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REASONABLE GROUND WATER PUMPING LEVELS UNDER THE APPROPRIATION DOCTRINE: LAW, POLICY AND ALTERNATIVES

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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 Because of unanticipated delays in the publication of that work, citation was made to an earlier unpublished version of their views prepared in collaboration with Professor Brown.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

DOUGLAS L. GRANT*

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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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 mean, 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.

Douglas L. Grant*

Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: Underlying Social Goals†

INTRODUCTION

This is the second of two articles dealing with reasonable groundwater pumping level regulation in appropriation doctrine states.[1] The earlier article reported that most appropriation doctrine groundwater codes protect senior well owners in the maintenance of reasonable pumping levels, but the codes give little specific guidance on how to apply that criterion. The objective of both articles is to help fill the need for a means of measuring reasonableness.

The first article summarized notable features of the reasonable pumping level statutes in different appropriation doctrine states and then focused on the economic dimension of the reasonable pumping level concept. It suggested that the pumping level statutes could be construed to set a goal of optimum economic development, *i.e.*, an economically efficient allocation of the groundwater resource. The earlier article then considered the use of cost-benefit analysis to pursue the goal of economic efficiency.

This article focuses mainly on goals besides economic efficiency. For the sake of a convenient label, these other goals are grouped under the heading of social goals.[2] Thus, the two articles, when read together, use an analytical framework divided into economic efficiency and social goals. While this framework does not provide mechanical answers to pumping level problems, the author hopes that the discussion based on it will at least help to identify and illuminate the issues involved in pumping level decisions.

To set the stage for discussing social goals, this article begins with a

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1. The first article is Grant, *Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals*, 21 NAT. RES. J. 1 (1981).

2. This label is also used in C. CORKER, GROUNDWATER LAW, MANAGEMENT AND ADMINISTRATION 130–35 (1971). The dichotomy here between economic goals and social goals should not be confused with the public finance theory dichotomy between private goods and social goods. On the latter, see R. MUSGRAVE & P. MUSGRAVE, PUBLIC FINANCE THEORY AND PRACTICE 6–7 (1973).

brief look at the normative incompleteness of the economic efficiency goal as pursued through cost-benefit analysis. Then comes detailed consideration of possible social goals under the reasonable pumping level statutes and related appropriation doctrine laws and traditions. The article concludes with some general thoughts on implementing the reasonable pumping level concept.

INCOMPLETENESS OF THE EFFICIENCY GOAL

Economic efficiency is not a self-defining concept. A useful starting point for discussion is the Pareto criterion, which has occupied a central position in theoretical discussions of efficiency for the last half century.[3] The Pareto criterion in its pure form says that a resource allocation is optimal (efficient) if no change could be made that would make at least one person better off and no one worse off. Conversely, a different allocation would be superior (more efficient) if it would make at least one person better off and no one worse off.[4] As a test of whether the government should act to alter a resource allocation, the Pareto criterion is highly restrictive. The status quo will almost always be Pareto optimal, and any alternative will seldom be Pareto superior. To illustrate, suppose that existing law protects the historic diversion levels of senior appropriators and that changing the law to protect only reasonable levels would yield large net gains to society. The Pareto criterion says the change is not superior to the status quo if, as will almost surely be the case, any senior appropriator would consider himself worse off under it.

In response to the restrictiveness of the Pareto criterion, a variation was developed.[5] According to this variation, a new allocation of resources is superior to (more efficient than) the status quo if the gainers *could* compensate the losers and still be better off.[6] This variation is often called the potential Pareto improvement criterion because it requires only hypothetical, not actual, compensation to those who will lose from the change. It is hardly a value neutral decision-making tool because some normative argument is required to justify why those who lose should have to do so for the benefit of the gainers.[7]

3. *See* J. HEAD, PUBLIC GOODS AND PUBLIC WELFARE 3–14 (1974).

4. *Id.* at 5–6; A. RANDALL, RESOURCE ECONOMICS: AN ECONOMIC APPROACH TO NATURAL RESOURCE AND ENVIRONMENTAL POLICY 101 & n. 1 (1981); P. SASSONE & W. SCHAFFER, COST-BENEFIT ANALYSIS: A HANDBOOK 8–9 (1978).

5. J. HEAD, *supra* note 3, at 6–10.

6. A. DASGUPTA & D. PEARCE, COST-BENEFIT ANALYSIS: THEORY AND PRACTICE 57 (1972); E. MISHAN, COST-BENEFIT ANALYSIS 390–96 (rev. ed. 1976); P. SASSONE & W. SCHAFFER, *supra* note 4, at 9–11. The evolution of this criterion through several stages is detailed in J. HEAD, *supra* note 3, at 6–10.

7. B. ACKERMAN, ECONOMIC FOUNDATIONS OF PROPERTY LAW xiii (1975). It has been argued that the more progressive the tax structure is and the more intense competition is, the more likely a potential Pareto improvement will result in an actual Pareto improvement (gainers but no losers) or something close to it. E. MISHAN, *supra* note 6, at 393. *But cf.* P. SASSONE & W. SCHAFFER, *supra* note 4, at 11 (finding the progressive tax structure argument less than completely convincing).

The potential Pareto improvement criterion underlies cost-benefit analysis.[8] If the dollar value of expected benefits exceeds the dollar value of expected costs, then hypothetically the gainers could compensate the losers and still come out ahead. In this way, cost-benefit analysis can identify allocative efficiency, *i.e.*, the pattern that maximizes net benefits. Since the losers receive no actual compensation, a thorough cost-benefit analysis will include a separate statement of how the benefits and costs are distributed among people.[9]

Following the cost-benefit analysis, a question remains: Why should the gainers gain at the expense of the losers? If economic efficiency were the only goal in resource allocation, this question would be ridiculous. The simple and easy answer would be: Because it is efficient. Usually, however, this question is not answered so easily.[10]

Although the courts seldom, if ever, formally apply the potential Pareto improvement criterion or cost-benefit analysis, they do deal with efficiency arguments. The normative limits of efficiency claims have not escaped judicial awareness. For example, in one case upstream junior appropriators argued they should be allowed to divert water to the detriment of downstream senior appropriators because they could use it for greater benefit to more people with less waste. The court rejected this argument with the comment that "equity does not consist in taking the property of a few for the benefit of the many, even though the general average of benefits would be greater."[11] This example is not offered to suggest that courts never allow efficiency to be pursued unless the Pareto criterion in its pure form is satisfied, *i.e.*, no losers, or actual compensation is paid to the losers under liability or eminent domain rules. Rather,

8. A. DASGUPTA & D. PEARCE, *supra* note 6, at 57–61; E. MISHAN, *supra* note 6, at xviii; P. SASSONE & W. SCHAFFER, *supra* note 6, at 8–12.

9. P. SASSONE & W. SCHAFFER, *supra* note 6, at 23–24; *see also* E. MISHAN, *supra* note 6, at xviii–xix and 412–15.

10. For a comprehensive theoretical discussion of why cost-benefit analysis is indeterminate as a criterion for shaping legal rules, see Kennedy, *Cost-Benefit Analysis of Entitlement Problems: A Critique*, 33 STAN. L. REV. 387 (1981).

11. Morris v. Bean, 146 F. 423, 436 (D. Mont. 1906), *aff'd* 159 F. 651 (9th Cir. 1908) and 221 U.S. 485 (1911). *Cf.* Furrer v. Talent Irrigation Dist., 258 Ore. 498, ___, 466 P.2d 605, 613 (1964) (irrigation district could not escape liability in negligence for property damage to a farmer's land caused by leakage from its canal by showing that its canal operation substantially benefited other farmers and the public generally, for outweighing the harm done to the plaintiff alone). The results in both cases might have been explainable on a rationale of promoting long run efficiency by protecting security of investment (*see* text *infra* at notes 19–21) but the courts did not speak in that language and seemed to be concerned about something else—whether called equity, fairness, distribution, or whatever.

its purpose is to illustrate judicial recognition that economic efficiency is not always the only goal in resource allocation.

Of course, a state legislature has the authority to make economic efficiency its only goal in the pumping level situation (assuming no vested rights are taken in the process). The next section considers whether any states have done that or whether the reasonable pumping level statutes and related appropriation doctrine laws recognize goals in addition to economic efficiency.

SOCIAL GOALS

The inquiry into social goals begins with distributional preferences, the most frequently identified social goal in resource allocation literature. Then the possibility of other social goals unrelated to distribution is explored.

Distributional Preferences

The distinction in resource allocation theory between economic efficiency and distribution has been explained as follows: "Efficiency questions relate to the size of the pie available; distribution questions to who gets what share."[12] Both kinds of questions often will arise in the pumping level context. The typical problem presents two choices regarding the water in dispute: (1) leave it in the ground to provide lift for the pumps of senior appropriators and possibly to serve other purposes such as preventing the intrusion of saline water into the aquifer,[13] or (2) allow new appropriators to withdraw it for use on the surface. If senior appropriators are already pumping from a reasonable depth, the reasonable pumping level statutes either prohibit juniors from lowering the depth or allow it only if juniors pay the increased pumping costs of seniors.[14] If the senior wells are operating above a reasonable pumping depth, however, the juniors will be free to pull the level down to such a depth, and

12. J. HIRSCHLIEFER, J. DEHAVEN, J. MILLIMAN, WATER SUPPLY: ECONOMICS, TECHNOLOGY AND POLICY 36 (1960).

13. The possible other functions are described in Grant, *supra* note 1, at 28.

14. The pumping level statutes themselves generally do not address whether a protected reasonable level is mandatory in the sense that it cannot be lowered at all or whether a junior appropriator can pull the level lower if he pays damages to affected parties. Other groundwater statutes may affect the result. In the Odessa subarea of Washington, for example, groundwater regulations say that the water table in a particular zone shall not drop more than 300 feet below the static water level as measured in 1967. 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 a reasonable pump lift statute. Pima Farms Co. v. Proctor, 30 Ariz. 96, 245 P. 369 (1926), and Current Creek Irrigation Co. v. Andrews, 9 Utah 2d 324, 344 P.2d 528 (1959), allowed junior appropriators to keep pumping despite violation of senior rights upon in kind replacement of water to the seniors, although these cases were not decided under reasonable pumping level statutes. Pima Farms is discussed in text *infra* at notes 27–29. A recent Idaho case that took a similar approach is discussed in note 33 *infra*.

the seniors will have to pay their own increased pumping costs. Thus, reasonable pumping level determinations can raise not only the efficiency issue of how the particular quantity of water in dispute should be used but also the issue of proper wealth or income distribution between senior and junior appropriators.

The discussion below considers distributional preferences that may operate in pumping level situations. The general approach is to describe different features of distributional theory and, as each feature is stated, to discuss pumping level law in light of it. Several preliminary points are in order. First, the reasonable pumping level statutes tend to be so vacuously worded that frequent reference to the broader appropriation doctrine context in which those statutes exist is unavoidable. Second, the inquiry into distributional preferences cannot end with identification of the distributional effects of various appropriation doctrine laws and traditions. One must also ask whether those effects have policy significance, *i.e.*, whether they really represent distributional goals or are merely incidental by-products of rules based on a goal of promoting economic development. Finally, the organizational scheme below borrows from an article by Guido Calabresi and A. Douglas Melamed, in which they divide distributional preferences into those regarding wealth (or income) and those regarding the distribution of specific goods, often called merit goods.[15]

Wealth Distribution

Calabresi and Melamed suggest that all societies have wealth distribution preferences, such as for more (or less) equality of distribution and for less (or more) willingness to reward producers for their contributions to economic development.[16] For convenience, these examples are considered in reverse order.

Reward of producers. Although the reasonable pumping level statutes say little explicitly about rewarding producers for their contributions, similarly worded statutes from Colorado and Idaho are of interest for what they say about potential conflict or tension between economic development and protection of the diversion systems of senior appropriators.[17] 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, but early appropriators shall be protected in the maintenance of reasonable groundwater pumping levels. . . ." The earlier article suggested that although this tension is not expressly recognized in many other reasonable pumping level statutes, it

15. Calabresi & Melamed, *Property Rules, Liability Rules and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1098 (1972).

16. *Id.*

17. COLO. REV. STAT. § 37-90-102 (Supp. 1981); IDAHO CODE § 42-226 (Supp. 1982).

is often likely to be at the heart of pumping level disputes regardless of the specific statutory structure in a given appropriation doctrine state.[18]

Concern about protecting the diversion systems of senior appropriators could have any of several origins. First, it might represent a policy of promoting long run economic development of groundwater by affording security of investment,[19] with any distributional benefits for senior appropriators viewed as merely incidental or irrelevant. Second, it might be based on the view that security of investment is a value in its own right to be maximized, in combination with other values, under the banner of efficiency.[20] Third, it might represent a distributional preference for senior appropriators as a reward for pioneering the development of groundwater in their area—a reward they are entitled to keep, at least in large part, over time.[21]

Only the last of these possibilities is significantly distributional in orientation. Whether a policy of rewarding developers underlies the concern for protecting the diversion systems of senior appropriators cannot be determined by looking at the reasonable pumping level statutes alone. Nor do related but more general water statutes give us guidance.[22] Thus, it is necessary to turn to appropriation doctrine traditions.

The appropriation doctrine has long been characterized by a policy of promoting economic development by affording security to investors in the beneficial use of water.[23] A distributional rather than economic development objective, however, is stressed in an account of the inception of the appropriation doctrine in the West given by Elwood Mead, the

18. Grant, *supra* note 1, at 14–15.

19. *E.g.*, Moyer v. Preston, 6 Wyo. 308, 318–19, 44 P. 845 (1896) ("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 accorded to that right."); C. MEYERS, A HISTORICAL AND FUNCTIONAL ANALYSIS OF THE APPROPRIATION SYSTEM 6 (1971). *See also* Farnham, *The Improvement and Modernization of New York Water Law Within the Framework of the Riparian System*, 3 LAND & WATER L. REV. 377, 378 & n. 4 (1968).

20. *See infra* pp. 22–23.

21. *Cf.* R. NOZICK, ANARCHY, STATE AND UTOPIA 154 (1974) (suggesting that most people think it is relevant in assessing the distributive justice of a situation to consider how that distribution came about). Sax, *Selling Reclamation Water Rights: A Case Study in Federal Subsidy Policy*, 64 MICH. L. REV. 13, 32–34 (1965) discusses whether the pioneer-reward theory explains why farmers receiving federal reclamation project water for land not in excess of applicable acreage limitations are allowed upon sale of the land to cash in on values created by the federal reclamation subsidy. He rejects the theory as inappropriate for modern reclamation projects where the water made available by the project generally is not used to open new land to cultivation but to provide supplemental water for existing farms.

22. WYO. STAT. § 41-2-109 (Supp. 1982) directs the state development commission to formulate water plans that identify appropriate state, regional and local management goals "including the obtaining of economic efficiency and a desirable distribution of income." The statute itself does not list any distributional preferences, however. That task is left to the state water commission. The commission has not completed any of its planning projects and has not yet addressed income distribution goals. Letter from Michael Reese to Douglas L. Grant (October 5, 1981).

23. Grant, *supra* note 1, at 23 and authorities cited therein.

Territorial Engineer and first State Engineer of Wyoming and later Commissioner of the U.S. Bureau of Reclamation.

> Justice seemed to demand that when there was not water for all, those who first used water from a stream should have the better right to continue that use, and the doctrine of priority was the result. This doctrine grew out of the belief of the first settlers that their claims were superior to those of later comers, and they insisted that the owner of the last ditch built should be the first to suffer when the stream failed to supply the needs of all. The first builders of ditches could not anticipate how many were to follow. Unless protected by some such principle, the greater their success, the sooner they would be injured by the attempts of others to benefit from their experience.[24]

In reading Mead's account, it is useful to remember that the appropriation doctrine originated in community custom and only later was given judicial and legislative sanction.[25] His reference to what "[j]ustice seemed to demand" in the minds of the first settlers appears to relate more to distributive justice than to economic efficiency. Mead's account seems plausible. The early settlers, many of whom already had their water rights, were more likely attracted to the priority principle as a matter of distributive justice than as a tool to promote additional water development.

Western courts and legislatures no doubt initially sanctioned and later continued to adhere to the priority principle because of its power to promote economic development by affording security of investment in water use projects.[26] However, that does not necessarily mean they rejected the distributive facet of the priority principle stressed by Mead. This point is illustrated by *Pima Farms Co. v. Proctor*,[27] a 1926 case involving wells that tapped an underground stream. The senior appropriator in that case was a farmer with several shallow wells. The junior appropriator had a number of large wells used to supply water to irrigators of land five or six miles away. The senior appropriator sought to enjoin operation of the junior wells because they lowered the water level below the reach of his wells. The court said its task was to formulate "a rule

24. E. MEAD, IRRIGATION INSTITUTIONS 65 (1903). *Cf.* 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.").

25. 1 W. HUTCHINS, WATER RIGHTS LAWS IN THE NINETEEN WESTERN STATES 159–71 (1971); Phillips, *The Doctrine of Appropriation: An Example of American Born Common Law*, 1939 A.B.A. SECTION REAL PROP., PROBATE & TRUST LAW 38.

26. *See* C. MEYERS, *supra* note 19.

27. Pima Farms Co. v. Proctor, 30 Ariz. 96, 245 P. 369 (1926). Although percolating groundwater in Arizona is not governed by the appropriation doctrine, underground streams are. Higdon & Thompson, *The 1980 Arizona Groundwater Management Code*, 1980 ARIZ. ST. L. J. 621, 624–26 (1980).

that will permit successive appropriations of an independent underground stream of flowing water to the point of exhaustion, and at the same time give reasonable protection to the rights of the senior appropriator with as little expense and hardship upon the subsequent appropriators as possible."[28] The court enjoined the defendant from interfering with the plaintiff's wells as then constructed, but suspended the injunction pending acceptance by the defendant of a plan to furnish water to the plaintiff through one of its canals on equal terms with its other customers.

The court obviously wanted to foster full development of the water. At the same time, it rejected an argument by the defendant that the plaintiff had no cause of action so long as he could still get water by deepening his wells, regardless of the cost to him. The court was concerned about "reasonable protection to the rights of the senior appropriator." This concern had a distributive justice aspect, as revealed by the court's statement that "to permit a junior appropriator, who, perhaps, obtains his knowledge of such body of water by the pioneering explorations and sacrifices of the first appropriator, to lower the water level and thereby destroy or greatly impair the latter's means of diversion, including his pumps and water containers, does not comport with justice and equity."[29]

In sum, the modern reasonable pumping level statutes might be regarded as embracing solely an economic efficiency goal. Under this view, the reason for giving senior appropriators some legal protection of pumping levels is to afford the security needed to induce investment in groundwater development. But only reasonable, rather than historic, pumping levels are protected because too much security for early investors could cut off development prematurely by exposing latecomers to inestimable liability to senior appropriators for lowering historic pumping levels.[30] One may argue, however, that such a view of the priority principle and the pumping level statutes is too narrow. The early history of the priority principle reveals a distributive as well as an efficiency aspect. At least a residue of the early conception of distributive justice described by Mead survived as a policy of the appropriation doctrine in the *Pima Farms* case. Arguably it should have a role in the modern reasonable pumping level statutes alongside the policy of economic efficiency.

28. 30 Ariz. at ___, 245 P. at 371.

29. 30 Ariz. at ___, 245 P. at 373. *Cf.* Trelease, *New Water Legislation: Drafting for Development, Efficient Allocation and Environmental Protection*, 12 LAND & WATER L. REV. 385, 414 (1977) ("From the standpoint of equity and justice, it should be remembered that development takes place over time. The first users take cheap, easily available, always available water. There is no shortage. When more and more uses are made, shortages are created as demands increase to meet or exceed low flow supply. Additional risks are created and additional costs must be met. It seems not unfair for the government to place those risks and those costs on those who create them.").

30. This economic efficiency analysis of the reasonable pumping level statutes is developed more fully in Grant, *supra* note 1, at 23–26.

Equality of distribution. Economist Tibor Scitovsky has written that in trying to ascertain the public's feelings about equality, "all one can do is guess."[31] The present inquiry is governed by statute, and thus legislative feelings rather than the public's feelings about equality are primary. Nonetheless, Scitovsky's statement applies: all one can do is guess about legislative intent regarding the role (if any) of equality of distribution under the reasonable pumping level statutes.

Some of Scitovsky's additional remarks are useful in discussing equality of distribution in the pumping level context, even though his focus is broader. He starts from the premise that in a society such as ours where economic incentives are preferred over coercion to get goods and services produced, perfect equality in the distribution of wealth or income is unattainable because of the need to reward producers as an incentive to produce. He believes, however, the public will resent wealth and income inequalities that are too great. If this is true, the dividing line between what is too great and what is not becomes important. While Scitovsky does not claim to know where the dividing line is, he identifies three factors that determine its location. He says society is more likely to tolerate inequalities under the following circumstances: (1) the inequalities are correlated with merit or one's contribution to societal value; (2) people feel they have equal chances with others of reaching the top; and (3) the least well off are more nearly assured of the necessities of life.[32]

The first two factors listed prompt some comments and questions about wealth distribution policy as it applies in the pumping level context (the third factor will be mentioned later in the subsection on Merit Goods). First, the old caselaw that gave senior appropriators a right to maintenance of historic diversion systems without regard to their reasonableness[33] tended to enhance the wealth position of senior appropriators at the expense of juniors. Juniors either could not pump at all or had to pay the increased pumping costs of seniors. The reasonable pumping level statutes now in force narrow the wealth inequality between seniors and juniors by allowing juniors to pump down to a reasonable level and requiring seniors to pay their own increased pumping costs down to that level. In

31. T. SCITOVSKY, PAPERS ON WELFARE AND GROWTH 252 (1964). Scitovsky was talking about "equity," but by that he means "if not equality, at least something that approximates it closely enough to satisfy" the public. *Id.* at 251.

32. *Id.* at 251–53.

33. The leading example is Noh v. Stoner, 53 Idaho 651, 26 P.2d 1112 (1933), subsequently disapproved in Baker v. Ore-Ida Foods, Inc., 95 Idaho 575, 583, 513 P.2d 627, 635 (1973) (dictum). Recently, however, in Parker v. Wallentine, ___ Idaho ___, 650 P.2d 648 (1982), the Idaho court ruled that *Noh* still applies to domestic wells drilled before a 1978 amendment to the state groundwater code. In other words, such wells are absolutely protected in their historic means of diversion. To balance the right of the senior well user in the case and the public interest in maximum groundwater development, the court denied injunctive relief but gave the senior well owner damages for increased diversion expenses.

other words, the modern statutes promote greater equality in the distribution of wealth or income as between juniors and seniors. Do these statutes represent merely a legislative policy of facilitating new development by latecomers? Or, in the last half of the 20th century when areas of underdeveloped groundwater are fewer, do they also represent a legislative judgment that an earlier distributional policy of rewarding senior appropriators for contributing to societal development now has less appeal to justify inequality in the distribution of wealth or income?[34]

Second, to what extent in the past was acceptance of greater wealth or income inequality between senior and junior appropriators based on a view that latecomers had a good chance to "reach the top" by going somewhere else with a less fully developed water supply?[35] If that view was a factor, does enough of it survive in the last half of the 20th century to continue to justify much deference to senior diversion systems (as distinguished from senior water rights)?

In closing as in opening this subsection, the guesswork nature of the discussion must be acknowledged. One might question whether junior appropriators are sufficiently less well off economically than seniors and whether the two groups are sufficiently large or significant enough[36] to call into operation a broad societal principle such as reasonable equality of wealth distribution. More fundamentally, one might question whether American society is committed to such a principle.[37]

Merit Goods

The merit good concept comes from the field of public finance. The concept is subject to enough debate to require some explanation of its use in this article. Richard A. Musgrave's classic treatise on public finance theory defines merit wants as "those which are considered so meritorious that their satisfaction is provided for through the public budget, over and above what is provided for through the market and paid for by private buyers."[38] Musgrave's examples are publicly furnished school luncheons, subsidized low cost housing, and free education. Other examples are publicly furnished police protection and museums.

34. *See supra* note 21.

35. *Cf.* Phillips, *supra* note 25, at 43 (characterizing appropriation doctrine property rights as a monument to the passion of western pioneers "for justice and a legal system . . . which accorded equality of opportunity to all").

36. Distributional preferences seem to be aimed more at groups of people rather than individuals. See B. DAVIE & B. DUNCOMBE, PUBLIC FINANCE 16–17 (1972).

37. *Cf.* G. LEFCOE, AN INTRODUCTION TO AMERICAN LAND LAW: CASES AND MATERIALS 6–7 (1974) (characterizing the concept of equality in this country as being, at best, more of a commitment to a measure of mobility through competition than a preference for equal cistribution of wealth). *See also* J. HEAD, *supra* note 3, at 27 and n. 50 (questioning whether there is real agreement in many societies on the meaning of reasonable equality between the well off and the less well off).

38. R. MUSGRAVE, THEORY OF PUBLIC FINANCE 13 (1959).

Since merit goods entail governmental intervention into the marketplace production and consumption of certain goods and services, more of them are consumed than otherwise would be the case. Furthermore, the governmental intervention occurs through the public budget, *i.e.*, taxation and spending to make the goods and services available to consumers on a subsidized basis. A major source of controversy about merit goods lies in how to rationalize or explain why the government should interfere with consumer sovereignty in the production and consumption of goods and services.

Among the reasons that have been advanced to justify governmental intervention in the marketplace with respect to merit goods are the following: (1) government intervention is needed to correct consumer preferences that are distorted by ignorance or irrationality, *e.g.*, the view that education should be free because the uninformed do not appreciate the advantages to them of an education; (2) intervention is needed to correct distributional problems, *e.g.*, the view that education should be free so it is available to the poor[39] (compare Scitovsky's claim that income inequalities are more easily tolerated if the least well off are more nearly assured of the necessities of life[40]); (3) intervention is needed because greater consumption of a merit good or service benefits not only the immediate consumer but others in society, *e.g.*, the view that education should be free because it benefits not only the particular pupil but the community. Different types of merit goods have been given labels corresponding to these three rationales, namely, corrective goods, necessity goods and public goods.[41]

Many merit goods, though not all,[42] share all three rationales, as illustrated by the example of free education. Some merit goods, though, may be explainable only on a fourth and rather different ground. They

39. Why not cure the distributional problem with a monetary subsidy to the poor? "The social philosophy of Western society appears to be such that the freedom to tolerate inequality in the distribution of luxury consumption and saving is purchased at the cost of earmarked (specific) subsidies which assure equality in the consumption of necessities." Musgrave, *Provision for Social Goods* in J. MARGOLIS & H. GUITTON, PUBLIC ECONOMICS 124, 143–44 (1969). Musgrave has pointed out, also, that there is an element of paternalism with in-kind rather than cash subsidies because if the subsidy has merely a redistributional purpose, a cash payment would be better since the recipient could then use the cash in line with his or her own preferences. R. MUSGRAVE & P. MUSGRAVE, *supra* note 2, at 81.

40. Free education for the poor would also be supported by Scitovsky's second principle. *See* SCITOVSKY, *supra* note 31.

41. The three rationales are stated and the shorthand labels suggested in J. HEAD, *supra* note 3, chs. 10 & 11. Although Calabresi and Melamed treat merit goods as a distributional preference, the first and third rationales are obviously efficiency related. The same may even be true of the second rationale, if it is viewed as an expression of interpersonal utility preferences. *See* Calabresi & Melamed, *supra* note 15 at 1094. *See also* R. MUSGRAVE & P. MUSGRAVE, *supra* note 2, at 81.

42. At least, Musgrave would not limit the merit good concept to cases where all three features are present. *See* R. MUSGRAVE & P. MUSGRAVE, *supra* note 2, at 81.

may simply represent an autocratic aspect of society, *i.e.*, a belief that it is acceptable for some elite group to impose its preferences.[43]

In the pumping level context, an analogy to merit goods can be found in water use preferences. The earlier article noted that a number of states with reasonable pumping level statutes also have laws that declare preferences for certain kinds of water use, most commonly for domestic use. The article also suggested that at least some of these preference laws could be construed to affect the setting of reasonable pumping levels.[44] One example given was Oregon, where the state water resources director is authorized to designate domestic and livestock use for first preference in critical areas[45] and deny or limit permits for new wells that would cause "undue interference" with existing wells.[46] If domestic use has been designated for preferred status, arguably the economic pumping reach of small domestic users would be highly significant in determining reasonable pumping levels.[47]

A South Dakota case that came down while the earlier article was at press seems to adopt this approach.[48] The court held that the state water rights commission erred in granting a permit for an irrigation well and gave as one reason that the well had a detrimental effect on the supply to domestic wells nearby. The court added:

> SDCL 46-1-5(1) states that the use of water for domestic purposes is the highest use of water, and takes precedence if such use is consistent with [the] public interest. . . . Although the Commission is no longer required to regulate irrigation to absolutely protect artesian pressure for domestic uses, reasonable domestic use must be assured before irrigation is allowed. SDCL 46-6-6.1. There is a "vested right" in the use of the water for domestic purposes.
>
> SDCL 46-6-6.1 does not, we are convinced, give the Commission unbridled power to approve irrigation projects without giving consideration to the maintenance of artesian head pressure as a method of delivery. This statute merely requires a balancing of interests between irrigation and delivery of water by artesian pressure for domestic use.[49]

The latter paragraph evidences a striking receptiveness to special status

43. *Id.*
44. Grant, *supra* note 1, at 18–20.
45. OR. REV. STAT. § 537.735(4)(c) (1981).
46. OR. REV. STAT. § 537.620(3) (1981).
47. Of course, this would not be true of a preference statute having only a more specialized effect. For discussion of the different kinds of water use preferences, see Oeltjen & Fischer, *Allocation of Rights to Water: Preferences, Priorities and the Role of the Market*, 57 NEB. L. REV. 245, 256–60 (1978); Trelease, *Preferences to the Use of Water*, 27 ROCKY MTN. L. REV. 133 (1955).
48. Fraser v. Water Rights Comm'n, 294 N.W.2d 784 (1980).
49. *Id.* at 789.

for domestic uses when one realizes that section 46-6-6.1 says state officials are authorized to control the location and capacity of large wells "for the purpose of ensuring or protecting water for reasonable domestic use, *without* the necessity of requiring maintenance of artesian head pressure in a domestic use well."[50] The court seems to be saying that even though there is no "necessity" to maintain artesian head pressure in domestic wells, it might sometimes be reasonable to do so.

A statutory preference for domestic (or other) water use that affects pumping levels would not be a true merit good preference in the public finance sense discussed above. With standard merit goods such as free education and subsidized low cost housing, the governmental intervention in the marketplace takes the form of taxation and monetary subsidies. With water use preferences, the intervention is through governmental regulation.

Nevertheless, some parallels can be drawn between merit goods and water use preferences. If a preference for domestic use affects the setting of reasonable pumping levels, the end result is similar to the merit good situation in that governmental intervention makes water available to consumers for the preferred use at lower cost (*i.e.*, from a shallower pumping depth) than might occur under market conditions.[51] Furthermore, a domestic use preference might be claimed to rest on one or more of the three merit good rationales stated above: (1) domestic water is a corrective good, *e.g.*, the unwashed do not appreciate the health or other values of personal cleanliness; (2) domestic water is a necessity good, *e.g.*, it is necessary for life and should be available without (too much) regard to personal income; (3) domestic water is a public good, *e.g.*, its use confers health, olfactory or other benefits on members of society due to the immediate consumer's greater cleanliness. Instead, a domestic use preference might be based on the fourth explanation for merit goods stated earlier, *i.e.*, it may simply represent an autocratic aspect of society in which it is considered acceptable for some elite group to impose its preferences.

Viewing water use preferences as akin to the public finance concept of merit goods is unconventional. If correct, though, such a view could affect pumping level decisions by helping to focus the debate about the legitimacy of water use preferences. These preferences are sometimes criticized for blocking economic progress by sheltering low value uses from market forces. Whether a preference is or continues to be warranted may, of course, be affected by marketplace economics. The merit good

50. S.D. CODIFIED LAWS ANN. § 46-6-6.1 (Supp. 1982) (emphasis added). See note 33 *supra* for another recent case illustrating special treatment for domestic wells.
51. *Cf.* J. HEAD, *supra* note 3, at 254–56 (suggesting no reason exists why a merit good policy could not be implemented by regulation rather than taxation and monetary subsidy).

parallel should make clear, however, that the debate must also extend to whether the preferred water use has significant corrective good, necessity good, or public good aspects, and to the propriety of governmental intervention in the marketplace based on those grounds or, possibly, on autocracy grounds alone.

Another example—one that is hard to classify within the analytical framework used in this article—may now be considered. A general tradition that is sometimes codified into law[52] views family farms as desirable even though larger corporate farms might be more economically efficient. The tradition may have anti-monopoly (*i.e.*, efficiency) and wealth distribution aspects, as well as a merit good aspect representing a judgment about the value to society of a certain kind of life that transcends marketplace pricing.[53] In the pumping level context, a general family farm policy may come into conflict with a goal of economic efficiency, at least if efficiency means maximizing net benefits as measured in the marketplace.[54] Because of economies of scale, a large irrigator may be able to afford to pump from a considerably greater depth than a small one.[55] If pumping levels are geared to the economic feasibility of large farms, small ones may be driven out of existence except perhaps for those that fortuitously can combine to construct and operate joint wells. If the continued existence of small family farms is a societal goal, then pumping levels should be coordinated with that.

The same type of issue arises with potentially greater stakes when agricultural uses come into conflict with municipal or industrial uses that can afford to pump water from substantially greater depths. Does the agrarian way of life have some special merit, not reflected in market prices, that entitles it to insulation from the forces of economics? Frank Trelease has observed:

> In much of the rural west water is held almost in reverence. Water rights are heirlooms to be treasured beyond their intrinsic value. There is real resistance to the notion that water is an article of commerce and subject to trading in the market place. The notion persists that water for cattle, for hay, for fodder, for feed grain, for cash crops is the highest and best use of the resource.[56]

Where this notion is translated into law, which is mainly in the context of water right transfers,[57] it appears to represent a merit good preference based more on pure autocracy (the power of a political elite) than on any of the other three rationales for merit goods. A question yet to be answered is the extent to which a similar, perhaps unwritten, policy will operate in the reasonable pumping level context.

In summary, pumping levels in some appropriation doctrine states may have to be coordinated with groundwater use preference statutes. Family farm or rural lifestyle policy may also be relevant in some areas. One way to examine these considerations is to view them in light of the merit good concept from the field of public finance.

Other Social Goals (Besides Distributional Preferences)

Economic Efficiency Broadly Viewed

Whether there are any resource allocation goals apart from economic efficiency and distributional preferences depends upon how broadly one defines those two goals, especially the efficiency goal. The potential Pareto improvement criterion of efficiency seeks to maximize net resource benefits over time.[58] Much of the theoretical resource allocation literature takes a broad view of what to count as the benefits and costs of a proposed course of action: all positive and negative effects that are of social concern should be counted, whether or not they are items of commerce or can be valued in market terms.[59] Thus, the calculation would include numerous nonmarket items of personal utility or disutility such as environmental amenities.

At the theoretical level, this broad view of economic efficiency has even been extended to take into account distributional preferences. This extension is achieved simply by postulating that people care about not

52. *See, e.g.*, 7 U.S.C.A. § 2266(a) (Supp. 1982) (reaffirmation of policy to foster and encourage small farms in Food and Agriculture Act of 1977); WASH. REV. CODE ANN. §§ 90.66.010 to 90.66.910 (Supp. 1982) (Family Farm Water Act).

53. The provision of the Food and Agriculture Act of 1977, *supra* note 52, states in part: "Congress hereby specifically reaffirms the historical policy of the United States to foster and encourage the family farm system of agriculture in this country. Congress firmly believes that the maintenance of the family farm system of agriculture is essential to the social well-being of the Nation and the competitive production of adequate supplies of food and fiber. Congress further believes that any significant expansion of nonfamily owned large-scale corporate farming enterprises will be detrimental to the national welfare." Food and Agriculture Act of 1977, Pub. L. No. 95-113, § 102(a), 91 Stat. 913, 918.

54. *See* text *infra* at note 60 for discussion of a broader view of economic efficiency.

55. *See* Corey, *Size of Farm in Relation to Irrigation Pumping Costs*, 12 TRANSACTIONS AM. SOC'Y AGRICULTURAL ENGINEERS 795 (1969).

56. Trelease, *Federal-State Problems in Packaging Water Rights* in ROCKY MTN. MIN. L. FDN., *Water Acquisition for Mineral Development Institute*, Paper 9, Pg. 11 (1978).

57. *E.g.*, IDAHO CODE § 42-222(1) (Supp. 1982) (no change from agricultural use to another use is allowed if that would significantly affect the agricultural base of the area); MONT. CODE ANN. § 85-2-402(3) (1981) (appropriator of more than 15 cubic feet per second may not change from agricultural use to industrial use).

58. Net benefits means benefits minus costs. The time dimension requires discounting future benefits and costs to present value. *See* E. MISHAN, *supra* note 6, Part IV; P. SASSONE & W. SCHAFFER, *supra* note 4, ch. 6.

59. *See, e.g.*, E. MISHAN, *supra* note 6, at 126; R. SUGDEN & A. WILLIAMS, THE PRINCIPLES OF PRACTICAL COST-BENEFIT ANALYSIS 93 (1978); Calabresi & Melamed, *supra* note 15 at 1094 & n. 11. One of the costs of any resource allocation rule would, of course, be the administrative cost of implementing it.

only how much they have themselves but whether others have enough. If personal utilities are interdependent in this fashion, then the distribution of income becomes an item of personal utility or disutility that fits within the theoretical efficiency calculus.[60]

Of course, it is one thing to have a broad economic efficiency criterion in theory and quite another to apply it in practice. Much effort has been devoted to developing methods of "shadow pricing" for items that are not traded in the market or are traded at prices which are thought to be distorted.[61] Yet economists generally agree that at least some items cannot be assigned reliable shadow prices either at all or at a cost low enough to make the effort worthwhile.[62] In those cases, the cost-benefit analyst is advised to list the items separately and describe them in nondollar terms.[63]

In a sense, it may not make much difference whether items that are not readily and accurately valued in dollars are treated under (a) the efficiency goal but separately described in nondollar terms or (b) a separate category of other social goals and described in nondollar terms. Either way the hard questions remain. What, if any, such items are of concern under the reasonable pumping level statutes and related appropriation doctrine laws and traditions? And how can they be evaluated in relation to more tangible concerns? These questions are considered below with respect to two items—being there first and security of investment.

Being There First as a Value in Its Own Right

Calabresi and Melamed use a threefold classification of factors bearing on resource allocation—economic efficiency, distributional goals, and other justice reasons.[64] Since they take a fairly broad view of economic efficiency and distributional goals, they acknowledge difficulty in finding anything to put in their other justice reasons category. They suggest, though, that dialogue about resource allocation may be enlightened by putting into this category "reasons which, though possibly originally linked to efficiency, have now a life of their own" and "reasons which, though distributional, cannot be described in terms of broad principles

60. The leading article is Hochman & Rodgers, *Pareto Optimal Redistribution*, 59 AM. ECON. REV. 542 (1969); *see also* J. DUE & A. FRIEDLAENDER, GOVERNMENT FINANCE: ECONOMICS OF THE PUBLIC SECTOR 120–22 (1973). This approach will not fully collapse distributional preferences into economic efficiency, though, unless one also postulates that individual preferences are aligned with societal preferences.

61. *See, e.g.*, E. MISHAN, *supra* note 6, chs. 13 & 14; P. SASSONE & W. SCHAFFER, *supra* note 4, ch. 5; R. SUGDEN & A. WILLIAMS, *supra* note 59, ch. 8.

62. *See* P. SASSONE & W. SCHAFFER, *supra* note 4, at 51. There is disagreement, however, on how many of these items cannot be assigned shadow prices.

63. *See, e.g.*, E. MISHAN, *supra* note 6, at 406–07; P. SASSONE & W. SCHAFFER, *supra* note 4, at 34–37; R. SUGDEN & A. WILLIAMS, *supra* note 59, at 180–81.

64. Calabresi & Melamed, *supra* note 15, at 1093–1105.

like equality."[65] Their most specific example is the significance in the law of nuisance attached to "being there first," by which they no doubt have in mind the doctrine of coming to the nuisance.[66] Although they recognize that the significance of "being there first" might be part of either a long run efficiency goal based on protecting expectancies or a distributional goal, they imply that it might also be part of an independent concept of justice.[67]

Obviously, the priority principle of the appropriation doctrine attaches great significance to being there first. Whether this significance has some independent basis, apart from long run efficiency or distribution, is an intriguing possibility but unfortunately one about which little hard evidence can be adduced either to prove or to disprove it. Of interest, however, is the observation of a leading water law scholar that time priority features exist in numerous water law systems throughout the world. He concluded that time priority represents "the verbal identification of a very widespread human trait."[68]

Security of Investment as a Value in Its Own Right

Security of investment is a pervasive theme of the appropriation doctrine. Senior appropriators are given security by the priority principle. Junior appropriators are given security, to the extent possible in view of their status, by the related rules that (1) a junior is entitled to the maintenance of stream conditions existing as of the time of his appropriation[69] and (2) no appropriator can change the point of diversion, place of use, or nature of use of his right if that will injure any other appropriator including juniors.[70] The security of investment afforded by these rules originally served and continues to serve the function of promoting full economic development of water resources.

Yet, to paraphrase Calabresi and Melamed, one wonders whether security of investment, though linked to efficiency, now has a life of its own. The appropriation doctrine prohibits unreasonably wasteful diversion, transportation and use of water, but generally the courts have been quite reluctant to require appropriators to use better methods to avoid waste than are customary in the community.[71] Perhaps the security of

65. *Id.* at 1105.

66. That the defendant was there first and the plaintiff came later is a relevant factor, though generally not decisive in itself, bearing on whether the defendant is liable for committing a nuisance. *See* R. STEWART & J. KRIER, ENVIRONMENTAL LAW AND POLICY 231–33 (1978).

67. Calabresi & Melamed, *supra* note 15, at 1123.

68. Trelease, *supra* note 29, at 414–415.

69. This rule is discussed in 1 W. HUTCHINS, *supra* note 25, at 576–77.

70. *Id.* at 623–44.

71. Fisher, *Western Experience and Eastern Appropriation Proposals* in D. HABER & S. BERGEN, THE LAWS OF WATER ALLOCATION IN THE EASTERN UNITED STATES 75, 108–09 (1956).

investment derived from this deference to custom is based entirely on a long term efficiency goal, *i.e.*, protection of expectancies to encourage investment. However, there may be more to it than that. At least one commentator has suggested that the courts seem more deferential to custom in applying the rule against waste of water than in analogous tort law negligence cases.[72] The prevailing view in the latter is that customary safety practices in an industry are relevant but far from controlling on the issue of reasonable care by the defendant. Thus, the law seems to give more security to investors in water development under the appropriation doctrine than to industrial investors generally. Could it be that security of investment has come to have a life of its own in appropriation doctrine water law that is not matched in the tort law of negligence?

Modest support for such a hypothesis can be found in a turn of the century study of irrigation in several arid regions of the world by French geographer Jean Brunhes.[73] He looked for relationships between the physical environment and the organization and regulation of economic activity. He reached three conclusions: (1) menacing irregular natural environments create psychological uncertainty that varies with the degree and type of physical hazard; (2) generally people seek to free themselves from such psychological uncertainty by associating their common interests under fixed laws; but (3) whether and exactly how they do so depends on their attitudes toward cooperation and individualism, which in turn is a function of various ethnic, historic, legal and political influences. If Brunhes is correct, it would hardly be surprising if the water law system developed by settlers in the arid west was designed (in part) to free them from psychological uncertainty about water supply and thus included something of a fixation on security of investment going beyond the dollar value of the goods produced with the water.

If security of investment has a life of its own, in theory it could be measured in dollars and treated under the economic efficiency goal (even if that goal is viewed in a narrow marketplace sense). Security of investment as a value in its own right is readily subject to dominion by one person to the exclusion of others, so that others who want it would have to pay to get it. Thus, security of investment is readily subject to pricing and market exchange.[74]

72. J. SAX, WATER LAW, PLANNING AND POLICY: CASES AND MATERIALS 273–74 (1968).

73. J. BRUNHES, ETUDE DE GEOGRAPHIC HUMAINE: L'IRRIGATION SES CONDITIONS GEOGRAPHIQUES, SES MODES, ET SON ORGANISATION DANS LA PENINSULE IBERIQUE ET DANS L'AFRIQUE DU NORD 429–39 (1902). Brunhes work is discussed in A. MAASS & R. ANDERSON, *supra* note 24, at 9–10, 399–400. I wish to thank Mary Ann Lyman for translating portions of Brunhes for me from the original French.

74. The reason some values are not priced by the market is that for physical or other reasons they lack the characteristic of excludability. *See* R. MUSGRAVE & P. MUSGRAVE, *supra* note 2, at 52–53; J. SINDEN & A. WORRELL, UNPRICED VALUES: DECISIONS WITHOUT MARKET PRICES 433–36 (1979).

With irrigated farmland, for example, if the security of investment associated with pumping level stability is a value in its own right that transcends the dollar value of the crops to be produced with the water, this value should be reflected in the market price of the farmland.[75] In theory, then, one might expect to measure this value in dollars by comparing the market prices of different farms that are essentially identical except for the stability or instability of the pumping levels of their groundwater rights. The price differential might be due partly to a capitalization of the expected greater net crop income from lower pumping costs on the parcel with a more stable pumping level, and partly to a payment for security of investment as a value in its own right transcending expected net crop income. Allocation of the price differential between these causes may be difficult if not impossible, but allocation would be unnecessary since the important objective would be to quantify in dollars *all* the benefits or costs associated with greater security of investment.[76]

Measuring security of investment as an end in itself through the comparative land price approach encounters difficulties in practice, however.[77] Gathering a data base of truly comparable parcels with differing pumping level security would be no easy task. Even then, the difference in market price may understate security of investment as a value for its own sake because of the effect of property taxes. If security has a value in its own right transcending the net dollar value of goods produced with the water, the market price of high security land should be higher than low security land. If land is assessed for property taxes according to its market value, the property tax burden of high security land would in turn increase.[78] By hypothesis, though, security in its own right will not add to the flow of net income from the property and help to pay the higher property taxes. Thus, the cost to a buyer of high security land is not only the initial higher market price but also the future higher property tax burden.

Since part of what the buyer is willing to pay to get the more stable

75. The demand for land is a function of all of its characteristics that are of utility to consumers, and in theory the annual flow of utility can be capitalized to measure the value of the land. J. SINDEN & A. WORRELL, *supra* note 74, at 291.

76. Double counting must be avoided, of course. One could not count both the net dollar value of increased crop production and increased land prices that reflect a capitalization of increased crop income. On double counting in irrigation projects, see A. GIFFORD, JR. & G. SANTONI, PUBLIC ECONOMICS: POLITICIANS, PROPERTY AND EXCHANGE 71 (1979); E. MISHAN, *supra* note 6, at 78–80.

77. *Cf.* R. SUGDEN & A. WILLIAMS, *supra* note 59, at 161–62 (reporting that because of such difficulties the comparative land price approach to measure amenities and disamenities has been successful only for extreme disamenities such as high levels of aircraft noise).

78. This would not be true if, as in Idaho, agricultural land is taxed not according to its market value but under a capitalization of economic rent or crop rental approach. IDAHO CODE § 63-105CC (Supp. 1982).

pumping level will be absorbed by higher property taxes, the initial market price he will pay for the land is likely to understate the true value to him of the greater security.[79] To illustrate, assume that security of investment as a value in its own right is worth $400 annually to a buyer. If a four percent capitalization rate is used, security of investment would add $10,000 to the price of the land before taxes are considered. With a one percent tax levy, annual property taxes would rise $100, leaving a net benefit of $300. Applying the same capitalization rate to a net benefit of $300, the actual increase in market price would be $7,500 rather than $10,000.

If security of investment has a life of its own that is difficult to measure in dollars, some other means to evaluate its importance would be useful. As a start in this direction, one might note that the security of a water user's investment is a function of more than pumping level stability. For example, irrigators are subject to considerable fluctuation in the cost of such factors of production as fertilizer, energy and borrowed capital. Their crop production can vary due to hail, wind, frost, insects and plant disease. Furthermore, the selling prices of their crops fluctuate. With all these variables, the question is whether legal regulation of pumping levels can make much of a contribution to an irrigator's security of investment. On the other hand, one might ask whether such regulation nonetheless has a useful role in combination with other governmental efforts to prevent other variables from fluctuating too widely, *e.g.*, crop price supports, crop disaster aid programs, and efforts to control interest rates.

SUMMARY

The earlier article suggested the reasonable pumping level statutes invite the construction that they contemplate a goal of economic efficiency. That article discussed efficiency in the sense of maximizing net groundwater values that are measured in the marketplace. The present article has sought to explore the significance under the pumping level statutes of social goals—distributional and otherwise. Since the pumping level statutes tend to be vacuously worded, this article has focused mainly on related appropriation doctrine laws and traditions rather than on specific language in the pumping level statutes.

The exploration indicates that the common law priority principle started out with a wealth distribution facet that may well have some continuing vitality in appropriation doctrine states. Also, groundwater use preference statutes exist in some appropriation doctrine states. In a sense, these statutes constitute a merit good preference. Possibly some other policies akin to merit good preferences may come into play, *e.g.*, a preference

79. *See* J. SINDEN & A. WORRELL, *supra* note 74, at 299.

for an agrarian lifestyle. Finally, but by no means clearly, general appropriation doctrine laws and traditions may include other values that are not priced directly or separately in the marketplace, namely, a special justice dimension to being there first and a life of its own for security of investment.

The important question, of course, is: How significant are these distributional or other social values under particular reasonable pumping level statutes? As noted earlier, the Colorado and Idaho reasonable pumping level statutes explicitly recognize tension or potential conflict between achieving economic development and protecting the diversion systems of senior appropriators.[80] These statutes allow, if not require, an agency or court that makes pumping level decisions to consider various nonefficiency concerns that might be express or implicit in broader appropriation doctrine laws and traditions. Furthermore, it seems unlikely that other western legislatures intended to make economic efficiency in a narrow marketplace sense the only goal when the vacuously worded reasonable pumping level statutes are read in their broader appropriation doctrine context.

Perhaps the strongest case against considering social goals can be built upon the Nevada reasonable pumping level statute, since it is more specific than most in stating what factors should be considered. After stating that a groundwater appropriation is subject to reasonable lowering of the static water level at the point of diversion, the statute says: "In determining such reasonable lowering of the static water level in a particular area, the state engineer shall consider the economics of pumping water for the general type of crops growing and may also consider the effect of water use on the economy of the area in general."[81] One might argue that by stating what "shall" and "may also" be considered, the statute precludes consideration of anything else.

It would seem prudent, however, for the state engineer in Nevada to consider other statutes that expressly authorize him to give certain water uses preferred status[82] and to limit the depth of domestic wells in designated groundwater areas.[83] Furthermore, even if the pumping level statute were construed to allow him to consider only the factors listed, this construction would not necessarily limit the inquiry to economic efficiency in a narrow marketplace sense. The directive to look at "the economics of pumping water for the general type of crops growing" in the area seems intended to protect the growing of such crops, at least to

80. *See* text *supra* at notes 17 and 18.
81. NEV. REV. STAT. § 534.110(4) (1981).
82. NEV. REV. STAT. § 534.120(2) (1981).
83. NEV. REV. STAT. § 534.120(3) (1981). NEV. REV. STAT. § 534.030 (1981) states the procedures for declaration of designated groundwater areas.

some extent, even though that may not be the most efficient use for the water. Although this directive could be aimed at long run efficiency by protecting expectancies, it sounds very much like either a merit good type preference for existing crops or a desire to provide security of investment for existing uses (customary uses) as an end in itself.[84]

The statutory authorization to consider also "the effect of water use on the economy of the area in general" would allow the state engineer to weigh or blend into his decision the goal of economic efficiency in groundwater allocation. But even this language is not necessarily limited in scope to narrow marketplace efficiency. Arguably, the authorization to consider the "economy" of the area in general opens the door to looking at family farm policy and wealth distribution considerations since the character of an economy can depend on how wealth is distributed within it.[85]

CONCLUSION

The earlier article opened by quoting the following statement about the reasonable pumping level concept from a National Water Commission study: "No definitive guidelines exist as to what the measure of reasonableness is or how it will be applied."[86] Although the reasonable pumping level statutes incompletely enumerate factors that should bear on the measure of reasonableness, the root cause of the uncertainty lies deeper. Additional factors can be ascertained from study of appropriation doctrine laws and traditions, albeit with varying degrees of clarity. Definitive guidelines in the sense of rules that will yield mechanical answers, however, are impossible or at least unwise. Unless one is willing to accept a simplistic, tunnel vision approach, the need is inevitable to weigh potentially competing concerns about economic efficiency, wealth and merit good distribution, and (perhaps) other social goals.

The task then is to develop procedures to achieve knowledgeable and responsible weighing of such concerns. The essence of the problem is captured by the following commentary upon water management under the Alaska water code. That code allows new appropriations only for uses that will be in the public interest, and it enumerates a number of factors

84. *See* the discussion of custom and security of investment as an end in itself, in text *supra* at notes 64–73.

85. The pattern of wealth distribution can, of course, affect the demand for various consumer items, which in turn determines what is an efficient allocation of resources. *See* Kennedy, *supra* note 10, at 422.

86. Grant, *supra* note 1, at 1, quoting NATIONAL WATER COMMISSION, A SUMMARY DIGEST OF STATE WATER LAWS 56 (1973).

bearing on the public interest.[87] Despite the enumeration Frank Trelease, the code's principal draftsman, has commented:

> Making decisions such as these will be very difficult. No law can make them. They must be made by people. No economic formula can solve these problems by push button techniques. . . . It is believed that the real strength of the Code lies in its procedures, which will enable all viewpoints to be brought together and all factors considered, so that choices will be made, not by action of an appropriator or polluter, and not to further the policy of a single purpose agency, but on an informed basis by officials responsible to the State for "maximum use consistent with the public interest" for the "maximum benefit of (all) its people."[88]

Similarly, the strongest approach to the pumping level problem seems to be to use procedures which will enable all viewpoints to be brought together and all factors considered, so that choices will be made on an informed basis by officials responsible to the state for the maximum benefit of all its people.[89] The reasonable pumping level statutes are readily adaptable to that approach.

87. ALASKA STAT. § 46.15.080(b) (1977): "In determining the public interest, the commissioner shall consider (1) the benefit to the applicant resulting from the proposed appropriation; (2) the effect of the economic activity resulting from the proposed appropriation; (3) the effect on fish and game resources and on public recreational opportunities; (4) the effect on public health; (5) the effect of loss of alternate uses of water that might be made within a reasonable time if not precluded or hindered by the proposed appropriation; (6) harm to other persons resulting from the proposed appropriation; (7) the intent and ability of the applicant to complete the appropriation; and (8) the effect upon access to navigable or public waters."

88. F. TRELEASE, A WATER CODE FOR ALASKA 17 (1962), excerpted in F. TRELEASE, CASES AND MATERIALS ON WATER LAW 146, 148 (3d ed. 1979).

89. *Cf.* C. CORKER, *supra* note 2, at xviii–xix ("The most that can be hoped is mechanisms which permit flexible and ad hoc solutions applicable to a particular basin, designed to achieve maximum net benefit and to avoid offending community concepts of distributive justice.").

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REASONABLE GROUND WATER PUMPING LEVELS UNDER THE APPROPRIATION DOCTRINE: LAW, POLICY AND ALTERNATIVES

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ABSTRACT

This report investigates what factors should be considered in the setting of reasonable pumping levels in appropriation doctrine states. The introduction covers some elements of groundwater hydrology and describes other groundwater management tools that also affect pumping levels in appropriation doctrine states. The various reasonable pumping level statutes are compared and contrasted. The economic development policy of the appropriation doctrine is examined from a historical perspective, and the possible contribution of modern cost-benefit analysis to the setting of pumping levels is assessed. The need to integrate non-economic or social goals as well is investigated. Finally, several alternatives to the reasonable pumping level approach are evaluated.

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REASONABLE GROUND WATER PUMPING LEVELS UNDER THE APPROPRIATION DOCTRINE: LAW, POLICY AND ALTERNATIVES

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Douglas L. Grant*

The extent to which well owners should be protected against declining water levels is an enduring issue of ground water law.[1] The nature and treatment of the problem have been shaped over the years by the legal doctrine that a jurisdiction applies to ground water.[2] In appropriation doctrine states the problem was first prominent as a controversy about 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 ground water pumping levels.[4] Little concrete implementation of the reasonable pumping level concept has occurred, though. A National Water Comission report 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 from strong support[6] to harsh criticism.[7] Thus, the currently important questions are how to implement the reason-

able pumping level concept and whether it is so defective that it should be scrapped for some other approach.

In 1970 ground water use expressed as a percentage of total water use in the western states ranged from a high of 62% in Arizona to a low of 2% in Montana.[8] The heavier ground water use and more acute water level problems have tended to occur in nonappropriation doctrine states.[9] In the future, however, pressure for more intensive ground water management is likely to mount throughout the West. Contributing factors should include: (1) rising water demands associated with population growth, mineral development, instream flow maintenance, and water-based recreation;[10] (2) higher energy costs for ground water 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 begin within the framework of existing tools, including in most appropriation doctrine states the reasonable pumping level concept.

The primary objective of this article is to contribute to the need for analysis of the measure of reasonableness.[13] The introduction describes some hydrologic aspects of the pumping level issue, related ground water 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. Policies underlying the statutes are analyzed both in historical context and in light of modern resource allocation theory. The article closes with a brief examination of some alternatives to the reasonable pumping level concept, followed by some thoughts on implementing the concept.

I. INTRODUCTION

A. Hydrologic Aspects of the Problem[14]

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

1. Aquifer Structure

Underground formations that will yield ground water in significant quantities are called aquifers.[16] Aquifers are either confined or unconfined. In an unconfined aquifer the water is held merely 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 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.

2. Operation of Wells

Withdrawing water from a well causes the water table or pressure surface to drop. 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 phenomena. They are not necessarily permanent conditions either. If a well is shut off,

the water table or the presure surface may soon return nearly to its original level around the well.

General water table or pressure surface decline can occur 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 -- often called mining.[18]

Intereference with an appropriator's means of diversion may be a localized matter involving only a couple wells with overlapping cones of depression or pressure relief. Instead, the interference may involve hundreds of wells and widespread overdraft of an entire basin or large subarea of it.[19] Numerous cases may, of course, fall anywhere between these two extremes.

B. Related Ground Water Management Tools

Reasonable pumping level regulation is not the only mechanism available in appropriation doctrine states to cope with declining ground water levels. Two related tools are discussed below.

1. Well Spacing

Some states also have well spacing statutes.[20] Well spacing can prevent pumping level problems due to 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 ground water areas, unless the circumstances in a particular case 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, leaves room for judgment. The underlying substantive standard in all these cases might appropriately be keyed to the state's concept of a reasonable pumping level.

2. Regulation of Mining

The reasonable pumping level statutes could apply to water level decline associated with widespread long-term overdraft. A number of appropriation doctrine states with such statutes also have legislation or case law aimed more specifically at general overdraft, however.[24] The two basic approaches are to allow controlled mining and 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 controlled mining. The court held that a state statute protecting existing water rights against impairment from new wells did not prevent mining two-thirds of the water in a nonrechargable basin over a 40 year period. Although some of the remaining water could still be economically withdrawn for domestic use and perhaps a few other uses, projections indicated the infeasibility of withdrawing such water 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 required 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 discussion to follow of factors bearing on the measure of reasonableness under the pumping level statutes should also apply to controlled mining in situations like Mathers.

Turning now to the prohibition of mining, statutes in some states limit ground water 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 if the best use of some storage is withdrawal and consumption on the surface but further depletion of storage 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]

The present question is whether such statutes leave any role for the reasonable ground water pumping level concept, outside of localized well interference

cases. In theory, an absolute prohibition of mining would not. Water level decline due to general overdraft would be taken care of by a rule of no overdraft. As a practical matter, however, proof of mining may entail an expensive and uncertain contest between expert witnesses regarding total recharge and discharge.[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. Especially is this true if the pumping level statute has been implemented by detailed administrative regulations and if ground water 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 of 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.

C. Social and Economic Variables

The fact settings in which the reasonable ground water 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 has 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 to irrigate the pasture and garden and supply household needs coming from a shallow well. Instead of a domestic user, the senior appropriator might be an agricultural, municipal, industrial, recreational, or other type user of varying size and economic capability.

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 ground water extraction costs and be facing cessation of water use if not loss of occupancy of the land. Perhaps 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 ground water 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.

II. EXISTING STATUTES

A. 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]

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 of a reasonable means of diversion approach.[38]

B. Artesian Pressure

Some of the reasonable pumping level statutes are silent about artesian pressure.[39] This should not necessarily foreclose legal protection of diversion systems using a combination of artesian pressure and pumping to lift ground water to the surface. A couple 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.

C. Water Level and 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 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 ground water 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 ground water 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 invite simpler calculation based on a ground water level unaffected by recent pumping.[50]

D. Modification of Protected Pumping Levels

The reasonable pumping level statutes tend to be silent about modification of levels over time. The Idaho court has said in dictum, though, 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, e.g., 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 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 proper-

ty that cannot be taken without just compensation.[56] Has a vested water right been taken by the pumping level amortization?[57]

A rough parallel in zoning law would be the phase out of a nonconforming building that cannot economically be moved or remodeled to conform. The zoning cases involving 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 withstand 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 thirty years old and the "evidence indicates that wells of this type are depreciated out by this time."[59]

E. Factors Bearing on Reasonableness

Perhaps the most striking common feature of the reasonable pumping level statutes is their lack of specific guidance regarding the measure of reasonableness. The little express statutory guidance available is analyzed below.

1. Economics

A number of the reasonable pumping level statutes mention economics.[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 ground water resource. These concerns are likely to be important regardless of whether a particular pumping level statute mentions both, one, or neither 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 aspect 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 ground water 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 ground water.[68] The Idaho statute provides: "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 shall be protected in the maintenance of reasonable ground water 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 ground water. A common law appropriation doctrine case from Colorado illustrates the problem. In City of Colorado Springs v. Bender,[69] the plaintiffs irrigated about fifty acres of pasture and cultivated land under a senior ground water 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 diver-

sion, and it remanded the case for determination of the level 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]

The supreme court did not list the factors involved, but the plaintiffs' historical use of water seems to be one of them. 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 fifty acre irrigator, is it relevant that the plaintiffs historically were fifty acre irrigators?

A few years after the Bender decision, Colorado enacted its present legislation calling for full economic development of designated ground water but also protecting senior appropriators against the lowering of water levels below reasonable economic limits of withdrawal.[71] While the ground water in Bender probably would not have constituted designated ground water 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] Arguably, however, the legislation forecloses as subjective a view of a senior appropriator's situation as the Bender language might allow.[73] 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 basin is considered."[74] If a fifty acre irrigator does not fit 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 count for much.[75] Kansas and Nevada have similar statutory provisions tending to preclude a highly subjective approach.[76]

Variations in statutory language could affect the weight of the competing concerns of protecting early appropriators in their investments and overall development of ground water. 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 bene-

ficial use" may be somewhat flexible,[79] the traditional understanding of beneficial use[80] leaves doubt that the statutory language would 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 upon maximum beneficial use of ground water, 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 may affect the tension between recognizing the economic limits of senior appropriators and overall economic development. Although the prior-

ity principle is fundamental to the appropriation doctrine,[82] not all states with that doctrine are equally committed to it. To the extent that concern about the economic limits of senior appropriators derives from the notion that priority in time should give special right or status,[83] the weaker a state's commitment to the priority principle is in other aspects of ground water management, the less may be the expected protection of small senior appropriators in their diversion systems.

Wyoming, for example, seems to have a relatively weak commitment to the priority principle for ground water. One statute authorizes the state engineer to cope with insufficiency of supply in ground water 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 ground 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 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 they fare well, however, it is not because of their priority in time, but because of the nature of their uses. A small irrigator with a senior ground water 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 for preferred status, arguably the economic reach of domestic users should be highly significant in deciding what constitutes undue interference in those areas.[91] Nevada has a similar statutory scheme,[92] but adds an apparently unique provision to minimize the impediment to further ground water 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]

2. Other Factors

The reasonable pumping level statutes contain few references to factors other than economics that should affect pumping levels. A few mention water quality,[94] but more generally applicable water quality statutes may require or at least authorize consideration of this factor anyway.[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 law in some states regarding coordinated management of surface and ground water.[97] Finally, as already noted, some western water codes state preferences for domestic and other uses.

3. Summary

An administrative agency or a 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 couple 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 other guidance is to be found, it must come from probing more deeply.

III. UNDERLYING GOALS

In an effort to fill gaps in express statutory directives, general goals implicit in the reasonable pumping level statutes and related features of appropriation doctrine law are explored below. Variations exist among the states, of course, and identifying a

particular theme in some states is no guarantee that the theme holds in yet another state. The purpose is to illuminate possible goals to facilitate asking the right questions in any particular jurisdiction.

Water or natural resource statutes in some states distinguish between economic and social goals in resource management.[98] That distinction is a useful organizing principle for the discussion below.

A. Economic Goals

1. A Historical Perspective

a. Preventing or Curtailing Overdevelopment

The western water law doctrine of prior appropriation began in the mid-nineteenth century as a means of allocating rights in surface streams.[99] Although it was soon applied to underground streams,[100] no strong movement to extend the doctrine to other ground water, called percolating water,[101] emerged until the second quarter of the twentieth century.[102] Before that, percolating water was governed by several systems, namely, the absolute ownership doctrine, the rule of reasonable use, and the correlative rights doctrine.[103]

In many western states a major factor in the extension of the appropriation doctrine to percolating water was a desire to regulate overdevelopment of such water.[104] The principle that priority in time gives priority of right can prevent overdevelopment when

supplemented by a permit system under which new permits are denied once a desired level of development is reached. Where overdevelopment has already occurred, the priority principle can curtail it by forcing closure of wells in inverse order of priority until the desired reduction is reached.[105] Whether the objective is preventing overdevelopment or cutting back on it, however, some standard is needed to determine when overdevelopment occurs. Unless a senior appropriator is guaranteed not only the right to a given quantity of water but also his historic means of diverting it, the priority principle alone cannot define when overdevelopment occurs.

The protection of means of diversion issue has arisen on surface streams as well as with ground water,[106] but there drawing the line on development is often simply resolved by the physical impossibility of diverting more water than is flowing in a stream in a given year. Ground water 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] The reasonable pumping level statutes make sense as a legislative effort to state a standard for ground water, albeit of uncertain contour, regarding the line between permissible development and overdevelopment[108] -- a standard which can then be implemented through the priority principle.

b. 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 not forever limited to surface streams. The rule of absolute ownership, which dominated percolating ground water law in this country during the last half of the nineteenth century,[111] freely allows a landowner to extract ground water without regard to the impact upon a neighbor's well.[112] The doctrine's failure to protect well owners in their source of supply was an important factor in its subsequent decline;[113] fear was expressed that people would not invest to develop wells if a neighbor might later

sink a deep well that dries up the earlier well.[114] In contrast the reasonable use rule, which became popular during the early part of the twentieth century,[115] provided a measure of protection. It allowed one well owner to interfere with another's well only if his use was reasonable under the circumstances.[116] Ironically, appropriation doctrine advocates later criticized the reasonable use doctrine for failing to provide enough security of investment.[117] The objection was that anyone owning land overlying the source of supply might, at any time, commence a "reasonable" use of water that would interfere with the supply to prior users.

In a number of western states, preventing or curtailing overdevelopment was no doubt a stronger force behind extension of the appropriation doctrine to percolating ground water or adoption of the reasonable pumping level concept, or both, than was promoting development. In others, the reverse appears to have been the case. Nowhere was concern about promoting ground water development evidenced more strongly than in Idaho. 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 Idaho water law authority discussed the need for a ground water code. He made the point that ground water is "probably . . . the greatest undeveloped asset or resource" in the state.[121]

Subsequent statutory enactments in Idaho reflect the same sentiment. In 1951 the legislature enacted a ground water code affirming earlier judicial adoption of the appropriation doctrine for all ground water,[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 has herein provided . . . .[123]

This statute recognizes that: (1) stored ground water is not always used most economically to provide 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.

In concluding this examination of the economic development tradition of the appropriation doctrine as it relates to ground water 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 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 could have been written about modern ground water law in those western states where: (1) the doctrines of absolute ownership, reasonable use or correlative rights were rejected for 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 ground water 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 the tension between promoting economic development by affording security of investment and blocking new economic growth with too much security is neither peculiar to the pumping level problem nor of recent origin.

2. A Cost-Benefit Perspective

The dual objectives of promoting development and preventing or curtailing overdevelopment blend together in a policy of optimum development, i.e., neither too

little nor too much. 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 emunciated 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 is the proper concern with 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 ground water management.[131] Serious pursuit of a goal of optimum economic development in the setting of ground water pumping levels hardly seems possible without resort to some form of cost-benefit analysis.

Thorough treatments of cost-benefit analysis, including such difficulties as the selection of a proper discount rate to cope with the time dimension of resource allocation decisions and the avoidance of double counting of costs or benefits, are readily available.[132] Discussed below are some special considerations that arise in the use of cost-benefit analysis to implement the reasonable ground water pumping level concept.

a. Physical Complexity of Ground Water Management

Numerous potential physical effects from ground water withdrawal must be identified and quantified in dollars if the goal is to maximize net benefits from the resource 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 is connected with a surface stream, either by receiving recharge from it or discharging into it.[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 about 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. Ground water 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 ground water level decline may be the drying up of phreatrophytes that provide wildlife habitat.[140]

Of course, not all of these potential physical consequences will be involved 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 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 ground water 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 ground water withdrawal is lacking in specific cases.[142]

b. Uncertainty in the Psychology of Policy Implementation

Suppose a proposal is made to drop the water table below the economic reach of some senior appropriators, forcing them out of existence, because it is thought this will facilitate development of newer more productive uses of the water. Despite the expected short run economic gain, it must be asked whether the decrease in security of investment will reduce economic development in the long run. Thus, full cost-benefit analysis of ground water pumping level policies requires the making of 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 ground water. 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 ground water, unlike coal for example, a "common pool" resource because extracting ground water from one well can affect the availability of water at other wells.[145] Suppose the law does not limit ground water 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. 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 not underdevelopment but overdevelopment 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 is a goal of ground water 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 ground water 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 ground water.[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 ground water use in the Highs 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]

Even if the observation was correct, it fails to refute traditional appropriation doctrine thinking

about security of investment. Early High Plains settlers believed their ground water 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 1950's.[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 ground water 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 stiffles 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 pump as long as the benefits he obtains exceed his own water extraction costs even though the total costs, i.e., 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 ground water 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 stiffle desirable economic development.[155]

In short, using cost-benefit analysis to establish ground water pumping level policy requires assessment of costs in the form of undue deterrence or overstimulation of development associated with varying levels of security of investment. The difficulty is the amount of guesswork that is likely to have to go into such an assessment.

c. Selection of a Geographical Accounting Area

Cost-benefit analysis requires choice of a geographical accounting area, i.e., 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. Ground water 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 ground water 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.

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 Wyoming appropriators from an interstate stream 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, absent legislation to the contrary, it had done so in earlier cases involving easements and other private

rights across a common boundary and because: "Montana cannot be assumed 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, 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 ground water 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 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 impair 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, at least partly, for the exact opposite reason. The Thompson case arguably is authority for a state agency empowered to do cost-benefit analysis of ground water pumping levels to carry the accounting beyond state boundaries if there would be something in it for the agency's own state through improved interstate water relations.

B. Social Goals

1. Normative Limitations of Cost-Benefit Analysis

The theoretical basis of cost-benefit analysis is a measure of economic efficiency known as the Pareto criterion.[165] The basic Pareto criterion states that a resource allocation is optimal if no change could be made under which at least one person would believe he is better off and no one would believe he is worse off. Conversely, a new allocation would be superior if at least one person would believe he is better off under it and no one would believe he is worse off.[166] This form of the Pareto criterion has virtually no practical application, though. The status quo will almost always be Pareto optimal; a superior alternative will seldom be available.[167] To illustrate, suppose existing law protects the historic but inefficient diversion systems of senior appropriators. Changing the law to protect only reasonable diversion systems would not be Pareto superior even though large net benefits were expected to accrue to society if, as will almost certainly be the case, any senior appropriator would consider himself worse off under the change.

A variation of the Pareto criterion states that a new allocation is superior to the status quo, even though some would believe they are worse off under it, if those who gain from the change could compensate the

losers and still be better off.[168] This modifies the basic Pareto criterion with a compensation principle and may be described as Pareto with hypothetical compensation. What it requires to make an alternative allocation superior is not actual compensation but only the ability of the gainers to compensate the losers and still be better off. This version of the Pareto criterion is not a value neutral decision-making tool, however.[169] Because the compensation is only hypothetical and the losers in fact lose, some normative argument is required to explain why they should do so for the benefit of the gainers. This normative problem can be avoided only if an alternative is superior under the basic Pareto criterion, i.e., when there are no losers but only gainers.[170]

It is the Pareto criterion with hypothetical compensation that underlies cost-benefit analysis. If the dollar value of expected benefits exceeds the dollar value of expected costs, then hypothetically the gainers could compensate the losers and still come out ahead. In this way, cost-benefit analysis can identify the alternative that maximizes net benefits. In addition to quantifying costs and benefits, a thorough cost-benefit analysis will include a separate statement of the distributional effects of a proposed course of action.[171] After this is done, however, the normative question remains of whether the gainers should gain at the expense of the losers.

Although the courts are unaccustomed to talking in terms of the Pareto criterion or cost-benefit analysis, the normative problem just stated has not escaped judicial attention. For example, in a negligence action for property damage due to leakage from an irrigation canal, the Oregon court said:

> if the plaintiff's land is harmed by the conduct of the defendant, the latter cannot escape compensating the plaintiff for the harm simply by showing that the defendant's use had a greater social value than the plaintiff's. Thus, in the present case, it is immaterial that defendant's conduct in the operation of the canals was of great social value in that it would substantially benefit the other farmers in the area and the public generally, far outweighing the harm done to plaintiff alone. A landowner does not have to contribute to others a part of the value of his land without compensation, even if it is for a public purpose. The requested instruction, in effect, would have told the jury that it could deny plaintiff recovery if it decided that the social value of the operating canal was sufficiently great. This would clearly have constituted reversible error.[172]

This is not meant to imply that courts allow efficiency to be pursued only if a change in the status quo meets the basic Pareto criterion or if actual compensation is paid under liability rules or eminent domain procedure. Rather, the point is that efficiency in resource allocation is seldom if ever the sole concern of legal rules regarding water use. It is thus now appropriate to turn to other possible concerns of the reasonable pumping level statutes and related appropriation doctrine law.

2. Distributional Goals

In an innovative article about law and resource allocation, Calabresi and Melamed note that all societies have wealth distribution preferences such as for more (or less) equality of distribution and for less (or more) willingness to reward producers for their contributions to economic development.[173] They say preferences may also exist regarding the distribution of specific goods, sometimes called merit goods.[174] An example is the view that everyone should have a certain minimum of education, health care, or police protection regardless of personal wealth. These observations supply a useful framework for discussing distributional goals in pumping level policy.

A major difficulty in attempting to isolate basic distributional policies of the appropriation doctrine should be noted before going further, however. Even after a particular distributional impact of the appropriation doctrine is identified, it may be hard to tell whether that impact reflects fundamental distributional policy or is merely a by-product of rules based upon some other policy such as promoting economic development.

a. Wealth Distribution

Earlier this article alluded to the utilitarian influence in American property law.[175] With its empha-

sis upon maximizing development, the appropriation doctrine seems particularly rooted in economic utilitarianism.[176] The predominant theme of utilitarianism probably is the greatest good for the greatest number, but this does not necessarily lead to any particular view regarding the proper distribution of wealth. Some utilitarians contend that under the economist's principle of decreasing marginal utility of income, equality of distribution is more likely to produce the greatest good for the greatest number.[177] Others favor inequality on the theory that if producers are rewarded to give them an incentive to produce, society as a whole will be better off with the resulting higher level of production despite the inequality of distribution.[178]

Equality in American property law has been characterized as being, at best, more of a commitment to a measure of social mobility through competition that a preference for equal distribution of wealth.[179] The priority principle of the appropriation doctrine seems consistent with that. Giving a superior water right to the first in time hardly promotes equality of distribution. The Desert Land Act and other federal land grant statutes, however, have provided a certain equality of opportunity for people to acquire arid western land upon which to put water to beneficial use and acquire wealth.[180]

Historically, the reasonable pumping level concept was an alternative to absolute protection of historic means of diversion. Viewed that way, it not only promotes development but distributes wealth to a greater number, i.e., junior as well as senior appropriators. It may even distribute wealth more evenly, i.e., juniors may get more than if they have to pay damages to seniors.

b. Merit Goods

Domestic and other use preferences under the appropriation doctrine seem to be more of a merit good than a wealth distribution preference.[181] The implicit policy is that domestic users should be able to get water regardless of limited economic reach.

Pumping level policy can raise other merit good issues in a less direct fashion. The family farm has traditionally been viewed as socially desirable even though larger operations might be more efficient.[182] In a loose sense, the family farm might be viewed as a merit good. There is evidence that because of economies of scale, a large irrigator can afford to pump from a considerably greater depth than a small one.[183] If pumping levels are geared to what is reasonable for large farms, small ones may be driven out of existence (except those which, fortuitously, can combine to the construct and operate a joint well). If the continued

existence of small family farms is in fact a societal goal, then pumping levels should be coordinated with that it. Much the same issue arises, with potentially greater stakes, when agricultural uses conflict with municipal or industrial uses that can afford to pump water from substantially great depths. Does the agrarian way of life have some special merit entitling it to insulation from the forces of economics?[184]

Questions can also arise regarding what might be called "demerit" goods. For example, even among farms of the same size, the kind of crop produced may affect economic pumping levels. Should pumping level regulations be predicated upon, and thus encourage if not require, the production of one crop rather than another? To take a whimsical example, suppose the greatest dollar return from the land in a given area (and, hence, the greatest economically feasible pumping depth) could be attained by producing some unique variety of irrigated opium plant. Surely the American view of opium production as unmeritorious would preclude the setting of pumping levels based on the economic return from opium production. What if the greatest dollar return could be attained by the production of malt barley, however, but the religious beliefs of a significant number of landowners in the area lead them to prefer not to produce a crop used to manufacture an alcoholic beverage?

3. Other Social Goals

Do any noneconomic goals besides distributional preferences affect pumping level policy in appropriation doctrine states? Calabresi and Melamed developed a threefold classification of factors bearing on resource allocation -- economic efficiency, distributional goals, and other justice reasons.[185] They acknowledge difficulty in deciding what to put in the other justice reasons category, given the breadth of the other two. They make the interesting suggestion, however, that this final category may include reasons "which, though possibly originally linked to efficiency, have now a life of their own."[186]

Security of investment has been a pervasive theme in the appropriation doctrine. It is a major objective of the principle that first in time is first in right. It is also an objective of the rule that junior appropriators are entitled to the maintenance of stream conditions existing as of the time of their appropriations[187] and the corollary that an appropriator may not change the point of diversion or the place or manner of use of a water right if it will injure any other appropriator, including junior appropriators.[188] Furthermore, while the appropriation doctrine prohibits waste in diverting, transporting and using water, only reasonable efficiency is required; and the courts have been generally reluctant to require methods that are more

efficient than customary in the locality.[189] A commentator has even suggested that the courts give more deference to custom here than in tort law negligence cases, where the prevailing view is that customary safety practices are relevant but far from controlling on the issue of reasonable care.[190] All of this leads to speculation that security of investment, though possibly originally linked to efficiency, has come to have a life of its own under the appropriation doctrine.

French geographer Jean Brunhes' turn of the century study of irrigation in several arid regions of the world led him to theorize that: (1) menacing irregular natural environments create psychological uncertainty varying with the degree and type of physical hazard, (2) generally people seek to free themselves from such psychological uncertainty by associating their common interests under fixed laws, and (3) whether and exactly how they seek to do so, however, is a function of their attitudes toward cooperation and individualism, which in turn depends upon a variety of ethnic, historic, legal and political influences.[191] If Brunhes is correct, it would hardly be surprising for the new western water law doctrine of prior appropriation to develop a fixation upon security of investment to cope with the uncertainties of water supply and for that fixation to come to have a life of its own.

The presently important question is how much importance security of investment should continue to have as the twentieth century draws to a close. In many areas, overdevelopment is a greater problem than encouraging more development. Also, today's irrigators face considerable uncertainty about various factors of production, such as fertilizer and energy costs. Why should physical pumping level be the subject of special stabilizing regulation when the other uncertainties are not? Is it only because the government can more readily stabilize pumping level by legal command than it can fertilizer and energy costs?

Security of investment in ground water management can be discussed in cost-benefit terms, even though it has been treated so far under the category of other justice reasons rather than economic efficiency.[192] A decision to lower pumping levels will have a "cost" to existing appropriators in the form of reduced security of investment.[193] Whether this kind of cost should be taken into account in cost-benefit analysis, however, depends upon how legitimate a value security of investment is. As economist E. J. Mishan pointed out: "The question of which effects are to count and which not, must, in the last resort, depend upon a consensus in the particular society."[194] Much of the difficulty in giving specific content to the reasonable pumping level concept seems to stem from the lack of a modern con-

sensus about the legitimacy of security of investment as a value for its own sake.

IV. ALTERNATIVES

The two extreme approaches to the pumping level issue are: (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 against interference by junior users. Whatever the merits of these extreme views,[195] 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. Some other middle ground approaches are examined below.

A. Proportionality

The proportionality alternative has been explained as follows:

> Well owners A, B, and C have been pumping 10, 20, and 30 units respectively for a total of 60 from a basin with an annual recharge of 60. The water level is not declining. Now D drills a new well and pumps 40 units and the water table drops, causing the pumping costs of the three senior appropriators to increase by 10 -- A's by 2, B's by 4 since he had to deepen the well in addition to pumping from a lower depth, and C's by 4. Since the

> seniors' continued pumping is as responsible for the decline as D's pumping is, they should each contribute their proportionate share of the externality.[196]

The "externality" to be shared might be computed in different ways,[197] but in simple form would be the total increase in pumping costs to all well owners from mining the basin by 40 units after D begins pumping. The rationale advanced for sharing such costs is that continued pumping by the three seniors is just as responsible as D's pumping for the overdraft. In short, the justification for apportionment of overdraft costs is physical causation.

There are several difficulties with this approach. First, the administrative or legal costs of ascertaining the proportionate share of each well might not be worth the trouble. Especially is this true in case of widespread overdraft involving numerous wells.[198] Second, legal liability is generally predicated on more than mere physical causation alone. It tends to be fixed at least in part on the basis of moral and other policy considerations.[199] Third, most states already have some pumping level law, and shifting to a proportionality rule would raise a number of questions. In an appropriation doctrine state with the reasonable pumping level approach, why should the gainers from the shift gain at the expense of the losers? The logic of physical cause in fact seems a feeble answer. Also, how would the proportionality rule affect the appropria-

tion doctrine tradition of economic development? Would it produce overdevelopment because D (in the illustration above) is not required to pay the total marginal cost of his pumping the extra 40 units, including increased pumping costs to the three senior well owners? Or, would it lead to underdevelopment because the risk of future higher pumping costs if new wells are opened will deter investment in pumping plants?[200] In addition, would a mechanical proportionality rule be consistent with distributional goals such as use preferences and family farms. Finally, if security of investment has come to have a life of its own, the uncertainty of the proportionality rule associated with the risk of future new wells is a drawback.

B. Restatement (Second) of Torts § 858

The Second Restatement of Torts would allow a land proprietor or his grantee to withdraw water from beneath the land and use it for a beneficial purpose without liability for interfering with use by others unless, inter alia, "the withdrawal of ground water unreasonably causes harm to a proprietor of neighboring land through lowering the water table or reducing artesian pressure, ..."[201] The comment on this provision would impose liability for well interference if one person drills a large well too close to another's well. "There is usually water for both if

the proper distance is kept between them, and since in this case the person causing the harm could have easily avoided it, the harm he causes to the owner of the first well is unreasonable."[202]

This example illustrates a difference between focusing upon the unreasonable causing of harm, as the Restatement does, and some of the reasonable pumping level statutes. For example, Alaska has no well spacing legislation, and its pumping level statute says that priority of appropriation does not give a right to prevent the lowering of a water table or artesian pressure "if the prior appropriator can reasonably obtain his water under the changed conditions."[203] If the new water level is still within the economic reach of the senior appropriator, apparently the statute denies him relief against a junior whose well is too close. The same may be true of statutes like those in Colorado and Idaho,[204] which guarantee only the maintenance of reasonable pumping levels. To authorize relief such language would have to be stretched to allow inquiry not only into what the pumping level is but how it got there.

Based on experience in Arizona under the reasonable use doctrine, a critic of the Restatement has argued that its approach "in practice encourages increased pumping and excessive withdrawals at least until a complaint is made alleging unreasonable

uses."[205] The same could probably be said of the reasonable pumping level statutes unless administering state agencies issue pumping level regulations before withdrawals become excessive.

C. Pump Tax

A pump tax has been suggested as a means to achieve economic efficiency in ground water management.[206] Under a full-scale taxing approach, the amount of the tax would be based on the estimated value of the water if withdrawn in the future discounted to present value. Those present pumpers whose uses produce revenues less than the pump tax and their other costs would then cease pumping, thus saving the resource for future, more valuable uses.[207] The National Water Commission has suggested that if full-scale pricing is too great a departure from orthodoxy, a more modest pump tax could at least move ground water use in the general direction of economic efficiency. For example, says the Commission, a decision could arbitrarily be made to manage a nonrechargeable aquifer for a life of 40 years. After determining how much water can be withdrawn annually, a pump charge could be set in an amount that would encourage pumping only of the water scheduled for availability in a particular year, no more and no less. The necessary level of pump tax would be determined through trial and error.[208]

The pump tax approach has been criticized for practical difficulties in political acceptance.[209] These difficulties may well be insurmountable in states with an appropriation doctrine tradition. Certainly, the pump tax could have wealth distribution effects vastly different from the priority principle of the appropriation doctrine. Beyond that, the pump tax does not resolve the hard policy questions in pumping level management. It is more a tool to implement policy than to decide what the policy should be. If it were agreed that maintaining a certain pumping level or rate of controlled pumping level decline is desirable, that policy decision could be implemented in any of several ways, i.e., by regulation (such as first in time is first in right), by a pump tax, or even by a subsidy in which the government pays people not to pump.[210] The pump tax concept itself fails even to reach the hard and fundamental problem of balancing possibly competing economic efficiency and social goals to determine desirable pumping levels in specific cases.

V. CONCLUSIONS

This article opened with the statement from a National Water Commission study that: "No definitive guidelines exist as to what the measure of reasonableness is or how it will be applied."[211] Although the

reasonable pumping level statutes incompletely enumerate factors that should bear on the measure of reasonableness, the root cause of the uncertainty lies deeper. Additional factors can be ascertained from study of appropriation doctrine laws and traditions. Definitive guidelines in the sense of rules or some methodology that will yield mechanical answers, however, are impossible or at least unwise. Unless one is willing to accept a simplistic approach like the proportionality rule, the need is inevitable to weigh potentially competing concerns about economic efficiency, wealth and merit good distribution, and (perhaps) security of investment as a goal in itself.

The task then is to develop procedures to achieve knowledgeable and responsible weighing of such concerns. The essence of the problem is captured by the following commentary upon water management under the Alaska water code. That code allows new appropriations only for uses that will be in the public interest, and it enumerates a number of factors bearing on the public interest.[212] Despite the enumeration, Dean Frank Trelease, the code's principal draftsman, has commented:

> Making decisions such as these will be very difficult. No law can make them. They must be made by people. No economic formula can solve these problems by push buttom techniques. . . . It is believed that the real strength of the Code lies in its procedures, which will enable all viewpoints to be brought together and all factors considered, so that choices will be made, not by action

> of an appropriator or polluter, and not to further the policy of a single-purpose agency, but on an informed basis by officials responsible to the State for "maximum use consistent with the public interest", for the "maximum benefit of (all) its people."[213]

Similarly, there would seem to be no stronger approach to the pumping level problem than using procedures designed to enable all viewpoints to be brought together and all factors considered, with choices made on an informed basis by officials responsible to the state for the maximum benefit of all its people.[214]

Because of the case-by-case nature of private litigation and fortuity in which cases are brought to court and how well they are presented, a comprehensive, informed, and forward looking approach to pumping regulation must come from administrative agencies.[215] A number of western water or ground water codes give state agencies broad power to issue regulations implementing state water laws.[216] Generally such statutes could be interpreted to authorize the issuance of reasonable pumping level regulations. In some states, statutes specifically empower agencies to issue reasonable pumping level regulations or orders[217] or otherwise clearly contemplate administrative action regarding pumping levels.[218] The water agencies in most western states have not been quick to issue pumping level regulations, however.

Agency inaction is understandable. There is no shortage of other pressing business. Adequate physical and economic data is not always available. Perhaps most importantly, ultimate justification of pumping level decisions depends greatly upon a consensus among the people affected regarding appropriate factors and their relative weights.[219] The existing pumping level statutes are broad enough to accommodate almost any consensus that might emerge; but without a consensus, an agency has difficulty defending its pumping level decisions.

The one consensus that must be avoided is that pumping levels have dropped too far, perhaps irreversibly, and something should have been done long ago. Generally this point has not been reached in appropriation doctrine states with reasonable pumping level statutes. There is still time to develop preventive regulations. The dilemma is that: (1) answers to what pumping levels are reasonable depend so much upon public consensus, (2) no public consensus has yet emerged, but (3) specific answers cannot forever be left to the future.

If agencies are disinclined to act in the absence of public consensus, the solution is to promote knowledgeable public consensus.[220] Public involvement procedures used recently by the Idaho Water Resource Board to develop a state water plan illustrate a promis-

ing approach.[221] Before the plan was drafted, the board held numerous public information meetings and prepared newspaper supplements that identified major water problems in different basins, presented alternative planning concepts, and solicited responses. After the plan was drafted but before it was adopted, public hearings were held in various locations.[222] All this costs time and money, but with pumping level regulations it could be limited to specific geographical areas. A skillful agency can use public participation not only to gather information but to disseminate data that can help to crystallize public consensus.

FOOTNOTES

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1. See, e.g., Hutchins, Protection in Means of Diversion of Ground Water Supplies, 29 Cal. L. Rev. 1 (1940); Moses, Basic Ground Water Problems, 14 Rocky Mt. Min. L. Inst. 501 (1968); Sorensen, Groundwater - The Problems 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); Comment, Who Pays When the Well Runs Dry?, 37 U. Colo. L. Rev. 402 (1965); Note, Protection of Ground Water Diversions, 5 Utah L. Rev. 181 (1956).

2. For criticism of the doctrinal approach to ground water problems, see C. Corker, Ground Water Law, Management and Administration, National Water Commission Legal Study No. 6, at 112 (1971) [hereinafter cited as C. Corker] This study is the most comprehensive and thorough analysis of ground water 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, 25 P.2d 255 (1940).

4. See statutes in note 33 infra.

5. National Water Commission, A Summary Digest of State Water Laws 56 (1973).

6. See, e.g., W. Hutchins, Selected Problems in the Law of Water Rights in the West 179 (1942); Comment, South Dakota's Artesian Pressure - Should It Be a Protected Means of Diversion?, 16 S.D.L. Rev. 481 (1971); Note, Protection of Ground-Water Diversions, 5 Utah L. Rev. 181 (1956).

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. Dept. of the Interior, Westwide Study Report

on Critical Water Problems Facing the Eleven Western States 50 (1975):

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

Even Montana reported one area of ground water 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).

9. See General Accounting Office, Ground Water: An Overview 5-15 (Report to Congress by the Comptroller General 1977); see generally 1 U.S. Water Resources Council, The Nation's Water Resources 1975-2000, Second National Water Assessment 18 and 58-59 (1978).

10. See U.S. Dept. of the Interior, Westwide Study Report on Critical Water Problems Facing the Eleven Western States, 54-62 (1975); but cf. 1

U.S. Water Resources Council, The Nation's Water Resources 1975-2000, Second National Water Assessment 2 (1978) (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. General Accounting Office, Ground Water: An Overview 2 (Report to Congress by the Comptroller General 1977).

13. Space limitations preclude systematic treatment of such institutional and procedural questions as the relationship 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, A Layman's Guide to Groundwater Hydrology in C. Corker, supra note 2 at 38-49 and 56-70; D. Muckel, Pumping Ground Water So As to Avoid Overdraft in U.S.

Dept. of Agriculture, The Yearbook of Agriculture 1955 294-99 (House Doc. No. 32, 84th Cong., 1st Sess.); D. Todd, Ground Water Hydrology 17, 26-29, 149-51 (1959).

15. For comprehensive discussions of ground water hydrology see D. Todd, Ground Water Hydrology (1959); W. Walton, Groundwater Resource Evaluation (1970).

16. Underground streams are rather rare. Far more common is precolating ground water, which saturates the interstices of sand, gravel, and other permeable rock materials. See National Water Commission, Water Policies for the Future 23 (1973).

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

18. See D. Todd, Ground Water Hydrology 201 (1959); W. Walton, Groundwater Resource Evaluation 608 (1970).

19. See D. Muckel, Pumping Ground Water So As to Avoid Overdraft in U.S. Dept. of Agriculture, The Yearbook of Agriculture 1955 300 (House Doc. No. 32, 84th Cong. 1st Sess.); W. Walton, Groundwater Resource Evaluation 611 (1970).

20. See, e.g., notes 21-23 infra.

Kansas has no well spacing statute as such, but several local ground water management districts

have developed well spacing regulations. E.g., Rules and Regulations, Kansas Water Appropriation Act: Western Kansas Groundwater Management District No. 1, Rule 5-21-3; Equus Beds Groundwater Management Districtct No. 2, Rule 5-22-2. Such rules are authorized by Kan. Stat. Ann. § 82a-1028(o) (Supp. 1979).

21. Wyo. Stat.Ann. § 41-3-909(a)(v) (1977).

22. Colo. Rev. Stat. § 37-90-137(2) (1973). For the definition of designated ground water, see note 68 infra.

23. S.D. Compiled Laws § 46-6-5 (1967). See also S.D. Compiled Laws § 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 § 46-6-6.1(5) (Supp. 1979) and pp. 43-45 infra discussing controlled mining in Colorado.

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

27. Wash. Rev. Code Ann. § 90.44.130,-.230 (1962). See also Kan. Stat. Ann. § 82a-711 (1977).

28. Colo. Pev. Stat. § 37-90-111(1)(b) (1973) (for designated ground water); Idaho Code § 42-237a (g) (Supp. 1980); S.D. Compiled Laws § 46-6-3.1 (Supp. 1979) (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 ground water levels were too high. It also increases the opportunity for underflow into the reservoir by increasing the gradient." D. Muckel, Pumping Ground Water So As to Avoid Overdraft in U.S. Dept. of Agriculture, The Yearbook of Agriculture 1955 294, 295 (House Doc. No. 32, 84th Cong., 1st Sess.). See also D. Todd, Ground Water Hydrology 212-13 (1959); W. Walton, Groundwater Resource Evaluation 607 (1970). For a nonappropriation doctrine case taking account of this phenomenon, see City of Los Angeles v. City of San Fernando, 123 Cal. Rptr. 1, 537 P.2d 1250, 1307-10 (1975).

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

32. Alaska Stat. § 46.15.030 (1977); Colo. Rev. Stat. §§ 37-90-102 and 37-92-102 (1973); Idaho Code §§ 42-226, -229 and -230 (1977 and Supp. 1980); Kan. Stat. Ann. §§ 82a-703 and -707 (1977); Mont. Code Ann. §§ 85-2-101, -102(14) (1979); Nev. Rev. Stat. § 534.020 (1973); N.M. Stat. Ann. §§ 72-12-1 and -18 (1978); N.D. Cent. Code § 61-01-01 (1960); Or. Rev. Stat. §§ 537.515, -.525,-.535 (1979); S.D. Compiled Laws §§ 46-6-1 to -3 (1967 and Supp. 1979); Utah Code Ann. § 73-1-1 (1953); Wash. Rev. Code Ann. §§90.44.020, -.035,-.040 (1962 and Supp. 1980); Wyo. Stat. Ann. §§ 41-3-901, -905, -930, -936 (1977).

As of April 16, 1979, it was still an open question in Colorado whether ground water not tributary to a natural stream and not located within any designated ground water basin is governed by the appropriation doctrine. Southeastern Colorado Water Conservancy Dist. v. Huston, ___ Colo. ___, 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 ground water areas); Idaho Code §§ 42-226, -237a(g) (1977 and Supp. 1980); Kan. Stat. Ann. §§ 82a-711, -711a (1977); Mont. Code Ann. § 85-2-401(1), -508, -511 (controlled ground water areas) (1979); 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 § 46-6-6.1 (Supp. 1979); Wash. Rev. Code Ann. § 90.44.070 (1962); Wyo. Stat. Ann. § 41-3-933 (1977).

Although the Colorado statute is limited to designated ground water (see note 68 infra), no permit may issue for a well outside a designated ground water 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. Colo. Rev. Stat. § 37-90-107(3)-(5) (1973) (defining "unreasonable impairment" in designated ground water 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 ground water, whether within or outside a designated area, requires each appropriator to establish "some reasonable means of effectuating his diversion." Colo. Rev. Stat. § 37-92-102(2)(6) (1973).

34. N.M. Stat. Ann. § 72-12-3E (1978). Heine v. Reynolds, 69 N.M. 398, 367 P.2d 708 (1962), held 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. 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 24 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. Ann. § 82a-711 (1977) ("impairment shall include the unrea-

sonable . . . lowering of the static water level . . . beyond a reasonable economic limit").

37. Current Creek Irrigation 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); Note, Protection of Ground Water Diversions, 5 Utah L. Rev. 181 (1956).

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 the Current Creek case, note 37 supra, 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); Comment, South Dakota's Artesian Pressure - Should it be a Protected Means of Diversion?, 16 S.D.L. Rev. 481, 489; Comment, Towards an Economic Distribution of Water Rights, 1970 Utah L. Rev. 442, 444.

39. Colo. Rev. Stat. § 37-90-102, -107(3)-(5), -111(1)(b)(1973); Idaho Code § 42-226,-237a(g)

(1977 and Supp. 1980); Kan. Stat. Ann. § 82a-711, -711a (1977); Nev. Rev. Stat. § 534.110(4) (1979); Or. Rev. Stat. §§ 537.525(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 tit. 42 ch. 16 (1977). This recognition does not necessarily mean, however, that such diversion systems are entitled to protection against interference from subsequent wells. Compare Wyo. Stat. Ann. §41-3-909(a)(vii) (1977) with Wyo. Stat. Ann. § 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 § 46-6-6.1 (Supp. 1978); Wash. Rev. Code Ann. § 90.44.070 (1962); Wyo. Stat. Ann. § 41-3-933 1977).

43. Prior to 1972, the South Dakota water commission protected artesian pressure diversion systems apparently without exception. See Comment, South Dakota's Artesian Pressure - Should it be a Protected Means of Diversion?, 16 S.D.L. Rev. 481, 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 § 46-6-6.1 (Supp. 1979).

44. In Department of National Resources and Conservation v. Crumpled Horn, No. 7076, interlocutory findings of fact and conclusions of law at 6-7 and 12 (9th Jud. Dist. of Mont., In and for Teton County May 16, 1978), the lessee of what the court called a "free flowing" stock water well was awarded damages against a junior ground water 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 stock water 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.

45. Alaska Stat. § 46.15.050 (1977); Kan. Stat. Ann. § 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. Ann. § 41-3-933 (1977).

46. Colo. Rev. Stat. § 37-90-102 (1973); Idaho Code § 42-226 (Supp. 1980); Mont. Code Ann. § 85-2-508 (1979); Rev. Code Wash. Ann. § 90.44.070 (1962).

47. Kan. Stat. Ann. § 82a-711a (1977).

48. Rev. Code Wash. 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, namely, ch. 90.44, which includes a safe sustained yield statute as well as the reasonable pump lift statute.

50. Kan. Admin. Reg. 5-1-(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, A Layman's Guide to Groundwater Hydrology in C. Corker, supra note 2, 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, Jr., American Planning Law: Land Use and the Public Power ch. 116 (1975).

54. See, e.g., Art Neon Co. v. Denver, 488 F.2d 188, 122 (10th Cir.), cert. den. 417 U.S. 932 (1973) (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 struc-

ture, 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 monopoly 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."

55. See 1 W. Hutchins, Water Rights Laws in the Nineteen Western States 623-44 (1971) and text accompanying notes 187-88 infra.

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 sources cited in note 53 supra. Perhaps the period may even have to be related to the remaining economic life of the structure.

59. Department of Natural Resources and Conservation v. Crumpled Horn, No. 7076, interlocutory findings of fact and conclusions of law at 4 (9th Jud. Dist. of Mont., In and For Teton County, May 16, 1978). No appeal has been taken; see note 44 supra.

60. Colo. Rev. Stat. §§ 37-90-102,-107(5),-111(1)(a) (1973); Idaho Code § 42-226 (Supp. 1980); Kan. Stat. Ann. § 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 (Supp. 1979) § 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 109-110 infra and accompanying text.

66. Department of Natural Resources and Conservation v. Crumpled Horn, No. 7076, interlocutory findings of fact and conclusions of law at 11 (9th Jud. Dist. of Mont., In and For Teton County, May 16, 1978) (emphasis added).

67. Id., memorandum op. at 1. (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 ground water. Basically this is ground water within the boundaries of designated geographical areas which is not tributary to a surface stream. See Colo. Rev. Stat. § 37-90-103(b) (1973). It could conceivably include some tributary ground water, however. See Note, A Survey of Colorado Water Law, 47 Den. L. J. 226, 317, n. 648 (1970).

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

70. 148 Colo. at _____, 366 P.2d at 556 (emphasis added).

71. See note 68 supra for the definition of designated ground water.

72. A commentator has said that the legislation "codified the principle of reasonable diversion by adopting some of the language of the Bender case." Note, A Survey of Colorado Water Law, 47 Den. L. J. 230, 335 (1970).

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, Groundwater - Hydrology and the Problem of Competing Well Owners, 14 Rocky Mt. Min. L. Inst. 523, 540 (1968).

74. Colo. Rev. Stat. § 37-90-111(1)(a) (1973).

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. Kan. Stat. Ann. § 82a-711 (1977); Nev. Rev. Stat. § 534.110(4) (1979).

77. Notes 61 and 64 supra and accompanying text.

78. Wyo. Stat. Ann. § 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, Water Rights

Laws in the Nineteen Western States 522-46 (1971).

81. See generally Hutchins, Legal Ground Water Problems in the West, 22 National Reclamation Ass'n. Proc. 81, 82 (1953). For further discussion of the policy of promoting economic development by affording security of investment, see notes 109-10 infra and accompanying text. Various departures from the priority principle in Wyoming may weaken the historic importance of security of investment, however. See notes 84-87 infra and accompanying text.

82. See 1 W. Hutchins, Water Rights Laws in the Nineteen Western States 396 (1971).

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 late-comers 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. Ann. § 41-3-912 (1977).

85. Wyo. Stat. Ann. § 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, Water Rights Laws in the Nineteen Western States 567-83 (1971).

87. Wyo. Stat. Ann. § 41-3-907 (1977).

88. Supra p. 9-11.

89. Mont. Code Ann. § 85-2-507(4)(c), (f) (1979); Nev. Rev. Stat. § 534.120(2) (1979); Or. Rev. Stat. § 537.735(3)(g) (1979); S.D. Compiled Laws § 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 ch. 324, § 1, 1978 Idaho Sess. Laws) from the reasonable pumping level provisions of the state ground water code. Parker v. Wallentine, No. 930 (6th Jud. Dist. of Idaho, In and For Teton County, June 23, 1977, and August 20, 1979) (orders granting temporary and permanent injunctions).

90. Or. Rev. Stat. §§ 537.620(3), -.735(3)(c) (1979).

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. Colo. Rev. Stat. § 37-90-107(4)(1973); Kan. Stat. Ann. § 82a-711 (1977); Or. Rev. Stat. § 537.525(8) (1977).

95. E.g., Alaska Stat. 46.03.10,-.20(10),-.60,-.70 (1977 and Supp. 1979); Nev. Rev. Stat. § 534.020(2) (1973). See also C. Corker, supra note 2, ch. V at n. 89.

96. Idaho Stat. § 42-237a(g) (Supp. 1979); Or. Rev. Stat. § 537.525(9), - .620 (3) (1977). See also Mont. Code Ann. § 85-2-507(2)(b)(ii) (1979).

97. E.g., Alaska Stat. tit. 46, ch. 15 (1977) (no distinction made in state water code between ground water and surface water); Colo. Rev. Stat. §§ 37-92-102,-401, -501 (1973); Wyo. Stat. Ann. § 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 the laws need to be revised to better take account of the frequent physical interrelationship of surface and ground water. National Water Commission, Water Policies for the Future 233 (1973).

98. E.g., Alaska Stat. § 46.03.010(a)(1977) ("overall economic and social well-being" of the people of the state); Mont. Code Ann. § 85-1-101(2) (1979) ("maximum economic and social prosperity for [Montana] . . . citizens"). The same distinction is used in C. Corker, supra note 2, at xxii and 127-42 and, to a lesser extent, in National Water Commission, Water Policies for the Future 271, n. 81 (1973).

99. See F. Trelease, Federal-State Relations in Water Law, National Water Commission Legal Study No. 5, at 21-29 (1971). See also 1 Waters and

Water Rights § 18.1 (R. Clark ed. 1967); 1 W. Hutchins, Water Rights Laws in the Nineteen Western States 159-65 (1971).

100. See J. Gould, Waters 281 (1883); J. Long, Irrigation § 43 (2d ed. 1916).

101 See note 16 supra.

102. Major water law treatises published in 1911 and 1912 reported that the appropriation doctrine was inapplicable to percolating ground water. 2 S. Wiel, Water Rights in the Western States § 1106(3d ed. 1911); 2 C. Kinney, Law of Irrigation and Water Rights § 1190 (1921).

103. These doctrines have been explained and analyzed at length by a number of writers, e.g. 6A American Law of Property §§ 28.65-28.68 (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).

104. See National Water Commission, Water Policies for the Future 231 (1973). A number of detailed accounts of the extension of the appropriation doctrine to percolating ground water are available, 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 Agricultural History 662 (1977); Hutchins, Ground Water Legislation, 30 Rocky Mt. L. Rev. 416 (1958); Hutchins, Legal Ground Water Problems in the West, 22 National Reclamation Association Proceedings 81 (1953).

105. But cf. National Water Commission, Water Policies for the Future 231-32 (1973) (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).

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

107. C. Corker, supra note 2, at ix. For discussion of other differences between groundwater and surface water management, see id. at 148-49 and 152.

108. The reasonable pumping level concept is, of course, not the only tool for coping with overdevelopment. Another important, but not unrelated tool, in legislative policy on ground water mining. See discussion pp. 7-9 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, National Water Commission Legal Study No. 1, at 6 (1971).

111. 5 R. Powell, Real Property ¶ 725 (1968) reports that twenty-eight states had accepted the rule at some point prior to 1922.

112. The water may not be extracted for a malicious purpose or allowed to go to waste, though. 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 subsidance caused by negligence in extracting ground water. Friendswood Deveopment Co. v. Smith-Southwest Industries, 576 S.W.2d 21 (Tex. 1978) (decision given prospective effect only).

113. See W. Hutchins, Selected Problems in the Law of Water Rights in the West 158 (1942). 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 ground water 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).

114. E.g., Meeker v. City of East Orange, 77 N.J.L. 623, 637 A. 379 (1909).

115. See 2 S. Wiel, Water Rights in The Western States § 1041 (3d ed. 1911); 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); R. Powell, Real Property ¶ 726 (1968).

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 not all that many 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 seeming concern for the reasonableness of the means. See W. Hutchins, Selected Problems in the Law of

Water Rights in the West 168-79 (1942); Annot., 121 A.L.R. 1044 (1939).

120. Thompson and Fiedler, Some Problems Relating to Legal Control of Ground Waters, 30 J. of American Water Works Ass'n. 1049, 1075 (1938). See also W. Hutchins, Selected Problems in the Law of Water Rights in the West 179 (1942).

121. Parry, An Underground Water Code, 23 Idaho State Bar Proceedings 19 (1949).

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

123. Ch. 182, §1 1953 Idaho Sess. Laws. 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 ground water context.

125. M. Horwitz, The Transformation of American Law, 1780-1860 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).

128. See generally C. Corker, supra note 2 at 128.

129. National Water Commission, Water Policies for the Future 380-81 (1973).

130. Trelease, Policies for Water Law: Property Rights Economic Forces, and Public Regulation, 5 Nat. Res. J. 1, 14 (1965).

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.

132. E.g., A. Dasgupta & D. Pearce, Cost-Benefit Analysis (1972); F. Mishan, Cost-Benefit Analysis (2d ed 1976); P. Sassone & W. Schaffer, Cost-Benefit Analysis: A Handbook (1978).

133. See C. Corker, supra note 2, at 128.

134. See pp.4-5 supra.

135. For discussion of streamflow-groundwater interaction in standard hydrologic works, see W. Walton, Groundwater Resource Evaluation 174-88 (1970) and D. Todd, Ground Water Hydrology 151-55 (1959).

136. For further discussion, see W. Walton, Groundwater Resource Evaluation 623-27 (1970).

137. Government Accounting Office, Ground Water: An Overview 15 (Report to Congress by the Comptroller General 1977).

138. For further discussion, see D. Todd., Ground Water Hydrology 177-78 (1959).

139. Government Accounting Office, Ground Water: An Overview 16-17 (Report to Congress by the Comptroller General 1977).

140. For an account of opposition to phreatophyte removal because of its effect on wildlife habitat, see Cilluly, Wildlife Versus Irrigation, 99 Science News 184 (1971)

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

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, A Layman's Guide to Groundwater Hydrology in C. Corker, supra note 2, at 80-81, 95-96; General Accounting Office, Ground Water: An Overview 30-34 (Report to Congress by the Comptroller General 1977); National Water Commission, Water Policies for the Future 245 (1973); W. Walton, Groundwater Resource Evaluation 1 (1970).

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

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).

146. Governor's Comm'n. to Review California Water Rights Law, Final Report 144 (1978).

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

148. See Kansas and New Mexico statutes in note 32 supra; City of Corpus Christi v. City of Pleasanton, 154 Tex. 289, 276 S.W.2d 798 (1955). Until 1945, however, Kansas had the absolute ownership doctrine. National Water Commission, A Summary Digest of State Water Laws 330 (1973).

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

150. D. Green, The Land of the Underground River 165, 167, 168 (1973).

151. Bagley, supra note 149, at 173, noted the influence of economic conditions upon ground water 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 Green, supra note 150, at 183.

153. This premise is made explicit in the Colorado and Idaho statutes cited in note 68 supra.

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. Tarlock, Water Resource Management 686 (2d ed. 1979).

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

156. See generally, National Water Commission, Water Policies for the Future 42 (1973); P. Sassone & W. Schaffer, Cost-Benefit Analysis: A Handbook 159-60 (1978).

157. See General Accounting Office, Ground Water: An Overview 5-8 (Report to Congress by the Comptroller General 1977).

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 powrs 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. 221 U.S. at 487. 162. C. Corker, Water Rights in Interstate Streams in 2 Waters & Water Rights § 131.3 (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.

163. Fundingsland v. Colorado Ground Water Commission, 171 Colo. 487,___, 468 P.2d 835, 836 (1970).

164. 575 P.2d at 377.

165. See A. Dasgupta & D. Pearce, Cost-Benefit Analysis: Theory and Practice 54-69 (1972); E. Mishan, Cost-Benefit Analysis 382-402 (rev.ed. 1976); P. Sassone & W. Schaffer, Cost-Benefit Analysis: A Handbook 6-12 (1978).

166. B. Ackerman, Economic Foundations of Property Law xi-xii (1975).

167. See A. Dasgupta & D Pearce, Cost-Benefit Analysis: Theory and Practice 57 (1972); P. Sassone & W. Schaffer, Cost-Benefit Analysis: A Handbook 8-9 (1978).

168. See A. Dasgupta & D. Pearce, Cost-Benefit Analysis: Theory And Practice 57 (1972); E. Mishan, Cost-Benefit Analysis 390-96 (rev.ed. 1976); P. Sassone & W. Schaffer, Cost-Benefit Analysis: A Handbook 9-11 (1978).

169. B. Ackerman, Economic Foundations of Property Law xiii (1975). See also E. Mishan, Cost-Benefit Analysis 412-13 (rev.ed. 1976).

170. It has been argued that the more progressive the tax structure is and the more intense competition is, the more likely a Pareto improvement under the hypothetical compensation standard will result in an actual Pareto improvement or something close to it. E. Mishan, Cost-Benefit Analysis 393 (rev. ed. 1976). But cf. P. Sassone & W. Schaffer, Cost-Benefit Analysis: A Handbook 11 (1978) (viewing the progressive tax structure argument as less than completely convincing).

171. P. Sassone & W. Schaffer, Cost-Benefit Analysis: A Handbook 23-24 (1978). See also E. Mishan, Cost -Benefit Analysis xviii-xix (rev.ed. 1976).

172. Furrer v. Talent Irrigation Dist., 258 Or. 498, _____, 466 P.2d 605, 613 (1970). Similarly, Colarchik v. Watkins, 144 Mont. 17, _____, 393 P.2d 786, 789 (1964), held that: "a court cannot create a ditch right for one landowner on another's property without first compensating the landowner for the value of the easement . . . The mere fact that less damage would be done . . . [by granting an easement] does not create

a basis for granting respondent an easement." In Morris v. Bean, 146 F. 423, 436 (D. Mont. 1906), aff'd 159 F.651 (9th Cir. 1908) and 221 U.S. 485 (1911), the court stated that allowing numerous upstream junior appropriators to take water to the detriment of downstream seniors may benefit more people with less waste "but equity does not consist in taking the property of a few for the benefit of the many, even though the general average of benefits would be greater."

173. Calabresi and Melamed, Property Rules, Liability Rules, and Inalienability: One View of the Cathedral, 85 Harv. L. Rev. 1089, 1098 (1972).

174. Id. at 1100. The leading text uses the term "merit wants" to refer to goods or services which are "considered so meritorious that their satisfaction is provided through the public budget, over and above what is provided for through the market and paid for by private buyers." R. Musgrave, The Theory of Public Finance 13 (1959).

175. Text accompanying note 125 supra.

176. See Tarlock, Appropriation for Instream Flow Maintenance: A Progress Report on "New" Public Western Water Rights, 1978 Utah L. Rev. 211, 211-12. Also present, perhaps, is an element of the labor theory of property often associated

with John Locke. See note 83 supra; see generally L. Becker, Property Rights: Philosophic Foundations (1977).

177. R. Brandt, Ethical Theory 415 (1959).

178. Id. at 420.

179. G. Lefcoe, An Introduction to American Land Law: Cases and Materials 6-7 (1974).

180. See generally, P. Gates, History of Public Land Law Development ch. 22 (1968) (written for Public Land Law Review Commission).

181. The standard examples of merit goods, such as free education, low cost public housing and medicare, involve governmental intervention in the market through taxation and monetary subsidies. A water use preference is a less direct subsidy through governmental regulation to produce lower cost domestic water than under market allocation. Standard merit goods are thought to involve benefits to society that transcend the benefits to individual recipients. See J. Due & A. Friedlaender, Government Finance: Economics of the Public Sector 79-80, 191 (1973). Arguably, the same is true of low cost domestic water.

182. See, e.g., 43 U.S.C. § 431 (1976) (160 acre limitation in Reclamation Act of 1902); Wash. Rev. Code Ann. §§ 90.66.010-.910 (Supp. 1980) (Family Farm Water Act).

183. E.g., Corey, Size of Farm in Relation to Irrigation Pumping Costs, 12 Transactions of the American Society of Agricultural Engineers 795 (1969).

184. Cf. Trelease, Federal-State Problems in Packaging Water Rights in Rocky Mountain Mineral Law Foundation, Water Acquisition for Mineral Development, paper 9, p. 11 (1978) ("In much of the rural west water is held almost in reverence. Water rights are heirlooms to be treasured beyond their intrinsic value. There is real resistance to the notion that water is an article of commerce and subject to trading in the market place. The notion persists that water for cattle, for hay, for fodder, for feed grain, for cash crops is the highest and best use of the resource." See also A. Maass & R. Anderson, . . . and the Desert Shall Rejoice: Conflict, Growth and Justice in Arid Environments 5 (1978).

185. Calabresi & Melamed, Property Rules, Liability Rules, and Inalienability: One View of the Cathedral, 85 Harv. L. Rev. 1089, 1093-1105 (1972).

186. Id. at 1105. Their other suggestion for the final category is "reasons which, though distributional, cannot be described in terms of broad principles like equality." Id.

187. For discussion of this rule, see 1 W. Hutchins, Water Rights Laws in the Nineteen Western States 576-77 (1971).

188. Id. at 623-44.

189. Fisher, Western Experience and Eastern Appropriation Proposals, in D. Haber & S. Bergen, The Laws of Water Allocation in the Eastern United States 75, 108-09 (1956).

190. J. Sax, Water Law, Planning and Policy: Cases and Materials 273-74 (1968).

191. J. Brunhes, Étude de géographic humaine: L'irrigation ses conditions geographiques, ses modes, et son organisation dans la péninsule ibérique et dans l'Afrique du Nord 429-39 (1902). I wish to thank Mary Ann Lyman for translating portions of Brunhes for me from the original French. Brunhes work is discussed in A. Maass & R. Anderson, . . . and the Desert shall Rejoice: Conflict, Growth, and Justice in Arid Environments 9-10, 399-400 (1978).

192. Whether security of investment is sufficiently quantifiable in dollar terms to be included in calculations is not addressed here. It may be possible, though, to identify different parcels of irrigated land which are essentially identical in all respects except as to the security of supply of the appurtenant water right, and

then ascertain the differing market values of the parcels.

193. Cf. Michelman, Property, Utility and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law, 80 Harv. L. Rev. 1165, 1214 (1967) (identification of "demoralization" as a cost of taking private property without just compensation).

194. E. Mishan, Cost-Benefit Analysis 116 (1976).

195. See notes 38, 120, 143-46, and 153 supra and accompanying text.

196. 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. Tarlock, Water Resource Management 686, 688, (2d ed. 1979). The same type of approach is discussed in Lowe, Ruedisili & Graham, Beyond Section 858: A Proposed Ground-Water Liability and Management System for the Eastern United States 8 Ecology L. Q. 131, 153-55 (1979).

197. See Friedman, The Economics of the Common Pool: Property Rights in Exhaustible Resources, 18 U.C.L.A L. Rev. 855, 876-79 and 884-86 (1971).

198. See Lowe, Ruedisili & Graham, Beyond Section 858: A Proposed Ground-Water Liability and Management System for the Eastern United States, 8 Ecology L. Q. 131, 153-54 (1979).

199. W. Prosser, Handbook of the Law of Torts 244 (4th ed. 1971), states the traditional approach: "Once it has been established that the defendant's conduct has in fact been one of the causes of the plaintiff's injury, there remains the question whether the defendant should be legally responsible for what he has caused. Unlike the fact of causation, with which it is often hopelessly confused, this is essentially a problem of law. It is sometimes said to be a question of whether the conduct has been so significant and important a cause that the defendant should be legally responsible. But both significance and importance turn upon conclusions in terms of legal policy, so that this becomes essentially a question of whether the policy of the law will extend the responsibility for the conduct to the consequences which have in fact occurred."

200. This last question is asked in Sato, Book Review, 24 Stan. L. Rev. 429, 435 (1972).

201. Restatement (Second) of Torts § 858 (1979). The other two grounds for liability are withdrawing ground water in excess of the land proprietor's reasonable share or unreasonably harming a person entitled to use the water of a watercourse or lake with which the groundwater has a direct and substantial connection.

202. Id. Comment f.

203. Alaska Stat. § 46.15.050 (1977).

204. Colo. Rev. Stat. § 37-90-102 (1973); Idaho Code § 42-226 (Supp. 1980).

205. Clark, The Role of State Legislation in Ground Water Management, 10 Creighton L. Rev. 469, 482-83 (1977).

206. E.g., J. Hirshleifer, J. DeHaven, & J. Milliman, Water Supply - Economics, Technology and Policy 61, 64-66 (1960).

207. National Water Commission, Water Policies for the Future 240 (1973).

208. Id.

209. Clark, The Role of State Legislation in Ground Water Management, 10 Creighton L. Rev. 469, 483 (1977).

210. See J. Dales, Pollution Property and Prices 81-84 (1968). The text should not be understood as implying that the National Water Commission was unaware of this point. See National Water Commission, Water Policies for the Future 246 (1973).

211. P. 1 supra.

212. Alaska Stat. § 46.15.080(b)(1977): "In determining the public interest, the commissioner shall consider (1) the benefit to the applicant

resulting from the proposed appropriation; (2) the effect of the economic activity resulting from the proposed appropriation; (3) the effect on fish and game resources and on public recreational opportunities; (4) the effect on public health; (5) the effect of loss of alternate uses of water that might be made within a reasonable time if not precluded or hindered by the proposed appropriation; (6) harm to other persons resulting from the proposed appropriation; (7) the intent and ability of the applicant to complete the appropriation; and (8) the effect upon access to navigable or public waters."

213. F. Trelease, A Water Code for Alaska 17 (1962), excerpted in F. Trelease, Cases and Materials on Water Law 146, 148 (3d ed. 1979).

214. C. Corker, supra note 2, at xviii: "The most that can be hoped is mechanisms which permit flexible and ad hoc solutions applicable to a particular basin, designed to achieve maximum net benefit and to avoid offending community concepts of distributive justice."

215. See generally Hines, Nor Any Drop to Drink: Public Regulation of Water Quality, 52 Iowa L. Rev. 186, 200-01 (1966).

216. E.g., Alaska Stat. § 46.15.020(b)(1)(1977); Mont. Code Ann. §§ 85-2-113(2),-507(4) (1979);

Nev. Rev. Stat. §§ 534.020(2),-.120(1)(1979); Wyo. Stat. Ann. § 41-3-909(a)(i)(1977).

217. Colo. Rev. Stat. § 37-90-111(1)(b) (1973); Idaho Code §§ 42-226, -237a(g)(1977 and Supp. 1980).

218. E.g., Kan. Stat. Ann. § 82a-711a (1977) ("in determining such reasonable . . . lowering of the static water level in a particular area, the chief engineer shall consider . . . "); Nev. Rev. Stat. § 534.110(4)(1979) ("In determining such reasonable lowering of the static water level in a particular area, the state engineer shall consider. . . .")

219. See note 194, supra and accompanying text.

220. Cf. C. Corker, supra note 2 at 260 ("In part, the problem [of avoiding rescue projects to relieve the distress caused by groundwater mining] is hydrologic. But in larger part, the problem is in effectively and convincingly communicating the conclusions about hydrologic information which is available. A community dependent on mined groundwater should be aware of that fact, at as early a date as possible, and with all the dimensions of the problem that are discoverable.")

221. Idaho Water Resource Board, The Objectives: Part One of the State Water Plan (1974); Idaho

Water Resource Board, The State Water Plan - Part Two (1976).

222. Idaho Water Resource Board, The State Water Plan - Part Two vii, 5 (1976).

SELECTED WATER RESOURCES ABSTRACT

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Reasonable Ground Water Pumping Levels Under the Appropriation Doctrine: Law, Policy and Alternatives

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16. *Abstract*

This report investigates what factors should be considered in the setting of reasonable pumping levels in appropriation doctrine states. The introduction covers some elements of groundwater hydrology and describes other groundwater management tools that also affect pumping levels in appropriation doctrine states. The various reasonable pumping level statues are compared and contrasted. The economic development policy of the appropriation doctrine is examined from a historical perspective, and the possible contribution of modern cost-benefit analysis to the setting of pumping levels is assessed. The need to integrate non-economic or social goals as well is investigated. Finally, several alternatives to the reasonable pumping level approach are evaluated.

17a. *Descriptors*

Pumping Levels, Groundwater hydrology, Groundwater management tools

17c. *COWRR Field & Group* 04A

18. *Availability* IWRRI

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20. *Security Class. (Page)*

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