Journal of Environmental and Sustainability Law

Missouri Environmental Law and Policy Review
Volume 3
Issue 3 *1995-1996*

Article 5

1995

Proposed Methodology for Developing a Groundwater Classification System in Missouri

Greg Moldafsky

PROPOSED METHODOLOGY FOR DEVELOPING A GROUNDWATER CLASSIFICATION SYSTEM IN MISSOURI

by Greg Moldafsky

I. INTRODUCTION

A. Groundwater - Background Information

Groundwater is stored beneath the earth's surface amongst saturated rock, sand, gravel, and soil.[1] Groundwater does not flow in a series of lakes and rivers like surface water.[2] "Instead, the precipitation that seeps into the ground fills pores of rock formations similar to the way water fills a sponge."[3] Groundwater is part of what is known as the hydrological cycle.

> As the earth warms, water evaporates from moist ground, plants, and surface water. The air and water vapor rise into the atmosphere, where the air cools and the water vapor condenses to form clouds. Precipitation in the form of rain, hail, sleet, or snow falls to the earth. Some of the precipitation evaporates before it reaches the ground; some of it runs off the earth's surface into streams, rivers, lakes, and some of the precipitation soaks into the ground.[4]

The precipitation will eventually soak through the ground until it reaches an aquifer.[5] Only water that has reached the saturated zone is referred to as groundwater.[6]

Although Missouri is home to numerous streams, lakes, and rivers, surface water accounts for only a small percentage of the state's total water supply.[7] The largest extent of Missouri's water is found from a "few feet to hundreds of feet beneath the earth's surface."[8] This water, groundwater, serves approximately 34% of the state's population with their daily water needs. These needs include agricultural uses, industrial uses, public drinking supplies, and domestic drinking supplies.[9] In rural Missouri, groundwater also serves as a major source of drinking water.[10] The fact that groundwater provides so many uses for such a variant population lends credence to the fact that one of the most striking features about groundwater in Missouri is its diverse character. This diverse character is mainly attributable to Missouri's geology, both rock formations and soil types.[11] In general, Missouri has six different regions of groundwater: the Missouri-Meramec-Mississippi River Valleys;[12] the Southeastern Lowlands;[13] the Ozarks;[14] the St. Francois Mountains;[15] the Osage-Salt Plains;[16] and the Glaciated Plains.[17] In addition to the geologic characteristics, is Missouri's topography. The Karst[18] topography, found in many

---

1 MISSOURI DEP'T OF NATURAL RESOURCES, MISSOURI'S HIDDEN WATERS 1 [hereinafter HIDDEN WATERS].
2 *Id.*
3 *Id.*
4 *Id.*
5 *See infra* text accompanying note 31.
6 HIDDEN WATERS, *supra* note 1.
7 *Id.*
8 *Id.*
9 *Id.* *See also* Peter N. Davis, *Federal and State Water Quality Regulation and Law in Missouri*, 55 Mo. L. REV. 411 (1990). "Of Missouri's 4,929,000 population, ... 1,676,000 are served from groundwater." *Id.* at 411 n.1 (citing TASK FORCE ON MISSOURI GROUNDWATER ISSUES, MISSOURI'S GROUNDWATER: PROTECTING A THREATENED RESOURCE I-6 (1987)).
10 HIDDEN WATERS, *supra* note 1. "Groundwater is the source of 74% of all rural domestic (self-supplied) water, 75% of all irrigation water, 22% of public water supplies, and 39% of all industrial (self-supplied) water." Davis, *supra* note 9, at 411.
11 HIDDEN WATERS, *supra* note 1, at 3.
12 The rivers in this area rapidly recharge thereby providing virtually an unlimited supply of groundwater with a yield of more than 1,000 gallons per minute. In addition, the water table in this region is near the surface and is easily accessible from shallow wells. Overall, the quality of groundwater in this area is good. *Id.*
13 Aquifers in this region recharge rapidly and yield large quantities of water. The quality of the groundwater varies with the depth of the aquifer, but overall the quality is good. *Id.*
14 The quality of the groundwater in this area is rated from good to excellent. Generally, the yield of aquifers in this region range from 15-500 gallons per minute, although some sections may go as high as 1,000 gallons per minute. *Id.* at 4.
15 The volume and yield of groundwater in this area is relatively small, making most groundwater insufficient for domestic use. *Id.*
16 Aquifers in this area yield poor quality, highly mineralized water, although "fresh water may be obtained from some shallow wells." *Id.*
17 This rather large, highly mineralized region yields only 5-15 gallons per minute. *Id.*
18 "Karst areas include permeable soil and rock, springs that bring groundwater to the earth's surface, sinkholes that connect surface water to groundwater, caverns and small openings that convey water through integrated underground channels, and losing streams that transport water underground." HIDDEN WATERS, *supra* note 1, at 2.

of these regions, is an equally important factor that helps to characterize Missouri's groundwater.[19]

B. Current Regulations Governing Groundwater

While individual states generally are responsible for managing the groundwater resource, the federal government does maintain some statutory authority in this area. This authority, however, comes from statutes that have been enacted at various periods over the last twenty years. This has led to many inconsistencies in both the EPA regulations and the decisions that sprang from them.[20] The statutes that have most effected groundwater include: the Safe Drinking Water Act (SDWA);[21] the Clean Water Act (CWA);[22] the Resource Conservation and Recovery Act (RCRA);[23] and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).[24] In addition, the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA),[25] the Toxic Substance Control Act (TSCA),[26] and the Surface Mining Control and Reclamation Act (SMCRA)[27] all, to some degree, aid in the protection of groundwater. As the above list illustrates, there are a variety of federal programs in place that may aid the EPA in regulating and monitoring groundwater. Taken together, however, these statutes still do not provide a comprehensive program to manage groundwater.[28] Furthermore, as indicated above, the nature of groundwater, its "geographical occurrence, physical and chemical properties, uses, and sources of contamination all demand local flexibility."[29] This is why it is so crucial for individual states to implement their own comprehensive groundwater management programs.

Under Missouri law, groundwater is highly regulated. The regulations place requirements on activities that might impact aquifers and numeric standards for groundwater quality. Missouri's Clean Water Law[30] regulates groundwater by virtue of its definition of "waters of the state."[31] The definition specifically refers to subsurface waters, aquifers, as the resource the Clean Water Law is designed to protect. The regulations define aquifer as:

> [a] subsurface water-bearing bed or stratum which stores or transmits water in recoverable quantities that is presently being utilized or could be utilized as a water source for private or public use. It does not include water

[19] *Id.*

[20] UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, GROUND-WATER PROTECTION STRATEGY 3 (August 1984) [hereinafter GROUND-WATER STRATEGY].

[21] 42 U.S.C. §§ 300f-300j-10 (1988). Although SDWA is primarily concerned with protecting public water supplies, it does have provisions that provide protection to groundwater. The underground injection control program (UIC) is one such provision. The primary purpose of the UIC is to protect sources from injections that would "prevent compliance with national primary drinking water regulations, or otherwise adversely affect public health." ROBERT J. SANER, ESQ., FEDERAL GROUND-WATER LAW: SUMMARY OF EXISTING STATUTES 3-4 (1991) (prepared for The American Water Works Association) [hereinafter FEDERAL SUMMARY]. Another provision of SDWA, the sole source aquifer program, allows the EPA to designate an area as a sole source aquifer so long as it is a principal water supply. GROUND-WATER STRATEGY, *supra* note 20, at 24. Such a designation allows the EPA to challenge all federally assisted projects that would potentially harm groundwater quality within the aquifer. *Id.* A third provision gives the EPA authority to take emergency action to protect against any action that may pose "an imminent and substantial endangerment" to public health. FEDERAL SUMMARY, *supra* note 21, at 4. This includes groundwater, as suggested by the language of the provision which specifically references contamination of underground sources of drinking water as a legitimately protectable interest. *Id.*

[22] 33 U.S.C. §§ 1251-1387 (1988). While the primary purpose of the CWA is the protection of surface waters from pollutant discharges, it also has a secondary purpose - protection of the groundwater resource. FEDERAL SUMMARY, *supra* note 21, at 5. This task is accomplished through two provisions. The first provision is the CWA area-wide treatment management planning program. Under the statute, an acceptable plan must include a process to protect groundwater from "land or subsurface disposal of pollutants." *Id.* The second provision, the CWA's wetlands program, deals more directly with groundwater since wetlands are often fed by groundwater. Under this program the Army Corps of Engineers can deny a permit to discharge if it is determined that such a discharge would have an "unacceptable adverse effect on municipal water supplies, and fish and wildlife areas." *Id.* at 6.

[23] 42 U.S.C. §§ 6901-6992k (1988). RCRA's cradle to grave regulatory program places considerable emphasis on protecting groundwater through its comprehensive permit program. FEDERAL SUMMARY, *supra* note 21, at 7. In addition, RCRA both restricts and prohibits the disposal of hazardous wastes in "underground mines and caves, landfills, deep injection wells and injection wells affecting underground sources of water." *Id.* RCRA provides further protection of groundwater under the Underground Storage Tank (UST) provisions of the Act. The UST program specifically is designed to detect, prevent and correct leaching from underground storage tanks. *Id.*

[24] Congress enacted CERCLA in response to public concern about the hazards presented by inactive waste sites. CERCLA established a fund, as well as legal and administrative procedures for the cleanup of inactive waste sites that threaten public health and the environment. GROUND-WATER STRATEGY, *supra* note 20, at 23. The statute itself gives the EPA immense power. Possible involvement in a Superfund site can affect future business transactions, as well as, give rise to both civil and criminal penalties. While most statutes operate prospectively, CERCLA has been held to apply retroactively. The threat of groundwater contamination is perhaps one of the single biggest factors in evaluating sites for response action. *Id.* at 24. In addition, since groundwater is specifically included within the statutes definition of "environment," any groundwater contamination is subject to a myriad of cleanup and monitoring requirements. FEDERAL SUMMARY, *supra* note 21, at 10.

[25] 7 U.S.C. §§ 136-1369 (1988).

[26] 15 U.S.C. §§ 2601-2629 (1988).

[27] 30 U.S.C. §§ 1201-1328 (1988).

[28] FEDERAL SUMMARY, *supra* note 21, at 14.

[29] THE CONSERVATION FOUNDATION, GROUNDWATER: SAVING THE UNSEEN RESOURCE 1 (1985) (this booklet represents the proposed conclusions and recommendations of the National Groundwater Policy Forum) [hereinafter UNSEEN RESOURCE].

[30] MO. CODE REGS. tit. 10, §20 (1994).

[31] "All rivers, streams, lakes and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined on locate completely upon lands owned, leased or otherwise controlled by a single person or by two or more persons jointly or as tenants in common. These waters also include waters of the United States lying within or adjacent to the state." *Id.* §20-2.010(82).

> in the vardose zone. For purpose of the effluent regulation, sandy, gravely alluvial soils in or on the floodplains of intermittent streams are not an aquifer.[32]

Chapter 7.015 of the regulations is the specific provision that sets out the Effluent Guidelines that limit discharges to subsurface waters.[33] This section prohibits the release, storage or disposal of any water into an aquifer, unless such water meets the quality standards specified for groundwater in Chapter 7.031.[34] This condition applies at a point ten feet below the release point.[35] Other provisions of this chapter prohibit releases to caves or sinkholes, require effective closure of abandoned wells, and require site-specific monitoring of land application treatment systems to ensure compliance.[36] This chapter also includes provisions that allow for alternative effluent limitations, provided a comprehensive analysis demonstrates that the beneficial uses in the aquifer are negligibly impaired.[37] The scope and burden of proof required by such a demonstration makes this provision of little use.

As mentioned above, the Water Quality Standards are found at Chapter 7.031 of the regulations. This chapter contains a specific section on groundwater which sets out four requirements.[38] First, effluent cannot result in a violation of the listed groundwater standards.[39] Second, if the specific groundwater contributes a significant flow to surface waters designated for aquatic protection, potentially more stringent surface water criteria must also be met.[40] The third requirement specifies the compliance location as the point where the pollutant enters the aquifer, thus applying the standards to any point anywhere within any aquifer.[41] The fourth provision allows for alternative criteria, provided an adequate demonstration can be made.[42] Few situations would be expected to support such a demonstration based on the stringent requirement that "the existing ambient pollutant concentrations exceed the applicable standards, [while] existing and potential uses are not impaired."[43]

Missouri's regulations are excessively stringent.[44] While the "hidden nature of groundwater" has made it difficult to conduct scientific research on the effects of aquifers in noncompliance, there exists the potential for significant liability if shallow groundwater is even negligibly impacted.[45] Missouri's current regulatory system assigns to all groundwater the same level of protection - the drinking water standard.[46] This scheme fails to "recognize the natural diversity, natural quality, maximum sustainable yield, and current level of contamination found throughout Missouri's various aquifers."[47] This arbitrary assignment of protection wastes both the state's time and money; effective groundwater protection is a question of both environmental protection and cost effectiveness.[48]

These principles could be most effectively combined within a methodology that breaks groundwater into classes and management zones.[49] Contamination standards would be set according to the class of the groundwater in question. Approximately twenty states and the EPA have all either proposed or implemented some type of groundwater classification scheme.[50] This paper will examine EPA's groundwater strategy as well as those of other states in an effort to develop an appropriate methodology for Missouri.

II. Legal History - Existing Classification Schemes

A. EPA's Groundwater Protection Strategy

In 1984, the EPA published *Ground Water Protection Strategy*,[51] which suggests the implementation of a groundwater classification system as the best method of protecting present and future beneficial uses of groundwater.[52] The EPA classification scheme provides three

---

[32] *Id.* § 20-2.010[7].
[33] *Id.* § 20-7.015[7][A]-[F].
[34] *Id.* § 20-7.015[7][A].
[35] *Id.*
[36] *Id.* § 20-7.015[4][B].
[37] *Id.* § 20-7.015[4][F].
[38] *Id.* § 20-7.031[5][A]-[D].
[39] *Id.* § 20-7.031[5][A].
[40] *Id.* § 20-7.031[5][B].
[41] *Id.* § 20-7.031[5][C].
[42] *Id.* § 20-7.031[5][D].
[43] Michael F. Bollinger, Regulation of Groundwater in Missouri: Current Requirements and Recommended Changes, Presentation to the 5th Annual Business and Industry Environmental Conference 3 (June 8, 1994).
[44] *Id.* at 5.
[45] *Id.*
[46] *Id.* at 6.
[47] Regulatory Environmental Group for Missouri (REGFORM), Proposed Methodology for Developing Groundwater Standards for Missouri 3 (Draft March 21, 1995) [hereinafter REGFORM Draft Proposal].
[48] *Id.*
[49] *Id.*
[50] Bollinger, *supra* note 43, at 3.
[51] Ground-Water Strategy, *supra* note 20.

classes of groundwater protection, with individual class determinations based on the "value of the groundwater and its vulnerability to contamination."[53] The actual class determination, however, will be made according to which federal program controls. For those statutes that require regulated entities to go through a permitting process (i.e. RCRA), the determination will be made based on the permit data submitted by the applicant at the time of the application.[54] Under CERCLA, however, the class determination would be made at the time of contamination assessment.[55] If a state or federal agency has already gathered sufficient data for a particular site, that data may be used in a class determination.[56] Furthermore, where a state has mapped or designated a particular area of groundwater with a specific class, that classification will be used.[57]

Class I protection would extend to Special Resource Waters. The EPA suggests that special measures need to be taken to protect these waters because of their high vulnerability to contamination.[58] Waters with high hydraulic conductivities, such as Karst formations or sand and gravel aquifers, as well as those waters with special recharge conditions like a "high water table overlain by thin and highly permeable soils" would all qualify as special resource waters.[59] In addition, the EPA characterizes Special Resource Waters as those waters which are either 1) an "irreplaceable source of drinking water" or 2) "ecologically vital." An irreplaceable source of drinking water can include waters that serve as the sole source or supplementary source of drinking water for substantial populations.[60] Ecologically vital waters, on the other hand, are waters that primarily feed ecologically sensitive systems that, must be protected to maintain a unique habitat.[61]

Waters that are currently being used for drinking water purposes or potentially could be used for drinking are designated Class II under EPA's groundwater strategy.[62] In addition, waters that have other beneficial uses may fall within this classification. In general, this is the default classification for all waters that do not fall within Class I or Class III. As such, most groundwater across the United States will fall into this category.[63] Unlike Class I, vulnerability is not a factor used in designating waters for Class II.[64]

The protection afforded Class II ground waters is primarily derived from EPA's current statutory authority. Usually, contamination will be cleaned up to background levels or drinking water standards.[65] For potential sources of drinking water or water used for agricultural or industrial purposes, however, alternative procedures may be applied.[66] It is important to note that EPA specifically recognizes that in some cases alternative cleanup standards are needed. In such cases, the main regulatory thrust is to contain the contamination to avoid migration into more highly regulated aquifers.[67]

Groundwater that has no potential for being used as a source of drinking water and has invariably limited beneficial use, will be designated as Class III. This class includes waters that are contaminated, either naturally or by human activity, that "cannot be cleaned up using methods reasonably employed in public water system treatment."[68] In addition, waters with a Total Dissolved Solid (TDS) level of 10,000 mg/L will also be included in Class II.[69] Although an aquifer may meet the criteria described above, the water may still not be designated as Class III, if the groundwater could potentially migrate into either a Class I or a Class II aquifer or into surface water, so as to adversely effect human health or the environment.[70] Such waters would be classified as Class II.

The EPA recognizes that the level of protection given Class III groundwater may be less than in other classes.[71] Cleanup requirements may also be diminished. The EPA envisions Class III groundwater cleanup determinations to

52 *Id.* at 5.
53 *Id.*
54 *Id.* at 48.
55 *Id.*
56 *Id.*
57 *Id.*
58 *Id.* at 43 Much of this vulnerability stems from the hydrological characteristics of the areas under which these waters lie. *Id.*
59 *Id.*
60 *Id*
61 *Id.* at 44. The EPA gives examples of unique habitats as "those associated with wetlands that are habitats for unique species of flora and fauna or endangered species." *Id.*
62 *Id.* at 45.
63 *Id.*
64 *Id.*
65 *Id.*
66 *Id.*
67 *Id.*
68 *Id.* at 46.
69 *Id*
70 *Id*
71 *Id.* at 47.

be done on a case-by-case basis.[72] Such determinations will be based on the risk to human health and the environment.[73] If contamination does occur, the EPA may grant variances or permit elevated concentration limits to combat the situation.[74]

B. State Groundwater Classification Schemes

1. Nebraska

In Nebraska, all groundwater is initially classified based on the potential for that aquifer to be used for drinking water purposes.[75] Determinations are based on the background condition or beneficial use[76] of the groundwater prior to some environmental release.[77] Nebraska has established a classification system that utilizes three classes. The first class, Class GA, includes groundwater that is currently being used as a public drinking water supply or is proposed to be used as a public drinking water supply. This class specifically includes wells that are only used occasionally for drinking water and wells that are temporarily not in use.[78] The second class, Class GB, includes groundwater that is currently being used, or potentially could be used, as a private drinking water supply.[79] Groundwater that may potentially be used as a public drinking supply, but cannot make Class GA, is also included.[80] This is Nebraska's default class. Nebraska's third class, Class GC, includes groundwater that has "little or no potential for being used as a public or private drinking water supply."[81] Class GC determinations are made on a case-by-case basis. Generally, waters that will be included in this class have poor quality, either due to natural or man-made causes, or have hydro geologic conditions that makes it impossible to develop a drinking water supply.[82] One noteworthy feature of Nebraska's classification system is that it specifically allows for the reclassification of groundwater provided a showing of "just cause" can be made.[83]

2. Colorado

Colorado has implemented an extensive water quality control program that, among other things, establishes statewide standards and a system for classifying groundwater to protect existing and potential beneficial uses.[84] Colorado's classification system divides groundwater into five classes: Domestic Use-Quality; Agricultural Use-Quality; Surface Water Quality Protection; Potentially Usable Quality; and Limited Use and Quality.[85] These general classes, however, are implemented only on a site-specific basis after enough relevant data is acquired to allow regulators to appropriately define a given aquifer.[86]

Domestic Use-Quality is defined as groundwater that is currently being used domestically or, based on available information, potentially could be used domestically.[87] Additionally, such groundwater must have background levels that will adequately assure compliance with Human Health Standards and have TDS levels that are less than 10,000 mg/L.[88] Groundwater that is currently used, or could potentially be used for agricultural purposes is classified as Agricultural Use-Quality.[89] Furthermore, such groundwater must have background levels that will sufficiently comply with the Agricultural Standards and have TDS levels under 10,000 mg/L.[90] In order to ensure the protection of the state's numerous lakes, streams and rivers, Colorado has adopted a separate class, Surface Water Quality Protection, which applies to any proposed or existing activity that does, or will, impact groundwater such that the water quality of a surface water body will be compromised.[91] Colorado's Potentially Usable Quality class applies to all groundwater that is not used for domestic or agricultural uses.[92] These waters generally will not adequately comply with the Human Health or

---

72 *Id.*
73 *Id.* Since most groundwater in Class III is unusable, generally, there should be little or no risk. *Id.*
74 *Id.*
75 118 NEB. ADMIN. R. & REGS. § 7.001 (1991).
76 The regulations establish a variety of beneficial uses including: drinking water, irrigation, livestock watering, industrial and commercial purposes. The regulation go on further to state that the most sensitive beneficial use of groundwater is drinking water. *Id.* § 6.001-.002.
77 *Id.* § 7.002.
78 *Id* § 7.003.01A.
79 *Id.* § 7.003.02.
80 *Id.*
81 *Id.* § 7.003.03.
82 *Id* § 7.003.03A.
83 *Id.* § 8.001.
84 5 COLO. CODE REGS. §3.11 (1995).
85 *Id.* §3.11.4.
86 *Id.* §3.12.
87 *Id.* §3.11.4(B)(1).
88 *Id.*
89 *Id.* §3.11.4(B)(2).
90 *Id.*
91 *Id.* §3.11.4(B)(3).
92 *Id.* §3.11.4(B)(4).

Agricultural Standards, although domestic or agricultural use may be a reasonably expected future use. Such an expectation may be based on "background levels of water quality, geologic and hydrologic conditions, the degree to which any particular types of pollutants present are subject to treatment; the economic reasonableness of such treatment; and whether pollution arises from natural sources."[93] Colorado's default class, Limited Use and Quality, applies to all groundwater that does not meet the requirements of any of the other classes. Generally, such groundwater will have TDS levels in excess of 10,000 mg/L. Additional groundwater may be classified as Limited Use and Quality if it is exempted by the Colorado Oil and Gas Conservation Commission.

Perhaps the most striking feature of Colorado's classification system is that the groundwater classes are applied only on a site-specific basis.[94] In effect, Colorado has struck a compromise on a recurring problem: whether to initially map all groundwater within the state or to have a classification system that is solely reactive. By promulgating general classes with interim narrative quality guidelines, the Colorado Department of Public Health and the Environment was able to successfully implement a groundwater classification system that, over time, as the appropriate data is gathered, will eventually map all the groundwater within the state.

3. Illinois

As a result of concern over the protection of groundwater resources within the state, the Illinois General Assembly enacted the Illinois Groundwater Protection Act (IGPA).[95] The purpose of the Act is to "restore, protect, and enhance the groundwaters of the State, as a natural and public resource."[96] The General Assembly further noted that the "groundwater resources of the State be utilized for beneficial and legitimate purposes"[97] and managed for the benefit of Illinois' citizens.[98] Furthermore, and perhaps most importantly, the IGPA recognizes that "groundwaters differ in many important respects from surface waters, including water quality, rate of movement, direction of flow, accessibility, susceptibility to pollution, and use."[99] Using these directives as a guide, the Illinois Environmental Protection Agency drafted implementing regulations that created an extensive groundwater classification system for the State of Illinois. This classification system breaks groundwater into four classes, as well as groundwater management zones, to achieve the desired goal of protecting groundwater resources within the state.[100] Class I, Potable[101] Resource Groundwater, is defined to include all ground waters that are located ten feet[102] or more below the surface and that produce groundwater in amounts sufficient to maintain a potable use.[103] Several tests can be used to determine potable quantities. These include demonstrated use, suitable hydrogeologic parameters, or thickness associated with aquifers found in various rock types.[104] Perhaps the most significant hydrogeologic parameter examined is sustained yield. Under this test, water in strata must have the capability to sustain a yield of "at least 150 gallons per day in a borehole of reasonable size and over a typical collection thickness."[105] Besides those ground waters that meet the above requirements, the Illinois Pollution Control Board has the authority to add other waters to Class I.[106]

Class II represents Illinois' default class which includes all groundwater that does not fall within Class I, III, or IV.[107] This class, General Resource Groundwater, generally includes groundwater that is not potable because: 1) it does meet quantity or quality limitations; 2) it has not been otherwise specially classified as Class III; or 3) it does not meet the limited usefulness requirements of Class IV.[108]

---

93 *Id.*

94 *Id.* §3.12.

95 Ill. Rev. Stat. ch. 111½, para. 7451 (1989).

96 Ill. Admin. Code tit. 35, §620 (1991) (referencing Introductory Materials - page 3).

97 *Id.*

98 *Id.*

99 *Id.* (referencing Introductory Materials - page 4).

100 Ill. Admin. Code tit. 35, §620.201 (1991).

101 Potable is defined as "generally fit for human consumption in accordance with accepted water supply principles and practices." Ill. Rev. Stat. ch. 111½, para. 7453(h) (1989).

102 Illinois adopted a ten foot rule recognizing that "many surface activities can impact very shallow underground water without also impacting the bulk of potable ground waters." As an examples, the Illinois Pollution Control Board cites agricultural issues. Agricultural communities were concerned that the adopted standards would disallow the use of "chemical alteration of all subsurface waters, including disallowing the use of agricultural chemicals that operate through roots." Ill. Admin. Code tit. 35, §620 (1991) (referencing Introductory Materials - page 12).

103 Ill. Admin. Code tit. 35, §620.210 (1991).

104 *Id.* §620.210(a).

105 *Id.* §620.210(a)(4). The 150 gallons per day limit is that limit which the EPA defines as a yield sufficient for groundwater to serve as a water source for a household unit. Ill. Admin. Code tit. 35, §620 (1991) (referencing Introductory Materials - page 10).

106 Ill. Admin. Code tit. 35, §620.210(b) (1991).

107 *Id.* §620.220.

108 *Id.* §620.220(a). The Illinois Pollution Control Board notes that at some point it may be necessary to subdivide Class II as more experience is gained in the implementation of the classification system. Ill. Admin. Code tit. 35, §620 (1991) (referencing Introductory Materials - page 13).

Additional waters may also be designated Class II by the Illinois Pollution Control Board provided that a showing can be made, among other things, that the groundwater is capable of industrial, agricultural, recreational or other beneficial uses.[109]

Illinois' Class III Special Resource Groundwater regulations are specifically derived from the EPA's groundwater protection strategies.[110] For the most part, all Class III groundwater is subject to highly stringent standards. This class is reserved for those waters that are either "demonstrably unique" or those that are "vital for a particularly sensitive ecological system."[111] Waters that might be considered unique include Outstanding National or State Resource Waters, while examples of waters that play an ecological role include wetlands, lakes, caves, ponds, prairies, and streams.[112]

Class IV, Other Groundwater, was codified in the regulations to accommodate groundwater that is of limited beneficial use.[113] These waters may be of limited use due to particular practices or natural conditions. Examples of such waters include those that occur in the zone of attenuation surrounding a landfill, those that naturally contain more than 10,000 mg/L of total dissolved solids, and those that are located in mining-disturbed areas.[114] Additionally, this class also includes all groundwater that has been designated as an exempt aquifer by the Illinois Pollution Control Board.[115]

To fully implement its groundwater classification scheme, the IEPA has provided for the establishment of groundwater management zones within each class.[116] The regulations specify that a management zone be established for groundwater that has become contaminated. Once established, groundwater remediation can begin. The goal of the remediation, if practicable, is to clean the groundwater to the standards of its applicable class.[117] The IEPA noted in the background materials to the regulations that they had considered implementing a separate "remedial groundwater" class into which "various substandard but potentially remediable groundwaters would reside either temporarily or permanently."[118] The IEPA, however, decided against the implementation of such an idea because of the ongoing problem that exists with a remedial class; to which class do remedial groundwaters return after remediation.[119]

One notable feature of Illinois' groundwater classification system is that any groundwater can be reclassified by following the adjusted standards provisions of the regulations.[120] These provisions require the petitioning party to present before the Illinois Pollution Control Board information consisting of geographic and hydrogeologic parameters and characteristics.[121] Furthermore, the regulations require the petitioner to demonstrate that the reclassification is necessary for social and economic development as well as the existing and anticipated uses of the specific groundwater.[122] Alternatively, the regulations also allow for the reclassification of any groundwater by site-specific rulemaking.[123]

III. Proposed Methodology for Missouri

A. Proposed Classification System

As described earlier in this paper, Missouri's current regulatory authority governing groundwater does not explicitly recognize "natural variation in quality, yield, actual or potential use."[124] Instead, Missouri treats all groundwater equally, under a single, drinking water standard. This approach, however, fails not only to recognize the natural diversity found throughout Missouri's groundwater, but also fails to address the often "profound impacts historic conditions can exert on local groundwater and useability."[125] These limitations and the lack of flexibility that plagues Missouri's current groundwater regulations can be alleviated by implementing a groundwater classification scheme that utilizes groundwater management zones to combat localized environmental impacts.

In defining a classification system, it is of foremost importance to adequately define the resource that needs to be

[109] Ill. Admin. Code tit. 35, §620.220(b) (1991).
[110] *Id.* §620.230.
[111] *Id.* §620.230(a).
[112] Ill. Admin. Code tit. 35, §620 (1991) (referencing Introductory Materials - page 13).
[113] Ill. Admin. Code tit. 35, §620.240 (1991).
[114] *Id.* §620.240(a)(g).
[115] *Id.* §620.240(d).
[116] *Id.* §620.250.
[117] Ill. Admin. Code tit. 35, §620 (1991) (referencing Introductory Materials - page 14).
[118] *Id.*
[119] *Id.* (referencing Introductory Materials - page 14-15).
[120] Ill. Admin. Code tit. 35, §620.260 (1991).
[121] *Id.*
[122] *Id.*
[123] Ill. Admin. Code tit. 35, §620 (1991) (referencing Introductory Materials - page 15).
[124] Regulatory Environmental Group for Missouri (REGFORM), Proposed Methodology for Developing Groundwater Standards for Missouri E-1 (July 13, 1995) (hereinafter REGFORM Proposal).
[125] *Id.*

protected.[126] The lack of scientific research and data available on groundwater behavior makes this difficult. While a restrictive definition may not adequately include all the resources the state wishes to protect, a overly broad definition may not offer the level of protection desired. Illinois definition appears to be the most thorough. Under its regulations, "aquifer means saturated (with groundwater) soils and geologic materials which are sufficiently permeable to readily yield economically useful quantities of water to wells, springs, or streams under ordinary hydraulic gradients."[127] It may be necessary to add language that exempts shallow alluvial aquifers from this definition.[128] These aquifers present special management problems that the state may not wish to address in this classification methodology.

Once an adequate definitional basis is established, the next step is to decide how individual aquifers will be classified. Classification systems can be either anticipatory or anticipatory.[129] Reactive systems do not classify groundwater until a regulatory decision influencing a particular site is made or until a contamination incident occurs. The EPA's groundwater protection strategy adopts this approach. Although a reactive system is more economical, it is generally less protective than anticipatory systems. Reactive systems undermine the desired policies of providing regulatory management guidance and land use controls for individual aquifers, because they assign classes on an *ad hoc* basis.[130] Furthermore, although the state may initially save money implementing such a system, in the long run a reactive system may actually lead to increased regulatory costs. "Reactive systems can substantially increase the uncertainty, delay, and cost associated with development decisions."[131]

The better, albeit, more expensive approach, is an anticipatory classification system. Anticipatory systems map all aquifers up front, thereby predetermining the applicable groundwater regulatory requirements.[132] In this way the state can better manage the entire groundwater resource. In addition, the regulated community will be better informed as to the standards to which they will be held. Missouri would be best to adopt this anticipatory approach. Although the task of initially mapping the state's groundwater resources may seem both daunting and expensive, the benefits will outweigh the burdens. Furthermore, much of the work may already be done. The Division of Geology and Land Survey of the Missouri Department of Natural Resources has substantially mapped most of the groundwater in Missouri based on the water's susceptibility to contamination.[133]

The next step in the process of designing a classification system is to formulate the various classes that will be required to adequately protect the groundwater resources within the state. It is important to take into consideration factors such as current use, quality, yield, and aquifer conductivity when initially establishing groundwater classes.[134] For Missouri, four classes should suffice: Class I - Drinking Water Supply Ground Water; Class II - General Resource Ground Water; Class III - Special Resource Ground Water; and Class IV - Other Ground Water.

Groundwater that is currently being used as a drinking water supply or potentially could be used for that purpose would fall into Class I.[135] In general, federal drinking water standards shall serve as the benchmark for waters within this class, with individual determinations based on both ambient quality and delivery rates.[136] Class I groundwater should have a hydraulic conductivity greater than 1×10^{-4} and a sustained yield in excess of 1400 gallons of water per day.[137]

Class II, General Resource Ground Water, would include groundwater that is suitable for uses other than drinking, such as agricultural or industrial.[138] This class would be less stringent than the others, and, as such, would be primarily for subsurface waters that are contaminated, either naturally or by human activity, which cannot be cleaned up using reasonable methods.[139] The development of a numerical standard look-up table would be especially advantageous for this class; however, provisions would have to be enacted to allow for site specific amendment of these standards.[140] These

---

126 UNSEEN RESOURCE, *supra* note 29, at 14-15.

127 35 Ill. Adm. Code § 620.110 (1994).

128 Such language could be "[f]or purposes of these regulations, sandy or gravely alluvial soils in or on the floodplains of intermittent streams are not an aquifer." REGFORM PROPOSAL, *supra* note 124, at Appendix B, page 1.

129 UNSEEN RESOURCE, *supra* note 29, at 16.

130 *Id.*

131 *Id.*

132 *Id.*

133 *See* DON E. MILLER ET AL., AQUIFER CLASSIFICATION BASED ON VULNERABILITY TO CONTAMINATION (prepared by the Missouri Dep't of Natural Resources, Division of Geology and Land Survey).

134 REGFORM PROPOSAL, *supra* note 124, at 6.

135 *Id.*

136 *Id.*

137 *Id.*

138 *Id.*

139 REGFORM DRAFT PROPOSAL, *supra* note 47, at 7.

140 REGFORM PROPOSAL, *supra* note 124, at 6.

standards could be based on risk assessment principles, including exposure pathways and risk to human health and the environment. To ensure that the groundwater will not be used for drinking water purposes in the future, it may be necessary to have a provision in place that will allow the state to place some type of institutional control, such as deed restrictions, on the property.

Class III groundwater should be highly protected. This class would include special resource waters that are unique because: 1) they are irreplaceable sources of water in areas without alternative surface supplies; 2) they are aquifers of high quality and flow that have the potential to significantly affect the quality of streams that they recharge; 3) they are vital to a particularly sensitive ecosystem; or 4) they recharge outstanding state or national resource waters.[141] Stringent cleanup standards would be recommended for any waters, such as sinkholes, losing streams, and cave systems, that are within this class.[142]

Class IV groundwater would be "neither potable nor useful for agricultural or industrial purposes, nor of outstanding quality, either due to limited productivity and/or migration potential, natural contamination, historic releases, or proximity of regulated disposal areas."[143] Class IV designations should be made on a site-specific, case-by-case basis. Groundwater may be designated as Class IV when cleanup to Class I, Class II, or Class III standards is unnecessary, because it has a limited use, is impractical, or is technologically infeasible.[144] Groundwater that falls within a groundwater management zone will also be classified as Class IV.[145] Such a classification may either be temporary or permanent. Because the Class IV designations are based on the "conclusion that further remediation is impracticable or of no benefit to human health or the environment," standards for this class may be based on present or future concentrations.[146]

B. Groundwater Management Zones

Groundwater management zones would serve as three-dimensional areas used to help facilitate environmental cleanups, where contaminants have been released from a site.[147] These zones would allow "site-specific water quality standards and would facilitate the active management of existing local impacts on aquifers."[148] Under this proposal, groundwater management zones must have the approval of the state. Management zones would exist until the corrective action restores the impaired water to its original class, or a determination is made that the water must be reclassified due to the impracticability of the cleanup.[149] A groundwater management zone can be established for any class of groundwater.[150] Attached to the end of this paper is an illustration of a groundwater management zone.

C. Sample Scenarios

To understand fully how this classification scheme will operate, several illustrative examples have been included below. These examples were developed as part of a project for the Regulatory Environmental Group for Missouri and are reprinted here, with their approval.

Example 1

Assume there is an existing facility located above groundwater that has not been classified. The facility conducts a subsurface investigation and discovers that its operations have impacted an aquifer, which beyond the area of impact would meet the definition of Class I. The facility proposes that a groundwater management zone be established while remedial options to address the contamination it caused are evaluated and implemented. The facility initiates a pump and treat remedy with Class I standards as the remedial goal. The groundwater remediation is successful, the standards are achieved in 18 months, and the groundwater management zone is eliminated.

Example 2

In a Brownfield initiative, a company investigates relocating a manufacturing plant to an abandoned plant in the metropolitan St. Louis area. The site investigation reveals that historic operations created a groundwater contamination plume within a shallow aquifer that would otherwise qualify as Class II. The Missouri Department of Natural Resources and the prospective purchaser agree that unless the groundwater is pumped, it does not pose a threat to human health or any other natural resource. They further agree that no groundwater remediation would be required. The prospective purchaser proposes a Class IV designation which, after review, is approved by MDNR. As a condition for Class IV designation, MDNR requires a notice in the deed for the property.

[141] REGFORM DRAFT PROPOSAL, *supra* note 47.
[142] REGFORM PROPOSAL, *supra* note 124, at 7. Much of these unique resources result from Missouri's diverse geology, specifically its karst topography.
[143] *Id.*
[144] *Id.* at E-2.
[145] *Id.* at 7.
[146] *Id.*
[147] REGFORM DRAFT PROPOSAL, *supra* note 47, at 8.
[148] *Id.*
[149] REGFORM PROPOSAL, *supra* note 124, at 8.
[150] *Id.* at 4.

Example 3

A facility conducts a pre-sale investigation and discovers existing TCE contamination in the vicinity of a former wastewater lagoon. The owner enters the state voluntary cleanup program and documents that Class II cleanup standards are an appropriate remediation goal. A groundwater extraction and venting remedy is installed and implemented for two years, during which time the groundwater is considered to be within a groundwater management zone. Due to the presence of residual contaminants unique to the site, the concentration of groundwater contamination is reduced, but not to Class II standards. The facility owner documents that the Class II standards cannot be achieved, and applies for and obtains approval for a change of classification to a Class IV. At that time, the groundwater management zone is eliminated.

IV. Conclusion

Missouri's current regulatory system is rigid, offering only one level of protection for groundwater. Having only one level of protection, drinking water quality, is both infeasible and impractical. A groundwater classification system is necessary if Missouri wishes to effectively address the diverse character of groundwater resources throughout the state. In addition, a classification scheme will add flexibility to the current regulatory system thereby maximizing both cost effectiveness and protection of groundwater.[151] Many states have successfully implemented groundwater classification systems. This paper has presented several suggestions regarding the development of a groundwater classification methodology. In general, a valid classification methodology must first, establish groundwater classes, and second, establish provisions that allows for the establishment of groundwater management zones. The time to act is now.

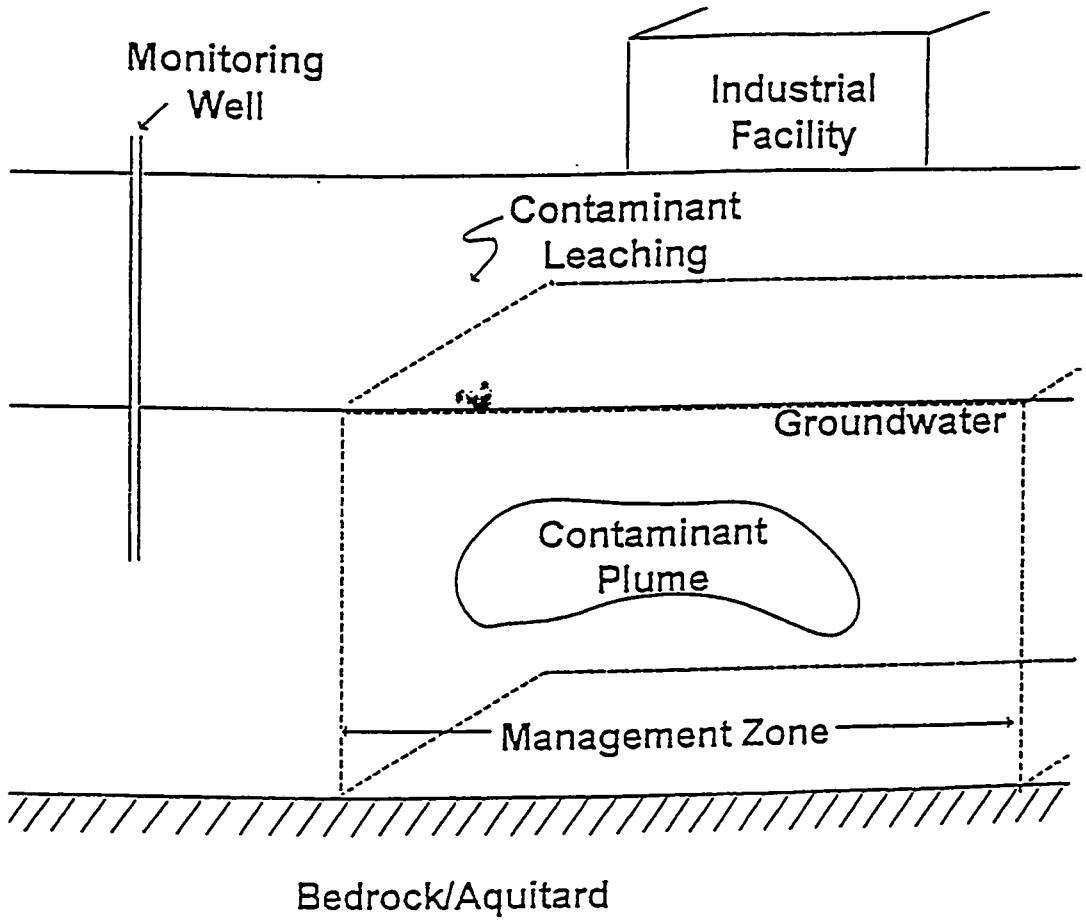

Figure 1

Conceptual Diagram of a Groundwater Management Zone

Burns & McDonnell Waste Consultants, Inc.

[151] Bollinger, *supra* note 43, at 6.