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STATE OF ILLINOIS
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Ground-Water Quantity Laws and Management

by JEAN A. BOWMAN

ILLINOIS STATE WATER SURVEY
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Title: Ground-Water Quantity Laws and Management.

Abstract: A historical review is presented of ground-water quantity laws and management in the United States. The present ground-water quantity laws and system of management in Illinois are compared with laws and programs in other states, and recommendations are made for improvements in Illinois laws. A review is presented of recent transitions in judicial and legislative ground-water quantity law in eight midwestern states. Results of a survey of the nature and distribution of ground-water management area programs throughout the United States are also summarized.

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Indexing Terms: Common law, ground-water management areas (GWMA), ground-water quantity law, ground-water quantity management, judicial decisions, legal aspects, natural resource ownership, regulations, statutory law, United States, water supply, water use.

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CONTENTS

Note regarding the spelling of *ground water:*

The Illinois State Water Survey uses *ground water* (two words) as a noun and *ground-water* (hyphenated) as a modifier. These are the forms generally used in this report. However, in reporting on ground-water management programs in various states, we attempted to follow the usage that appeared in the responses to our survey. Thus if *groundwater* (one word) was used in the name of an agency, the title of a statute, or the name of a particular type of management area, we tried to duplicate this usage in the report.

Ground-Water Quantity Laws and Management

by Jean A. Bowman

ABSTRACT

In the last decade, Illinois has seen many changed attitudes and laws governing the use and withdrawal of ground water. Almost certainly, the next decade will see continued change as the legal structure is adapted to increasing demand for ground water and to the resultant and growing pressures on our ground-water resources. This report summarizes ground-water quantity laws and management programs in Illinois and a number of other states. It compares the present system in Illinois with those in other states and lists recommendations for improvements in Illinois laws.

Laws governing ground-water withdrawals have gradually been adjusted to reflect the desire and need to prevent resource depletion and conflicts among users. Courts today are more inclined to regard ground water as a shared public resource subject to management and regulation than as private property with rights of unlimited use. State legislatures are passing comprehensive ground-water management statutes to prevent depletion and conflict, and to reduce historic reliance on the courts to settle ground-water disputes. Both of these trends are evident in the Midwest.

In the last decade midwestern states have seen 1) significant shifts in court decisions on ground-water use, with greater recognition of the reciprocal or mutually dependent nature of ground-water rights; and 2) more legislation establishing comprehensive ground-water management programs that emphasize the reciprocal liabilities of ground-water use. These shifts are in general alignment with similar changes on a national scale.

This report examines this transition, with special attention to midwestern states and to recent changes in their ground-water quantity laws. The report also examines the use of specially designated ground-water management areas to accomplish regional ground-water management. A summary is presented of a nationwide survey of the nature and distribution of ground-water management area programs around the country.

The report reviews 1) the underpinnings of common ground-water law, starting with the English rule of absolute ownership; 2) recent transitions in midwestern ground-water law; and 3) the nature and distribution of ground-water management area programs around the country. This is the second in a series of three reports on ground-water quantity management options for Illinois.

INTRODUCTION

Illinois is fortunate to have abundant water resources. The availability of water from the Great Lakes, the four major rivers (the Wabash, Ohio, Mississippi, and Illinois Rivers), numerous smaller rivers and streams, and the three major aquifer groups (deep sandstone, shallow dolomites, and buried and surficial sand and gravel deposits) has enhanced growth in industry and agriculture and encouraged the development of cities and towns throughout the state. In general, there has been plenty of water available to meet the growing needs. However, since the water resources of the state are

not distributed uniformly, the demand for water occasionally has exceeded regional supplies.

Most regions of the state have ample water; but as cities, industries, and agricultural irrigation continue to expand, causing demands for clean water to increase, the potential for water shortages, "water raids," and water use conflicts will surface in areas with marginal supplies. Hydrologic studies and other planning and management efforts have been most concentrated in those areas. The goal from the outset has been to ensure adequate water for those places with demands larger than the supplies, without imposing unnecessary water use regulations or restrictions on the rest of the state; that is, to regulate water use only when and where necessary.

A number of related studies have been conducted on issues related to this philosophy of regional, rather than statewide, ground-water management. These studies are described in a series of three reports:

1) Water Survey Report of Investigation 109 (Bowman and Collins, 1987), which examined effects of irrigation and drought on the ground-water resources of Illinois, and the extent to which they create the need for regional ground-water management.

2) The current report, which evaluates ground-water laws and management programs in Illinois and other states, especially midwestern states.

3) A report that will present the results of an updated ground-water supply-and-demand study that has attempted to determine the balance between ground-water uses (both present and projected) and potential aquifer yields. The results will help define areas that may need concentrated planning and management to avoid shortages and conflicts. This will be a joint Water Survey Report of Investigation and State Water Plan Task Force Special Report.

These studies have been supported by the Illinois Department of Transportation, Division of Water Resources. They have been conducted in conjunction with the efforts of the State Water Plan Task Force special Committee on Ground-Water Quantity.

This report contains results of a study of ground-water laws and management programs in a number of states. There is an emphasis on 1) the changing laws in other midwestern states; and 2) states that are using special ground-water management area or district programs to manage ground-water withdrawals only when and where restrictions are necessary. The conclusions drawn from this work are briefly noted here; they are described more fully later in the report.

1) Illinois should strive to keep its ground-water quantity law in general alignment with laws in the rest of the country.
2) Illinois should continue to work toward implementation of a unified ground-water management area program.
3) If ground-water management areas are introduced, they should be the joint responsibility of state and local interests; costs and decisions should be shared.

Portions of this report have been published in two journal articles (Bowman and Clark, 1989; Bowman, 1990).

From Capture to Conservation

American courts and legislatures have experimented over the last hundred years or so with methods for governing ground-water withdrawals. Laws have developed on an ad hoc basis, resulting in a dynamic patchwork that varies by region, state, and locality; they are a complex and often contradictory body of constitutional law, regulations, statutory law (resulting from legislative action), and common law (resulting from court cases and judicial decisions). Ground-water laws reflect diverse resource management theories. This area of the law is still evolving as the search for an adequate ground-water management paradigm continues.

Early laws regarded ground water as private property; rules governing its use were property-based rules of "capture" giving rights of unlimited use. Rules of capture for ground water are roughly equivalent to saying, "If you can pump it, you own it" (or you can use it without liability to others) (Bowman and Clark, 1989). In a pre-industrialized society this was an adequate way to "manage" ground-water withdrawals; demands on the resource were limited and scattered, which minimized possibilities for well interference.

It did not take long, though, for population growth and the associated expansion in ground-water use to exert new pressures on the courts' early inclination to abide by rules of unrestricted pumpage even when that pumpage impeded neighbors from obtaining their own fair share of ground water. Growing cities, industries, and agricultural irrigation all meant more demand for ground water, which led to more competition for ground water in some places.

The idea that ground water could be used without liability to other users gradually came under increased scrutiny, and-the practice of allowing free-for-all competition for ground-water resources fell from favor. Eventually the rules governing ground-water withdrawals began shifting from simple rules of capture to rules requiring proportional sharing

(Bowman and Clark, 1989; Goldfarb, 1988; Gould, 1986; Tarlock, 1985).

Today there is general recognition in many courts and legislatures of the common-pool nature of ground water: there is a reciprocal dependency in which one pumper's rights can affect and be affected by all pumpers' rights (Bowman and Clark, 1989). The evolution from property-based rules of capture to rules requiring sharing and conservation of ground water as a public resource is evident in courts and state legislatures. Courts are gradually abandoning the permissive rules of capture and replacing them with rulings that impose liability for using more than a fair share of limited ground water.

Although not new to the courts, these kinds of modifications of common law have been somewhat slow to gain support and have not been universally embraced. Therefore, state legislatures have taken a heightened role in creating comprehensive ground-water management programs. Many of these programs emphasize conservation and sharing in times and places of shortage, paralleling the recent trend in common law. In the past, water rights were almost exclusively determined by the courts. This is no longer true. Legislatures are beginning to replace common law with statutes and regulations as a means of establishing long-term ground-water management and of preventing serious ground-water depletion and well-interference conflicts.

These transitions reflect the emergence of a "management doctrine" for ground water. This doctrine 1) recognizes the reciprocal relationship among ground-water users; 2) acknowledges ground water as a shared public resource; and 3) allows flexibility to regulate withdrawals suitable for a particular aquifer (Goldfarb, 1988; Gould, 1986). Such changes in ground-water law reflect an important turning point in ground-water resource management. Ground water is coming to be legally treated as a public resource, the use of which is based on rights related to the concept of reciprocal dependency rather than on private property rights of unlimited use.

Observations on National Change

Historically, ground-water management strategies used in the United States have fit into one of two categories: western prior appropriations or eastern reasonable use. Chronic water shortages in the arid western states have dictated that ground-water withdrawals there be largely regulated by permit appropriations. Those appropriations have usually favored seniority. On the other hand, plentiful ground-water supplies in the humid eastern states have offset the need for strict appropriations. In most eastern states, most property owners have been entitled to unlimited and non-permitted use of the water beneath their land as long as the use is "reasonable" and injury to a neighboring well does not arise out of malice.

These regional patterns, however, are dissipating. Most of the change has occurred in the West. Ground-water management schemes have been devised there which go beyond common law in allocating limited resources equitably and in transferring ground water to more highly valued uses. More recently, some eastern states have also modified their laws by implementing management programs in response to increased ground-water demand and deteriorating ground-water quality. The eastern and western United States both seem to be diverging from their respective traditional ground-water doctrines. There appears to be a convergence toward middle ground with the adoption of a management doctrine for ground water.

Acknowledgments

This report was prepared under the general supervision of Richard G. Semonin, Chief of the Illinois State Water Survey, and Ellis W. Sanderson, Head of the former Ground-Water Section. The work was sponsored by the Illinois Department of Transportation, Division of Water Resources, under the direction of Donald R. Vonnahme and Gary R. Clark. Gail Taylor edited the report, and John W. Brother and Linda J. Hascall prepared the graphics.

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OVERVIEW OF GROUND-WATER DOCTRINES

Before midwestern ground-water laws and the use of ground-water management area programs nationwide are examined, a general review of common ground-water doctrines and the historical underpinnings of ground-water management will be helpful.

Ground-Water Ownership and Use Rights

The association of ground water with private property rights in court rulings for so many years led many to the conclusion that they actually own the ground water under their land. However, it is not practical to assign ownership rights to ground water, which cannot be contained within boundaries and which by its nature moves from place to place (Clark, 1985).

In most courts and states today, ground water is legally regarded as a common-pool resource that cannot be owned by any person or entity. The rights to use ground water are usufructuary; that is, they are among the legal rights that entitle a person to use or enjoy something that the person does not own. Ground water is a shared public resource that is held in trust by the state for the benefit of its citizens.

Since it is not private property, ground water is subject to management and regulation by the state, which is not to say that states own ground water. The question of state ownership of common-pool resources was addressed by the United States Supreme Court in two recent cases. In the case of *Douglas versus Seacoast Products, Inc.* [1977], the Court in discussing state ownership of wildlife stated:

> Ownership must be understood as no more than a nineteenth century legal fiction expressing the importance to its people that a state have the power to preserve and to regulate the exploitation of an important resource.

In the case of *Sporhase versus State of Nebraska* [1982], the Supreme Court concluded:

> Although appellee's [Nebraska's] greater ownership interest may not be irrelevant to commerce clause analysis, it does not absolutely remove Nebraska ground water from such scrutiny. For appellee's argument is still based on the legal fiction of state ownership.

The *Sporhase* case is discussed further in the section "Constitutional Challenges and the 'Taking' Issue."

Ground water is a common-pool resource like air, ocean fisheries, and wild fish and game: no one "owns" it, but it is there to be used by all. With unrestricted use, the actions of one user may create external costs for all users, and there is almost certain to be some divergence between private and social costs.

Any user who reduces consumption runs the risk that another user will take the resource for present use anyway. Therefore there is little motivation to save for tomorrow even when, as in the case of ground water, there is little doubt that the future value of the resource will be greater than the present value.

That is the classic common-pool resource rub: so as not to be cheated out of their share, users accelerate their exploitation, taking the chance that they may exhaust the resource or diminish its future productivity. So the problem with ground-water use, as with the use of most common-pool resources, is that rather than risk reducing pumpage to save for the future and having another user pump the water for present use, most users will use as much ground water as they can for as long as they can. This presents obvious problems when the demand for ground water exceeds the supply.

In short, ground water is a common-pool resource whose management has long been associated with property law. This has been problematic in assigning ground-water use rights when demands exceed supplies.

Common Law Doctrines for Ground Water

Ground-water use is governed by a combination of common (judicial) and statutory (legislative) law. Common ground-water law has been the prevailing ground-water legal system in the United States since the mid-1800s. It is a large body of case law that has accumulated from a reliance on courts to settle ground-water disputes; it is one mechanism for conflict resolution.

Most common ground-water law falls under four major doctrines: 1) absolute ownership; 2) reasonable use; 3) correlative rights; and 4) prior appropriation. The American Law Institute (ALI) redefined the rule of reasonable use in 1978 in its second Restatement of Torts, Section 858, resulting in what some consider to be a fifth ground-water doctrine.

In addition to these doctrines, a good deal of case law has also developed around the notion that there are two kinds of ground water: that which flows in an "underground stream" and that which is diffused or percolates through a porous medium (Cox, 1982). Ground-water hydrologists today universally recognize that all ground water is percolating, and that any legal distinction between underground streams and percolating water is unnecessary.

On the other hand, there is good reason for a similar distinction drawn in some western states between tributary ground water (hydraulically connected to a surface water body) and non-tributary ground water (deep, percolating aquifers). Since pumpage from an aquifer that is hydraulically connected to surface water could deplete streamflow, tributary ground water is subject to surface water law (either riparian or prior appropriation). Non-tributary ground water is governed in the courts by ground-water doctrines, which are discussed below.

Absolute Ownership Doctrine

Early ground-water disputes in the United States were settled according to the English rule of absolute ownership, which allows landowners to pump ground water from under their land without bearing any responsibility to neighboring landowners. Ground-water use is limited only by the discretion of the landowner. It is a simple rule of capture based on the outdated belief that ground-water movement is incomprehensible and that landowners must therefore not be held responsible for any unanticipated consequences of their pumping (Cox, 1982; Goldfarb, 1988; Tarlock, 1985). In the case of competition, the biggest pump wins (Goldfarb, 1988).

The rule stems from an 1843 English common law case [*Acton versus Blundell*] in which the court determined that a landowner has a proprietary interest in ground water, and what is "his is his alone from the heavens to the depths of the earth." The rule was upheld in American courts for many years, with the reasoning of one judge in an early case [*Frazier versus Brown,* 1861] often cited:

> . . . because the existence, origin, and course of such waters, and the causes which govern and direct their movements are so secret, occult, and concealed that an attempt to administer any set of legal rules in respect to them would be involved in hopeless uncertainty, and would be, therefore, practically impossible . . .

This rule has been abandoned almost everywhere in the United States.

Reasonable Use Doctrine and American Law Institute Restatement of Torts

By the early 1900s courts began to temper ground-water decisions with what is known today as the American rule, or the rule of reasonable use. The reasonable use rule is now the predominant form of common ground-water law in the United States, especially in eastern states (Cox, 1982).

This rule follows the basic rule of capture and differs from the rule of absolute ownership in only two ways: 1) waste and malicious use are prohibited; and 2) the water must be used on overlying land unless it can be used elsewhere without injuring other overlying owners (Goldfarb, 1988). Unlike the reasonable use doctrine for surface water, the ground-water reasonable use rule has no provisions for proportional sharing and no preference for domestic uses.

The rule of reasonable use stems from a 1900 case [*Forbell versus the City of New York*] in which extensive withdrawals from a city well field were held responsible for lowering the regional water table and causing crop failure for farmer Forbell. The court ruled that the city's practice of pumping large quantities of water and piping it to a distant place constituted an unreasonable interference with Forbell's right to use ground water under his land for a reasonable purpose.

Today, most states that abide by the rule of reasonable use have statutes protecting the mission of municipal and public water suppliers to do whatever necessary to provide water. This may include condemning property to take advantage of the underlying ground water.

The original rule of reasonable use protected small pumpers from water raids by cities, but not necessarily from well interference problems caused by newer uses on overlying land, such as supplemental irrigation (Tarlock, 1985). Therefore the American Law Institute (ALI) redefined the rule in 1978 in its second Restatement of Torts, Section 858, "Liability for Use of Groundwater."

The ALI rule established three criteria for determining unreasonable interference with a neighbor's water use: 1) well interference by lowering of the water table or reduction of artesian pressure; 2) pumping in excess of one's fair share of the annual supply or total store of ground water; and 3) interference with stream and lake levels that are dependent on ground water, including such interferences that infringe on persons entitled to the use of that surface water (Goldfarb, 1988). The comments explaining

the restatement shed light on the rationale for the changes:

> The reasonable use rule in its original form met this problem by imposing liability for interference with neighboring wells and springs by withdrawing large quantities and piping it to distant places for municipal and industrial use. As usually stated, the rule gave no protection against identical harm caused by a large industrial plant or apartment house built on neighboring overlying land. Recently it has been recognized, however, that the salient factor is not the place of the use but the withdrawal of water in unprecedented quantities for purposes not common to the locality, and that it is fair and just to place the cost of improving neighboring facilities upon the person or organization whose withdrawals render them inadequate, even though the water is used on the land from which it is withdrawn. In brief, the restatement continues the common law of capture among similarly situated pumpers but tempers capture when a large pumper injures a prior smaller one. The lessons of David and Goliath remain strong.

The ALI's restated reasonable use rule is gradually being tested and, for the most part, upheld in courts around the country. It has influenced the outcome of ground-water court cases in a number of states, most notably Ohio [*Cline versus American Aggregates Corporation,* 1984], Wisconsin [*State versus Michels Pipeline Construction, Inc.,* 1974], Nebraska [*Prather versus Eisenman,* 1978], and Michigan [*Maerz versus U.S. Steel Company,* 1982].

Only Indiana has tried to reject the ALI rule in *Wiggins versus Brazil Clay and Coal Company* [1983], a case in which an individual's well was impacted by dewatering processes at a nearby mine. That Indiana Supreme Court decision, however, was not upheld by a federal district court in a subsequent Indiana dispute between a large-scale commercial irrigator and an independent farmer [*Prohosky versus Prudential Insurance Company of America,* 1985].

Correlative Rights Doctrine

A 1903 California case [*Katz versus Walkinshaw*] established the correlative rights doctrine, which goes beyond the reasonable use rule by providing a means for allocating water in times of shortage (Reidy, 1984). The rule holds that landowners over a common aquifer have an equal or correlative right to the beneficial use of the water in the aquifer to the full extent of their needs when the common supply is sufficient. In times of shortage, they are entitled to a proportionate share of the water based on their reasonable needs and on some measure of safe annual yield.

Although this rule has seen its chief development in California, a number of other states have enacted legislation that is similar in principle to the correlative rights doctrine. Those programs are discussed in more detail in later sections of this report.

Prior Appropriation Doctrine

Ground water is allocated on a first-come, first-served basis under the prior appropriation doctrine. The first water user obtains a protected interest in the amount of water that can be put to use reasonably. That interest holds even in times of shortage. Junior users take their appropriation from whatever water remains. Although this doctrine has been adopted by most of the arid western states, many of those states also impose additional water use regulations that resemble the correlative rights doctrine, signifying establishment of a "management doctrine" for ground water.

Beyond the Courts: The Management Doctrine

Many states have recognized the need for ground-water management beyond that provided by court rulings. They are passing legislation to address a variety of ground-water quantity and quality problems. Many states have developed comprehensive ground-water management programs; some of these programs address ground-water quantity and quality problems separately, while others attempt to combine them. Although there is an obvious physical (and, in some cases, administrative) relationship between ground-water quantity and quality management, this report addresses only quantity management.

Ground-water management programs often address two main types of ground-water quantity problems: 1) well interference and supply interruption, and 2) the broader problem of long-term resource depletion. A ground-water basin can be seen as a natural underground reservoir in which the extraction of water by wells at one location influences the quantity of water available at other wells within the basin. It follows that when water users within a basin are withdrawing more water than is being replenished over the same time period, the total quantity of water available to all users is diminished.

This has led to the management concept of safe annual yield, which is the amount of ground-water recharge in a normal weather year and therefore the amount that can be used annually without depleting the resource. Many states restrict annual ground-water pumpage to some measure of safe annual yield or to an agreed-on level of aquifer depletion in aquifers that have little or no measurable recharge. Other forms of management vary.

Ground-water quantity management mechanisms often include such provisions as use permit requirements, water use monitoring and reporting, well spacing, well construction standards, prioritized allocations, and restricted usage in times of shortage. In addition, many statutes impose liability on the responsible party or parties for restoring impacted wells. These types of regulations have been used to address such problems as well interference, supply interruption, long-term aquifer depletion, and subsidence.

Constitutional Challenges and the "Taking" Issue

The search for an adequate ground-water management paradigm is far from over. However, programs like those mentioned above clearly represent a progression in ground-water management philosophies. They are a significant departure from the original laws of ground-water ownership, and they exemplify the management doctrine.

In some cases, the introduction of comprehensive management programs has effectively stripped landowners of their unlimited rights of control over their "property" (ground water). Naturally, the new regulations have met with resistance from resource users, who have claimed that the government is taking their property without just compensation, a violation of the fifth amendment of the United States Constitution. In general, such "taking" claims have not held up in court. Regulations for the preservation of public health, safety, or general welfare are not found to be a "taking of property" requiring compensation to an owner (even though property is destroyed or its value is substantially decreased), provided all use is not denied.

Regulation of the right of water use under due process is merely a proper exercise of the government's police power in which compensation is not due. It is clear that governmental regulation of uses of private property is a fact of life and has been for a long time. (Consider building codes, land use and zoning rules, animal control and welfare laws, pollution abatement laws, and so on and on.) The use of natural resources that are tied, however remotely, to property has not been exempt from regulation, although the establishment of regulations frequently has been hotly contested.

In at least two states (Texas and Arizona), broad ground-water management plans have been contested by resource users as unconstitutional. In Texas, attempts since the early 1900s to enact comprehensive resource management have been suppressed on the basis of state interference with private property rights.

Texas is one of the few states in the country that still abides by the absolute ownership doctrine for ground water. The state of Texas maintains that it has a right to invoke police power to conserve its natural resources (Cisneros, 1980). The broader claim is that landowners have no vested property interest in obtaining ground water from beneath their land: if landowners are able to capture and use water (under certain restrictions) from under their land they may do so, but it is not the state's responsibility to protect the landowner's expectation of having ground water available for the taking since ground water cannot be "owned" in the conventional sense.

In 1917 the "conservation amendment" to the Texas Constitution was adopted, which stated that the state's public policy was to conserve natural resources, including underground water. The legislature failed, however, to take concrete action to establish ground-water conservation. In 1949 the Texas Groundwater District Act was finally passed, but it does not allow for statewide regulation; in fact, it specifically acknowledges the right of private ownership of ground water. The act allows for permissive regulations that are established by local ground-water users in special management districts.

The constitutionality of the act has not been expressly tested in court. However, several cases have set precedents that make state regulation of ground water analogous to state regulation of oil and gas (Cisneros, 1980). The United States Supreme Court determined that a state may constitutionally regulate oil and gas to prevent the "unreasonable and wasteful depletion of a common supply of oil and gas to the injury of others entitled to resort to and take from the pool" [*Champlin Refining Co. versus Corporate Commission of Oklahoma,* 1932].

A few years after the *Champlin* decision, the Texas Supreme Court upheld the constitutionality of the Texas Railroad Commission's regulation of oil and gas production. The decision [*Brown versus Humble Oil and Refining Co.,* 1935] noted that the Texas Constitution empowers the legislature to enact con-

servation legislation, and that "state regulation is not unconstitutional merely because it operates as a restraint on the exercise of private property rights or results in a loss to an individual."

A similar constitutional debate arose in Arizona. A 1980 Groundwater Management Act created four active management areas surrounding the major cities and two slightly less restrictive irrigation non-expansion areas. Ground-water withdrawal in the active management areas is permitted to people who hold water rights. Well registration, well spacing, and well construction standards are also used as management tools. Ground-water pumping taxes are levied as a means of supporting the programs and, more importantly, as a means of supporting the purchase and retirement of irrigation water rights.

As in Texas, this legislation has been contested as unconstitutional on the basis of "taking" private property (ground water), based on legal precedent set *in dicta* (or according to a judicial opinion that may not be pertinent to subsequent cases and should not be used as a legal precedent) in 1904 [*Howard versus Perrin*]. In this opinion, the judge ruled that "waters percolating generally through the soil beneath the surface are the property of the owner of the soil."

A 1981 Arizona Supreme Court ruling [*Town of Chino Valley versus City of Prescott*] stated that there is "no right of ownership in ground water prior to its capture," meaning that ground water is not a constitutionally protected private property right, but rather a public resource subject to regulation. The *Chino Valley* case was a long-standing dispute over water raids between two adjacent towns and involved numerous other court cases, all debating the historical constitutional protection of property rights to ground water.

The *Chino Valley* decision, considered to be the definitive decision to date, continued:

> [There is] no doubt but that the overdraft of ground water in [Arizona] is a serious problem which has no chance of correcting itself, and that it is necessary for comprehensive legislation to both limit ground-water use and allocate its use among competing interests.

At the heart of cases like these lies the claim by landowners that regulation of a resource upon which their income depends is the same thing as taking money directly out of their pockets. Restricting the amount of water that farmers may use for irrigation reduces their crop yields, which in turn reduces their profits. These outcries are not limited to ground-water regulations. In an 1887 case [*Mugler versus Kansas*], the United States Supreme Court established the foundation for government regulation of private property: "All property in this country is held under the implied obligation that the owner's use of it shall not be injurious to the community."

One hundred years later, the United States Supreme Court handed down a second definitive decision regarding the question of "taking" when it is applied to regulation of natural resources on private property, and the rationale had changed very little. The case [*Keystone Bituminous Coal Association versus DeBenedictis,* 1987] involved a dispute regarding whether coal mining was causing land subsidence in Pennsylvania. In its opinion, the court stated:

> Under our system of government, one of the state's primary ways of preserving the public weal [good] is restricting the uses individuals can make of their property. While each of us is burdened somewhat by such restrictions, we, in turn, benefit greatly from the restriction placed on others. These restrictions are properly treated as part of the burden of common citizenship.

A 1949 Washington Supreme Court case [*State versus Dexter*], which is discussed by Wilkinson (1987), enforced a previous ruling that required selective logging and reforestation on private land. The judge reasoned:

> Private enterprise must utilize its private property in ways that are not inconsistent. with the public welfare. . . . Surely, where natural resources can be utilized and at the same time perpetuated for future generations, what has been called constitutional morality requires that we do so.

A widely publicized 1979 case [*Woodbury County Soil Conservation District versus Ortner*] established the state's overriding interest in soil conservation (Wilkinson, 1987). Farmers in Woodbury County, Iowa, had refused to comply with soil erosion control regulations, maintaining that the regulations constituted a taking of their private property. The court noted:

> A law does not become unconstitutional just because it works a hardship. The argument. that one must make substantial expenditures to comply with regulatory statutes does not raise constitutional barriers.

The *Champlin, Humble Oil, Chino Valley, Keystone, Dexter,* and *Woodbury County* cases are all examples of legal decisions regarding the "taking" issue and natural resources. While they do not all

apply to ground water, they clearly establish a legal consensus that the public good overrides private gain when it comes to use of natural resources on private property, and that the "taking claim has proven to be an exceedingly narrow defense" (Wilkinson, 1987).

The "taking" question was not at stake in a recent definitive United States Supreme Court ground-water decision [*Sporhase versus State of Nebraska,* 1982], but the question of ground-water ownership was. More specifically, the question at stake was state ownership or hoarding of ground water, and control over its interstate transfer.

Ground-water quantity management has historically been conducted at the state level, with federal intervention both seldom and indirect (Tarlock, 1985). The Clean Water Act and other subsequent ground-water quality protection laws have placed the federal government squarely at the helm for directing ground-water quality management. The *Sporhase* decision gave the federal government a potentially much stronger role in interstate ground-water quantity management by ruling that ground water is a commercial commodity the same as coal, oil, and gas, and that states do not own it and cannot hoard it unless that would be necessary for public health reasons (Banks, 1983; DuMars, 1985; Utton, 1985).

The *Sporhase* case involved a dispute in which owners of contiguous tracts of land in Nebraska and Colorado were transporting ground water across the border without a permit. Had permits been applied for, they would have been refused because Nebraska does not allow export of ground water to another state unless there is a reciprocal requirement that the state receiving Nebraska's ground water will send the same amount back in return. Colorado law prohibits export of ground water outside its borders and therefore does not meet Nebraska's reciprocity requirement.

The Court, in the *Sporhase* decision, determined that ground water is an article of commerce, not private property. The Court determined that ground water cannot be owned by individuals or states, which leads to the "universal principle that water rights are usufructuary" (B. Barker, Illinois Department of Transportation, Division of Water Resources, unpublished memorandum, 1982). As an article of commerce, ground water is subject to the United States Constitution's interstate commerce clause, which holds that since the welfare of all the states transcends that of any single state, certain natural and created resources must be shared fairly among the states.

Again, the *Sporhase* case is not described in legal commentaries as a "taking" case. However, the Court's reasoning in establishing ground water as an article of commerce clearly hearkens back to some of the earlier "taking" cases in which the "good of all overrides the good of one."

GROUND-WATER MANAGEMENT IN EIGHT MIDWESTERN STATES

Midwestern states, for the most part, do not face chronic, severe water shortages. Until recently, ground-water abundance has been the underlying assumption for water management. Figure 1 shows that in 1980 the Midwest relied almost entirely on common law for ground-water management. Illinois and Ohio still followed the rule of absolute ownership, placing them among the last in the country to abandon that law. The only exceptions to common law were found in Minnesota and Wisconsin, which both required -permits for water withdrawal from high-capacity wells.

During the last decade, some of the traditional assumptions about ground-water management in the Midwest have changed, as shown in figure 2. Part of the region has adopted a more proactive role by initiating comprehensive ground-water management programs; and since statutory law overrides common law where they overlap, the reactive role of leaving ground-water conflicts up to the courts has been diminished. Nevertheless, throughout the region ground-water management remains a mixture of common and statutory law, varying from state to state and sometimes within states.

Illinois, Indiana, Iowa, Minnesota, and Wisconsin all have statutes for regulating ground-water use to varying degrees. Michigan, Missouri, and Ohio lack statutory ground-water quantity law and still rely on some form of common law. Differences in the way these states are revising their ground-water management place them generally into two camps: proactive or preventive management (Illinois, Indiana, Iowa, Minnesota, and Wisconsin) or a more reactionary management (Michigan, Missouri, and Ohio).

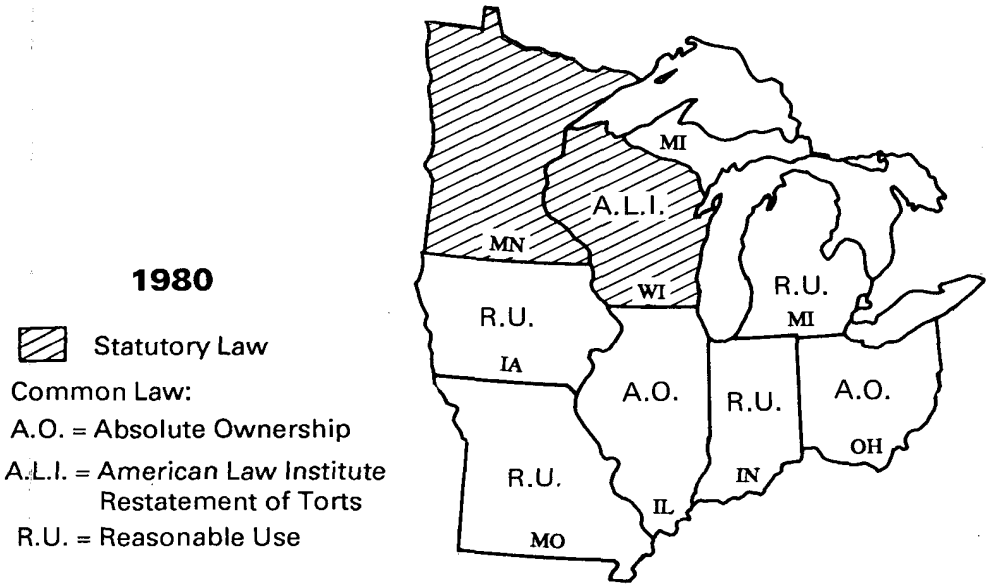

Figure 1. Types of ground-water laws and management doctrines followed by eight midwestern states in 1980, showing that most states took a proprietary approach through common law to manage ground-water use conflicts

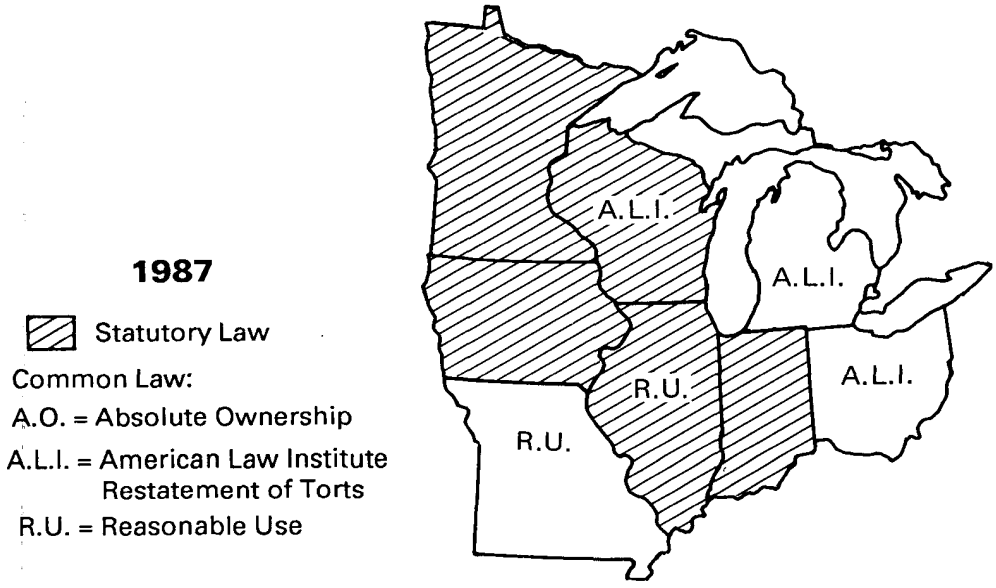

Figure 2. Types of ground-water laws and management doctrines followed by the same states in 1987, showing the trend toward statutory and common law management emphasizing conservation and sharing of resources

Reactionary Management in Michigan, Missouri, and Ohio

Michigan, Missouri, and Ohio are all actively considering comprehensive ground-water management programs. In the meantime, they follow common law doctrines. In Michigan and Ohio, however, the doctrines are being redefined as a result of a number of important, recent legal cases. A 1980 case in Michigan [*Jones versus East Lansing-Meridian Water and Sewer Authority*] found that liability could be imposed on the owners of a new well in cases where interference with neighboring wells had been anticipated and alternatives to drilling new wells were available but had not been used (Steeler and Morandi, 1983). This decision was clearly influenced by the ALI restatement of torts.

A second Michigan case [*U.S. Aviex Corp. versus Travelers Insurance Company,* 1984] set a national precedent by ruling specifically that ground water cannot be "owned" in the conventional sense. At question was an insurance company's obligation to cover a policy holder's costs incurred in correcting chemical contamination of the ground water. The insurance company claimed that as part of the insured's property, ground water should have been excluded from the liability coverage. The court ruled, however, that since ground water cannot be owned and was not part of the insured's property, the costs for cleanup were covered by the insurance policy.

In Ohio a recent state Supreme Court decision [*Cline versus American Aggregates Corp.,* 1984] finally did away with the rule of absolute ownership adopted in Ohio in the 1861 *Frazier versus Brown* case. The *Cline* case involved a sand and gravel mining company accused of dewatering about 50 wells in a nearby subdivision. Before the case reached the state Supreme Court, a district court judge upheld the rule of absolute ownership with the challenge that the rule is admittedly obsolete today, but that the business of redefining state ground-water law belongs with the state legislature, not the courts. In fact, the case did prompt an ongoing reexamination of ground-water management by Ohio's legislature (Fahey and Denbow-Hubbard, 1984).

Preventive Management in Illinois, Indiana, Iowa, Minnesota, and Wisconsin

Until 1983 Illinois ground-water use was regulated by the common law rule of absolute ownership. A review of three court cases regarding ground-water rights in Illinois reveals the difficulty courts have had in settling on consistent common law rulings (Clark, 1985). For a more complete discussion of these cases, the reader is referred to Clark (1985). In *Edwards versus Haeger,* an 1899 case between a dairy farmer and a mill operator in Kane County, the Illinois Supreme Court ruled that:

> Water which is the result of natural and ordinary percolation through the soil is part of the land itself and belongs absolutely to the owner of the land.

That case was followed years later by *Behrens versus Scharringhausen* [1959], a Cook County dispute in which a farmer (Behrens) accused a sand and gravel mining company of interfering with his wells in their mine dewatering processes. The state Appellate Court determined that since Behrens had been able to drill a deeper well and obtain a satisfactory water supply, his rights to the ground-water supply had not been irreparably damaged.

The court stated that the decision would have held regardless of the prevailing common law (absolute ownership or reasonable use), because the issue of ground-water use rights and ownership was not technically at stake in the case. The court in the *Behrens* case did state its opinion that the absolute ownership doctrine should be overturned by the Supreme Court in Illinois in favor of the reasonable use rule.

In a third ground-water case [*Lee versus City of Pontiac,* 1981] the state Appellate Court reviewed existing common laws relating to ground-water use. The case involved Lee's trucking business on the edge of the city of Pontiac; the city had widened and deepened a drainage ditch east of Lee's property and caused his well to dry up (Clark, 1985).

The court could have done one of two things: 1) uphold the absolute ownership rule from *Edwards versus Haeger,* or 2) abandon that rule and adopt the reasonable use rule for Illinois, as the court in the *Behrens* case had suggested. The court concluded that 1) it was not in a position to overturn the state Supreme Court's earlier decision [*Edwards versus Haeger*] upholding the rule of absolute ownership, and 2) there was really nothing wrong with that doctrine anyway. The concluding statement said:

> In summary, we find nothing which indicates that Illinois has, or should, deviate from the English rule laid down in Edwards.

Two years later, the Illinois Legislature passed the Water Use Act of 1983, which states explicitly in Section 6 that the "rule of reasonable use shall apply

to ground-water withdrawals in the state." The signing of the act meant that the doctrine of absolute ownership for ground water no longer applied in Illinois.

In adopting the reasonable use rule for ground water, the legislature used language from an 1842 surface water case in Illinois [*Evans versus Merriweather*] that declared reasonable use to mean "the use of water to meet natural wants and a fair share for artificial wants." There is a subtle but important distinction between definitions of "reasonable" in surface and ground-water law. The surface water reasonable use doctrine allows for proportional sharing ("fair share"), while the ground-water version does not.

Illinois adopted the surface water reasonable use doctrine for its ground-water law; this constitutes a departure from the usual ground-water reasonable use rule applied in most states (Clark, 1985). The statutes require registration for new high-capacity wells (greater than 100,000 gallons per day, or gpd). Other statutes allow for restricted withdrawals in four newly created ground-water management districts (counties) in the event of a water emergency.

The application of the reasonable use rule in Illinois was tested and upheld in a recent court case [*Bridgman versus Sanitary District of Decatur,* 1987]. The Decatur Sanitary District constructed a ditch near the property of Bridgman, who claimed that the construction dewatered her property and also caused contamination to her well. The outcome of this appellate court case was that dewatering of a well by a sanitary district trench could be determined to constitute an unreasonable interference with the well owner's right to ground water for natural wants.

Indiana has required the registration of all high-capacity wells (greater than 100,000 gpd) since 1983. In 1984, well construction and pump setting regulations were established for two intensively irrigated counties adjacent to the Illinois state line. At the same time, a commission was established to examine the need for more comprehensive ground-water management; the recommendation was for establishment of a statewide ground-water permit system. This was scaled down by the legislature to a series of mandated basin studies and ground-water data collection efforts.

As a result of the studies, a law took effect in 1985 that protects residential wells statewide and requires reporting of annual water use by all owners of high-capacity wells in the state. Under the 1985 law, the state may restrict ground-water withdrawal in response to well interruption problems if 1) the problems can reasonably be traced to one or more large-capacity ground-water wells; and 2) the impacted wells conform to basic well construction guidelines if drilled after January 1, 1986. The owner of the responsible facility is liable for providing an adequate supply of water of comparable quality. That includes the immediate, temporary provision of adequate potable water. In addition, a permanent supply must be provided through restoration of the well to its former capability, permanent provision of water of equal quality and quantity, or permanent restriction of ground-water withdrawals such that the impacted well can resume production of its normal water supply.

Three important aspects of this legislation stand out. First, existing well owners (prior to December 31, 1985) are "grandfathered" into the program with equal protection from interference without having to comply with well construction standards. Second, owners of high-capacity wells may be released from future liability after compensating for an initial interruption problem. Finally, the underlying assumption of the statute appears to be that water supply conflicts are one-on-one and that impacts on one well may be directly traced to another.

Indiana has one other statute on the books that dates back to 1951 and has never been activated. It allows the state to declare restricted use areas; permits would be required for any new ground-water users, and existing users would be allowed to use up to a 100,000 gpd limit, after which a permit would be required.

In Iowa, the common law of reasonable use was replaced by a permit and regulatory system in 1982 (Steeler and Morandi, 1983). The state requires permits for withdrawals of surface and ground water in amounts greater than 25,000 gpd. Special restrictions apply for protecting streamflows as well as specific aquifers, including the Jordan Sandstone and Dakota formation of the Cretaceous system. Water use reports and access ports for measurements of water levels are required. Aquifer tests and observation wells may also be required to determine effects of authorized ground-water withdrawals on other water uses. Iowa law also provides for an administrative means for resolving well interference conflicts when existing or proposed permitted uses cause or will cause interference in a nonregulated well.

Minnesota has an aggressive, allocative ground-water law. It requires permits for ground-water withdrawals exceeding 10,000 gpd or totaling more than 1 million gallons per year, unless the withdrawals are from domestic wells serving fewer than 25 persons. Owners of high-capacity wells are required to

monitor and report pumpage on a regular basis. The general criteria for allocating water are based on the following priority framework: 1) domestic water supply, 2) other uses less than 10,000 gpd, 3) agricultural irrigation and agricultural processing in excess of 10,000 gpd, 4) power generation in excess of 10,000 gpd, and 5) other uses in excess of 10,000 gpd.

The statutes further hold that any ground-water user responsible for well interference problems will be liable for the full cost of providing the injured party an alternative water supply of comparable quality and quantity. Finally, whenever total demands for ground water exceed the safe annual yield, the state is responsible for proportionally distributing the limited water according to the priority of uses named in the statute. All of these regulations apply statewide.

Wisconsin requires a permit for ground-water withdrawals exceeding 100,000 gpd, and requires monthly monitoring and reporting of pumpage from those wells. All other pumpage is governed by the ALI rule according to a 1974 case, *State versus Michels Pipeline Construction, Inc.* In this decision, the court acknowledged that while ground-water flow was a mystery at one time, present knowledge of hydrology has advanced to the point where a cause-and-effect relationship can be established between a tapping of underground water and the level of the water table (or piezometric surface) in the area. For this reason, according to the court, it is possible to impose liability fairly in ground-water disputes.

In summary, changes in midwestern ground-water law in the last decade have followed two general trends. First, courts have shifted away from rules of capture in favor of rules that allow for conservation, proportional sharing, restricted usage in times of shortage, and allocations of limited ground water when demand exceeds supply. This shows an increased awareness of the reciprocity of rights to a common-pool resource such as ground water.

Second, legislatures in the region have passed statutes establishing proactive management programs for ground water. These programs also allow for conservation, proportional sharing, restricted usage in times of shortage, and allocations of limited ground water. They do so through permit requirements, water use monitoring and reporting, well construction standards, prioritized allocations, designation of special management areas, and other similar management mechanisms.

These trends in midwestern ground-water law are in general alignment with similar changes on a national scale. Ground-water law has matured from simple rules of capture to more complicated rules of proportional sharing. This transition holds true throughout the country. Many western states have added management schemes to their appropriative laws. The management allows for proportional allocations and prioritization of uses in times and places of shortage. Many eastern states have also established ground-water management programs, which are in contrast with their historic reliance on the common law of reasonable use. There appears to be a general convergence toward middle ground with the adoption of a management doctrine for ground-water use.

GROUND-WATER MANAGEMENT AREAS: ONE EXAMPLE OF THE MANAGEMENT DOCTRINE

Some states apply ground-water management programs statewide. Others limit management to specific areas known as **ground-water management areas** (GWMAs). A number of states designate special management areas to address ground-water quantity and/or quality problems.

Although the specifics of ground-water management area programs vary from state to state and even within states, their form is fairly consistent: 1) most stem from specific legislation that enables the designation of management areas; 2) management areas are often (but not always) designated in areas that have severe or recurring ground-water supply problems; and 3) ground-water withdrawals are usually managed differently within the management areas than in the rest of the state. In some states, ground-water management areas have been established in addition to statewide permitting systems and other regulatory measures; other states regulate ground-water withdrawals only within management areas.

Programs like these have advantages and disadvantages. They may be used to avoid over-regulation when only localized regions are in need of resource management. On the other hand, if most or all of a state would benefit from ground-water use controls

but increased statewide control is thwarted because it is not politically popular, then the establishment of management areas may, in fact, represent a neglect of needed statewide regulation.

Ground-water management area programs have been developing around the country since the early 1940s. They became common in the High Plains when those states wanted to increase their control of irrigation water use (Aiken, 1980; Aiken and Supalla, 1979; Banks, 1981; Cisneros, 1980; Keller et al., 1981). This was due mainly to the rapid expansion of irrigation in the High Plains in the 1960s and 1970s, which led to economically and environmentally damaging declines in water levels in the Ogallala Aquifer.

Many of the affected states formed local districts (GWMAs) to control ground-water withdrawals. Other states followed suit, even though few faced problems of the severity of the Ogallala declines. Although not all heavily irrigated states have GWMAs, the GWMA,concept saw its greatest early development in states irrigated heavily from ground water, where economic and ground-water management concerns have often clashed.

Today ground-water management areas are used to address a variety of ground-water problems; this is reflected in the diversity of the programs. The use of ground-water management areas to control withdrawals is one example of the management doctrine. The following sections of the report discuss the methods and results of a nationwide survey conducted to collect information about the distribution and nature of GWMA programs around the country.

Survey Methods

A two-page questionnaire was sent to ground-water planners in every state but Illinois between April and June 1988. Illinois was excluded because the author already had access to information on existing and proposed GWMA legislation in Illinois. The questionnaire requested details about using GWMA programs to manage ground-water withdrawals. The purpose of the survey was to determine 1) which states use GWMAs to control ground-water withdrawals, and 2) how GWMAs in this country are formed, administered, and operated.

The questionnaire was divided into three sections: legal authority and general information, management mechanisms, and administration. Most of the questions requested a description of certain aspects of the GWMA program. Answers ranged from two or three sentences to two or three paragraphs for each question; and supplemental documentation was included with many of the responses. The questionnaire is included in Appendix A; the nature of the information sought through the questionnaire is outlined below:

A. Legal Authority and General Information
   1. Existence of statutes designating ground-water management areas
   2. Title, number, and date of statutes
   3. Formation process and authority for management areas
   4. Number, size, and locations of any existing or proposed management areas
   5. Motivation for designating management areas, including their use for ground-water quality and/or quantity problems
   6. Types of boundaries used for management areas

B. Management Mechanisms
   1. Regulations and restrictions of ground-water use within management areas, including permits, allocations, rotation of pumping days, well spacing, drilling moratoria, water use metering and reporting, well drilling and pump setting standards, and any other regulations used
   2. Statewide application of any of the regulations used in management areas

C. Administration
   1. Office, agency, or group that oversees the management areas and makes management decisions
   2. Funding sources for management areas
   3. Formal mechanisms for resolving water-use conflicts in management areas
   4. Water use priorities

A mailing list was developed by phone before the questionnaires were sent out, and an initial phone call was made to the office or agency that appeared to be most suitable for receiving and responding to the survey. The project was briefly described to verify that the questionnaire should in fact be sent to that office. In some cases, we were referred to an alternate office or agency. Mailing addresses were verified and names of specific individuals to whom the questionnaire should be addressed were also obtained by phone.

Survey Results

Responses to the survey were obtained from every state. The questionnaires were completed and returned for all but four states (Alabama, California, Maryland, and Nevada); information regarding those states was obtained in telephone interviews. Individuals in two different offices of the California Department of Water Resources were interviewed; the Maryland respondent followed up on the telephone interview by sending copies of the Maryland ground-water management statutes.

The responses ranged from brief statements that the state does not have a GWMA program to multiple-page letters detailing the program, with copies of the legislation, maps of management area locations, and other supporting documentation. The offices or agencies in each state that responded to the survey are listed in Appendix B.

The compiled survey results were sent to each of the respondents to determine whether 1) the laws had recently been changed, and 2) any incorrect interpretations of the survey responses had been made. Five states suggested minor modifications, all of which were made.

As shown in table 1, 27 states reported having GWMA legislation; four of those states have never formed management districts. Three additional states reported having GWMA legislation pending at the time they filled out the questionnaire. Some of the 27 states with GWMA legislation also have statewide ground-water management regulations, and of course many of the states that do not report having a GWMA program have some other type of ground-water management.

Since it was not the intention of this survey to collect information on all types of ground-water management programs, those states that did not report having a GWMA program are not discussed here. This is not intended to imply that those states lack ground-water management altogether. Similarly, programs other than GWMAs in states that do have GWMAs are excluded from discussion.

"GWMAs" mean different things in different states. The GWMA concept is one of regional ground-water management; management varies by region since specific regulations can be tailored to the regional needs. The majority of GWMA programs described in the survey responses had the following two characteristics. First, they stemmed from specific legislation either designating management areas or enabling the designation of areas. Second, the regulation of ground-water withdrawals within management areas differs from that in the rest of the state.

A definition of "GWMAs" should include, but not be limited to, these two factors. In some cases, ground-water quality protection regulations (such as land use restrictions, agricultural fertilizer application rules, and well-head protection plans) are also used or possible within management areas.

The only states listed in table 1 are those stating that they have a "GWMA program" or pending GWMA legislation. Several additional states have regional ground-water management programs but do not consider them to be GWMA programs even though another state might have labeled them as such. For example, the Delaware River Basin Commission allows for emergency ground-water withdrawal restrictions to be enforced throughout the basin. That includes part of Pennsylvania, but the respondents from Pennsylvania did not consider that a GWMA program.

A second example: California has regional water districts that hold some authority to regulate ground-water withdrawals, among other things. Again, the California respondents did not perceive that to be a GWMA program. Therefore California and Pennsylvania are not listed in table 1. In short, GWMAs are not all alike. For the purposes of this study, the survey responses were used to decide which states to include in table 1.

Legal Authority and General Information

The 27 states that reported having GWMA statutes all provided titles, numbers, and dates of the pertinent statutes. These are shown in Appendix C; they are listed as they appeared on the survey responses or as quoted in telephone interviews. The Illinois statute is also included in the list. Thirteen of the respondents sent copies of the statutes. States were asked if they currently had active management areas; ten of the respondents sent maps of management area locations.

Information was requested on formation of management areas. Most GWMA programs grant power to a central state authority (state engineer, department of water or natural resources, etc.) to designate management areas when and where they are considered necessary (see table 2). The exact rules vary considerably from state to state; most often the state authority is responsible for initiating the designation of an area, with allowances for some level of local input ranging from approval and acceptance to veto power. Some programs leave the initiation and formation of management areas up to local discretion. In these cases, some kind of petition of the

Table 1. States with Ground-Water Management Area Legislation

	GWMA legislation used	*GWMA legislation pending*	*GWMA legislation, no active areas*
Alaska		X	
Arizona	X		
Colorado	X		
Connecticut		X	
Delaware			X
Florida	X		
Hawaii	X		
Idaho	X		
Illinois	X		
Indiana			X
Iowa			X
Kansas	X		
Louisiana	X		
Mississippi	X		
Montana	X		
Nebraska	X		
Nevada	X		
New Jersey	X		
New Mexico	X		
New York	X		
North Carolina	X		
Ohio		X	
Oregon	X		
South Carolina	X		
South Dakota			X
Texas	X		
Utah	X		
Virginia	X		
Washington	X		
Wyoming	X		

intent to form an area is usually made. Sometimes the petition is made to a state authority, which makes the final decision on area formation, and in some cases the final decision is made by local referendum. A number of states have more than one kind of GWMA, allowing those states to customize regulations even further according to local needs. For example, 13 of the 27 GWMA states have management areas to address both ground-water quantity and quality problems (see table 3). In many cases those areas coincide, but some are formed by different processes.

For example, Nebraska has three types of management areas: "control areas," "management areas,"

Table 2. Formation Authority for Management Areas

	Local initiative	*State authority*	*Legislature*
Arizona	X		
Colorado	X	X	
Delaware			X
Florida			X
Hawaii		X	
Idaho		X	
Illinois			X
Indiana		X	
Iowa		X	
Kansas	X	X	X
Louisiana			X
Mississippi	X	X	X
Montana	X	X	
Nebraska	X	X	
Nevada		X	
New Jersey		X	
New Mexico		X	
New York	X	X	X
North Carolina		X	
Oregon		X	
South Carolina	X	X	X
South Dakota		X	
Texas	X	X	X
Utah		X	
Virginia		X	
Washington		X	
Wyoming		X	

and "special protection areas." One of the regulations authorized in the control areas is a well drilling moratorium. Because that is not a popular option among many irrigation interests, Nebraska also allows for management areas. The main difference is that a moratorium is not allowed in the latter; both are initiated and controlled locally. Special protection areas, on the other hand, are designated and administered by the Nebraska Department of Environmental Control to address ground-water quality concerns.

In Colorado, the state Groundwater Commission has designated eight "ground-water basins" and set broad management policies for them. Within those basins, ground-water users may form "management districts" and determine pumping limits and other regulations.

In Kansas, ground-water users may form "ground-water management districts" by petitioning the state. Areas requiring even more stringent water use restrictions (called "intensive ground-water use control areas") may also be designated by local petition

Table 3. Active Management Areas for Ground-Water Quantity and Quality

	Number of active management areas	*Ground-water quantity only*	*Ground-water quantity and quality*
Arizona	4		X
Colorado	8	X	
Delaware	0		
Florida	5	X	
Hawaii	3		X
Idaho	13	X	
Illinois	2	X	
Indiana	0	X	
Iowa	0	X	
Kansas	15		X
Louisiana	1		X
Mississippi	2		X
Montana	1	X	
Nebraska	5		X
Nevada	110	X	
New Jersey	2		X
New Mexico	31		X
New York	1		X
North Carolina	1		X
Oregon	9	X	
South Carolina	2		X
South Dakota	0	X	
Texas	22		X
Utah	5	X	
Virginia	2	X	
Washington	16		X
Wyoming	3	X	

or by the management district board members. In rare instances, the Kansas Chief Engineer may designate an intensive use area directly, as long as it is not within an existing management district.

The Florida legislature has divided the state into basins and mandated that water resources management be carried out in each basin; each basin is relatively autonomous with regard to management options. These examples are offered to illustrate the diversity in methods of forming management areas.

In addition to these kinds of formation processes, most GWMA statutes do not preclude the legislature from designating management areas directly. In some cases legislatures pass specific statutes designating one management area at a time. It is rare for these processes to be the only means of management area formation. It is more common for the legislature to enact broad enabling statutes that allow either a local entity or a state authority to form management areas when and where they are needed.

Table 4. Motivation for Designating Management Areas

	Over-pumpage	*Subsidence*	*Well interference*	*Salt-water intrusion*	*Mining and dewatering*	*Resource development*	*Water quality problems*
Arizona	X						
Colorado						X	
Delaware							
Florida	X			X		X	
Hawaii	X			X			
Idaho	X						
Illinois			X				
Indiana			X				
Iowa	X		X				
Kansas	X						X
Louisiana	X	X		X			
Mississippi	X			X			
Montana	X		X				
Nebraska	X						X
Nevada	X						
New Jersey	X			X			
New Mexico	X		X				
New York	X			X			
North Carolina					X		
Oregon	X						X
South Carolina	X	X	X	X			
South Dakota							
Texas	X	X	X				X
Utah	X		X				
Virginia	X		X				X
Washington	X	X	X	X			X
Wyoming	X		X				

Information was also sought on the types of ground-water problems that motivate the designation of management areas, and on the types of area boundaries used. Overpumpage and well interference problems were the problems most frequently cited as having motivated management areas (see table 4). Others listed include saltwater intrusion, water quality problems, subsidence, and ground-water mining or dewatering. In Colorado, the motivation for management areas is "to permit full economic development of certain ground-water resources by altering the doctrine of prior appropriation of state water laws."

Table 5 shows the types of boundaries listed for management area delineation. Many states use all three types, depending on the circumstances. In their survey responses, a number of states that use political boundaries, such as county or township lines, stated that those boundaries are used only as a last resort for administrative convenience.

Table 5. Determination of Management Area Boundaries

	Political boundaries	*Surface watersheds*	*Ground-water / aquifer units*
Arizona		X	
Colorado		X	X
Delaware			
Florida		X	
Hawaii	X	X	X
Idaho			X
Illinois	X		
Indiana			
Iowa			
Kansas	X	X	X
Louisiana	X		
Mississippi			X
Montana	X		
Nebraska	X	X	X
Nevada			X
New Jersey			X
New Mexico		X	X
New York		X	
North Carolina	X		
Oregon	X	X	X
South Carolina	X	X	X
South Dakota			X
Texas	X		X
Utah		X	
Virginia	X		
Washington	X	X	X
Wyoming	X		X

Management Mechanisms

States were asked what types of pumpage restrictions and other ground-water withdrawal controls (such as permits, allocations, rotation of pumping days, well spacing, drilling moratoria, and so on) are either used or possible within management areas, and whether they are also enforced statewide. Table 6 shows the types of regulations listed most often as used within management areas; in some cases they also apply statewide. The most common regulations include permit programs, well spacing requirements, ground-water allocations used in conjunction with permits or water rights, rotation of allowed pumping days, standards for well construction and depth and for pump setting, and metering and mandatory water use reporting. Others mentioned were drilling moratoria, water-level monitoring and monitoring-well requirements, and temporary restrictions on pumpage.

Table 6. Regulations Used in Management Areas

	Permits and water rights	*Well spacing*	*Allocations*	*Drilling moratoria*	*Rotation*	*Metering*	*Water use reporting*	*Well/pump standards*
Arizona	X	X	X			X		
Colorado	X	X	X			X		X
Delaware								
Florida	X	X	X			X	X	X
Hawaii	X		X			X		X
Idaho	X		X	X		X	X	X
Illinois								X
Indiana	X						X	X
Iowa	X	X	X		X	X	X	X
Kansas	X	X	X	X		X	X	X
Louisiana	X					X	X	X
Mississippi	X	X	X	X	X			
Montana	X	X	X	X	X	X	X	X
Nebraska	X	X	X	X	X	X	X	X
Nevada	X	X						
New Jersey	X		X	X		X	X	X
New Mexico	X	X	X	X		X	X	X
New York								
North Carolina	X	X	X			X	X	X
Oregon	X	X	X		X	X	X	X
South Carolina	X	X	X					
South Dakota	X	X	X				X	X
Texas	X	X	X			X	X	X
Utah	X	X	X	X		X	X	X
Virginia	X					X	X	
Washington	X	X	X	X				X
Wyoming	X	X	X	X	X	X	X	X

The survey responses provide some evidence that the more "drastic" policy options such as drilling moratoria are resorted to less frequently than the more "familiar" ones that may be perceived as less difficult for resource users to accept. These would include such regulations as permitting, well spacing, allocations, and metering.

Some respondents reported that these types of regulations were already in effect prior to management area formation. Therefore implementing them in management areas required only minimal deviation from past practices.

In addition to the regulations shown in table 6, many GWMA statutes allow for emergency groundwater use restrictions or shutdowns to be invoked under certain conditions. For example, most or all of the users within a management area may be required to observe temporary restrictions or shutdowns because of drought or unexpected growth in demand. Or restrictions or shutdowns may be in-

voked on one or more individual high-capacity wells because they are interfering with smaller wells. In both of these cases, the emergency shutdowns would normally be temporary, lasting until the drought ends or until the impacted well is fixed or replaced.

Administration

Information was sought on decision-making authority, funding sources, conflict-resolution processes, and hydrologic data collection activities. Most states place responsibility for making GWMA decisions with a central state authority (see table 7). This responsibility involves basic decisions regarding such issues as water rights and allocations, water use restrictions, water use metering and reporting, water pricing and pumping fees, water rights transfer policies, and controlled ground-water mining.

Specific ground-water management plans are often written by the state authority; in some cases, they are carried out by a local agency or office. Some states leave the majority of the planning authority with the local ground-water users, usually through an area manager or board of directors.

It is clear that management goals vary from one management area to another. For example, several management areas in Texas require certain well construction and pump setting standards to allow for full economic development of the resource, but only one of the areas requires pumpage metering and reporting.

In Kansas, several management areas allocate ground water (through permits) equal to average annual recharge to minimize the potential for ground-water mining. However, one of the heavily irrigated management areas in Kansas has chosen to sustain a certain level of overpumpage to maintain the region's economic stability.

Ground-water management area programs normally require some level of funding to cover administrative costs and to provide for periodic hydrologic studies necessary for responsible planning. This funding comes from a combination of sources in most states, as shown in table 8. General state tax revenues are often supplemented by locally levied property taxes. Several states (for example, Arizona, Louisiana, and Texas) assess a ground-water pumpage fee; others (for example, Colorado and New Jersey) fund areas partially through money collected from permit applications.

Most GWMA programs provide for some method of conflict resolution for disputes over water allocations and conflicts between ground-water users. In many states, conflicts are brought before a board or commission for a hearing, with appeals going to state district courts (see table 9). In some cases, dates of water appropriation or priorities of water use will be considered. Often, the hearings are held before a state board or commission; in some cases, a local board or commission from the management area settles disputes.

Table 9 also shows that several survey respondents (Florida, Indiana, Iowa, and Virginia) indicated the use of some type of "impact liability" as a means of mitigating conflicts that arise when pump-

Table 7. Decision Makers for Management Areas

	Local Board or Commission	*State authority*
Arizona		X
Colorado	X	X
Delaware		
Florida	X	
Hawaii		X
Idaho		X
Illinois		X
Indiana		X
Iowa		X
Kansas	X	X
Louisiana	X	
Mississippi		X
Montana		X
Nebraska	X	X
Nevada		X
New Jersey		X
New Mexico		X
New York		X
North Carolina		X
Oregon		X
South Carolina		X
South Dakota		X
Texas	X	
Utah		X
Virginia		X
Washington		X
Wyoming		X

Table 8. Funding Sources for Management Areas

	General state revenues	*Local property tax*	*Pumping tax/fee*	*Permit application fee*
Arizona			X	
Colorado	X	X		X
Delaware				
Florida		X		X
Hawaii	X			
Idaho	X			
Illinois				
Indiana				
Iowa				
Kansas	X	X		
Louisiana			X	
Mississippi	X	X		
Montana	X	X		
Nebraska		X		
Nevada	X	X	X	
New Jersey				X
New Mexico	X			
New York				
North Carolina	X			
Oregon	X			
South Carolina	X			
South Dakota				
Texas		X	X	
Utah	X	X		
Virginia	X			
Washington	X	X		
Wyoming	X			

ing of a large-capacity well interferes with the water supply for a smaller well. The pumpers responsible for interference are held liable for compensating the injured parties following a technical investigation but not necessarily a hearing.

This approach assumes that a certain level of responsibility is involved in high-capacity ground-water use, and that personal liability should be brought to bear in clear-cut cases of well interference. This is a significant departure from the traditional approach of taking such cases to court, where personal liability might or might not be imposed. Indiana and Iowa both impose this impact liability statewide as a means of protecting domestic wells from interference. By contrast, many of the other types of regulations used in GWMAs, such as well spacing, are designed to protect existing ground-water users from unreasonable impact by new users (such as irrigator versus irrigator or irrigator versus municipality) (Wickersham, 1984).

Fifteen of the survey respondents indicated that ground-water use priorities are stipulated within

Table 9. Conflict Resolution Mechanisms in Management Areas

	Hearing (state authority)	*Hearing (local authority)*	*Court appeals and adjudication*	*Impact liability*
Arizona			X	
Colorado	X	X	X	
Delaware				
Florida		X	X	X
Hawaii	X			
Idaho				
Illinois			X	
Indiana				X
Iowa				X
Kansas		X	X	
Louisiana		X		
Mississippi	X		X	
Montana	X		X	
Nebraska		X	X	
Nevada	X		X	
New Jersey	X		X	
New Mexico	X			
New York	X		X	
North Carolina	X			
Oregon	X			
South Carolina	X		X	
South Dakota				
Texas		X	X	
Utah	X		X	
Virginia				X
Washington	X			
Wyoming	X			

their management areas. Domestic requirements were listed as the highest priority, followed by such uses as livestock watering, agriculture, mining, electric power generation, and manufacturing. In most of the western states, water use priority follows water rights seniority, even within management areas; with rights of equal priority, water for domestic use generally prevails. One western exception to the prior appropriation rule: Arizona statutes provide for retirement of agricultural ground-water withdrawals in favor of municipal water use, to achieve long-term zero overdraft.

Individual State Ground-Water Management Area Programs

Brief summaries of each state GWMA program follow. Most of the information came directly from the survey responses (including written comments and telephone comments), or from the supporting documentation supplied with the survey responses.

Arizona. On June 12, 1980, the governor of Arizona signed the Groundwater Management Act. This act completely overturned previous ground-water law

in that state and is thought of as one of the most restrictive state regulatory programs for ground-water management in the country. The act applies statewide, but its primary provisions are currently applicable in only four Active Management Areas (AMAs) and two Irrigation Non-Expansion Areas (INAs).

The four AMAs include areas containing about 80 percent of the state's population (including Phoenix and Tucson) and the bulk of irrigated farmland. They are the areas with the most severe ground-water overdraft, where the legislature felt the most immediate need for regulatory intervention. The Irrigation Non-Expansion Areas were designated for areas that are not part of a management area, but where the current rate of withdrawal threatens the supply of ground water for irrigation.

No new land may be brought under irrigation in either type of control area. Within AMAs, only lands with a history of active irrigation between the period January 1, 1975, to January 1, 1980, can now be irrigated. Cities and towns get special treatment; irrigation rights are extinguished as farmlands are urbanized. Also, in both types of areas, ground-water withdrawals from all but small domestic wells must be measured and reported. The Arizona Department of Water Resources holds the authority to designate additional management areas.

All ground-water withdrawals within both types of management areas are regulated according to a plan developed and executed entirely by the state. The statutes specifically recognize that ground-water management activities anywhere in the state will benefit everyone living in the state. Therefore the statutes require that all ground-water management activities be funded on a 50-50 matching basis by general fund appropriations and by pump taxes collected from the water users. Each user that is not exempt from regulations (mainly domestic users) is required to install measuring devices, report annual pumpage, and pay the pumping tax, which can amount to about $5 per acre-foot.

Colorado. Colorado has eight designated basins and 13 management districts within those basins. The basins are all located in the eastern half of the state. Eight of the management districts had active management plans with formal rules and regulations in effect as of August 1987. The eight basins were designated by the Colorado Groundwater Commission, which has the authority to permit or deny the drilling of any new wells within the basins. The state engineer is the enforcing officer for the commission.

Management districts within the designated basins may be formed by a vote of local ground-water users. The management districts are controlled by boards made up of local citizens. Policies for ground-water withdrawals vary from district to district, and the policies within the basins differ from policies elsewhere in the state. Management activities are paid for by general state revenues at the state level, by special local taxes within local districts, and by limited cash receipts from permit application fees.

Delaware. The Delaware Environmental Protection Act provides that the Secretary of the Department of Environmental Protection may promulgate regulations for ground-water management areas. No such regulations have been promulgated, however.

Florida. The Florida Water Resources Act of 1972 divided the entire state into five surface watersheds and created five water management districts formed along hydrologic boundaries of the watersheds. Those districts are the primary water management agencies. The Florida legislature mandated management of water resources statewide to be carried out through the boards of each district. The districts have semi-autonomous control over planning and regulating both surface and ground-water supplies, including the power to levy ad valorem ("according to value") taxes. At least three of the districts have established permit requirements for ground-water withdrawals. They may also declare water shortage emergencies and restrict withdrawals to prevent seawater intrusion into fresh aquifers, land subsidence, and other ground-water impacts.

Hawaii. Three ground-water management areas have been established in Hawaii, all on the island of Oahu. They are Pearl Harbor (226 square miles), Honolulu (90 square miles), and Waialua (95 square miles). They were designated because of long-term decline of water levels and seawater intrusion into freshwater aquifers. Permits are required for ground-water withdrawals for all new users. All withdrawals must be metered and reported to the Commission on Water Resource Management, which is a six-member appointed commission under administration of the Department of Land and Natural Resources. That commission has the authority to conduct hearings and mediate contested allocations and well-interference complaints.

Idaho. Idaho has five Groundwater Management Areas and eight Critical Groundwater Areas, all on the southern boundary of the state. Eight of the

areas have been closed to any further ground-water development. "Critical groundwater area" is defined in the statute as any ground-water basin or designated part thereof not having sufficient ground water to provide a reasonably safe supply for irrigation of cultivated lands or for other uses in the basin at the then-current rates of withdrawal. "Groundwater management area" is defined in the statute as any ground-water basin or designated part thereof which the director of the Idaho Department of Water Resources has determined may be approaching the conditions of a critical groundwater area.

The Department of Water Resources manages withdrawals within the districts, designates districts, and develops management plans. An extensive public hearing and notification process (spelled out in the statute) must be followed when a new district is being formed, whether it be a critical groundwater area or a groundwater management area.

Illinois. The Water Use Act of 1983, as amended in 1987, requires that all new high-capacity wells (greater than 100,000 gpd) in the state be registered with the local Soil and Water Conservation District office. Each well is subject to an impact analysis by the Illinois State Water and Geological Surveys; if the analysis reveals a potentially negative impact from the proposed new well, the Soil and Water Conservation District office is notified. The statutes do not provide for refusal or denial of permission to drill the well, even if it may cause a negative impact on other existing wells.

In addition, the statute designated four counties as having special emergency restriction powers. If well interference problems occur within these four counties, the impacted party may notify the Soil and Water Conservation District office, which requests a technical evaluation of the problem by the Water and Geological Surveys. If a cause-and-effect relationship is established, the Soil and Water Conservation District may temporarily restrict or completely shut down water use from the well or wells responsible for the interference. To be protected by this statute, impacted wells must meet certain well construction standards. In spite of a number of complaints due to drought conditions and heavy irrigation water use, no emergency restrictions other than voluntary have ever been imposed.

Indiana. A law was passed in 1951 allowing the state Division of Water Resources to designate restricted use areas in emergencies; the law has never been used. The department could require permits for any new users, and existing users wishing to pump amounts above 100,000 gpd would also need a permit. The department could implement these statutes to prevent aquifer depletion and to settle well interference conflicts.

Iowa. Iowa has statutes providing for the designation of ground-water management areas to prevent long-term overwithdrawal, but the statutes have never been used. If such areas ever are established, they will be designated and managed by the state Department of Natural Resources, which will need to require permits, well spacing, and water use metering and reporting. All of these regulations are currently enforced statewide.

Kansas. Five ground-water management districts have been established in Kansas, and a fifth is presently being considered. The areas were established under the Groundwater Management District Act of 1972, which states specifically:

> It is hereby recognized that a need exists for the creation of special districts for the proper management of the ground-water resources of the state . . . and it is the policy of this act to preserve basic water use doctrine and to establish the right of local water users to determine their own destiny with respect to the use of ground water.

The districts, therefore, are locally established political subdivisions with the power to tax, plan for ground-water management, and restrict and regulate ground-water withdrawals.

The areas are primarily in the western and south-central regions of the state. The three western districts, which are very heavily irrigated from the Ogallala Aquifer, have adopted a management philosophy of a "planned depletion rate," which allows a certain, agreed-on rate of resource depletion. The other two districts have adopted a "safe yield" management philosophy, which means that through permits, they allocate ground-water use equal to or less than the safe yield of the aquifers. There are also six intensive ground-water use control areas, and one more under consideration, in which further groundwater development is not allowed. In addition, two special ground-water-quality areas have been established and are managed by the state Department of Health and Environment.

Louisiana. The "Capital Area Groundwater Conservation District" was formed in 1974 by the Capital Area Groundwater Conservation Commission. The district is centered around Baton Rouge and includes five counties, for a total of approximately 2,200 square

miles. The district was formed because of concern over long-term overwithdrawal problems, need to mitigate saltwater intrusion, and land subsidence problems. The commission has permitting authority, which has not been exercised in favor of reviews of well plans and use of educational programs to encourage conservation. Water use metering and reporting are mandatory within the district.

Mississippi. The Omnibus Water Bill of 1985 made the entire state of Mississippi a "Capacity Use Area," in which permits are required for all nondomestic ground-water uses from wells with surface casing diameters of 6 inches or larger. Two areas in the state are experiencing ground-water problems: Pascagoula in Jackson County in the extreme southern tip of the state; and Tupelo in Lee County in the northeast corner of the state. Ground-water withdrawals are more strictly controlled in these areas than elsewhere in the state.

The areas have been designated and are managed by the Bureau of Land and Water Resources, although statutes do provide for local formation of districts. Formal management plans have not been developed for Pascagoula or Tupelo; water use permit requests are considered on a case-by-case basis according to the exact hydrologic conditions at the proposed well site and the proposed use of the water.

Montana. Statutes passed in 1962 allow for designation of controlled ground-water areas in Montana. They are designated by the Board of Natural Resources, a citizen board that oversees the activities of the Department of Natural Resources and Conservation. Establishment of controlled areas may also be initiated by local petition.

One area (a 1-square-mile area in the Larson Creek drainage basin) is currently active. It was designated because of well interference and aquifer depletion caused by existing development and threatened further by potential future development. Ground-water use throughout the state must be permitted; within controlled areas, water use metering and reporting can be required but generally are not. Statutes also allow for allocations, well spacing requirements, rotation of pumping days, drilling moratoria, and any other means of controlling withdrawals necessary to prevent the depletion of the resource. The state DNRC manages the controlled areas.

Nebraska. Legislation passed in 1969 created 24 local political subdivisions called Natural Resource Districts, which were delineated along surface watershed boundaries. These districts can levy special taxes and plan and manage water resources. Included in their powers is the authority to establish ground-water management areas, which is initiated by local petition. The establishment of these areas does not require state approval, but state review is required. Ground-water control areas may also be established, which allow for stricter regulation of withdrawals, including well drilling moratoria. The Director of Water Resources must approve the designation of a control area, which is also initiated by local petition.

Local boards are responsible for preparing a specific ground-water management plan, and they have the authority to require permits, allocate ground-water withdrawals, and employ almost any type of regulatory mechanism needed to realize their ground-water management goals. The Department of Water Resources approves the control area regulations. The result is a system allowing for strong local control over ground-water management, with some state oversight.

The state has three control areas, one management area (which is really 24 small areas within one Natural Resource District), and one special water quality protection area. The control areas are in the southern portion of the state in the Upper Republican watershed, the Upper Big Blue watershed, and the Little Blue watershed. They were formed between 1977 and 1979.

Nevada. The state engineer has the authority to designate and oversee management of designated basins in Nevada. Approximately half of the state's area has been divided into 110 designated basins with special ground-water withdrawal regulations. The 110 basins include most of the population centers in the state. Permits are required for ground-water withdrawals throughout the state.

The main difference with the designated basins is that permits are issued before a new well is drilled, whereas outside the controlled areas permits are issued after the well has been drilled. Permits are issued subject to prior ground-water appropriation rights; within the designated basins, junior users' rights may be suspended. Well spacing, metering and water use reporting, and well drilling moratoria are also used within designated basins to control ground-water use. Funding presently comes from general state revenues, but it is expected that special local taxes from within the basins will be added in the future.

New Jersey. The New Jersey Water Supply Management Act of 1981 gave the state Department

of Environmental Protection the authority for identifying and implementing management areas. Two areas have been established. Both are in the coastal plain area of the state with boundaries determined by the minus-30-foot mean sea level water-level contour within the specific aquifers to be managed. Increasing withdrawals creating overdraft and seawater intrusion motivated the creation of the areas.

The Division of Water Resources is responsible for making management decisions within the control areas. Well permits, water allocation permits, and well registration are required statewide; in addition, restricted use and specific annual diversion limits are used in the control areas. Permits required statewide are for wells with a capacity of 100,000 gpd; within control areas, the permit requirement is 10,000 gpd.

Also located in New Jersey is the Delaware River Basin Commission, created by the Delaware River Basin Compact, P.L. 87-328, Statute 688, of the federal government. The compact affects the entire Delaware River Basin, which includes parts of New Jersey, Delaware, Pennsylvania, and New York.

The compact was motivated by a severe drought in the early 1960s. It allows the commission to issue permits and to require allocations, well spacing, well drilling moratoria, and other management mechanisms to control overpumpage. Regulations also allow for emergency restrictions on withdrawals in emergencies. The regulations are not applied uniformly throughout the basin but are used on a case-by-case basis. The Delaware River Basin Commission is responsible for making all planning and regulatory decisions; disputes are settled by hearings before the commission. Funding comes primarily from a state of Pennsylvania appropriation.

New Mexico. New Mexico has 31 active ground-water management areas covering about 85,000 square miles. All have been established since 1986. The New Mexico state engineer's office has the authority to designate and manage all control areas. Within management areas, the state requires permits for all ground-water withdrawals, as well as requiring well spacing, allocation, drilling moratoria, and other measures. These regulations do not apply outside the management areas. Water use priorities follow the seniority of the ground-water appropriation: the older the appropriation, the higher the priority. All management activities are funded through general state revenues.

New York. Federal designation of parts of Long Island as a sole-source aquifer includes options for the designation of special ground-water management areas for protection of ground-water quantity and/or quality. No management areas have been established yet, but statutes would allow the state Department of Environmental Conservation to designate any area as a management area (on the basis of local petition) if it has been federally designated as a sole-source aquifer. The department has not implemented any specific rules and regulations, pending the establishment of a management area.

North Carolina. One "Capacity Use Area" has been established as a result of the Water Use Act of 1967, which gave the state Department of Natural Resources and Community Development authority to designate management areas and make management decisions. The current capacity use area was established because of phosphate mining and extensive dewatering operations. The statutes in North Carolina cover "ground water and surface water or both." Within the capacity use area, permits are required for withdrawals, ground water is allocated, and there are well spacing requirements. There were 46 permittees at the time the questionnaire was returned; they are required to submit water-use and water-level reports. All ground-water withdrawals within the capacity use areas are regulated.

Oregon. Oregon has six "Critical Groundwater Areas," one proposed critical groundwater area, and three "Groundwater Withdrawal Areas." All of these stem from three related statutes dating back to 1955. Designation of the critical groundwater areas is made through declaration of intent by the state Department of Water Resources, after which the affected parties may contest the designation. The designations normally involve large areas; thus many parties are usually involved in a complicated series of hearings.

Two other management mechanisms are also available: designation of a withdrawal area, and designation of a classified area. Within a withdrawal area, the aquifer in question is withdrawn from any further appropriations. Within a classified area, the aquifer is open for development for certain types (classes) of water use in the future. These two mechanisms are preventive, rather than reactive like the critical groundwater areas, and therefore have much greater public acceptance. Within any of these areas, the state may require permits, well spacing, rotation of pumping days, ground-water allocations, and metering and reporting of ground-water use. All of these management activities are funded through general state revenues.

South Carolina. Two "Capacity Use Areas" have been designated in South Carolina. They are the Waccamaw, established in 1978 along the coastal plain, and the Low Country, established in 1981 also in the coastal plain. Approval by the legislature, state Water Resources Commission, and local interests are all necessary for establishment of capacity use areas. The pertinent statute is the Groundwater Use Act of 1969.

New wells are subject to pump tests before permits will be issued within the critical use areas. Test wells are also required, along with specific requirements for well depth and pump setting, well spacing (vertical and horizontal), and allocations for withdrawals. A network of monitoring wells exists for collecting water-level data. Data from pump tests and other aquifer tests are used along with other collected data to calibrate digital aquifer models to aid in making planning and management decisions.

South Dakota. Statutes for establishing water use control areas were passed in 1983 for use in the event that severe water shortages occurred. To date, the statutes have been used in surface water situations, but they have not yet been needed for ground-water shortages. If they were used, the South Dakota Water Management Board would designate areas and be responsible for making management decisions. Permits, well spacing, allocations, and priority dates of appropriations would be used to control groundwater withdrawals. The state currently has a statewide permitting requirement and an irrigation water use reporting requirement.

Texas. Through enabling legislation, 22 "Underground Water Conservation Districts" have been designated by the Texas Water Commission. Groundwater regulations are not enforced in Texas, except within the conservation districts. Statutes define ground water as private property, so any regulation is done on a permissive basis. Most of the conservation districts are in the panhandle region, the central plains, and along the southeastern coastal plain. They have been established by local petition, with state Water Commission approval, as a result of long-term overwithdrawal and well interference problems, as well as subsidence and seawater intrusion problems. The districts were formed from 1951 to 1987.

Within districts, local boards are responsible for preparing and implementing management plans, which can include permitting, well spacing, allocations, and drought management planning. Only one of the districts requires water use metering and reporting. Management activities are funded within each district by special local property taxes; two districts have user or pumpage fees.

Utah. The Utah state engineer has the authority to designate ground-water management areas. Five have been established; one is in the Salt Lake City region and the others are clustered in the southwest corner of the state. Within the areas, further appropriations may be either stopped or limited. Ground water is allocated through permits both within the areas and statewide; well spacing and water use metering and reporting requirements are also used within the areas.

The state engineer's office is authorized to make management decisions for the management areas, although public hearings are held to exchange information with local interests on the availability of ground water. After the public hearings, the state engineer's office typically prepares a written management policy, usually focusing on the appropriation of new water rights and also on the transfer of water rights within the basin. The management activities are funded by general state revenues. However, within the districts where water use metering and reporting are required, a water commissioner is employed to collect and report the data; the users are assessed the cost of the commissioner's salary.

Virginia. The Groundwater Act of 1973 allows for designation of ground-water management areas by the state Water Control Board or by petition by local interests. Two management areas have been established; one is located in the southeastern part of the state, and and one is on the eastern shore of the state. Designation of the southeastern area was motivated by well interference problems caused by a large industrial ground-water user, apprehension over the apparent prospect that the available groundwater supply had been or was about to be overdrawn, and saltwater pollution of ground water. The management area on the eastern shore was established to safeguard regional coordination of groundwater development among current and future water users.

Within the management areas, large, non-agricultural ground-water users must comply with permit requirements, including maintaining a totalizing flow meter at the well's outlet, recording daily water use and reporting it monthly, maintaining a water-level monitoring well located within 100 to 200 feet of the production well, and outfitting the monitoring well with continuous water-level monitoring equipment. Each water user is granted a certain amount of drawdown at the observation well; the amount is

specified in the permit. That drawdown may not be exceeded without risking loss of permitted water use rights. These management activities are funded through general state revenues.

Washington. The state Department of Ecology has designated 13 ground-water management areas and three ground-water subareas to date; an additional four management areas have been petitioned for. The areas are scattered throughout the state, and their designation has been motivated by long-term overpumpage problems, well interference complaints, saltwater intrusion problems, land subsidence, and other ground-water pollution problems.

Within the management areas, the state may require permits, well spacing, drilling moratoria, and allocations of ground water. Periodic water use metering and reporting practices were attempted in the heavily agricultural management areas, but compliance problems forced the agency to abandon the regulation. Although the state Department of Ecology is primarily responsible for preparing and overseeing a management plan, the project managers actively consult with local citizens, governments, and public interest groups, and coordinate local ground-water planning with them. Management activities are funded by general state revenues supplemented by local taxes from the management districts.

Wyoming. Well interference problems and possible aquifer overdraft motivated the establishment of three ground-water management areas in southeast Wyoming, totaling 2,484 square miles. Permits prior to drilling any new well are required statewide; but within the management areas, well spacing, drilling moratoria, rotation of pumping days, and ground-water allocation regulations are also imposed. In some cases, water use metering and reporting are required within the management areas. The state engineer's office is responsible for designating the management areas, developing a management plan, and making all management decisions. Management activities are funded by general state revenues.

GWMA Control — Local Ground- Water Users or State Government?

In spite of the diversity in ground-water management area programs, one important division did appear in the survey responses. That division stems from the question of control over management area decisions and regulations: should the local ground-water users themselves hold the formal authority to regulate their own ground-water use, or should the state government hold that authority? Most GWMA programs place the balance of authority with a central state agency or office. That is, management areas are initiated, operated, and funded at the state level, often with allowances for varying levels of input from local interests.

In contrast, a number of states have chosen to provide for strong local control of management areas. Colorado, Kansas, Nebraska, and Texas (which are the four High Plains states most heavily irrigated from ground water that have GWMA programs) stand out in this regard. Individual management areas in those states hold considerable formal authority for determining and carrying out all ground-water management. They decide, for the most part, if, when, and how to regulate ground-water withdrawals: should they save ground water for the future or enhance regional economic development today and run the risk that there will be less ground water tomorrow that will almost certainly cost more to pump?

Irrigation is a water use with strong ties to regional economies in states such as the four mentioned above where irrigation is practiced widely. Ground-water management programs in these places are often balanced between sustaining the present irrigation economy and preserving ground-water resources for present and future generations. On one hand, irrigated agriculture plays a vital role in many local and regional economies. On the other hand, irrigation has contributed to ground-water depletion and declining water levels in some areas, which in turn reduces the profitability of irrigation by raising pumping costs.

While depletion of ground-water resources is widely recognized as a serious problem, irrigators have historically been hard-pressed to accept reductions in their irrigation-supported crop yields brought on by limits on ground-water use. Therefore, maintaining rights of control over ground-water use and ground-water regulation is an especially jealously guarded tradition in heavily irrigated places.

Irrigation is also a water use with strong ties to land ownership and property law, which hearkens back to the days of property-based rules of capture for ground water as discussed at the beginning of this report. Private "owners" of ground water are reluctant to give up their rights of control over ground-water use.

When it comes to establishing ground-water management areas, ground-water users in the heavily irrigated High Plains states have successfully maintained most of their rights of control. If restrictions are to be imposed, then the ground-water users would

prefer them to come from as close to home as possible (McCleskey, 1972). Ultimately, this has provided those management areas with the means to balance ground-water management goals with their own regional irrigation economies.

The survey results suggest that the question of control (the ground-water users, or the state government?) has been paramount in states heavily irrigated from ground water. It is possible, however, that establishing regional ground-water management anywhere invites heightened interest on the part of regional ground-water users to take part in management and regulatory decisions.

As more states consider implementing GWMA programs to address local or regional ground-water supply problems, they will no doubt have to face the fundamental question of who is to be in charge: the users or the state government. Both local and state-controlled management areas should be examined carefully to see if effective, long-term management is in fact being carried out.

In summary, ground-water management areas are one of a number of means of addressing ground-water supply problems and, in some cases, ground-water quality problems as well. According to these survey results, they are used in at least 23 states, and an additional four states have GWMA legislation but have never formed management districts.

Despite the overall diversity in GWMA programs, two characteristics are found in most programs. First, they have legislation either designating management areas or enabling such designation. Second, they allow for tailored regulations of ground-water withdrawals within the management areas, which normally differ from regulations imposed statewide.

In some cases, no regulations are imposed statewide, and the management areas are the only places within the state where ground-water management occurs. In other cases, management areas are used in addition to a statewide regulatory program.

The distinction between local and state control of ground-water management areas should be studied further. Several basic questions come to mind:

1) Do most state and local interests share similar ground-water management goals? If not, then can one group implement effective resource management without the input of the other?

2) Can ground-water users be counted on to restrict their own water use adequately and soon enough to prevent harm to neighboring regions sharing the same aquifer? The local control approach relies more heavily on the good neighbor policy: ground-water users may choose not to regulate in order to preserve present economic development, or they may fail to act in time even when failure to act can impact their neighbors. That could be a risk some states would be unwilling to accept.

3) Should regional resources be managed on middle ground with a balance of input from both state and local interests?

These are just a few of the questions which, if answered, would give insight into the nature and effectiveness of regional ground-water management through ground-water management areas.

RECOMMENDATIONS FOR ILLINOIS

Given the fact that most places in Illinois have enough ground water to meet residents' needs, the current legal structure for ground-water withdrawals is probably adequate for most parts of the state. However, some regions are prone to water shortages, water raids, and water use conflicts; and the state should revise its water laws to better address these problem areas. The review of ground-water laws in other states leads to several recommendations for improvements in Illinois ground-water quantity law.

1) Much of the rest of the country is reassessing its legal structure for allocating ground water in times and places of shortage, and for both preventing and resolving ground-water quantity conflicts. For the most part, ground water is no longer thought of as private property with rights of unlimited use; rather, it is a public resource that is subject to control and management.

Illinois was one of the last states in the country to abandon the wasteful permissive ownership rules for ground water. Greater consideration should be given in the future to keeping the state's ground-water quantity laws in general alignment with those in the rest of the country.

2) Ground-water management areas are a good idea; they are used successfully in states throughout the country with very diverse hydrogeologic conditions and ground-water supply problems. Illinois should continue to strive to implement a unified ground-water management area program.

3) If ground-water management areas are introduced, they should be the joint responsibility of state and local interests; costs and management decisions should be shared. They should not be the sole responsibility of local interests for several reasons:

a) Not enough is known about the long-term effectiveness of permissive, self-guided ground-water management and regulation.

b) Local interests may not have the technical expertise needed to design and implement an appropriate management program.

c) The costs of effective management may be prohibitively high for local interests to bear, resulting in inferior management programs.

d) Local ground-water management by small, adjacent management districts or areas that overlie a common aquifer could result in uncoordinated, contradictory use and management of that aquifer.

On the other hand, ground-water management areas should not be the sole responsibility of a state agency. Management plans developed without any local input seldom produce effective results.

Illinois should adopt a ground-water management area program that includes the following features: a) ground-water management areas should be designated by referendum by an appropriate level of local government or a special district; b) the Division of Water Resources and other state natural resource agencies should assist in developing management plans that will be based on a thorough understanding of local and regional hydrogeology and of present and projected ground-water uses; and c) local boards or councils should be responsible for implementing the management policies with state oversight to ensure regionally consistent ground-water management.

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Appendix A. Questionnaire Used in Survey of State Ground-Water Management Areas

SURVEY OF STATE GROUND-WATER MANAGEMENT PROGRAMS

Name _____

Address _____

_____

_____Phone _____

PLEASE NOTE: *If you wish to receive a copy of the results of this survey, please check here _____.*
If you need additional space, please attach separate pages.

LEGAL AUTHORITY AND GENERAL INFORMATION

1. Does your state have statutes allowing for the designation of ground-water management areas?

   _____Yes _____No

   If Yes, please give the title, number, and date of the law.

   If No, you do not need to fill out the rest of this questionnaire. However, please return it to help us in compiling the results of this survey.

2. Are the management areas designated by a state agency, the legislature, or a local political entity?

3. Are there currently any active management areas?

   _____Yes _____No

   If Yes, how many are there and what are their approximate sizes and locations? (attach a map if desired)

4. What has been the major motivation for designating management areas? (e.g., well interference complaints, long-term overwithdrawal practices, need to mitigate salt water intrusion or subsidence problems, etc.)

5. Do management area regulations pertain to:

   _____ground-water quantity _____ground-water quality

6. How are management area boundaries determined? (e.g., political boundaries, natural boundaries)

MANAGEMENT MECHANISMS

7. What pumpage restrictions, water use restrictions, or other regulations are being employed or contemplated in the management areas? Please describe any that apply.

   _____permits _____allocations _____rotation

   _____well spacing _____drilling moratoria _____other

(7 cont'd) Are any of these applied statewide? If so, please explain briefly.

8. Is metering and/or periodic water-use reporting mandatory within the management areas? Statewide?

9. Are well construction, depth, or pump setting standards enforced within the management areas? Statewide? If so, please describe briefly.

10. Are the management areas and/or specific management regulations permanent, or are they temporary, depending, for example, on climatic conditions?

11. Are any regulations applied statewide that are not applied within the management areas? If so, please explain briefly.

ADMINISTRATION

12. What office, agency, or governmental unit administers the management areas and makes management decisions?

13. Are technical staff employed to maintain data on the management areas? If so, what types of data are collected, stored, analyzed, etc.?

14. What is the funding source for administering the management areas? (e.g., general state tax revenues, special local taxes, etc.)

15. Are there formal mechanisms for resolving water-use conflicts which may arise within the management areas? If so, please describe briefly.

16. Are there priorities on water uses during times of water shortage? If so, please explain briefly.

17. Please add any additional comments you wish to make on these issues.

THANK YOU FOR TAKING TIME TO COMPLETE THIS QUESTIONNAIRE.

Appendix B. Offices Responding to the Ground-Water Management Area Survey

ALABAMA	Dept. of Economic and Community Affairs Resource Development Section Montgomery, AL 36109 (205) 284-8735
ALASKA	Dept. of Natural Resources Div. of Land and Water Management P.O. Box 107005 Anchorage, AK 99510 (907) 762-2680
ARIZONA	Dept. of Water Resources Office of Water Management 99 East Virginia Avenue Phoenix, AZ 85004 (602) 255-1553
ARKANSAS	Soil and Water Conservation Commission One Capitol Mall, Suite 2D Little Rock, AR 72201 (501) 682-3962
CALIFORNIA	Dept. of Water Resources Div. of Planning P.O. Box 388 Sacramento, CA 95802 (916) 445-3157
	Dept. of Water Resources Div. of Geology and Groundwater 3251 S Street Sacramento, CA 95815 (916) 322-7164
COLORADO	Office of the State Engineer Ground Water Section, Designated Basins Branch 1313 Sherman Street, Room 818 Denver, CO 80203 (303) 866-3581
CONNECTICUT	Dept. of Agriculture and Natural Resources Water Compliance Unit 122 Washington Street Hartford, CT 06438
DELAWARE	Div. of Water Resources Groundwater Management Section 89 Kings Highway, P.O. Box 1401 Dover, DE 19903 (302) 736-4762

FLORIDA*	Dept. of Environmental Regulation Bureau of Ground Water Protection and Water Management Twin Towers Office Building 2600 Blair Stone Road Tallahassee, FL 32301 (904) 488-3601
GEORGIA	Dept. of Natural Resources Geologic Survey Division Room 400 19 Martin Luther King, Jr., Drive, S.W. Atlanta, GA 30334 (404) 656-3214
HAWAII	Dept. of Land and Natural Resources Div. of Water and Land Development P.O. Box 373 Honolulu, HI 96809 (808) 548-7533
IDAHO	Dept. of Water Resources Office of Planning and Policy 1301 North Orchard Statehouse Mail Boise, ID 83720 (208) 327-7900
INDIANA	Dept. of Natural Resources Div. of Water 2475 Directors Row Indianapolis, IN 46241 (317) 232-4163
IOWA	Dept. of Natural Resources Water Supply Section Henry A. Wallace Building 900 East Grand Avenue Des Moines, IA 50319 (515) 281-8998
KANSAS	Western Kansas Groundwater Management District 1 211 Main Street, P.O. Box 604 Scott City, KS 67871 (316) 872-5563 Equus Beds Groundwater Management District 2 313 Spruce Halstead, KS 67056 (316) 835-2224

**Also sent questionnaires to individual ground-water management area managers.*

KANSAS (continued)	Northwest Kansas Groundwater Management District 4 1175 S. Range, P.O. Box 905 Colby, KS 67701 (913) 462-3915
	Big Bend Groundwater Management District 5 125 S. Main, P.O. Box 7 Stafford, KS 67578 (316) 234-5352
KENTUCKY	Natural Resources and Environmental Protection Cabinet Dept. of Environmental Protection, Div. of Water Frankfort Office Bank, 18 Reilly Road Frankfort, KY 40601 (502) 564-3410
LOUISIANA	Capital Area Groundwater Conservation Commission P.O. Box 64526 Baton Rouge, LA 70896 (504) 924-7420
MAINE	Dept. of Natural Resources Office of Groundwater Planning State Planning Office State House Station #38 Augusta, ME 04330 (207) 289-3261
MARYLAND	Dept. of Natural Resources Water Resources Administration, Water Supply Division Tawes State Office Building 580 Taylor Avenue Annapolis, MD 21401 (301) 974-3675
MASSACHUSETTS	Dept. of Environmental Quality Div. of Water Supply One Winter Street, 9th Floor Boston, MA 02108 (617) 292-5528
MICHIGAN	Dept. of Natural Resources Water Resources Commission P.O. Box 30028 Lansing, MI 48909
MINNESOTA	Dept. of Natural Resources Div. of Waters 500 Lafayette Road St. Paul, MN 55155 (612) 297-2431

MISSISSIPPI	Dept. of Natural Resources Bureau of Land and Water Resources P.O. Box 10637 Jackson, MI 39209 (601) 961-5265
MISSOURI	Dept. of Natural Resources Water Resources Program P.O. Box 176 Jefferson City, MO 65102 (314) 751-7143
MONTANA	Dept. of Natural Resources and Conservation Water Resources Division 1520 E. Sixth Street Helena, MT 59620 (406) 444-6692
NEBRASKA*	Natural Resources Commission Nebraska State Office Building P.O. Box 94876 301 Centennial Mall South Lincoln, NE 68509 (402) 471-2081
NEVADA	Office of the State Engineer Div. of Water Resources 201 South Fall Street Carson City, NV 89710 (702) 885-4380
NEW HAMPSHIRE	New Hampshire Water Resources Division P.O. Box 2008 Concord, NH 03301 (603) 271-3406
NEW JERSEY	Dept. of Environmental Protection Div. of Water Resources CN 029 Trenton, NJ 08625 (609) 292-2957 Office of the Chief Engineer Delaware River Basin Commission P.O. Box 7360 West Trenton, NJ 08628 (609) 883-9500
NEW MEXICO	Office of the State Engineer 101 Bataan Memorial Building, State Capitol Sante Fe, NM 87503 (505) 827-6149

**Also sent questionnaires to individual ground-water management area managers.*

NEW YORK	Dept. of Environmental Conservation Div. of Water Room 201 50 Wolf Road Albany, NY 12233 (518) 457-6781
NORTH CAROLINA	Dept. of Natural Resources and Community Development Div. of Environmental Management, Groundwater Section P.O. Box 27687 Raleigh, NC 27611 (919) 733-3221
NORTH DAKOTA	State Water Commission Hydrology Division 900 East Boulevard Bismark, ND 58505 (701) 224-2754
OHIO	Dept. of Natural Resources Div. of Water 1939 Fountain Square, Bldg. E-3 Columbus, OH 43224 (614) 265-6744
OKLAHOMA	Water Resources Board Div. of Groundwater P.O. Box 53585 1000 N.E. 10th Street Oklahoma City, OK 73152 (405) 271-2555
OREGON	Dept. of Water Resources Div. of Groundwater Resource Management 3850 Portland Road, N.E. Salem, OR 97310 (503) 378-8456
PENNSYLVANIA	Dept. of Environmental Resources Bureau of Water Management P.O. Box 2063 Harrisburg, PA 17120 (717) 787-9637
RHODE ISLAND	Dept. of Natural Resources Div. of Environmental Management, Groundwater Program 291 Promenade Street Providence, RI 02908 (401) 277-2234

SOUTH CAROLINA	State Water Resources Commission Div. of Groundwater 1201 Main Street, Suite 1100 Capitol Center Columbia, SC 29201 (803) 737-0800
SOUTH DAKOTA	Dept. of Water and Natural Resources Water Rights Division Joe Foss Building 523 East Capitol Pierre, DS 57501 (605) 773-3352
TENNESSEE	Dept. of Health and Environment Bureau of Environment, Div. of Water Management T.E.R.R.A. Building 150 Ninth Avenue, North Nashville, TN 37203 (615) 741-0690
TEXAS	State Water Commission Ground Water Conservation Section P.O. Box 13087, Capitol Station Austin, TX 78711 (512) 463-8273
UTAH	Dept. of Natural Resources and Energy Div. of Water Rights 1636 West North Temple Salt Lake City, UT 84116 (810) 538-7390
VERMONT	Agency of Environmental Conservation Dept. of Water Resources, Ground Water Management Section 103 S. Main Street Building 10 North Waterbury, VT 05676 (802) 244-5638
VIRGINIA	State Water Control Board 287 Pembroke Office Park, Suite 310 Pembroke 2 Virginia Beach, VA 23462 (804) 499-8742
WASHINGTON	Dept. of Ecology Div. of Ground Water Management Mail Stop PV-11 Olympia, WA 98504 (206) 459-6000

WEST VIRGINIA	Div. of Water Resources Office of Groundwater 1201 Greenbrier Street Charleston, WV 25311 (304) 348-36 14
WISCONSIN	Dept. of Natural Resources Bureau of Water Resources Management, Groundwater Section 101 S. Webster Street, GEF II Box 7921 Madison, WI 53707 (608) 267-9350
WYOMING	Office of the State Engineer Herschler Building, 4th Floor East Cheyenne, WY 82002 (307) 777-7354

Appendix C. GWMA Statutes Listed in Survey Responses

ALASKA	Pending
ARIZONA	Arizona Groundwater Management Act (1980)
COLORADO	Colorado Groundwater Management Act; Article 37-90, C.R.S. (1965)
CONNECTICUT	Pending
DELAWARE	Delaware Environmental Protection Act (7 Del. C. Chapter 60)
FLORIDA	Florida Water Resources Act of 1972, Chapter 373, Part I
HAWAII	State Water Code, Chapter 174C, Hawaii Revised Statutes
IDAHO	Idaho Water Law, Section 2 of S.L. 1987, CH 347, 42-233a and 42-233b
ILLINOIS	Illinois Water Use Act of 1983 (as amended in 1987)
INDIANA	I.C. 13-2-6.1 (1983), I.C. 13-2-2.5 (1985), I.C. 13-2-2 (1951)
IOWA	Iowa Code Sections: 455B.262, 455B.264, and 455B.274 through 455B.278
KANSAS	K.S.A. 82a-1020 through 1040
LOUISIANA	Act 678 of 1974 (amended 738, 1980)
MISSISSIPPI	Mississippi Code of 1972, Water Laws, Chapter 3
MONTANA	Montana Water Law, Annotated Code, Title 85, Chapters l-3, 5, 15, 20
NEBRASKA	Neb. Groundwater Management and Protection Act, Neb. Rev. Stat. 46-656 - 674.20 (1975,1983,1986)
NEVADA	Nevada Designated Basins Act, Rev. Stat. 534.120
NEW JERSEY	New Jersey Water Supply Management Act, N.J.S.A. 58:1A-1 *et seq.* Delaware River Basin Compact, P.L. 87-328, Stat. 688
NEW MEXICO	New Mexico Annotated Statutes 72-12-1(1986)
NEW YORK	ECL, Art. 55, and Art. 15-0514
NORTH CAROLINA	Water Use Act of 1967, CH 143-215.11 *et seq.*
OHIO	Pending
OREGON	ORS 537.620 and 537.730-740 (1955), ORS 536.410 (1955), ORS 536.340 (1955)
SOUTH CAROLINA	Ground Water Use Act of 1969
SOUTH DAKOTA	SDCL 46-l0A, Water Use Control Areas (1983)
TEXAS	Texas Water Code, CH 52, revised 1985
UTAH	Section 73-5-14, and section 73-5-l Utah Code Annotated (1953)
VIRGINIA	Groundwater Act of 1973, as amended, 62.1-44.83 through 62.1-44.107
WASHINGTON	RCW 90.44.139 (1945) and RCW 90.44.400 (1985)
WYOMING	41-3-912 as amended