrawn from a well the water table or pressure surface drops. In an unconfined aquifer, the water table around the well is drawn down in the shape of an inverted cone called a cone of depression. If the capacity of the pump is too great for the depth of its intake and the permeability of the surrounding rock, the tip of the cone is pulled down so far that the well sucks air. In a confined aquifer, the imaginary pressure surface around the well is drawn down in the shape of an inverted cone called a cone of pressure relief. As the pressure surface falls below the overlying impermeable formation, a confined aquifer becomes unconfined.

Cones of depression and pressure relief are relatively localized and perhaps temporary conditions. If a well is shut off, the water table or the pressure surface may soon return nearly to its original level around the well.

General water table or pressure surface decline occurs if total discharge from the basin exceeds total recharge. Total discharge includes not only withdrawals from wells but natural discharge through springs, flow into streams, evaporation, and transpiration. An excess of discharge over recharge might be seasonal, with decline during the irrigation season and recovery later, or cyclical, with decline in dry years and recovery in wet years. Perennial withdrawals in excess of recharge will, of course, result in permanent decline called groundwater mining.[18]

Interference with an appropriator's means of diversion because of a decrease in water level or pressure may be a localized matter involving only a few wells with overlapping cones of depression or pressure relief. Conversely, the interference may involve hundreds of wells and widespread overdraft of an entire basin.[19] Individual cases may, of course, fall anywhere between these two extremes.

Related Ground Water Management Tools

Reasonable pumping level regulation is not the only mechanism available in appropriation doctrine states to cope with declining groundwater levels. Two related tools, well spacing and regulation of mining, are discussed below.

18. *See* D. TODD, *supra* note 14, at 201; W. WALTON, *supra* note 15, at 608.
19. *See* W. WALTON, *supra* note 15, at 611; Muckel, *supra* note 14, at 300.

Well Spacing

Some states have well spacing statutes which can work in conjunction with pumping level legislation.[20] Well spacing can prevent pumping level problems caused by overlapping cones of depression or pressure relief. Even in this situation, however, a well spacing statute will not necessarily supplant the reasonable pumping level concept. For example, a Wyoming statute gives the state engineer power to regulate "the spacing, distribution and location of wells in critical areas."[21] To develop spacing regulations, the state engineer would seem to need the guidance of some substantive standard outside the quoted statutory formula. Colorado requires at least 600 feet between wells outside designated groundwater areas, unless the circumstances in a particular instance warrant an exception.[22] Again, the state engineer needs some substantive standard to pass on requests for exceptions. South Dakota requires artesian and shallow wells to be located "in order that the flow of the wells may be properly equalized and least likely to interfere with each other."[23] This statute, too, requires that a judgment be made by the state engineer. The underlying substantive standard in all these situations might appropriately be keyed to the state's concept of a reasonable pumping level.

Regulation of Mining

While reasonable pumping level statutes could apply to water level decline associated with long term overdraft, a number of appropriation doctrine states with such statutes also have legislation or case law aimed specifically at such overdraft.[24] The two basic approaches are to allow controlled mining or to prohibit mining. Either way, the question arises of whether any role is left for the reasonable pumping level statutes.

The New Mexico case of *Mathers v. Texaco, Inc.*[25] illustrates con-

20. *See, e.g.*, notes 21-23 *infra*. Kansas has no well spacing statute as such, but several local groundwater management districts have developed well spacing regulations. *See e.g.*, Western Kansas Groundwater Management District No. 1, Rule 5-21-3 and Equus Beds Groundwater Management District No. 2, Rule 5-22-2, promulgated pursuant to the Kansas Water Appropriation Act, KAN. STAT. § 82a-1028(o) (Supp. 1979).
21. WYO. STAT. § 41-3-909(a)(v) (1977).
22. COLO. REV. STAT. § 37-90-137(2) (1973). For the definition of designated groundwater, see note 68 *infra*.
23. S.D. COMPILED LAWS ANN. § 46-6-5 (1967). *See also* S.D. COMPILED LAWS ANN. § 46-6-7 (1967).
24. See notes 27-29 *infra*.
25. 77 N.M. 239, 421 P.2d 771 (1966). *See also* S.D. COMPILED LAWS ANN. § 46-6-6.1(5) (Supp. 1980). See also pages 33 through 34 *infra* (discussing controlled mining in Colorado).

trolled mining. The New Mexico Supreme Court held that a state statute protecting existing water rights against impairment from new wells did not prevent the state engineer from granting additional permits which would, because the basin is nonrechargeable, necessarily lower the water table and increase pumping costs. The court upheld the state engineer's plan to allow mining of two-thirds of the water in the basin over a 40 year period. It was projected that by then some of the remaining water could still be economically withdrawn for domestic use and perhaps a few other uses, but not for agriculture or most other uses.[26] The mining schedule in *Mathers* appears premised upon a notion of pumping lift protection for existing wells that was considered reasonable in view of the nonrechargeable character of the basin. The lack of recharge guaranteed continuing water level decline and a fixed life for most wells if the resource was to be put to maximum beneficial use. The court's notion of reasonable protection was not fundamentally different from what is embodied in explicit reasonable pumping level statutes found in other states. Thus, much of the following discussion of factors bearing on the measure of reasonableness under pumping level statutes should also apply to controlled mining in situations like that in *Mathers*.

Where statutes prohibit mining, the standards used limit groundwater withdrawals to safe sustaining yield,[27] the anticipated average rate of future recharge,[28] or average annual replenishment of supply.[29] Most if not all of these statutes could be construed either to prohibit mining absolutely or to impose a flexible prohibition. Under the flexible approach mining would be allowed for a time, after which annual withdrawals would then be curtailed to bring total discharge into equilibrium with recharge. This would make sense where the best use of some of the water stored in the aquifer is for withdrawal and consumption on the surface but further depletion of the water would increase pumping and other costs beyond expected benefits. Another possible justification would be that mining the top part of storage may thereafter increase the sustained annual yield of a basin by increasing recharge or decreasing natural discharge.[30]

26. 77 N.M. at 243, 421 P.2d at 774.

27. WASH. REV. CODE ANN. § 90.44.130, .230 (1962). *See also* KAN. STAT. § 82a-711 (1977).

28. COLO. REV. STAT. § 37-90-111(1)(b) (1973) (for designated groundwater); IDAHO CODE § 42-237a(g) (Supp. 1980); S.D. COMPILED LAWS ANN. § 46-6-3.1 (Supp. 1980) (state water rights commission can permit greater withdrawals by certain users in certain basins, however). *See also* MONT. CODE ANN. § § 85-2-506(2)(a), -507(4)(b) (1979).

29. NEV. REV. STAT. § 534.110(6) (1979).

30. This phenomenon has been described more fully as follows: "The drop [in water level] increases the opportunity for recharge from influent streams. It reduces the area of seep lands and uneconomic losses through consumptive use and evaporation. It provides opportunity for penetration of rain falling on the valley floors, which under normal conditions did not happen because the groundwater levels were too high. It also increases the opportunity for underflow into the reservoir by increasing the gradient." Muckel, *supra* note 14, at 294-95. *See also* D. TODD, *supra* note 14, at 212-13; W. WALTON, *supra* note 15, at 607. For a nonappropriation doctrine case taking account of this phenomenon, see City of Los Angeles v. City of San Fernando, 14 Cal.3d 199, 537 P.2d 1250, 123 Cal. Rptr. 1 (1975).

The present question is whether such statutes leave any role for the reasonable groundwater pumping level concept, outside of localized well interference cases. In theory, an absolute prohibition of mining would end water level decline due to general overdraft. As a practical matter, however, where data on total recharge and discharge have not previously been established, proof of mining may entail an expensive and uncertain contest between expert witnesses.[31]

A senior appropriator seeking pumping level protection might well find a less expensive, speedier, and more certain remedy under a reasonable pumping level theory. This is especially true if the pumping level statute has been implemented by detailed administrative regulations and if groundwater aquifer modeling has not yet produced uncontrovertible data regarding mining, *i.e.*, long run total recharge and discharge figures for the particular area. If a flexible prohibition against mining were adopted instead of an absolute prohibition, it would then be necessary to determine how much depletion to allow before the ban on mining becomes operative. This determination ought to be influenced at least in part by what a reasonable pumping level is thought to be. Thus, the reasonable pumping level concept may be significant under both an absolute and a flexible prohibition of mining.

Social and Economic Variables

The fact settings in which the reasonable groundwater pumping level statutes must operate are diverse. The senior appropriator, who might benefit from pumping level protection, could be a small domestic user. One example would be a family farmer who receives irrigation water from an irrigation district, but because of the poor quality of that water supplements his supply with a small domestic well. Another would be a widow with six children who has a few acres on the outskirts of town where she pastures a milk cow and grows vegetables to feed her family, with water for both irrigation and household needs coming from a shallow well. Or, the senior appropriator might be an agricultural, municipal, industrial, or recreational user of varying size and economic capability.

31. For an example of widely divergent expert testimony regarding groundwater recharge and discharge, see Tappan v. Smith, 92 Idaho 451, 444 P.2d 412 (1968).

The junior appropriator, who might oppose pumping level protection for the senior, could be either a single small user whose well is simply too close or a large operator using the water for anything from municipal needs to energy production. Instead of a single junior appropriator, a number of junior wells in the aggregate may cause or threaten water level decline.

In an extreme case, a senior appropriator might be unable to afford additional groundwater extraction costs and be facing cessation of water use if not loss of occupancy of arid land that is worthless or uninhabitable without water. At the other extreme, junior and senior well owners might operate competing profitable businesses and be fighting over comparative economic advantage in production costs.

Which, if any, of these social and economic factors should be taken into account in setting reasonable groundwater pumping levels and how should they be weighed? A logical starting point in the search for answers is an analysis of the language of the present pumping level statutes.

EXISTING STATUTES

Appropriation Doctrine States with the Reasonable Pumping Level Approach

The appropriation doctrine governs both underground streams and percolating ground water in Alaska, Colorado, Idaho, Kansas, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.[32] All but New Mexico and Utah have some variety of reasonable pumping level statute.[33]

32. ALASKA STAT. § 46.15.030 (1977); COLO. REV. STAT. §§ 37-90-102, -92-102 (1973); IDAHO CODE §§ 42-226, -229, -230 (1977 & Supp. 1980); KAN. STAT. §§ 82a-703, -707 (1977); MONT. CODE ANN. §§ 85-2-101, -102(14) (1979); NEV. REV. STAT. § 534.020 (1979); N.M. STAT. ANN. §§ 72-12-1, -18 (1978); N.D. CENT. CODE § 61-01-01 (1960); OR. REV. STAT. §§ 537.515, .525, .535 (1979); S.D. COMPILED LAWS ANN. §§ 46-6-1 to -3 (1967 & Supp. 1979); UTAH CODE ANN. § 73-1-1 (1953); WASH. REV. CODE ANN. §§ 90.44.020, .035, .040 (1962 & Supp. 1980); WYO. STAT. §§ 41-3-901, -905, -930, -936 (1977).

As of April 16, 1979, it was still an open question in Colorado whether groundwater not tributary to a natural stream and not located within any designated groundwater basin is governed by the appropriation doctrine. Southeastern Colo. Water Conservancy Dist. v. Huston, 42 Colo. App. 52, 593 P.2d 1347 (1979).

33. ALASKA STAT. § 46.15.050 (1977); COLO. REV. STAT. §§ 37-90-102, -107(3)-(5), -111(1)(b) (1973) (designated groundwater areas); IDAHO CODE §§ 42-226, -237a(g) (Supp. 1980); KAN. STAT. §§ 82a-711, -711a (1977); MONT. CODE ANN. § 85-2-401(1), -508, -511 (1979) (controlled groundwater areas); NEV. REV. STAT. § 534.110(4), (5), (7) (1979); N.D. CENT. CODE § 61-04-06.3 (Supp. 1979); OR. REV. STAT. §§ 537.525(7)-(8), .620(3), .685(2) (1979); S.D. COMPILED LAWS ANN. § 46-6-6.1 (Supp. 1980); WASH. REV. CODE ANN. § 90.44.070 (1962); WYO. STAT. § 41-3-933 (1977).

Even New Mexico and Utah probably could employ the reasonable pumping level concept, if desired, without new legislation specifically authorizing it. A New Mexico statute prohibits the impairment of existing water rights within basins declared by the state engineer to have reasonably ascertainable boundaries.[34] Although this statute has been construed to allow controlled mining in a nonrechargeable basin,[35] it could equally well function as a reasonable pumping level statute in an appropriate case.[36] Traditionally, Utah has protected a senior appropriator's means of diversion without regard to its reasonableness,[37] but the Utah court may now be moving toward a reasonable means of diversion approach.[38]

Although the Colorado statute is limited to designated groundwater, see note 68 *infra*, no permit may issue for a well outside a designated groundwater area which would tap nontributary water if it would "materially injure" existing water rights. COLO. REV. STAT. § 37-90-137(2), (4) (1973). This statute could, if desired, readily be interpreted to mean that the unreasonable lowering of water level constitutes a material injury. *Cf. id.* § 37-90-107(3)-(5) (1973) (defining "unreasonable impairment" in designated groundwater areas to "include the unreasonable lowering of the water level . . . beyond reasonable economic limit of withdrawal"). Another Colorado statute that is at least arguably applicable to much tributary groundwater, whether within or outside a designated area, requires each appropriator to establish "some reasonable means of effectuating his diversion." *Id.* § 37-92-102(2)(b) (1973).

34. N.M. STAT. ANN. § 72-12-3E (1978). Heine v. Reynolds, 69 N.M. 398, 367 P.2d 708 (1962), held that the statute prohibits any impairment of a senior right rather than only substantial impairment. Under City of Roswell v. Berry, 80 N.M. 110, 452 P.2d 179 (1969), however, a "negligible effect" on the water quality in a senior well does not constitute impairment. Impairment is a legal conclusion declared by the court when additional pumping is not allowed. *See also* N.M. STAT. ANN. § 72-12-20 (1978) (no permit required to appropriate except in basins declared to have reasonably ascertainable boundaries).

35. Mathers v. Texaco, Inc., 77 N.M. 239, 421 P.2d 771 (1966). This case is discussed in the text accompanying note 25 *supra*.

36. Although the court in *Mathers, id.*, said that a decline in water level with resultant increase in pumping costs does not necessarily constitute an impairment, the court emphasized that the question of impairment must turn upon the facts in each case. Presumably the rate of decline of pumping level would have to be reasonable under all of the circumstances. *Cf.* COLO. REV. STAT. § 37-90-107(5) (1973) ("impairment shall include the unreasonable lowering of the water level . . . beyond reasonable economic limits of withdrawal or use"); KAN. STAT. § 82a-711 (1977) ("impairment shall include the unreasonable . . . lowering of the static water level . . . beyond a reasonable economic limit").

37. Current Creek Irrig. Co. v. Andrews, 9 Utah 2d 324, 344 P.2d 528 (1959); Hanson v. Salt Lake City, 115 Utah 404, 205 P.2d 255 (1949); *Protection, supra* note 1.

38. *See* Wayman v. Murray City, 23 Utah 2d 97, 458 P.2d 861 (1969). The narrow holding of this case is that a junior appropriator is not entitled to absolute protection of means of diversion when the owner of several old wells wishes to switch to a single new well. Although the court distinguished Current Creek Irrig. Co. v. Andrews, 9 Utah 2d 324, 344 P.2d 528 (1959), some have read *Wayman* as signaling a general change in attitude toward the means of diversion problem in Utah. Clark, *Arizona Ground Water Law: The Need for Legislation*, 16 ARIZ. L. REV. 799, 811 (1974); *South Dakota's Artesian Pressure, supra note 6, at 489; Comment, Towards an Economic Distribution of Water Rights*, 1970 UTAH L. REV. 442, 444.

Artesian Pressure

Although some of the reasonable pumping level statutes are silent about artesian pressure,[39] this silence should not necessarily foreclose legal protection of diversion systems using a combination of artesian pressure and pumping to lift groundwater to the surface. Two of those statutes are phrased to protect only reasonable *pumping* levels, however;[40] and arguably they imply that a means of diversion consisting wholly of artesian pressure, *i.e.*, a flowing artesian well, is per se unreasonable.[41]

Other statutes do expressly mention artesian pressure.[42] They stop short of guaranteeing that the owners of flowing wells will never have to install pumps, however.[43] The best that can be said for flowing artesian wells, under the most favorable of the statutes, is that in unique circumstances such a means of diversion might qualify as reasonable.[44] In the main, however, the statutes seem to contemplate the use of pumps, either exclusively or in conjunction with artesian pressure.

39. COLO. REV. STAT. §§ 37-90-102, -107(3)-(5), -111(1)(b) (1973); IDAHO CODE §§ 42-226, -237a(g) (1977 & Supp. 1980); KAN. STAT. §§ 82a-711, -711a (1977); NEV. REV. STAT. § 534.110(4) (1979); OR. REV. STAT. §§ 535.525(7)-(8), .620(3), .685(2) (1979).

40. COLO. REV. STAT. §§ 37-90-102, -111(1)(b) (1973); IDAHO CODE § 42-226 (Supp. 1980).

41. It seems unlikely that these statutes would be construed as reaching only pump wells and not declaring policy, one way or the other, for flowing artesian wells. Colorado and Idaho statutes do recognize the existence of artesian wells by requiring them to be equipped with valves to prevent wasteful flows. COLO. REV. STAT. § 37-90-110(1) (1973); IDAHO CODE §§ 42-1601 to -1605 (1977). This recognition does not necessarily meen, however, that such diversion systems are entitled to protection against interference from subsequent wells. *Compare* WYO. STAT. § 41-3-909(a)(vii) *with* § 41-3-933 (1977).

42. ALASKA STAT. § 46.15.050 (1977); MONT. CODE ANN. §§ 85-2-401(1), -508 (1979); N.D. CENT. CODE § 61-04-06.3 (Supp. 1979); S.D. COMPILED LAWS ANN. § 46-6-6.1 (Supp. 1980); WASH. REV. CODE ANN. § 90.44.070 (1962); WYO. STAT. § 41-3-933 (1977).

43. Prior to 1972, the South Dakota water commission protected artesian pressure diversion systems apparently without exception. *See South Dakota's Artesian Pressure*, *supra* note 6, at 484-85 (1971). The current law expressly disavows "the necessity of requiring maintenance of artesian head pressure in a domestic use well." S.D. COMPILED LAWS ANN. § 46-6-6.1 (Supp. 1980).

44. *See* Interlocutory Findings of Fact and Conclusions of Law 6-7, 12, Dep't of Natural Resources & Conservation v. Crumpled Horn, No. 7076 (Mont. 9th Jud. Dist. May 16, 1978). There the lessee of what the court called a "free flowing " stockwater well was awarded damages against a junior groundwater appropriator whose withdrawals dried up the senior well. The damages were for the cost of a pump, cement, and electricity for ten years.

Artesian pressure had raised water in the well casing to within about two feet of the surface. The lessee tapped the well casing with a buried pipe about six feet below the surface which ran downhill to a coulee where a stockwater facility was situated. Telephone interview with Laurence Siroky, Chief of the Water Rights Bureau, Montana Department of Natural Resources & Conservation (September 27, 1979). Mr. Siroky reports that no appeal has yet been taken in the case and none is expected.

Water Level Versus Pumping Lift

Some of the statutes refer to water level in the ground,[45] while others focus more upon pumping lift to the surface.[46] For example, a Kansas statute authorizes "a reasonable . . . lowering of the static water level,"[47] while a Washington statute is worded to protect "a reasonable or feasible pumping lift."[48] Any thought that the Washington language might indicate more concern than the Kansas language about the economics of lifting water to the surface is dispelled, however, by the further direction in the Kansas statute that the state engineer must consider the economics of pumping groundwater for the uses involved when he determines reasonable static water levels. Furthermore, even though the Washington statute speaks of pump lift rather than static water level, administrative regulations issued for at least one groundwater management subarea in Washington are worded in terms of static water level.[49]

The water level approach may be less complex, or at any rate less ambiguous, than the pumping lift approach in one respect. In determining the pumping lift of an existing well, what are the beginning and ending points of the measurement? Should the beginning point be affected by whether a well is located on a hill in a valley? What if the well is situated below the high point of land to be irrigated and additional surface pumping is needed to get the water to part of the land? How far down should the measurement go—to the static water table, to the bottom of the cone of depression, or to some other point? If the measurement includes the drawdown caused by operation of a pump, decision would be required about permissible well efficiency because the drawdown of a well is in part a function of its efficiency. Also localized differences in transmissibility within an aquifer can produce significant variations in drawdown. To what extent should that be taken into account? In contrast, a statute worded in terms of water level, especially static water level, may more readily

45. ALASKA STAT. § 46.15.050 (1977); KAN. STAT. § 82a-711, -711a (1977); MONT. CODE ANN. § 85-2-401(1) (1979); NEV. REV. STAT. § 534.110(4) (1979); N.D. CENT. CODE § 61-04-06.3 (Supp. 1979); OR. REV. STAT. § 537.525(7) (1979); WYO. STAT. § 41-3-933 (1977).

46. COLO. REV. STAT. § 37-90-102 (1973); IDAHO CODE § 42-226 (Supp. 1980); WASH. REV. CODE ANN. § 90.44.070 (1962).

47. KAN. STAT. § 82a-711a (1977).

48. WASH. REV. CODE ANN. § 90.44.070 (1962).

49. The Odessa subarea regulations seek to prevent water level decline of more than 300 feet below the static water level as measured in 1967. WASH. ADMIN. CODE § 173-130-070 (1977). It should perhaps be added, however, that these regulations were issued under an entire chapter of the Washington Code, chapter 90.44, which includes a safe-sustained-yield statute as well as the reasonable pump lift statute.

invite simpler calculation based on a groundwater level unaffected by recent pumping.[50]

Modification of Protected Pumping Levels

Reasonable pumping level statutes tend to be silent about modification of levels over time. In Idaho the court has said in dictum, however, that the state pumping level legislation implicitly contemplates modification to conform to changing circumstances.[51] The court's position seems sensible and may become a standard approach.

Coping with change in the pumping level context has a parallel in existing nonconforming uses under zoning law. In both cases the existing use, for example the uncommonly shallow well and the plumbing supply shop in a residential neighborhood, may be disharmonious if not totally incompatible with the plan for the area. The zoning law technique of amortization allows an inappropriate land use to continue without change for a fixed period, such as five years, after which it must terminate and the use must thereafter conform to the zoning for the area.[52] This gives the landowner time to recoup on his investment in existing facilities and to prepare for the change. The strongly prevailing modern view is that zoning amortization provisions are valid if reasonable.[53]

The zoning amortization analogy has its limitations, however. First, so many variables affect the question of reasonableness[54] that predicting results in specific fact situations from prior case law is difficult. Second, appropriation doctrine states commonly allow a change in the point of diversion, place of use, or purpose of use of a water

50. KAN. ADMIN. REG. 5-1-1(v) (1978) defines static water level as "[t]he depth of the top of the groundwater level below land surface which is not affected by recent pumpage." The static water level will not necessarily be uniform over a geographical area because, although the water table conforms generally to the topography of the overlying land, it does so in a flattened or subdued manner. Crosby, *supra* note 7, at 79.

51. Baker v. Ore-Ida Foods, Inc., 95 Idaho 575, 584, 513 P.2d 627, 636 (1973).

52. *See* D. HAGMAN, URBAN PLANNING AND LAND DEVELOPMENT CONTROL LAW § 88 (1971).

53. *See id.*; P. ROHAN, ZONING AND LAND USE CONTROLS § 41.04[2] (1978). For an exhaustive and detailed analysis of the case law, see 4 N. WILLIAMS, AMERICAN PLANNING LAW: LAND USE AND THE PUBLIC POWER § § 116.01-.11 (1975).

54. *See, e.g.*, Art Neon Co. v. Denver, 488 F.2d 118, 122 (10th Cir.), *cert. denied*, 417 U.S. 932 (1974) (a nonconforming advertising sign): "In the application of the reasonableness test . . . the courts have used a variety of factors and combinations thereof. These include the nature of the nonconforming use, the character of the structure, the location, what part of the individual's total business is concerned, the time periods, salvage, depreciation for income tax purposes, and depreciation for other purposes, and the monpoly or advantage, if any, resulting from the fact that similar new structures are prohibited in the same area. Where signs are concerned, the courts usually also mention the fact that the use is also of public streets since the message is directed to the passerby."

right only so far as other appropriators will not be injured.[55] Suppose that after the amortization period for a shallow well passes, its owner cannot afford to pump from the new, lower water level for the same use as before. In addition, assume that any economically feasible change in point of diversion, place of use, or purpose of use will injure nearby wells or that the cost of gathering data to prove no injury would be prohibitive. Though appropriation doctrine water rights are subject to police power regulation, they are generally regarded as property that cannot be taken without just compensation.[56] Has a vested water right been taken by the pumping level amortization?[57]

Although this precise question has not been litigated, a roughly parallel question in zoning law has: Is a vested property right taken by a zoning amortization ordinance that phases out the right to maintain a nonconforming building that cannot economically be moved or remodeled to conform? The zoning cases that involve substantial structures—rather than mere nonconforming use of unimproved land, outdoor advertising signs, junkyards, and the like—generally have required a fairly long amortization period to survive constitutional challenge.[58] Thus, if a water right at a shallow well cannot readily be changed in point of diversion, place of use, or purpose of use to enable continued exercise of it, a short amortization period may be constitutionally suspect.

A recent trial court decision from Montana took an approach akin to amortization, although no future period of use was involved. The court held a junior appropriator liable for causing increased pumping costs at two senior wells. The owner of a third senior well using what the court called a cement well pit was denied damages for the cost of a new well and pump, however, because that well was more than 30 years old and the "evidence indicates that wells of this type are depreciated out by this time."[59]

Factors Bearing on Reasonableness

Perhaps the most striking common feature of the reasonable pumping level statutes is their lack of specific guidance regarding the mea-

55. *See* 1 W. HUTCHINS, WATER RIGHTS LAWS IN THE NINETEEN WESTERN STATES 623-44 (1972).

56. 4 WATERS & WATER RIGHTS § 304.4(B) (R. Clark ed. 1970).

57. For discussion of a similar problem, finding a probable taking, see Carlson, *Report to Governor John A. Love on Certain Colorado Water Problems*, 50 DEN. L. J. 293, 340-42 (1973).

58. *See* D. HAGMAN, *supra* note 52; P. ROHAN, *supra* note 53; N. WILLIAMS, *supra* note 53. Perhaps the period may even have to be related to the remaining economic life of the structure.

59. Interlocutory Findings of Fact and Conclusions of Law 4, Dep't of Natural Resources & Conservation v. Crumpled Horn, No. 7076 (Mont. 9th Jud. Dist. May 16, 1978). No appeal has been taken; see note 44 *supra*.

sure of reasonableness. The scant express statutory guidance that is available is analyzed below.

Economics

A number of the pumping level statutes indicate that economic factors should affect the measure of reasonableness.[60] The economic concerns fall into two categories: (1) protecting senior appropriators against water level decline beyond their economic capacity to continue to pump, and (2) achieving overall economic development of the groundwater resource. These concerns are likely to be important regardless of whether a particular pumping level statute mentions them.

For example, the Alaska pumping level statute,[61] which has been copied almost verbatim in Montana and North Dakota,[62] permits the lowering of artesian pressure if prior appropriators can "reasonably" acquire their water under the changed conditions. Although the statute does not delineate factors bearing on reasonableness, commentary on it by its principal draftsman indicates an economic component to the standard: " 'Unreasonable' changes in water conditions seem to be those in which later appropriators with superior economic capacity such as power companies or cities impose costs 'beyond the economic reach' of smaller appropriators such as irrigators."[63] Another Alaska statute invites consideration of overall economic development by declaring a policy of managing water "to enhance . . . the overall economic . . . well-being" of Alaskans.[64] Even without this latter statute, the same policy may well be implicit in the appropriation doctrine in view of its historic function of promoting economic development.[65]

The two kinds of economic concerns stated above were evident in a recent trial court decision from Montana. The judge decided that the defendant's junior well affected "some of the senior appropriators to the extent that it is not *economical,* practical, or convenient for . . . [them to pay added groundwater withdrawal costs] considering their historical means of appropriation."[66] In an accompanying opinion, the judge referred to a general Montana statute declaring a policy of encouraging the development and conservation of the waters of the state for the maximum benefit of its people.[67] Thus, he seemed concerned with both the economic capacity of individual senior appropriators and overall development of water.

The Colorado and Idaho pumping level statutes, in closely similar language, recognize potential tension between protecting the diversion systems of senior appropriators and overall economic development of groundwater.[68] The Idaho statute provides "[W]hile the doctrine of 'first in time is first in right' is recognized, a reasonable exercise of this right shall not block full economic development of underground water resources, but early appropriators shall be protected in the maintenance of reasonable groundwater pumping levels. . . ." Although this tension is not expressly recognized by statute in many states, it is often likely to be at the heart of pumping level issues regardless of the specific statutory structure in a given jurisdiction.

The tension cannot be resolved without determining how subjectively the economic limits of senior appropriators should be judged. The more subjectively the economic limit criterion is applied, the greater is the potential impediment to aggregate economic development of groundwater. A common law appropriation doctrine case from Colorado illustrates the problem. In *City of Colorado Springs v. Bender,*[69] the plaintiffs irrigated approximately 50 acres of pasture and cultivated land under a senior groundwater right. They sought to enjoin junior appropriators from lowering the water table below the intake of their pumping facilities. The state supreme court held that priority of appropriation does not give a right to an inefficient means of diversion, and it remanded the case for determination of the level

60. COLO. REV. STAT. §§ 37-90-102, -107(5), -111(1)(a) (1973); IDAHO CODE § 42-226 (Supp. 1980); KAN. STAT. §§ 82a-711, -711a (1977); NEV. REV. STAT. § 534.110(4) (1979); OR. REV. STAT. § 537.525(8) (1979).

61. ALASKA STAT. § 46.15.050 (1977).

62. MONT. CODE ANN. § 85-2-401(1) (1979); N.D. CENT. CODE § 61-04-06.3 (Supp. 1979).

63. Trelease, *Alaska's New Water Use Act,* 2 LAND & WATER L. REV. 1, 35 (1967); *cf.* C. CORKER, *supra* note 2, at xviii ("To be meaningful, 'reasonable pump lift' must recognize economic values of water.").

64. ALASKA STAT. § 46.03.010(a) (1977).

65. For discussion of the policy of promoting economic development by affording security of investment, see notes 109-10 and accompanying text *infra.*

66. Interlocutory Findings of Fact and Conclusions of Law 11, Dep't of Natural Resources & Conservation v. Crumpled Horn, No. 7076 (Mont. 9th Jud. Dist. May 16, 1978) (emphasis added).

67. Memorandum Opinion 1, Dep't of Natural Resources & Conservation v. Crumpled Horn, No. 7076 (Mont. 9th Jud. Dist. May 16, 1978). The statute, then designated as MONT. REV. CODES ANN. § 89-866(3) (Supp. 1977), has since been recodified as MONT. CODE ANN. § 85-1-101(2) (1979). Curiously, the judge never mentioned Montana's specific pumping level statute. No appeal has been taken in the case; see note 44 *supra.*

68. COLO. REV. STAT. § 37-90-102 (1973); IDAHO CODE § 42-226 (Supp. 1980). *See also* COLO. REV. STAT. § 37-90-107(5) (1973).

The Colorado statute is limited to designated groundwater. Basically this is groundwater within the boundaries of designated geographical areas which is not tributary to a surface stream. *See* COLO. REV. STAT. § 37-90-103(6) (1973). It could conceivably include some tributary groundwater, however. *See* Note, *A Survey of Colorado Water Law,* 47 DEN. L. J. 226, 317 n. 648 (1970) [hereinafter cited as *Colorado Water Law*].

69. 148 Colo. 458, 366 P.2d 552 (1961).

at which each junior appropriator must cease diverting water to meet the demands of a senior appropriator. It instructed the trial court that

> the conditions surrounding the diversion by the senior appropriator must be examined as to whether he has created a means of diversion from the aquifer which is reasonably adequate for the use to which he has *historically* put the water of his appropriation. . . .
>
> . . . [Senior appropriators] cannot be required to improve their extraction facilities beyond their economic reach, upon a consideration of all the factors involved.[70]

Although the supreme court did not list the factors to be considered, one seems to be the plaintiffs' historical use of water. Query, however, whether their historical use was irrigation or *small scale* irrigation? In other words, if economies of scale would enable a 400-acre irrigator to pump from a much greater depth than a 50-acre irrigator, is it relevant that the plaintiffs historically were 50-acre irrigators?

A few years after the *Bender* decision, Colorado enacted its present legislation which calls for full economic development of designated groundwater while at the same time protecting senior appropriators against the lowering of water levels below reasonable economic limits of withdrawal.[71] Although the groundwater in *Bender* probably would not have constituted designated groundwater under the subsequent legislation, the parallel between the statutory concern with economic limits of withdrawal and the economic reach language of *Bender* is obvious.[72]

Bender seems to have contemplated a subjective or personal approach in determining the economic reach of an appropriator.[73] Arguably, the legislation forecloses so subjective a view of a senior appropriator's economic capability. The legislation states it shall not "be construed as entitling any prior designated ground water appropriator to the maintenance of the historic water level or any other level below which water still can be economically extracted when the *total economic pattern* of the particular designated ground water

70. *Id.*, 366 P.2d at 556 (emphasis added).

71. See note 68, *supra* for the definition of designated groundwater.

72. A commentator has said that the legislation "codified the principle of reasonable diversion by adopting some of the language of the *Bender* case." *Colorado Water Law*, *supra* note 68, at 335.

73. "The [*Bender*] opinion refers to two types of economic information—'financial resources' and the 'high values' which are produced by the water use. . . . Does the court's reference to financial resources mean that the lower court must hear evidence on the capital reserves or savings accounts of the well owners? Apparently so." Widman, *supra* note 1, at 540.

basin is considered."[74] If a 50-acre irrigator does not fit into the total economic pattern of the basin, apparently his inherent economic limitations on depth of withdrawal due to the size of his operation should not be given much weight.[75] Kansas and Nevada have similar statutory provisions tending to preclude a highly subjective approach.[76]

Variations in statutory language could affect the weight given the competing concerns of protecting early appropriators in their investments and developing groundwater. As noted earlier, the Alaska pumping level statute focuses on assuring that senior appropriators will be able reasonably to continue to withdraw water, although Alaska also has a more general statutory policy of enhancing the overall economic well-being of Alaskans.[77] The Wyoming pumping level statute, in contrast, focuses on managing water levels to achieve "maximum beneficial use of the water in the source of supply."[78] While the phrase "maximum beneficial use" may be somewhat flexible,[79] it is doubtful given the traditional understanding of beneficial use[80] that the statutory language should include the pump lift benefits to senior appropriators from leaving more water in the ground. At any rate, the pumping level statute itself does not express concern about continued operation by senior appropriators with a shallow economic reach. Arguably such concern is implicit, to a degree at least, from the appropriation doctrine tradition of fostering economic development by affording security of investment in water facilities.[81]

In sum, the Alaska pumping level statute focuses upon reasonable protection for senior appropriators, with probably some interplay from a more general statutory declaration of a policy of overall economic development. The Wyoming pumping level statute focuses

74. COLO. REV. STAT. § 37-90-111(1)(a) (1973) (emphasis added).

75. Especially is this so if the language italicized in the text is read together with the declared state policy of full economic development. COLO. REV. STAT. § 37-90-102 (1973).

76. *See* KAN. STAT. § 82a-711 (1977); NEV. REV. STAT. § 534.110(4) (1979).

77. *See* notes 61 and 64 and accompanying text *supra*.

78. WYO. STAT. § 41-3-933 (1977).

79. The original draft of the bill for this statute used the words "maximum economic development" rather than "maximum beneficial use." F. TRELEASE, CASES AND MATERIALS ON WATER LAW 515 (3d ed. 1979). The latter phrase would seem to be broader in scope than the former.

80. *See generally* 1 WATERS AND WATER RIGHTS § 54.3 (R. Clark ed. 1967); 1 W. HUTCHINS, *supra* note 55, at 522-46.

81. *See generally* Hutchins, *Legal Ground Water Problems in the West*, 22 NATIONAL RECLAMATION ASS'N. PROC. 81, 82 (1953) [hereinafter cited as *Legal Ground Water Problems*]. For further discussion of the policy of promoting economic development by affording security of investment, see notes 109-10 and accompanying text *infra*. Various departures from the priority principle in Wyoming may weaken the historic importance of security of investment, however. See notes 84-87 and accompanying text *infra*.

upon maximum beneficial use of groundwater, with perhaps some interplay from the appropriation doctrine tradition of affording security of investment to early appropriators. Whether these variations in statutory pattern will in fact produce differing results in similar cases, though, remains to be seen.

Another factor that may affect the tension between recognizing the economic limits of senior appropriators and overall economic development is the extent of a state's commitment to the rule that priority in time gives priority in right. Although the priority principle is fundamental to the appropriation doctrine,[82] not all appropriation doctrine states are equally committed to it. To whatever extent the policy against allowing water levels to fall below the economic limits of senior appropriators is based on the notion that priority in time should give some special right or benefit,[83] states with a weaker commitment to the priority principle in other aspects of groundwater management may be expected to give less protection to small senior appropriators in their means of diversion systems.

Wyoming, for example, seems to have a relatively weak commitment to the priority principle as it applies to groundwater. One statute authorizes the state engineer to cope with insufficiency of supply in groundwater control areas[84] through a system of rotation if "cessation or reduction of withdrawals by junior appropriators will not result in proportionate benefits to senior appropriators."[85] Depending upon the interpretation given "proportionate benefits," this statute could produce results differing significantly from strict adherence to the rule that priority in time gives priority in right.[86] Another statute declares that domestic and stock use wells "shall have a preferred right over rights for all other uses, regardless of their dates of priority, subject to the provisions of section [41-3-911]. . . ."[87] Section 41-3-911 then provides in part:

> Whenever a well withdrawing water for beneficial purposes shall interfere unreasonably with an adequate well developed solely for domestic or stock uses . . . the state engineer may, on the complaint of the operator of the stock or domestic well, order the interfering appropriator to cease or reduce withdrawals of underground water, unless such appropriator shall furnish at his own expense, sufficient water at the former place of use to meet the need for domestic or stock use. In case of interference between two (2) wells utilizing water for stock or domestic use . . . the appropriation with the earliest [*sic*] priority shall have the better right.

Returning to some of the fact situations mentioned earlier,[88] the family farmer and the widow with domestic wells should continue to receive water so long as each has "an adequate well," despite withdrawals by larger appropriators. If that is so, however, it is not because of their priority in time, but because of the nature of their uses. A small irrigator with a senior groundwater appropriation would seem not to fare as well.

A number of other states also have statutes that depart from the priority principle.[89] The most common departure is a preference for domestic or certain other uses.

In addition to departing from the priority principle, preferred status for some water uses may affect the tension between protecting early appropriators and overall economic development in another way. For example, Oregon empowers its water resources director to designate preferred uses in certain areas and to deny or limit permits for new wells that would cause "undue interference" with existing wells.[90] Where domestic use has been designated a preferred status, arguably the economic reach of domestic users should be highly significant in deciding what constitutes undue interference in those

82. *See* 1 W. HUTCHINS, *supra* note 55, at 396.

83. *See* A. MAASS & R. ANDERSON, . . . AND THE DESERT SHALL REJOICE: CONFLICT, GROWTH AND JUSTICE IN ARID ENVIRONMENTS 3 (1978) ("The 'first in time, first in right' principle has been accepted, apparently, because of a widespread belief that man is entitled to the product of his own labor and therefore to protection against latecomers of land he has worked.") *See also* E. MEAD, IRRIGATION INSTITUTIONS 65 (1907).

84. Control areas may be designated in any of the following situations: "(i) The use of underground water is approaching a use equal to the current recharge rate; (ii) Ground water levels are declining or have declined excessively; (iii) Conflicts between users are occurring or are foreseeable; (iv) The waste of water is occurring or may occur; or (v) Other conditions exist or may arise that require regulation for the protection of the public interest." WYO. STAT. § 41-3-912 (1977).

85. *Id.* § 41-3-915(a)(iv) (1977).

86. The more typical appropriation doctrine approach has been codified in the Colorado Water Right Determination and Administration Act of 1969 as follows: "No reduction of any lawful diversion because of the operation of the priority system shall be permitted unless such reduction would increase the amount of water available to and required by water rights having senior priorities." COLO. REV. STAT. § 37-92-102(2)(d) (1973). *See generally* 1 W. HUTCHINS, *supra* note 55, at 567-83.

87. WYO. STAT. § 41-3-907 (1977).

88. See pages 7 through 8 *supra.*

89. MONT. CODE ANN. § 85-2-507(4)(c), (f) (1979); NEV. REV. STAT. § 534.120(2) (1979); OR. REV. STAT. § 537.735(3)(c) (1979); S.D. COMPILED LAWS ANN. § 46-6-6.2 (Supp. 1979). In a case now on appeal, an Idaho district judge ruled that domestic wells were exempted by IDAHO CODE § 42-227 (1977) (subsequently amended by 1978 Idaho Sess. Laws, ch. 324, § 1) from the reasonable pumping level provisions of the state ground water code. Parker v. Wallentine, No. 2930 (Idaho 6th Jud. Dist. June 23, 1977, & August 20, 1979) (orders granting temporary and permanent injunctions), *appeal docketed,* No. 13482 (Idaho Sup. Ct. Sept. 26, 1979).

90. OR. REV. STAT. § § 537.620(3), .735(3)(c) (1979).

areas.[91] Nevada has a similar statutory scheme,[92] but adds an apparently unique provision to minimize the impediment to further groundwater development due to preferred status for domestic wells. The state engineer is authorized to prohibit new domestic wells in areas where water can be furnished by an entity such as a water district or a municipality.[93]

Other Factors

While few reasonable pumping level statutes refer to factors other than economics that should affect pumping levels, in most states other statutes can give some guidance on other factors. Only some pumping level statutes explicitly mention water quality,[94] but more generally applicable water quality statutes might require or at least authorize consideration of this factor.[95] An occasional statute indicates that pumping level regulation should take into account the effect upon senior surface water rights.[96] Again, the same may arguably be compelled or authorized by more general laws in some states regarding coordinated management of surface water and groundwater.[97] Finally, as already noted, some western water codes contain preferences for domestic and other uses.

Summary

An administrative agency or court undertaking to make decisions under a reasonable pumping level statute must know what factors to consider and how to weigh them. The existing pumping level statutes vary in the express guidance they give. A number of them refer to economic factors. Some declare a policy of full economic development; some express concern about the economic limitations of senior appropriators. A few recognize potential conflict between the two types of economic concerns. Some states have water quality, water administration, or use preference statutes that might figure into pumping level decisions. Overall, however, the existing pumping level statutes are incomplete in listing factors, weighting them, or declaring policy with specificity. If further guidance on economic and other factors is to be found, it must come from probing more deeply by searching for goals that underlie the statutes.

91. *Cf.* Prather v. Eisenmann, 200 Neb. 1, 261 N.W.2d 766 (1978) (statutory preference for domestic use in a jurisdiction having a combination of the reasonable use and correlative rights doctrine relied upon to find unreasonable harm in a well interference case).

92. NEV. REV. STAT. § § 534.110(7), .120(2), (3)(c) (1979).

93. NEV. REV. STAT. § 534.120(3)(d) (1979).

94. KAN. STAT. § 82a-711 (1977); OR. REV. STAT. § 537.525(8) (1977).

95. *See e.g.*, ALASKA STAT. § § 46.03.010, .020(10), .060, .070 (1977 & Supp. 1979); NEV. REV. STAT. § 534.020(2) (1979). *See also* C. CORKER, *supra* note 2, at ch. V n. 89.

96. IDAHO STAT. § 42-237a(g) (Supp. 1980); OR. REV. STAT. § § 537.525(9), .620 (3) (1977). *See also* MONT. CODE ANN. § 85-2-507(2)(b)(ii) (1979).

97. *See, e.g.*, ALASKA STAT. § § 46.15.010-.270 (1977) (no distinction made in state water code between groundwater and surface water); COLO. REV. STAT. § § 37-92-102, -401, -501 (1973); NEV. REV. STAT. § 533.370(4) (1979), as applied in Griffin v. Westergard, 96 Nev. Adv. Op. 166, 615 P.2d 235 (1980); WYO. STAT. § 41-3-916 (1977). *See generally* 5 WATERS AND WATER RIGHTS § 441 n.30 (R. Clark ed. 1972). The National Water Commission concluded that in many states laws need to be revised to better take account of the frequent physical interrelationship of surface and groundwater. WATER POLICIES, *supra* note 16, at 233.

UNDERLYING ECONOMIC GOALS

Economic factors loom so large in pumping level management that it is appropriate to begin the effort to fill gaps in express statutory directives by exploring the economic goals implicit in reasonable pumping level statutes and related features of appropriation doctrine law. Variations exist among states, of course, and identifying a particular theme in some states is no guarantee that the theme holds in yet another state. The purpose of the following discussion is to catalog economic concerns to help agencies and courts focus on the right questions when they seek to implement the measure of reasonableness in a particular jurisdiction.

A Historical Perspective

Preventing or Curtailing Overdevelopment

The western water law doctrine of prior appropriation developed in the mid-nineteenth century as a means of allocating rights in surface streams.[98] Although it was soon applied to underground streams,[99] no strong movement emerged to extend the doctrine to other groundwater that percolated through the soil without forming an underground stream[100] until the second quarter of the twentieth century.[101] Before that, percolating water was governed by several rules, namely, the absolute ownership doctrine, the rule of reason-

98. *See* F. TRELEASE, FEDERAL-STATE RELATIONS IN WATER LAW 21-29 (1971). *See also* 1 WATERS AND WATER RIGHTS § 18.1 (R. Clark ed. 1967); 1 W. HUTCHINS, *supra* note 55, at 159-65.

99. *See* J. GOULD, 4 TREATISE ON THE LAW OF WATERS § 281 (2d ed. 1891); J. LONG, IRRIGATION § 43 (2d ed. 1916).

100. See note 16 *supra.*

101. Major water law treatises published in 1911 and 1912 reported that the appropriation doctrine was inapplicable to percolating groundwater. 2 C. KINNEY, LAW OF IRRIGATION AND WATER RIGHTS § 1190 (2d ed. 1912); 2 S. WIEL, WATER RIGHTS IN THE WESTERN STATES § 1106 (3d ed. 1911).

able use, and the correlative rights doctrine.[102] A number of western states that now have the appropriation doctrine for all groundwater initially adopted or inclined toward adopting one of these other rules for percolating water.[103]

Many western states extended the appropriation doctrine to percolating water primarily to regulate overdevelopment of such water.[104] The priority principle of that doctrine can prevent overdevelopment when supplemented by a system which requires a permit to appropriate and denies new permits once a desired level of development is reached. That principle can also curtail overdevelopment by forcing closure of wells in inverse order of priority until the desired reduction is reached.[105] Whether the objective is preventing overdevelopment or reducing it, however, some standard is needed to determine the point of overdevelopment. Unless a senior appropriator is guaranteed not only the right to a given quantity of water but also his historic means of diversion, the priority principle alone cannot define when overdevelopment occurs.

The issue of protecting senior means of diversion has arisen with surface streams as well as groundwater;[106] with surface water, however, development is often limited simply by the amount of water flowing in a stream in a given year. Groundwater aquifers, in contrast, typically contain large quantities of storage accumulated over many years. This storage feature eliminates the possibility of a simple physical limit on withdrawals in a given year.[107] Since the problem is more complex with groundwater, it has attracted special legislative

102. These doctrines have been explained and analyzed at length by a number of writers. *See, e.g.*, 6A AMERICAN LAW OF PROPERTY §§ 28.65-.68 (A. Casner ed. 1954); 5 R. POWELL, REAL PROPERTY ¶ 725-27 (1968); Hanks & Hanks, *The Law of Water in New Jersey: Groundwater*, 24 RUTGERS L. REV. 621 (1970).

103. *See* 2 S. WIEL, *supra* note 101, at §§ 1039, 1066; Kirkwood, *Appropriation of Percolating Water*, 1 STAN. L. REV. 1, 2, n.4 (1948). An exhaustive collection of early percolating water cases appears in Annot., 55 A.L.R. 1385, 1390-98 (1928).

104. *See* WATER POLICIES, *supra* note 16, at 231. A number of detailed accounts of the extension of the appropriation doctrine to percolating ground water are available. *See, e.g.*, Clark, *Groundwater Legislation in the Light of Experience in the Western States*, 22 MONT. L. REV. 42 (1960); Dunbar, *The Adaptation of Groundwater–Control Institutions to the Arid West*, 51 AG. HIST.. 662 (1977); Hutchins, *Ground Water Legislation*, 30 ROCKY MT. L. REV. 416 (1958); *Legal Ground Water Problems*, *supra* note 81, at 81.

105. *But cf.* WATER POLICIES, *supra* note 16, at 231-32 (suggesting this theory usually does not work out in practice). For a court order putting the theory into practice, see Baker v. Ore-Ida Foods, Inc., 95 Idaho 575, 513 P.2d 627 (1973). The situation continued to be litigated, however, in Briggs v. Golden Valley Land & Cattle Co., 97 Idaho 427, 546 P.2d 382 (1976).

106. *E.g.* Schodde v. Twin Falls Land & Water Co., 224 U.S. 107 (1912); Tulare Irrigation Dist. v. Lindsay-Strathmore Irrig. Dist., 3 Cal.2d 489, 45 P.2d 972 (1925); Crowley v. District Court, 108 Mont. 89, 88 P.2d 23 (1939).

107. C. CORKER, *supra* note 2, at ix, 106-07. For discussion of other differences between groundwater and surface water management, see *id.* at 148-49, 152. *Cf.* Colorado Ground Water Comm'n v. Dreiling, 606 P.2d 836, 939 (1980) ("Under the appropriation doctrine as applied to the waters of a natural stream, a person is entitled to appropriate water so long as there is any water in the stream. . . . When applied to designated groundwaters, however, that doctrine is modified to allow only appropriation to the point of reasonable depletion. . . .").

attention. The enactment of reasonable pumping level legislation sets a standard limiting development of groundwater, which can then be implemented through the priority principle.[108]

Promoting Development

The appropriation doctrine has long been characterized by a policy of promoting water development by giving security to investors in such development. As the Wyoming court put it in 1896, "The climate is dry. The soil is arid, and largely unproductive in the absence of irrigation. . . . Irrigation . . . cannot be accomplished with any degree of success or permanency without the right to divert and appropriate water of natural streams for that purpose *and a security afforded to that right.*"[109] In fact, a study prepared for the National Water Commission concluded that the prime reason for the continued vitality of the appropriation doctrine is the economic development goal it accomplishes.[110]

Although the tradition of promoting development through security of investment began with surface streams, that policy was later extended to underground waters. The rule of absolute ownership, which dominated percolating groundwater law in this country during the last half of the nineteenth century,[111] freely allows a landowner to extract groundwater without regard for the impact upon a neighbor's well.[112] The doctrine fails to protect well owners in their source of supply, an important factor in its eventual rejection by most states.[113]

108. The reasonable pumping level concept is, of course, not the only tool for coping with overdevelopment. Another important, but not unrelated tool, is legislative policy on groundwater mining. See discussion at pages 5 through 7 *supra*.

109. Moyer v. Preston, 6 Wyo. 308, 318-19, 44 P.845, 847 (1896) (emphasis added).

110. C. MEYERS, A HISTORICAL AND FUNCTIONAL ANALYSIS OF THE APPROPRIATION SYSTEM 6 (1971).

111. 5 R. POWELL, *supra* note 102, at ¶ 725 reports that prior to 1922, 28 states had at one time accepted the rule, although less than half of them continue to do so.

112. The water may not be extracted for a malicious purpose or allowed to go to waste. F. MALONEY, S. PLAGER & F. BALDWIN, WATER ADMINISTRATION: THE FLORIDA EXPERIENCE § 54.2(a) (1968). Texas, an absolute ownership state, recently held that a well owner is liable to neighbors for land subsidence caused by negligence in extracting groundwater. Friendswood Dev. Co. v. Smith-Southwest Industries, 576 S.W.2d 21 (Tex. 1978) (decision given prospective effect only).

113. *See* SELECTED PROBLEMS, *supra* note 6, at 158. Other factors were disenchantment with the absolute ownership tenets that (1) the movement of percolating water was so occult and concealed that no workable regulatory system could be devised, (2) a person should have the same ownership rights in water under his land as in soil and rocks, and (3) limiting groundwater withdrawals would interfere with drainage necessary for mining, road construction, agriculture, etc. *See, e.g.*, Meeker v. City of East Orange, 77 N.J.L. 623, 74 A. 379 (1909).

Fear was expressed that people would not invest to develop wells if a neighbor might later sink a deep well that would dry up the earlier well.[114] In contrast the reasonable use rule, which became popular during the early part of the twentieth century,[115] provides a measure of protection. It allows one well owner to interfere with another's well only if his use is reasonable.[116] The rule was construed, however, to allow an owner of land overlying the source of supply to commence a nonwasteful use of water on that land at any time despite interference with neighboring wells. Thus, appropriation doctrine advocates came to criticize the reasonable use doctrine for failing to provide enough security of investment.[117]

While a number of western states extended the appropriation doctrine to percolating groundwater and added a reasonable pumping level concept primarily to control overdevelopment rather than promote new development, the reverse appears to have been true in other states. In Idaho, at least, there is strong evidence of concern about promoting more groundwater development. In 1933 the Idaho court had held[118] that under the common law of appropriation a senior well owner's historic means of diversion was protected against interference without regard to its reasonableness.[119] The court's approach soon drew strong criticism from a commentator in an engineering journal on the ground that it would impede water development: "[I]n many areas the first appropriator could require damages from every subsequent appropriator and each subsequent appropriator, in turn of priority, could require damages from all later appropriators, until the last one would have to pay tribute to all."[120] At the annual state bar meeting in 1949, a leading authority on Idaho water law discussed the need for a groundwater code. He made the

114. *E.g.*, Meeker v. City of East Orange, 77 N.J.L. 623, 74 A. 379 (1909).

115. *See* 2 S. WIEL, *supra* note 101, at § 1041; Huffcut, *Percolating Waters: The Rule of Reasonable User*, 13 YALE L. J. 222 (1904).

116. 1 WATERS AND WATER RIGHTS § 17.2 (R. Clark ed. 1967); 5 R. POWELL, *supra* note 102, at ¶ 726.

117. *E.g.*, NATIONAL RESOURCE PLANNING BOARD, REPORT OF SUBCOMMITTEE ON STATE WATER LAW, STATE WATER LAW IN THE DEVELOPMENT OF THE WEST 79 (1943).

118. Noh v. Stoner, 53 Idaho 651, 26 P.2d 1112 (1933).

119. This result was not compelled by precedent because few means of diversion cases had been decided under the appropriation doctrine. Most of those had involved surface diversions, and the results were inconclusive, with some cases protecting a senior's means of diversion only if it was reasonable and others giving protection without concern for the reasonableness of the means. *See* SELECTED PROBLEMS, *supra* note 6, at 168-79; Annot., 121 A.L.R. 1044 (1939).

120. Thompson & Fiedler, *Some Problems Relating to Legal Control of Ground Waters*, 30 J. OF AMERICAN WATER WORKS ASS'N. 1049, 1075 (1938). *See also* SELECTED PROBLEMS, *supra* note 6, at 179.

point that groundwater is "probably . . . the greatest undeveloped asset or resource" in the state.[121]

Subsequent statutory enactments in Idaho reflect the same sentiment in favor of development. In 1951 the legislature enacted a groundwater code affirming earlier judicial adoption of the appropriation doctrine for all groundwater,[122] and two years later it added

> . . . while the doctrine of "first in time is first in right" is recognized, a reasonable exercise of this right shall not block full economic development of underground water resources, but early appropriators of underground water shall be protected in the maintenance of reasonable ground water pumping levels as may be established by the state reclamation engineer as herein provided. . . .[123]

This statute recognizes (1) stored groundwater is not always used most economically in providing lift for the wells of early appropriators, and (2) absolute protection of historic means of diversion may hinder economic development.[124] The statutory safety valve against counterproductive security of investment under the priority principle is the reasonable pumping level concept.

The Idaho experience, then, is quite different from that in western states having serious groundwater depletion problems when they enacted reasonable pumping level statutes. It seems likely that at least some other states with relatively abundant and undeveloped groundwater supplies were motivated by the same concern for new development as Idaho when they enacted appropriation doctrine and reasonable pumping level legislation.

In concluding this examination of the economic development tradition of the appropriation doctrine as it relates to groundwater pumping levels, the following observations by a lawyer-historian are instructive:

> [The rule of priority] was put forth . . . as an offensive doctrine justified by its power to promote economic development. In a capital scarce economy, its proponents urged, the first entrant takes the

121. Parry, *An Underground Water Code*, 23 IDAHO STATE BAR PROCEEDINGS 19 (1949).

122. 1951 Idaho Sess. Laws, ch. 200.

123. 1953 Idaho Sess. Laws, ch. 182, § 1. This statute is currently in force as IDAHO CODE § 42-226 (Supp. 1980).

124. In an article that spawned much legal-economic literature, economist R. H. Coase argued that legal rules will not affect the efficient allocation of resources if certain conditions are met, such as zero cost in collecting property right transfer data and the accomplishing of transfers. Coase, *The Problem of Social Cost*, 3 J. LAW & ECON. 1 (1960). Coase's analysis does not undermine the approach of the Idaho statute because not all the conditions necessary for operation of the Coase theorem are satisfied in the groundwater context.

> greatest risks; without the recognition of a property right in the first developer—and a concomitant power to exclude subsequent entrants—there cannot exist the legal and economic certainty necessary to induce investors into a high-risk enterprise.
>
> . . . .
>
> The [subsequent] attack on the rule of priority reveals the basic instability of utilitarian theories of property. As property rights came to be justified by their efficacy in promoting economic growth, they also became increasingly vulnerable to the efficiency claims of newer competing forms of property. Thus, the rule of priority, wearing the mantle of economic development, at first triumphed over natural use. In turn, those property rights acquired on the basis of priority were soon challenged under a balancing test or "reasonable use" doctrine that sought to define the extent to which newer forms of property might injure the old with impunity.[125]

With slight revision this passage could have been written about modern groundwater law in those western states where (1) the doctrines of absolute ownership, reasonable use, or correlative rights were rejected in favor of the appropriation doctrine to promote economic development by giving security of investment; (2) the priority principle was initially regarded as giving a secure right to historic diversion systems without regard to their reasonableness; but (3) the initial inclination was replaced by a reasonable pumping level approach. In a state like Idaho, then, it might be said that while great security of investment (even absolute protection of historic diversion systems) may initially have been perceived as promoting development, this approach "became increasingly vulnerable to the efficiency claims of newer competing forms of property." The competing claims were those of newcomers who wanted to take stored groundwater that was providing lift for senior appropriators and use it more productively on the surface.

The commentary quoted above was in fact written about developments in American property law from 1780 to 1860 as the country moved from an agrarian to a more industrialized economy. It demonstrates that tension between promoting economic development by affording security of investment and blocking new economic growth with too much security is a problem neither peculiar to the pumping level question nor of recent origin.

A Cost-Benefit Perspective

The preceding discussion indicates that historically reasonable pumping level statutes have been aimed in different states at the seemingly divergent objectives of preventing or curtailing overdevelopment and promoting new development. In fact, these two objectives need not diverge but can mesh together into a policy of optimum development: neither too much nor too little. The statutes that call for full or maximum economic development could readily be interpreted to mean optimum development in the sense just stated. The Idaho court might have had this in mind in *Baker v. Ore-Ida Foods, Inc.* when it said:

> Idaho's Ground Water Act seeks to promote "full economic development" of our ground water resources. . . . We hold that the Ground Water Act is consistent with the constitutionally enunciated policy of promoting optimum development of water resources in the public interest. Idaho Const. art. 15, § 7. Full economic development of Idaho's ground water resources can and will benefit all of our citizens. Trelease, F. J., Policies for Water Law: Property Rights, Economic Forces, and Public Regulations, 5 Nat. Res. J. 1 (1965).[126]

The cited article by Dean Trelease cautions that maximization "does not mean . . . that man should develop and use water compulsively. . . . What is to be maximized is welfare from water use, not water use itself."[127] Nor does maximization refer to immediate benefits only; the problem is one of optimum allocation of water resources over time.[128]

At the national level, planning for optimum water development has long been dominated by cost-benefit analysis.[129] The Trelease article cited in *Baker v. Ore-Ida Foods, Inc.* regards extension of cost-benefit analysis from its traditional sphere of federal public works expenditures to new private water development projects as being "[f]or the most part . . . obvious."[130] Further, a comprehensive study prepared for the National Water Commission specifically advocates using a cost-benefit approach in groundwater management.[131] Serious pursuit of a goal of optimum economic development in the setting of groundwater pumping levels hardly seems possible without resort to some form of cost-benefit analysis.

Thorough discussions of the general principles of cost-benefit analy-

125. M. HORWITZ, THE TRANSFORMATION OF AMERICAN LAW, 1780-1860, at 33-34 (1977).

126. 95 Idaho 575, 584, 513 P.2d 627, 636 (1973).

127. Trelease, *Policies for Water Law: Property Rights, Economic Forces, and Public Regulation*, 5 NAT. RES. J. 1, 3-4 (1965) [hereinafter cited as *Policies for Water Law*].

128. *See id.* at 5, 13; *see generally* C. CORKER, *supra* note 2, at 128.

129. WATER POLICIES, *supra* note 16, at 380-81.

130. *Policies for Water Law*, *supra* note 127, at 14.

131. C. CORKER, *supra* note 2, at 128-30, 135-36. The advocacy was not without recognition of the need to consider also factors lying outside the traditional domain of economics. *Id.* at 137-42.

sis and points of debate in cost-benefit theory are readily available.[132] Discussed below are some special considerations that arise in the use of cost-benefit analysis to implement the reasonable groundwater pumping level concept.

Inadequate Geohydrologic Data

Numerous potential physical effects from groundwater withdrawal must be identified and quantified in dollars if the goal is to maximize net benefits from the resources over time.[133] One such effect is interference with the supply to other wells.[134] Another is interference with surface water rights if the aquifer either receives recharge from or discharges into the stream.[135] Yet another is land compaction and subsidence.[136] In the San Joaquin Valley of California, for example, the land surface has subsided as much as 29 feet in some areas, and approximately 4200 square miles have experienced subsidence exceeding one foot.[137] The undesirable effects of land subsidence include alteration of the flow of surface streams and irrigation canals, breakage of pavement, collapse of well casings, obsolescence of topographical maps, and damage to buildings when pilings extend into the zone of subsidence. Groundwater pumping can also affect the quality of future withdrawals if water level decline increases recharge from a polluted source.[138] The more dramatic occurrences have involved salt water intrusion into coastal aquifers, but extensive saline water intrusion of inland aquifers has also been reported.[139] Another environmental impact of groundwater level decline may be the destruction of phreatrophytes that provide wildlife habitat.[140]

Of course, not all of these potential physical consequences will be encountered in every reasonable pumping level problem. In general, as one moves from widespread overdraft to localized, overlapping cones of pressure relief or depression, significant physical consequences other than well interference should become less likely. Also, in a given state, widespread overdraft might be regulated more under

132. *E.g.*, A. DASGUPTA & D. PEARCE, COST-BENEFIT ANALYSIS (1972); E. MISHAN, COST BENEFIT ANALYSIS (Rev. ed. 1976); P. SASSONE, COST-BENEFIT ANALYSIS: A HANDBOOK (W. Schaffer ed. 1978).

133. See C. CORKER, *supra* note 2, at 128.

134. See page 4 *supra*.

135. For discussion of streamflow-groundwater interaction in standard hydrologic works, see D. TODD, *supra* note 14, at 151-55, and W. WALTON, *supra* note 15, at 174-88.

136. For further discussion, see W. WALTON, *supra* note 15, at 623-27.

137. GAO, *supra* note 8, at 15.

138. For further discussion, see D. TODD, *supra* note 14, at 177-78.

139. GAO, *supra* note 8, at 16-17.

140. For an account of opposition to phreatophyte removal because of its effect on wildlife habitat, see Gilluly, *Wildlife Versus Irrigation*, 99 SCIENCE NEWS 184 (1971).

a safe annual yield or natural recharge limitation[141] than under a reasonable pumping level statute. Nevertheless, to the extent that reasonable pumping levels are part of an overall program to optimize groundwater use, calculation of benefits and costs would seem essential. That, in turn, requires knowledge of the physical consequences of different alternatives. Unfortunately, all too often adequate hydrogeologic data to predict accurately the physical consequences of groundwater withdrawal is lacking in specific cases.[142]

Uncertainty About the Role of Security of Investment

Will a rule that allows the water table to fall below the economic reach of some senior appropriators, forcing them out of existence, promote optimum use of undeveloped groundwater by facilitating newer, more productive uses of the water? Even if short run economic gain can be expected, it must be asked whether the decrease in security of investment to appropriators will impede economic development in the long run. Thus, full cost-benefit analysis of groundwater pumping level policies requires making conclusions (or assumptions) about how security of investment affects economic development.

A major difficulty is that little is known about the relationship between security of investment and economic development of groundwater. The appropriation doctrine tradition holds that a fair degree of security is needed to promote development.[143] Another line of thought, associated with an article entitled "The Tragedy of the Commons,"[144] leads to the exact opposite conclusion. This view calls groundwater, unlike coal for example, a common pool resource because extracting groundwater from one well can affect the availability of water at other wells.[145] Suppose the law does not limit groundwater withdrawals but allows anyone to take as much as he can capture.

> The tragedy of the commons develops in the following way: Overlying owners drill wells in a common groundwater basin. After a period of time, total extraction approximately equals total replenishment to the basin, so that the basin is in a steady-state condition.

141. *See* notes 26-30 and accompanying text *supra*.

142. *See, e.g.*, C. CORKER, *supra* note 2, at A1-70 ("We are comparatively naive about aquifers because the reward for learning more about groundwater resources has not appeared to warrant the expenditure of large sums of money."); Crosby, *supra* note 7, at 80-81, 95-96; GAO, *supra* note 8, at 30-34; WATER POLICIES, *supra* note 16, at 245; W. WALTON, *supra* note 15, at 1.

143. *See* notes 109-10 and accompanying text *supra*.

144. Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

145. *See* J. HIRSCHLIEFER, J. DEHAVEN & J. MILLIMAN, WATER SUPPLY: ECONOMICS, TECHNOLOGY AND POLICY 59-66 (1960).

> Each owner, at that point, calculates whether it is to his benefit to increase the amount he pumps. The advantage to him of an additional amount of water almost invariably exceeds the disadvantage to him of a slightly lowered water table in the basin overall. The owner will ordinarily conclude that he should pump the additional amount: "But this is the conclusion reached by each and every rational [overlying owner] . . . sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his [pumping] . . . without limit—in a world that is limited."[146]

This suggests that a rule of capture, which affords no security of investment, will cause overdevelopment and not underdevelopment of a common pool resource. The rationale is that a rule of capture will stimulate efforts by each well owner to capture as much water as fast as possible before someone else gets it.

Which view about the relationship of security of investment and economic development is correct—traditional appropriation doctrine thinking or the tragedy of the commons analysis? If optimum economic development, *i.e.*, neither too much nor too little, is a goal of groundwater management under the appropriation doctrine, the answer is important in setting pumping levels.

In theory, the question is subject to empirical investigation. If the appropriation doctrine tradition is correct, then the absolute ownership rule should impede groundwater development because it is essentially a rule of capture.[147] If the tragedy of the commons view is correct, then the absolute ownership rule should lead to overdevelopment. In practice, however, empirical investigation can become terribly complex. For example, Texas has the absolute ownership doctrine while Kansas and New Mexico have the appropriation doctrine for percolating groundwater.[148] Tragedy of the commons analysis suggests overdevelopment should be worse in Texas, while traditional appropriation doctrine thinking leads one to expect relative underdevelopment in Texas. Yet, an observer of groundwater use in the High Plains region of those states (albeit a self-acknowledged casual observer) reported in 1961 that mining was occurring and tolerated in all three states and that the patterns of development in them were not dissimilar.[149]

146. GOVERNOR'S COMM'N TO REVIEW CALIFORNIA WATER RIGHTS LAW, FINAL REPORT 144 (1978).

147. *See* notes 111-114 and accompanying text *supra*.

148. *See* City of Corpus Christi v. City of Pleasanton, 154 Tex. 289, 276 S.W.2d 798 (1955); KAN. STAT. § § 82a-703, -707 (1977); N.M. STAT. ANN. § § 72-12-1, -18 (1978). Until 1945, however, Kansas had the absolute ownership doctrine. A SUMMARY DIGEST, *supra* note 5, at 330.

149. Bagley, *Water Rights Law and Public Policies Relating to Ground Water "Mining" in the Southwestern States*, 4 J. LAW & ECON. 144, 172 (1961).

Even if the observation were correct, it fails to refute traditional appropriation doctrine thinking about security of investment. Early High Plains settlers believed their groundwater came from an inexhaustible source—a gigantic underground river that originated in the Rocky Mountain region to the northwest and flowed under the High Plains on its way to the Gulf of Mexico. This theory prevailed well into the 1950s.[150] Given this belief, it is hardly surprising that abstract legal insecurity of investment under the absolute ownership doctrine did not impede development in Texas. Furthermore, even if some Texans began to doubt the inexhaustible supply theory, there was also the economic impact of favorable agricultural prices after World War II.[151] As the editor of a southwest farm journal wrote in 1948, "It is unsound to advocate to a farmer that he curtail pumping when with top market prices he can pay for his irrigation installation in the first year of operation."[152]

Perhaps the traditional view that lack of security impedes development is correct in situations requiring heavy investment of labor and capital that probably could not be recouped without legally protected security of investment. The contrary view that insecurity, *i.e.*, a rule of capture, leads to overdevelopment may be correct for situations in which large initial investment either is not required to capture the resource or can be quickly recouped under prevailing economic conditions. If so, the actual effect of a policy of reduced security of investment under the reasonable pumping level concept will depend upon (1) how landowners view their prospects of capturing enough groundwater to recoup development costs before someone with a deeper economic reach puts them out of business, and (2) their willingness to gamble.

The premise of some reasonable pumping level statutes that absolute protection of security of investment stifles economic development[153] presents an analogous situation. Opponents of this premise contend that junior well owners must be held liable for interference with the historic diversion systems of senior wells to avoid overdevelopment.[154] Their rationale is that without liability, a junior will

150. D. GREEN, THE LAND OF THE UNDERGROUND RAIN: IRRIGATION ON THE TEXAS HIGH PLAINS 165, 167-68 (1973).

151. Bagley, *supra* note 149, at 173, noted the influence of economic conditions upon groundwater development in the High Plains region of Kansas, New Mexico and Texas.

152. Gowen, *Economics of Irrigation*, SOUTHWESTERN CROP AND STOCK 50 (Sept. 1948), *quoted in* D. GREEN, *supra* note 150, at 183.

153. This premise is made explicit in COLO. REV. STAT. § 37-90-102 (1973) and IDAHO CODE § 42-226 (Supp. 1980).

154. Morse, *Well Pumping and a Declining Water Table—An Economic Analysis* (unpublished paper prepared for Water Law, Stanford University, June 1, 1967), *excerpted in* C. MEYERS & A. D. TARLOCK, WATER RESOURCE MANAGEMENT 686 (2d ed. 1979).

pump as long as the benefits he obtains exceed his own water extraction costs even though the total costs (his own costs plus increased pumping costs to seniors) exceed the benefits. This is the tragedy of the commons analysis all over again. Which view is correct should depend upon (1) the availability and reliability of predictive groundwater basin models, and (2) the willingness of landowners to gamble on new development.

Suppose, for example, that a landowner wants to put in a new well. Over a given time period, his expected gross benefits are $100,000 and his expected pumping costs are $60,000. In addition, the well will cause water level decline that increases the pumping costs of senior well owners by $20,000. Under a rule making him liable to seniors for interference with their historic diversion systems, he would develop the well if he were omniscient, since the total benefits are $100,000 and the total costs to him are $80,000 (assuming no litigation or negotiation expenses). The goal of economic efficiency says he should develop the well. Not being omniscient, however, the landowner does not know whether his liability to seniors will run $20,000 or double or triple that. If the landowner is not inclined to gamble, he will not develop the new well. If this illustration is typical, a legal rule giving seniors absolute (or high) security of investment will stifle desirable economic development.[155]

In short, using cost-benefit analysis to establish groundwater pumping level policy requires an assessment of costs in the form of undue deterrence or overstimulation of development associated with varying amounts of security of investment. The difficulty in making that assessment is that we know little in specific terms about how various degrees of security of investment will affect economic development of groundwater in diverse fact situations.

Selection of a Geographical Accounting Area

Cost-benefit analysis requires choice of a geographical accounting area: a physical area over which to count costs and benefits.[156] The area might be national, regional over several states, state-wide, or regional within a state. Groundwater codes have been a matter of state legislation and typically are administered by state agencies. Thus, the natural tendency may be to stop counting costs and benefits at state lines. One problem with this is that the physical effects of groundwater withdrawal are not necessarily limited to state boundaries. Also, if populations and economies develop at higher rates than can be supported by the long term water supply, crisis oriented solutions may be required that involve large expenditures and federally funded assistance.[157] Thus, a geographically wide cost-benefit perspective seems desirable.

155. This would seem to be true regardless of whether the legal remedy afforded seniors is damages or injunctive relief.

156. *See generally* WATER POLICIES, *supra* note 16, at 42; P. SASSONE & W. SCHAFFER, *supra* note 132, at 159-60.

This raises the legal question of whether a state water agency has power to count costs and benefits accruing outside state borders. *Bean v. Morris*[158] and *Thompson v. Colorado Ground Water Commission*[159] are of interest in this regard.[160] In *Bean,* the United States Supreme Court upheld a Montana federal court decree protecting senior appropriators in Wyoming against depletion of the stream by upstream junior appropriators in Montana. The court "assumed" Montana would be willing to ignore boundaries and allow the same rights to be acquired from outside the state as within. It made this assumption because (1) absent legislation to the contrary, it had done so in earlier cases involving easements and other private rights across a common boundary, and (2) "Montana cannot be presumed to be intent on suicide, and there are as many if not more cases in which it would lose as there are in which it would gain, if it invoked a trial of strength with its neighbors."[161] Thus, under *Bean,* a state inclined[162] to administer water for the benefit of people in another state would seem to have power to do so.

The remaining questions are whether such power may be delegated to an administrative agency and how readily such delegation will be found. The Colorado Ground Water Commission applies a three mile test to determine whether designated groundwater is available for new wells:

> [A] circle with a three mile radius is drawn around the proposed well site. A rate of pumping is determined which would result in a 40% depletion of the available ground water in that area over a period of 25 years. If that rate of pumping is being exceeded by the

157. *See* GAO, *supra* note 8, at 5-8.

158. 221 U.S. 485 (1910).

159. 194 Colo. 489, 575 P.2d 372 (1978).

160. *See also* MONT. CODE ANN. § 85-1-214(1) (1979) (state water agency may exercise any of its powers in an adjoining state unless not permitted under the laws of that state or the United States); C. CORKER, *supra* note 2, at 245-47 (discussing interstate agreements between administrative agencies regarding interstate waters).

161. Bean v. Morris, 221 U.S. 485, 487 (1910).

162. Corker, *Water Rights in Interstate Streams,* in 2 WATERS & WATER RIGHTS § 131.3(C) (R. Clark ed. 1967) concludes that *Bean* is ambiguous as to whether the Court's assumption about Montana's inclination to do so was an inference of fact, a rebuttable presumption, or a substantive rule of federal law stated as a legal fiction.

> existing wells within the circle, then the application for a permit to drill a new well may be denied.[163]

The issue in *Thompson* was how to apply the three mile test to a well that the plaintiff proposed to sink in Colorado near the Nebraska border, so that 24% of the circle fell in Nebraska. The aquifer flowed from Colorado into Nebraska. The commission considered only the Colorado portion of the circle, concluded the proposed well would cause depletion exceeding 40% over 25 years, and denied plaintiff's application for a permit. If the commission had considered the water supply in the whole three mile circle, the plaintiff would have been entitled to a permit because only the Colorado portion of the three mile circle was overappropriated. The court held that the state-line policy was within the commission's delegated authority and that it implemented legislative directives in a reasonable manner. The court accepted the commission's view that further appropriation on the Colorado side of the line "with intent to stabilize or reverse the aquifer flow to the benefit of Colorado, would seriously injure vested Colorado rights far west of the state line and could ignite a destructive aquifer depletion race with Nebraska, an adjoining state."[164]

The court upheld an application of the three mile test that benefited Nebraska, then, partly because it also benefited Colorado by avoiding a destructive aquifer depletion race with Nebraska. The Colorado commission's refusal to go beyond state boundaries in applying the three mile test in *Thompson* was held proper not because the effect in Nebraska was irrelevant to Colorado interests but for the exact opposite reason. The *Thompson* case arguably is authority for a state agency empowered to do cost-benefit analysis of groundwater pumping levels to carry the accounting beyond state boundaries if the agency's own state would gain through improved interstate water relations.

CONCLUSION

The two extreme approaches to the pumping level issue are that (1) well owners have no protection whatsoever in their diversion systems and each must pay his own costs of coping with declining water levels, and (2) existing appropriators are absolutely protected in their historic diversion systems and have injunctive or damage remedies

163. Fundingsland v. Colorado Ground Water Comm'n, 171 Colo. 487, 468 P.2d 835, 836 (1970). The latest refinement of the three mile test is discussed in Berens v. Ground Water Comm'n, 614 P.2d 352 (1980).

164. Thompson v. Colorado Ground Water Comm'n, 194 Colo. 489, 575 P.2d 372, 377 (1978).

against interference by junior users. Whatever the merits of these extreme views,[165] neither has much support in the West today. The appropriation doctrine states have overwhelmingly opted for a middle ground stated in terms of the reasonable pumping level standard.

Undoubtedly some of the appeal of this standard lies in the flexibility allowed because of its vagueness.[166] In implementing the standard, however, the task is to move somehow from a general, widely approved concept[167] to particular fact situations. This article has sought to contribute to that process by exploring, from historic and cost-benefit perspectives, the economic goals underlying or associated with reasonable groundwater pumping levels under the appropriation doctrine.

Few would contend, however, that economics is all that does or should count in resource allocation. While cost-benefit analysis can reveal that a new pumping level will be more economically efficient than an existing one, that computation alone cannot answer the normative question of why those who will gain from switching to the new level should do so if others will lose from the change.[168] Modern resource allocation literature recognizes the impact upon allocation decisions of other goals, often called social goals.[169] These include societal views regarding (1) the distribution of wealth, *e.g.*, how equally or unequally wealth should be distributed, and (2) the distribution of so-called merit goods, *e.g.*, whether everyone regardless of personal wealth should have available a minimum level of certain goods or services such as food, medical care, or education. Although wealth and merit good distribution are the most often discussed social goals, other possibilities have been suggested that were "originally linked to efficiency, [but] have now a life of their own."[170]

In short, the reasonable pumping level standard has an important economic dimension that must be understood if the standard is to be implemented intelligently. The analysis cannot stop there, however. Also necessary are an appreciation of the normative limitations of cost-benefit analysis and an awareness of social goals implicit in the

165. *See* notes 120, 143-46, and 154 and accompanying text *supra*.

166. *Cf.* Wydick, *Plain English for Lawyers*, 66 CALIF. L. REV. 727, 738 (1978) (a vague phrase is sometimes used intentionally to provide a general compass heading when it is not possible to map the trail in detail).

167. Who would want to argue against a standard of "reasonableness"?

168. *See* B. ACKERMAN, ECONOMIC FOUNDATIONS OF PROPERTY LAW xiii (1975); E. MISHAN, *supra* note 132, at 412-13.

169. *E.g.*, C. CORKER, *supra* note 2, at xxii, 127-42; WATER POLICIES, *supra* note 16, at 271 n.81; Calabresi & Melamed, *Property Rules, Liability Rules and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1098-101 (1972).

170. Calabresi & Melamed, *supra* note 169, at 1105.

reasonable pumping level statutes. In addition, related features of appropriation doctrine law, and possibly even laws not directly related to water allocation must be considered. A future article is planned to explore these points.

TECHNICAL AND FINANCIAL POLICY OPTIONS FOR DEVELOPMENT FORESTRY

GEORGE M. GUESS*

INTRODUCTION

Within the last five years, lending institutions and less developed country (LDC)[1] host governments have recognized the critical importance of forestry to rural development. Prior to that time, and still held as a minority view, experts advocated large scale industrial development of forest resources. For the most part, this strategy ignored the economic and ecological benefits of forestry to the developing society. Today, the debate now focuses primarily on means of integrating forestry benefits into rural development strategies. The issue is no longer *whether* forestry can contribute, but *how* it may contribute.

This question may be subdivided further: (1) What technical options exist for forestry integration into rural development? and (2) What financial policy options would be optimal for stimulating and guiding forestry for development? The first question relates to issues of administrative structure and scale, timber species, soil and climatic conditions, and managerial design and budgeting of an appropriate technical assistance package. The second relates to models of financial forestry for development in varying sociopolitical contexts. Although both sets of policy options are conceptually similar, the technical options are more closely tied to line level administrative decisions, while the financial options indicate strategies designed at staff policy levels.

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1. Todaro cites six characteristics of developing or less developed countries: (1) low levels of living; (2) low rates of productivity; (3) high rates of population growth; (4) high and rising levels of unemployment and underemployment; (5) significant dependence on agricultural production and primary product exports; and (6) dominance, dependence and vulnerability in international relations. M. TODARO, ECONOMIC DEVELOPMENT IN THE THIRD WORLD 24 (1977). Todaro also suggests that whether or not most of these countries are actually developing is a moot point. As he states, "It all depends on one's definition of development. However, for expository convenience and in order to avoid semantic confusion, we will use the adjectives 'developing,' 'less developed,' and 'underdeveloped' interchangeably throughout the text when referring to Third World countries as a whole. To do otherwise would unnecessarily complicate the discussion." *Id.* at 37. The abbreviation LDC will serve the same purposes for this article.