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Small Municipalities and Water Supply

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SMALL MUNICIPALITIES AND WATER SUPPLY

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Small municipalities have different challenges in providing public drinking water than do their urban counterparts. Because increasing pressures on small, rural governments mean they are less able to provide all the services demanded of them, dealing with water supply problems tends to have repercussions outside of water supply. This issue of *IMPACT* introduces how complex providing and protecting rural drinking water can be.

W A T E R   R E S O U R C E S

IMPACT

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INTRODUCTION
SMALL MUNICIPALITIES AND WATER SUPPLY

Laurel E. Phoenix

States are interested in building capacity in small, rural governments and promoting a regional perspective regarding land-use, planning, and compliance with state and federal regulations. This is particularly critical with regard to drinking water. The smaller the local government, the less likely that it will have the combination of factors required to fulfil its array of legal obligations. For example, small communities violate federal requirements for safe drinking water as much as three times more often than cities. How, then, can we assure the quality of rural drinking water?

Several trends have combined to increase the needs of small, rural governments. First, national programs for rural development are fragmented, poorly funded, and have lost funding since the devolutionary trend of the 1980s. Second, rural areas are undergoing an economic restructuring at the same time that they are not benefiting proportionately from national economic growth. Third, demographic trends show more people moving to some rural areas, particularly those with high amenity value. Rural growth pressures due to tourism, retirement, and footloose workers increase demand on small, rural governments to provide services to which these new populations are accustomed. Finally, the last decade's rising drinking water standards pose serious problems for many villages and towns.

All of the above is highly relevant to the provision of rural drinking water. Articles in this issue of *IMPACT* touch on a limited number of the myriad ways that rural drinking water can be affected, for good or ill. My intent is to impress upon the reader how few of these forces are under the control of small rural water systems, and how the problems of planning for, protecting, and providing rural drinking water are far more difficult than many small municipalities can shoulder, and are intricately tied to land use issues (urban and rural) that few municipalities want to face.

The article by Axness *et al.*, provides context and depth into the growing search for public drinking water by Brown County urban/suburban communities, with no regard for how their search for and contest over water supply sources affects rural communities that share their aquifer. Imagine this scenario replayed many times across the country in the face of urban sprawl, and imagine what this implies for rural communities with small budgets. Land use and water supply decisions by these larger municipalities impose an extraordinary cost on their rural neighbors. Rural governments are encouraged by the state to use a regional approach to solve problems and work with neighboring communities – why wouldn't the converse hold true in the case of these Brown County municipalities?

The article by Jaskula and Hohn traces the history and current administration of a new Wisconsin state plumbing code and its unknown effects on land use, development, and ground water quality. A plumbing code sounds like an unlikely potential nemesis of ground water quality, until you find that this code deals with septic tanks. This article is also interesting from a policy analysis viewpoint. The success of this new state code to better protect public health relies on two dubious assumptions: (1) homeowners with these new systems will be unlike their predecessors and faithfully maintain their systems and report their maintenance to the county; and (2) without outside funding, counties will be able to finance a maintenance tracking system of all existing and new systems in the county in order to ensure that homeowners are not endangering public health through improper maintenance.

The article by Hodgson looks at ground water quality from the perspective of federal regulations intended to protect ground water sources. The federal Source Water Assessment Program (SWAP) requires states to delineate source water assessment boundaries for all public water systems, inventory existing and potential sources of contamination within these boundaries, and determine the susceptibility of the water systems to those contaminants. Hodgson discusses criteria used to determine boundaries and susceptibility to contaminants, and then asks why transient noncommunity systems should be treated any differently than other community and noncommunity systems. He gives several examples where the weaker the criteria used to assess, the more these systems can endanger public health. Remember this article the next time you stop at roadside rest areas, rural campgrounds, or that cute little restaurant on the highway.

The article by Phoenix provides some brief case studies of how several towns and villages in rural upstate New York recently responded to either changes in federal drinking water regulations or critically low ground water levels. Reading about each community illustrates the variety and similarity of their water supply problems, and the ways they struggled to solve their drinking water problems. Particularly interesting are the comments by local officials when venting their frustration at the difficulties they face and how sometimes the need for potable drinking water drives them to unpalatable solutions.

Finally, the article by Berry *et al.*, looks at county commissioners in the West and how they perceive themselves and the water issues they address. Clearly, the strengths of agriculture and ranching in rural western economies influence how water issues in the west are prioritized, and to what degree county commissioners get involved with municipal water supply issues. This article illuminates the wide variety of water organizations with interests in different uses for water, and the role that

Introduction . . . cont'd.

local government officials play in defining and solving water problems.

I hope this issue provides you new perspectives on drinking water provision for small communities. As you read, try to visualize the array of forces driving change in rural areas, their ability to respond, and the critical nature of protecting, providing, and paying for safe drinking water in small municipalities.

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WHEN THE WELL RUNS DRY:
EXAMINING THE WATER SUPPLY ISSUES IN BROWN COUNTY, WISCONSIN

Kendra A. Axness, John Potokar, and Thomas Van Drasek

INTRODUCTION

Drinking water demand is putting pressure on Brown County, Wisconsin's, two water sources. The City of Green Bay uses Lake Michigan water, supplied via pipeline. Green Bay's suburbs and surrounding rural communities rely on municipal and private ground water wells to provide residents with water for household and industrial use (Consoer Townsend & Associates, Inc., 1992). The population of many rural communities has been growing, resulting in increasing demand for fresh water. Greater quantities of water have been withdrawn from the aquifer to meet this increased demand. It is estimated that at current pumping rates, wells located in central Brown County will not be able to provide enough ground water in 10 to 15 years without additional wells and optimized pumping schedules (WDNR, 2001). This decline in the aquifer may also mean inadequate ground water for surrounding rural areas.

This article will briefly discuss the root issues of the water supply problem, summarize the proposed solutions, and consider the impact of these solutions on the surrounding rural communities.

THE WATER SUPPLY PROBLEM

Water supply has become a problem in Green Bay and surrounding communities (Figure 1) for a number of reasons. A significant reason for the water shortage is the nature of the area's surface soils and subsurface geology, which limit aquifer recharge. Another reason is that much of the area's ground water is contaminated because of naturally-occurring radium in the aquifer. Finally, water supply is a problem because the population of the area is growing, and water usage by area residents is growing.

Groundwater and Geology

Prior to development of the area, potentiometric heads in the confined sandstone aquifer were above land surface in the lower Fox River Valley. This produced many springs and flowing wells. This aquifer is present beneath all of Brown County and disappears just west of the county. As the area developed, ground water levels declined. After development, the maximum depth to water under Green Bay in 1957 was 330 feet (Figure 2). After the pipeline in Green Bay was installed in 1955, there was a noticeable rebound in the aquifer, accompanied by a shift in the location of the lowest depth of the water table from downtown Green Bay to the area below Allouez and Ashwaubenon (Figure 3). By 1964, the reduction in pumping by Green Bay was offset by increased pumping from industry and growing communities surrounding the City of Green Bay and water levels again began to decline. A modeling study conducted by Conlon (1998) predicted that in the year 2030, the lowest point of the piezometric surface in the central Brown County area would be at or slightly above the Precambrian bedrock surface, severely restricting the amount of water available for distribution. Water levels in the Green Bay area have declined approximately 430 feet, from predevelopment to 1990. Continued decline in water levels in the aquifer may result in increased cost of pumping and potential water quality problems as deeper water is withdrawn.

Figure 1. Municipalities in Brown County (Brown County, 2001).

Water Quality

Declining water levels affect water quality. As wells are drilled deeper, water that is withdrawn has been exposed longer to surrounding rock layers. Over time, minerals in those rocks dissolve in ground water leading to higher concentrations of natural contaminants such as radium or iron (WDNR, 2001).

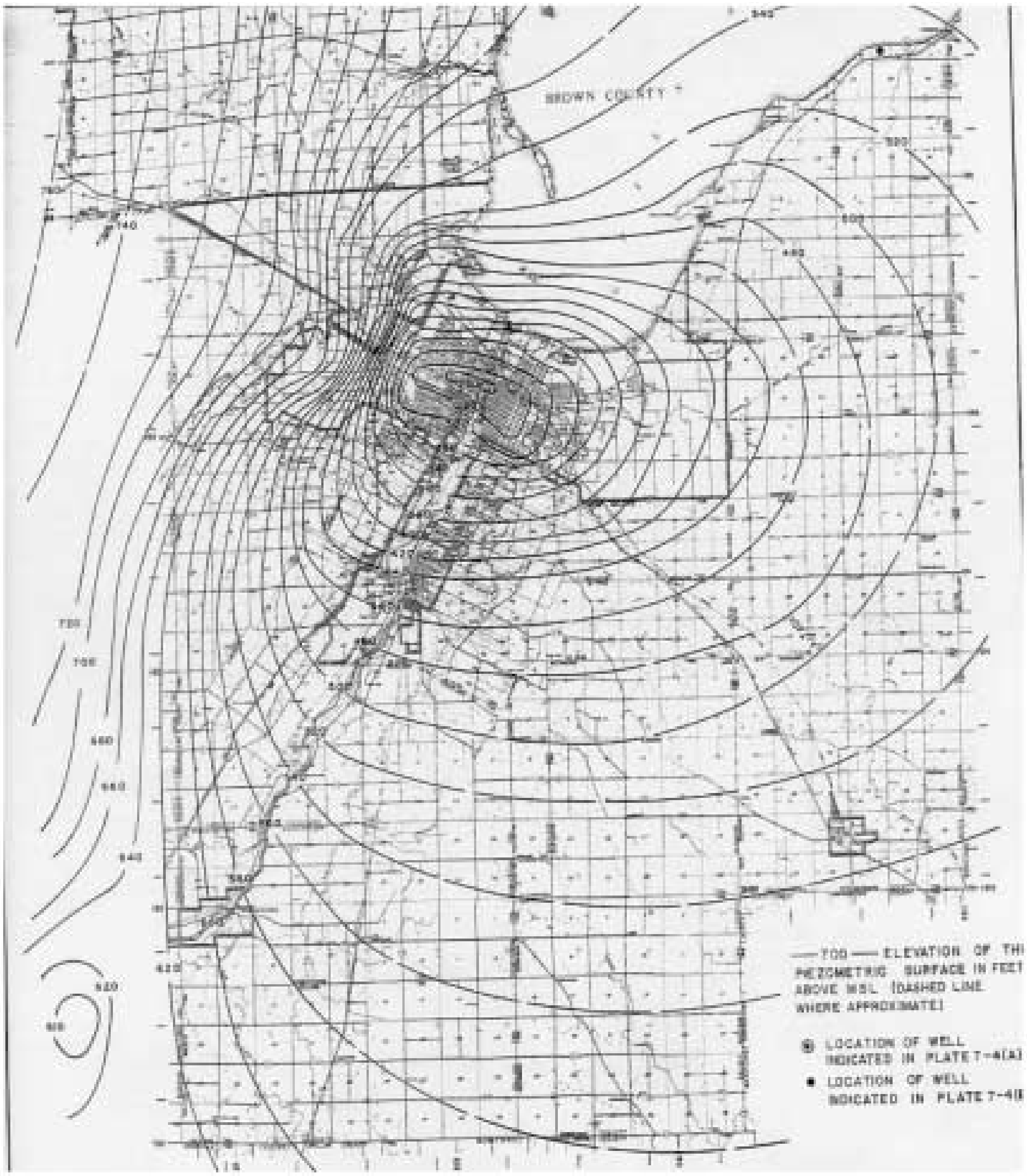

Figure 2. Piezometric Surface of Water in the Sandstone Aquifer, August 1957 (Donohue & Associates, 1976).

Authorities hired Donahue & Associates in 1973 to check water sources after there were complaints about bad taste and discolored laundry. The average concentration of iron in Brown County ground water was found to be 0.5-0.7 mg/l, which is approximately two times the recommended limit. The highest iron level recorded was 3.0 mg/l (Donahue & Associates, 1976). These concentrations were a significant increase over the 1974 iron levels of 0.3 mg/l. This extreme increase in iron levels over such a short time caused great concern. Other naturally-occurring minerals that were found in elevated concentrations as a result of withdrawal of water from deeper strata included manganese, sodium, potassium, silica, carbonate, bicarbonate, sulfate, chloride, fluoride and nitrite.

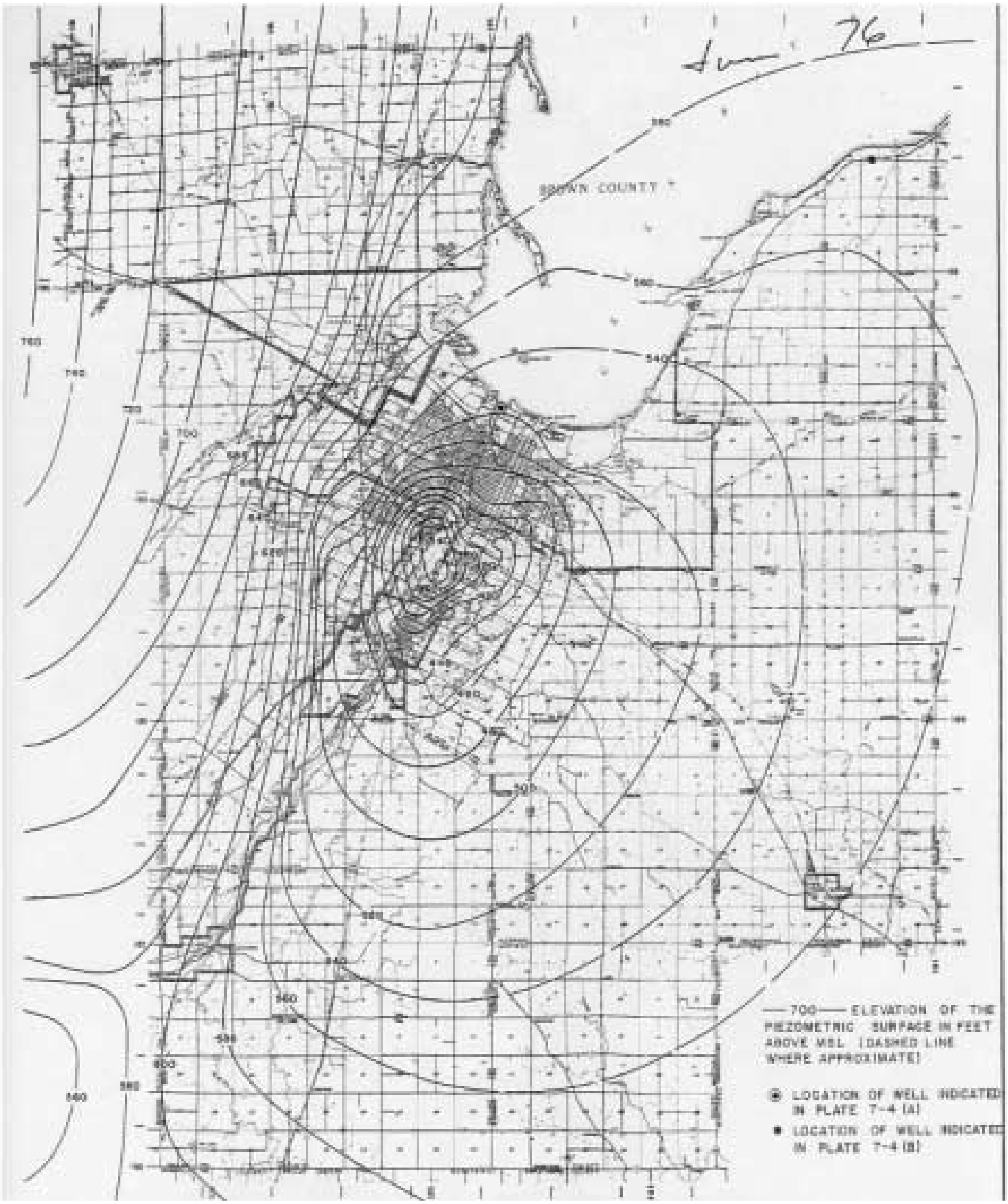

Figure 3. Piezometric Surface Water in the Sandstone Aquifer, January 1973 (Donohue & Associates, 1976).

Radium has also been a significant concern for the communities relying on ground water. Radium has been found in the ground water at levels three times the acceptable standard (Langenkamp, 1998). The suburbs of Allouez, Ashwaubenon, Bellevue, De Pere, Howard, and Ledgeview will be required to install water softening units to treat ground water high in radium (WDNR, 2001). The expense of the treatment units (estimated to be $500,000 per system) could be avoided if the Central Brown County Water Authority (CBCWA, 2001) communities connect to Green Bay's system or construct their own pipeline (Langenkamp, 1998).

Growth

To address the water quantity and quality problems associated with growth, several suburban communities (Allouez, Ashwaubenon, Bellevue, De Pere, Hobart, Howard, Scott, Lawrence, and Ledgeview) formed the CBCWA in 1999, and proposed to build their own pipeline. However, CBCWA communities have postponed pipeline plans in order to continue discussing an alternative of purchasing pipeline water from the City of Green Bay.

Members of the CBCWA prefer complete control over their water supply. Lacking that, they want the best possible economic deal from the City of Green Bay. Green Bay Mayor Paul Jadin says "Authority members must understand that Green Bay wants a profit on the water it sells to the CBCWA at least equal to the money the suburbs save by not building their own pipeline." Jadin says that the most complex part of the negotiation process has been keeping the authority at the table to continue discussions about joining the city's water system, even though the authority has made plans to build their own pipeline to Lake Michigan (P. Jadin, 2001, personal communications).

While the City of Green Bay is not threatened by the pending ground water shortage, the City's water demand is expected to exceed its supply capacity sometime in the future. Therefore, the City of Green Bay is also investigating various options for increasing available water supply, either through the construction of a second pipeline (either jointly with neighboring communities or on its own) or through the use of aquifer storage and recovery (ASR). ASR could also be used to supplement the available supply of water should the area communities choose to forego building their own pipeline to join with the City of Green Bay system. Conservation has not been a significant feature of the proposed water supply solutions.

Population and Water Use Trends

The population of CBCWA communities is expected to grow over the next 30 years, confirming the need to plan for additional demands on water supply. Table 1 shows the projected population for the nine CBCWA communities and the City of Green Bay for 2030. The table demonstrates that not only is population expected to grow, but daily water use per person is expected to increase substantially. The impact of this expected increase on the construction and management of future water supply projects could be significant. By managing demand, costs from construction of future water supply facilities and expansion of existing facilities may be reduced. Conservation has not been considered as a method to manage water demand.

The piezometric surface decline from current pumping by surburan communities is already reducing ground water levels in these rural areas

TABLE 1. Population and Water Withdrawal Projections for 2030 CBCWA Communities and Green Bay, Wisconsin.

	Population[1]	Water Withdrawal Rate (gal/day)[2]	Average Gallons Per Person Per Day
1990	170,506	7,315,070	43
2030	212,216	23,009,760	108
% Increase[3]	24	215	152

[1]Source: State of Wisconsin Department of Administration, 2001.
[2]Source: Walker *et al.*, 1998.
[3]Note that population and water withdrawal rates include only the nine CBCWA communities and Green Bay.

PROPOSED ENGINEERING SOLUTIONS

A variety of solutions have been proposed to manage the area's water supply and generate greater quantities of water. The solutions that have been proposed include drilling more and deeper wells in the western part of the county, building a second pipeline to Lake Michigan, and aquifer storage and recovery (ASR). ASR would be implemented by the City of Green Bay to expand capacity if the CBCWA communities opt to connect to Green Bay's system. While the aquifer will never completely "dry up," water quality and quantity problems will become increasingly severe without either management of water use or additional supply sources.

Suburban municipalities could avoid the capital expense of building a pipeline and also avoid the negotiations with the City of Green Bay by continuing to use the sandstone aquifer for their water supply. The aquifer is recharged in the western part of Brown County, where the confining geologic unit is thin and the soils are not as fine-grained. Therefore, water is expected to be more plentiful in the western part of Brown County. The 1953 Department of the Interior report recommended installing any new wells west and away from the existing city wells, as did the 1976 Donohue & Associates report (1976). In 1998, the U.S. Geological Survey (USGS) published its report, "Optimization of Ground-Water Withdrawal in the Lower Fox River Communities, Wisconsin" (Walker *et al.*, 1998). The report showed that the aquifer could continue to supply an adequate quantity of water through the interconnection of existing wells with strategically-placed new wells, using predetermined pumping rates. In addition, political water-sharing agreements would need to be established (Langenkamp, 1998).

The CBCWA gave the following reasons why the building of an independent Lake Michigan pipeline was selected as the best option for meeting the future potable water needs of the CBCWA communities: (1) the option contained the least variables and unknowns; (2) the engineering technology involved has been tested and used in Wisconsin; (3) the pipeline option was considered cost-effective because residents will eventually own the system; and (4) water rates could possibly decrease over time with an increase in the population of the CBCWA, while rates from the City of Green Bay would continue to increase annually.

The City of Green Bay has been planning to add a second pipeline to Lake Michigan, whether or not the CBCWA wants to purchase water from the city. The advantage to the City if CBCWA would like to purchase water is that it could spread the cost of a second pipeline over a larger populace, thus reducing costs, and it could potentially control the rate of growth in the suburbs through limiting future increases of water supplied.

IMPACT ON RURAL COMMUNITIES

As the suburbs and the City of Green Bay argue over whether they will pursue additional supplies separately or jointly, the effect of their decisions on local rural communities is never discussed. Their interests revolve around issues of cost to themselves and control of water supplies. Rural communities outside of Green Bay and CBCWA suburbs are also facing growth pressures and more demand on water supplies as sprawl extends to rural villages within commuting distance. The piezometric surface decline from current pumping by suburban communities is already reducing ground water levels in these rural areas.

If the growing communities of the CBCWA choose to access water from Green Bay's new pipeline or build their own pipeline, then ground water supplies would rebound once CBCWA hooks up to pipeline water. This rebound would prevent local rural communities from having to drill their wells deeper or having to install expensive systems to deal with increasing lead and radium levels. A higher water table would also mean reduced pumping costs for rural municipal and private wells.

If CBCWA chooses the option of drilling more wells to avoid the high financial costs of building their own pipeline or losing control of their water supply to Green Bay, then rural communities will continue to suffer from falling ground water levels from suburban overpumping. The Town of Scott in the northeast corner of Brown County is already in danger of losing ground water access under current well placements and pumping rates, and is trying to decide whether to drill deeper or be forced to buy water from the City of Green Bay. If CBCWA starts drilling wells in the western part of the county as suggested by the most recent USGS report (Walker *et al.*, 1998), then the western villages will start seeing ground water levels decline. This would add drilling, pumping, and water treatment costs on communities least able to afford them.

Brown County rural communities need to remind the City of Green Bay and CBCWA that a truly regional approach to the Brown County water supply problem would include looking at the impact of growth pressures, water demand, and water supply sources on rural water supplies. The data that the City of Green Bay and CBCWA use for population growth, water demand, and declining ground water levels never include their rural neighbors, and so leaves a large gap in rational planning for a critical regional resource.

LITERATURE CITED

Brown County, 2001. Brown County Municipality Map. *Available at* http://www.co.brown.wi.us/County_Clerk/Directory/municip.html.

CBCWA (Central Brown County Water Authority), 2001. Meeting Minutes from December 18, 2000. *Available at* http://cbcwaterauthority.com. *Accessed* November 13, 2001.

Conlon, T. D., 1998. Hydrogeology and Simulation of Ground-Water Flow in the Sandstone Aquifer, Northeastern Wisconsin. U.S. Geological Survey Water-Resources Investigations Report 97-4096, Middleton, Wisconsin.

Consoer Townsend & Associates, Inc., 1992. Green Bay Metropolitan Area Water Supply and Quality Study. Project No. 12-3520.

Donahue & Associates, Inc., 1976. Brown County Water Study, pp 100-130.

Langenkamp, Don, 1998. Aquifer's Condition Deteriorating. *Green Bay Press-Gazette*, May 10.

State of Wisconsin Department of Administration, 2001. Web Site. *Available at* http://www.doa.state.wi.us/dhir/boir/demographic/pop_proj.asp. *Accessed* November 9, 2001.

Walker, John F., David A. Saad, and James T. Krohelski, 1998. Optimization of Ground-Water Withdrawal in the Lower Fox River Communities, Wisconsin. U.S. Geological Survey Water Resources Investigations Report 97-4218, Middleton, Wisconsin, p. 22.

WDNR (Wisconsin Department of Natural Resources), 2001. Lower Fox River Basin Integrated Management Plan. PUBL WT-666-2001, Green Bay, Wisconsin.

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POTENTIAL IMPACTS OF COMM 83 ON RURAL GROUND WATER

Jeanette M. Jaskula and Warren A. Hohn

INTRODUCTION

There are approximately 1,990,000 households in Wisconsin in which 680,000 are residential and commercial buildings using some form of a private onsite wastewater treatment system (POWTS) (Corry, 1999). With so many households not relying on municipal treatment of their wastewater, the formation of effective criteria for the design, installation, inspection, and management of private septic systems is necessary. Most importantly, these standards must promote and ensure public health and protect Wisconsin's waters.

As demand for houses in rural areas grows, more POWTS will be installed. COMM 83 is the latest revision of the POWTS legislation in Wisconsin, allowing alternative technology systems to be used in areas previously undevelopable due to restrictive soil conditions. This paper first introduces the history of state and local controls of POWTS, and then covers why COMM 83 was revised and the ensuing controversy over its adoption. After brief descriptions of these new POWTS, COMM 83 improvements over previous codes are discussed, followed by problems of maintenance for different systems and related maintenance tracking concerns. Next, this paper looks at the land use implications of legalizing these formerly experimental systems, and the potential impact on rural drinking water from these new opportunities for rural development.

PRIVATE SEWAGE REGULATION AND ADMINISTRATION IN WISCONSIN

POWTS for domestic sewage are currently administered by the Wisconsin Department of Commerce (WDOC). Most of the sewage systems are inspected at the time of installation by local county zoning departments. The WDOC plan reviewers provide review services for public buildings as well as most pressurized systems (e.g., mounds, at-grades, etc.), new technology systems, and holding tanks. Most conventional in-ground systems are reviewed by county staff, especially for single family dwelling systems. Any design must be submitted by a licensed master plumber and a sanitary permit issued by the county or municipality in charge. Some agent status has been granted to the individual counties for holding tank approval and pressurized system approval. In order to determine what type of system is required, a certified soil tester-morphological (CSTM) evaluator must do a soil and site evaluation to determine the type of system required and how large the system must be for an individual application.

The Wisconsin Department of Commerce is correct in stating that zoning regulations determine development, and not state septic codes

COMM 83 regulates all sites where domestic wastewater is produced onsite but is not conveyed to a public wastewater facility under control of the Department of Natural Resources. Systems not covered include POWTS owned by the federal government and located on federal lands or POWTS held in trust by the federal government for Native Americans (Wisconsin Administration Code-COMM 83, 2000). Significant exceptions in this class are the numerous Indian casinos found in rural settings on tribal lands with high daily wastewater flows. However, many of the tribes have been obtaining COMM 83 approval to protect themselves legally. All counties have the option of delaying some of the new technologies until January 1, 2003.

Wisconsin's first plumbing code was adopted in 1914. The original intent was to protect public health, since water-borne diseases such as cholera and typhoid were present. The first major county involvement in the private sewage business was with the adoption of H63, which was created by emergency rule on June 21, 1980. The rule required counties to do field inspections of sanitary installations rather than issuing permits over the counter with no inspections. Today, every county must employ a CSTM to review soil tests and a licensed POWTS inspector to inspect system installation. H63 evolved over time into the current chapter COMM 83, which became effective on July 1, 2000.

COMM 83's CONTROVERSIAL REVISION

The previous POWTS code had not been significantly revised since 1980 when the Wisconsin mound was approved for general use. The WDOC revised the code for four important reasons: (1) to increase local control over the administration and enforcement of the code; (2) to provide citizens with access to modern wastewater treatment systems so that they can build homes and businesses on lots zoned by local government for those purposes; (3) to improve the treatment process and maintenance programs to help ensure that the systems protect public health and the ground water; and (4) to clarify the status of 680,000 treatment systems currently in use in the state, including systems installed prior to 1969 when there were few restrictions in the code (Corry, 1999).

A lawsuit seeking to invalidate the newly promulgated COMM 83 was filed in Dane County Circuit Court on June 5, 2000, by several municipal groups and grassroots environmental organizations seeking to block its implementation. Plaintiffs were: the League of Wisconsin Municipalities, 1000 Friends of Wisconsin, the Municipal

Environmental Group, Citizens for a Better Environment, and the Town of Caledonia. Highlights of the lawsuit included:

1. Fecal Coliform Danger – COMM 83 does not comply with Chapter NR 140 (Natural Resources Groundwater Quality) regulations.

2. No Ground Water Standards Met – COMM 83 does not comply with enforcement standards and preventative action limits in NR 140.

3. Nitrate Hazard – State law exempts the WDOC from ground water standards and exceeds the authority delegated to Commerce by the State Legislature.

4. Preapproved POWTS designs incorporated into component manual designs exceed authority delegated to Commerce.

5. Deficient Environmental Impact Statement (EIS) – In the adoption of COMM 83, WDOC has intended to go from a prescriptive code to a performance code, allowing increased flexibility to recognize new technologies. The EIS is insufficient because it fails to consider alternatives to these new technologies as required by the Wisconsin Environmental Policy Act (Essie, 2000).

Under protest, the new COMM 83 was adopted on July 1, 2000, without an injunction issued by the court.

TYPES OF ONSITE SEPTIC SYSTEMS

Before delving deeper into the COMM 83 controversy, the five most common types of sewage treatment designs should be outlined to understand their unique benefits and risks. Each system, with the exception of a simple holding tank, consists of an underground, watertight receptacle (septic tank) and a soil absorption bed (leachfield). The method of pumping effluent from the septic tank to the leachfield and the design of the leachfield differs in each treatment system. The following is a brief description of each treatment system.

Conventional In-Ground System

A conventional in-ground system can be used where the native soils are of a depth to provide at least 36 inches of suitable soil of the appropriate texture and structure between the bottom of the infiltrative surface and the area where the effluent drains out of the distribution pipes – and either the bedrock or the water table. Of the 36 inches of suitable soil, 24 inches must be *in situ* (native) soil found at the site. Because the bottom of the infiltrative surface is normally about 20 inches below the ground surface, conventional systems require at least 56 inches of soil between the soil surface and bedrock or the water table (WDOC, 1998).

Clogging can occur along the distribution pipes as solids and bacteria biomass accumulate in flow areas. The septic tank also requires periodic pumping of solids as well as inspection to determine if the tank remains watertight.

The conventional in-ground septic system is the most common system used in Wisconsin and nationwide due to the fact that it is the easiest and least costly to install and maintain. It has been codified in Wisconsin since 1969 and can be used in 47 percent of the state's land area. It constitutes 63 percent of all new systems installed and 57 percent of all replacement systems (WDOC, 1998).

In-Ground Pressure Distribution System

The principal difference between the in-ground pressure distribution system and the conventional system is the addition of a pump chamber that delivers effluent from the septic tank to the soil absorption bed in controlled pressurized doses. This reduces the probability that the system may clog. However, overheating pumps are one of the mechanical issues that arise with this type of system. In addition, deterioration of electrical wiring or the connections in the pump can be the result of harsh weather or corrosive gases inside the pump chamber.

Like the conventional in-ground system, 24 inches of unsaturated *in situ* soil from the infiltrative surface to the bedrock or ground water is necessary to install this treatment system. Space for the drain tile, gravel trench, and overlying fill above the soil absorption bed boosts the native soil requirement to 49-53 inches from the surface to the bedrock or the water table (WDOC, 1998).

These components, the same as those in conventional systems, have a long history in Wisconsin. Less than one-half of one percent of all new and replacement systems use the in-ground pressure distribution system (WDOC, 1999).

Wisconsin Mound

Like the in-ground conventional system, the Wisconsin mound also consists of a septic tank and a soil absorption bed. The mound system, however, allows the use of sand where native soil is insufficient. Effluent from the septic tank is pumped in pressurized doses to an aboveground, free-standing sand layer situated above 24 inches of *in situ* soil. The sand layer, placed upon an area of native soil, serves as the medium on which aerobic bacteria facilitate secondary treatment. The sand layer, in addition to the layer of native soil, provides 36 inches of vertical soil separation above bedrock or the water table (WDOC, 1998).

Mounds can be used in many different septic situations. For example, the A+4 mound system can treat wastewater effectively on sites with as little as four inches of soil beneath the layer of top soil called the "A horizon." Hence, the name "A plus 4" (WDOC, 1998).

The use of sand as a medium for wastewater treatment, rather than native soil, is more than 100 years old. Using sand in the mound system became available for general use in 1980, but new construction was restricted to sites with 24 inches of *in situ* soil. The WDOC maintains that there is no technical or public health reason for this restriction. The new code allows certain mound systems on sites with only six inches of *in situ* soil (where another 30 inches of sand can be added), which increases the suitable land area for this system by 25 percent. The mound constitutes 20 percent of all new systems installed and 23 percent of all replacement systems in Wisconsin (WDOC, 1999).

At-Grade

For at-grade systems, the distribution piping is placed on a prepared gravel bed at the ground surface (hence, at-grade). The effluent is pumped upward to be dispersed just below the land surface. Twenty-four inches of *in situ* soil is necessary to install an at-grade system totaling to 36 inches of suitable soil between the infiltrative surface and the bedrock or ground water. These systems are less expensive than the traditional mound. Before the adoption of the new COMM 83, at-grades were approved for experimental use only and constituted approximately 5 percent of new systems and 5 percent of replacement systems. The new code approves them for general use (WDOC, 1999).

Holding Tank

The holding tank is the simplest of all the onsite sewage systems. A tank is installed below ground that collects wastewater that must be pumped out periodically for treatment at another facility. A holding tank can be installed with a minimum of three inches of compacted bedding material. Counties have the option to ban holding tanks in certain areas (WDOC, 1998).

COMM 83 CHANGES FROM OLD CODE

Whereas the old COMM 83 was almost entirely a prescriptive code, the new COMM 83 is a combination prescriptive and performance code. To clarify, a prescriptive code gives the user a goal and a precise method to achieve that goal. A prescriptive example would be in Comm 82.35(3)(a): "cleanouts shall be located so that the developed length of drain piping shall not exceed 75 feet." A performance code gives the user the goal and does not necessarily require a particular method for achieving it. An example is Comm 82.40(7)(e) which states: "A water distribution system shall be designed so that flow velocity does not exceed eight feet per second." Theoretically, the new code is supposed to allow innovation and experimentation not allowed in the previous COMM 83.

Ultimately, many provisions in the old code are archaic and do not incorporate the current advances in POWTS technology. The principal improvement of the previous code is the addition of up-to-date septic technologies that reflect the current advances in wastewater treatment science. The single-pass sand filter, recirculating sand filter, aerobic treatment units (ATU), drip-line dispersal, and constructed wetlands are onsite septic technologies now available for general use under the new code. The new code enables property owners to meet environmental performance standards with treatment technologies that were not universally available under the old code.

The old code discriminated between replacement systems and newer systems installed for the first time. A new homeowner, for example, could not benefit from using a drip-line dispersal septic system; however, a current homeowner could use this system to replace a failing mound or in-ground system. In fact, under the restrictions of the old code many citizens were first installing a simple holding tank only to replace it later with one of the new septic technologies. This circuitous route to obtain the best septic technology was not cost effective for the landowner or the county and required two permits and plan approvals. In addition, the installer had to return to the site to do the conversion to the replacement septic system. The new COMM 83 gives homeowners and developers access to all nine septic technologies regardless of whether it is the first one on the property or a replacement.

Under the old code, the new, advanced septic technologies were approved for 'experimental' use only. The new code, adopted July 1, 2000, approved them for general use. These systems can be installed with only six inches of native soil. New types of mounds were also approved for general use. Figure 1 shows the distribution of soil depths within Wisconsin. Approximately 19 percent of Wisconsin's land area has a greater than 50 percent probability of having either bedrock or a high water table at less than six inches beneath the surface (WDOC, 1998). Advances in septic technology have allowed more systems to be installed where soil conditions were restrictive under the previous code.

The new code also improves the installation, maintenance, and reliability of the onsite sewage systems. Each installed system has a component manual detailing the installation instructions, inspection protocol, and a mandatory maintenance schedule ranging from three years for most systems to six months with filter systems that require more frequent cleaning. Each maintenance inspection is to be reported to the county, and the county is responsible to track these systems. Wood County, however, is the only county thus far that incorporates this tracking system. In addition, installers and inspectors are required to attend training courses prior to the installation of any new septic system type. A provision was also added that county staff or the state could intervene and classify a poorly maintained system as a public health hazard (WDOC, 1998).

About 200,000 systems still in use were installed prior to 1969 before modern wastewater codes were enacted (Corry, 1999). The new COMM 83 will take an inventory of these older systems and determine their effectiveness in treating wastewater. After 1969, a three-foot treatment zone was required beneath the drain field trench. The current code now designates a septic system as adequately treating wastewater if there is more than two feet of soil. Systems designed with only two feet or less will be presumed to be failing and in need of replacement.

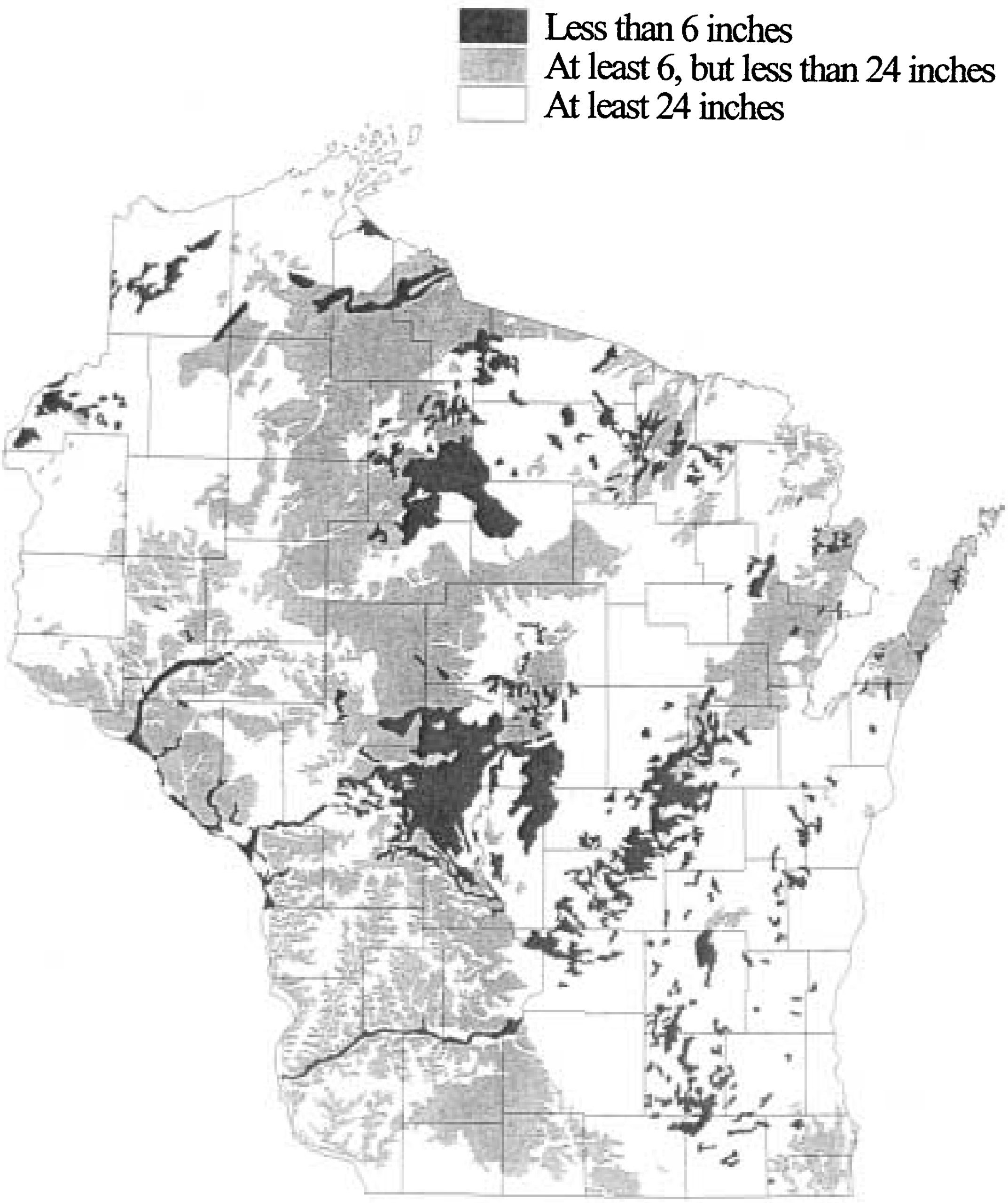

Figure 1. Soil Mapping Units by Predominant Depth to Bedrock or Water Table. (The soil information used for this map was Natural Resource Conservation Service 1994 STATSGO data. STATSGO was compiled at 1:250,000 and designed to be used primarily for regional, multistate, State, and river basin resource planning, management, and monitoring.

MAINTENANCE ISSUES

Many of the hi-tech systems require a great deal of maintenance and once they are not functioning properly, they may contaminate ground water with untreated sewage. One concern the state legislature had was that a good maintenance program had to be in place to meet the environmental protection intended by the new COMM 83. Thus, the state decided that counties must track maintenance on all these systems in order to protect public health. Many counties, especially the northern counties, felt that they did not have the personnel or computing capacity to track all of these septic systems and their maintenance requirements versus verified maintenance. Originally, the WDOC said they would provide a large database to handle the maintenance, but with passage of the new code, maintenance tracking was required of the counties. Some northern counties said they would bow out of the Wisconsin Fund Grant Program (for replacement of failing septic systems) if this was a requirement. However, the state said all systems including those installed prior to Wisconsin Fund involvement had to be inspected and maintained. This maintenance tracking program has not yet been solved. An owner also has responsibility to report to the counties within 10 days of any inspection, maintenance, or servicing.

The WDOC has a new credential available which is called a POWTS Maintainer. The duties of this person are: (1) to evaluate and monitor POWTS components to ensure that POWTS will operate as designed, protecting public health and the waters of the state; and (2) to provide the WDOC with data that they will use to make future regulatory decisions. Most counties find that most people do not report their holding tank pumping, which by the previous code had to be reported twice a year. Many people also do not maintain their septic systems. Some of the larger counties may be able to hire additional personnel or handle the reporting by increasing their computing capacity, but currently there is no set protocol in place in most counties. One county that has a fairly sophisticated system in place is Wood County, which hired a private consultant and financed the project by increasing county property taxes through a "user fee."

Wood County contracted with Carmody, Inc., to assist in the new COMM 83 requirement of reporting holding tank pumping within ten days. Wood County currently has records of 1,837 holding tanks with a gallonage capacity of 5.7 million gallons. County officials stated that the new system receives reports of about 22,000 gallons per day. Duane Gruel, Wood County Environmental Specialist, stated that they have not only seen environmental benefits, but health benefits as well (Anonymous, 2001). Counties will need more money to finance this sort of project, since searching current records for all existing systems will require considerable additional employee hours.

COMM 83 AND LAND USE

To what extent is COMM 83, a plumbing and health code intended to protect ground water, influencing the construction of homes and businesses in Wisconsin? It should first be noted that the Wisconsin legislature did not give the WDOC the authority to regulate land use through the plumbing code. The powers of the WDOC as contained in *s. 145.02 (1)* Wis. Stats. involve safeguarding the "public health and water of the state." The statutes do not ask the department to control land use by restricting access to plumbing systems. Michael Corry, Division Administrator of the Safety and Buildings Division of the WDOC, maintains that "COMM 83 and land use regulations have different purposes and different enabling statutes" (Corry, 1999). COMM 83 is designed to protect ground water from contamination. Land use codes, particularly zoning, are intended to limit the use of public and private lands.

Although COMM 83 is not specifically a land use code, it does influence land use in many ways. The new code can limit access to POWTS designs for some building lots because of the local soil conditions. The largest effects, according to Corry (1999), are where holding tanks are the only design permitted on a site due to the limited soil properties. If holding tanks are banned by the local government, or the developer simply decides not to build if a holding tank is the only option, construction of a home may be halted.

There are approximately 12,000 new homes built each year with onsite septic systems (Corry, 1999). Under the old code, 15.5 million acres of private, unincorporated land were suitable for some type of onsite septic system other than a holding tank. The new code, with the addition of better septic technologies, raises the amount of suitable land to 22.4 million acres. Figure 1 shows the general distribution of predominant soil types statewide. Soil depths between six and 24 inches (shaded gray) are the most vulnerable to development because newer septic technologies can now be installed where they were previously restricted under the old code.

Opponents of the new COMM 83 argue that this increase in suitable land area will promote urban sprawl and farmland conversion. Places with thin soils or steep slopes, where there have been natural limitations on development because of the difficulty in placing a conventional septic system, could now be developed. The introduction of new septic technologies that can be situated on even the most limited soil conditions may result in sprawling subdivisions. Dave Cieslewicz, director of the group 1000 Friends of Wisconsin, claims that 8.9 million acres or 25 percent of Wisconsin's land is available for development under the new COMM 83 (Cieslewicz, 2000). His group petitioned the WDOC to delay the passage of the new rules until all counties in Wisconsin developed effective land use plans. Before the new code was passed, Cieslewicz (2000) stated that only 22 percent of the communities most affected by the ruling had land use plans and approximately a third of this group had no zoning ordinances.

The WDOC maintains that the 1000 Friends of Wisconsin inappropriately classify the nearly nine million acres open for new septic technologies as if they were comprised of "large, pristine tracts of the Wisconsin countryside" (Corry, 1999). The suitable land, however, is scattered across every township in every county of Wisconsin and not situated in one geographic area of the state. In addition, all the land can be developed with holding tanks, unless banned by local governments. These areas are already open for development using holding tanks without the availability of new technology.

Because soil types can vary within a few feet, the restrictions under the old code to access new POWTS designs results in one lot in a subdivision that can be built while a neighboring lot cannot. Corry (1999) reports that it is not uncommon to have 5 percent or more of the approved lots wasted because of the restrictions under the old code. The result is a decrease in the density of the subdivision and an increase in demand for additional subdivisions. The new COMM 83, which increases the number of possible system types from four to nine, may in fact control urban sprawl and result in better land use practices.

The old code banned the use of treatment systems on suitable soil less than 24 inches deep. Farmers argued that this restriction steered developers to agricultural lands where the soils are deeper and well-drained. With the advancement of POWTS technology and an increase in the availability of system types for soils less than 24 inches deep, development pressure is taken off of good farmland (Corry, 1999). Others would say farmland will continue to be in demand since its topography makes it easier to develop.

It is also argued that availability of these new hi-tech systems will not appreciably increase rural development because many of these advanced systems cost three to four times the cost of in-ground conventional systems, and not everyone can afford $15,000 to $30,000 for a POWTS system.

With passage of the new regulations on July 1, 2000, the WDOC had the final word in the debate. Phil Albert, Acting Secretary of the WDOC stated, "... the private septic system code has no more to do with the expansion of development than it does the availability of water or electricity in those areas" (Albert, 1998). Houses and septic systems in Wisconsin are built on land where local officials have permitted residential construction. The decision to zone an area for residential use is made by a zoning board, not through adherence to a state health and safety code. If urban sprawl and farmland conversion continue under the new code, poor zoning practices are to blame, not Commerce Rule 83 (Albert, 1998). Clearly, opposing arguments abound but outcomes cannot yet be determined.

IMPACT ON RURAL GROUND WATER

The effect of COMM 83 on rural ground water depends on whether a community has developed a land use plan and supporting zoning regulations, whether that plan and those regulations have used septic system densities as a criterion for housing densities, and the community's current financial status (Laurel E. Phoenix, 2001, personal communication). Communities without well-developed land use plans and zoning regulations will surely see an unavoidable increased demand for residential development. They are helpless against the forces of growth, and have no tools to plan for and prevent ground water contamination through unwise land use practices. This was the basis of Dave Cieslewicz' argument to the court that enactment of COMM 83 be delayed until all Wisconsin counties had developed land use plans (Cieslewicz, 2000).

Communities with comprehensive land use plans and zoning regulations will still experience more demand for development, but can shape and contain that development if they adhere to their regulations. Those with plans and regulations in place are in a better position to reassess them in light of the higher density of septic systems possible under the new COMM 83, and revise where needed to protect ground water supplies. Fragmentation of water quality policy results from different governmental agencies promulgating laws affecting ground water (e.g., WDOC and WDNR). Thus, it would be wise for local governments to take a conservative approach to land use decisions that could degrade their ground water.

Any local government that has not yet learned that growth oftentimes does not pay may welcome these new development opportunities without seeing the inevitable future costs of increased service demands, much less the more subtle and cumulative effects of additional non-point source pollution generated by more residents (e.g., from cars, lawns, and septics) that can pollute groundwater.

Another economic issue is that rural officials may yearn for tax receipts from new development, before having figured out how much it will cost to get county employees certified as CSTMs or POWTS Maintainers, or the costs for maintenance tracking of old and new septic systems. Since homeowners are notorious for not maintaining their septic systems, not having a county POWTS maintenance tracking system in place could endanger public health, particularly in a growing area.

The WDOC is correct in stating that zoning regulations determine development, and not state septic codes. However, it is a moot point when the state knowingly promulgates a code when the majority of its counties have no land use plans or zoning regulations, and therefore have no way of assessing how this new code will affect land use or groundwater quality in their area.

CONCLUSION

By substantially revising COMM 83, the WDOC has given property owners the opportunity and flexibility to choose the best wastewater treatment technology. Given the increase in available septic technologies and the improvement of the design, installation, inspection, and maintenance of POWTS, the new provisions of COMM 83 appear long overdue. At the same time, COMM 83 is an unfunded mandate that will cost counties unknown amounts of money. How are they to afford this?

Many of the hi-tech systems require a large degree of maintenance and oversight. The only way to accomplish this is at the county level, requiring increased personnel and updated computer systems. This cost means counties must either be reimbursed through grants, impose user fees on their residents, or hope that growth will bring in more tax receipts. Failure to maintain these systems will result in raw sewage polluting the ground water and/or surface waters of the state.

With urban sprawl already a reality, any attempt to reduce the size of subdivisions and decrease farmland conversion is tremendously valuable. Because the code is relatively new, however, the extent to which the code promotes or controls urban sprawl cannot yet be ascertained. Although the WDOC states that poor zoning practices lead to urban sprawl, one is still left to wonder how the new COMM 83 will influence future zoning decisions, and what will happen in areas without zoning. As wastewater technology continues to advance, it is crucial that townships and counties develop effective land use policies that protect public health and preserve the integrity of natural resources in Wisconsin.

LITERATURE CITED

Albert, Phil, 1998. COMM 83: New Options for Improved Land Use. WDOC, Division of Safety and Buildings, Madison, Wisconsin. *Available at* www.Commerce.state.wi.us/SB/SB-Comm83%20article%2011-03-98.htm. *Accessed* October 29, 2001.

Anonymous, 2001. Holding Tank Maintenance Reporting. *The Daily Tribune*, January 26.

Cieslewicz, Dave, 2000. COMM 83 Litigations. 1000 Friends of Wisconsin and the Land Use Institute. *Available at* http://www.1000friendsofwisconsin.com/legislative/litigation.shtml. *Accessed* October 29, 2001.

Corry, Michael, 1999. Testimony on the Clearing House Rule 98-083 Comm 83 Private Onsite Wastewater Treatment Systems Before Assembly Committee on Natural Resources. WDOC, Division of Safety and Buildings, Madison, Wisconsin. *Available at* www.commerce.state.wi.us/SB/SB-Comm83Tes timony.pdf. *Accessed* October 29, 2001.

Essie, Patrick, 2000. COMM 83 Lawsuit. WOWDA News, pg. 1, June 6-7.

Wisconsin Administrative Code, 2000. Chapter COMM 83, Private Onsite Wastewater Treatment.

WDOC (Wisconsin Department of Commerce), Division of Safety and Buildings, 1998. Final Environmental Impact Statement: For proposed changes to Chapter 83, 85 and other related rules regulating private onsite wastewater treatment systems (POWTS). Madison, Wisconsin.

WDOC (Wisconsin Department of Commerce), Division of Safety and Buildings, 1999. General Descriptions of Common Types of Onsite Sewage Systems. Madison, Wisconsin.

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SOURCE WATER ASSESSMENT IMPLEMENTATION OBSTACLES: ARE TRANSIENT NONCOMMUNITY WELLS NOT AS IMPORTANT?

Jay Y. Hodgson

INTRODUCTION

Water management is often described as an environmental paradox; water is our most abundant natural resource and is vital for sustaining life, yet it is one of the most poorly managed resources throughout the world. Dependence on ground water supplies has increased with population growth largely because many surface waters have become polluted and unusable. Ground water accounts for 50 percent of the drinking water supplies within the United States. Ground water is especially important for rural communities, supplying nearly 85 percent of their drinking water needs. Unfortunately, only within recent decades has the United States placed emphasis on protecting ground water supplies from potential contamination. In the 1980s, it was forecasted that slow transport and propagation of contaminants would lead to growing water problems in the future (Pye and Patrick, 1983; Pye *et al.*, 1983). Studies in the last decade indicate the fruition of this forecast.

The public largely recognizes that ground water requires protective management. Responding to heightened concern, Congress passed a series of laws aimed at protecting ground water supplies. Most of these laws were written to specifically give the U.S. Environmental Protection Agency (USEPA) significant jurisdiction in establishing ground water guidelines and granting the states considerable latitude in selecting management strategies. The most recent ground water legislation, the 1996 Safe Drinking Water Act (SDWA) amendments, created the Source Water Assessment Program (SWAP) for sources of public drinking systems. Each state is required to: (1) delineate source water assessment area boundaries for all public water systems; (2) inventory existing and potential sources of contamination within these boundaries; (3) determine the susceptibility of the water systems to the contaminants; and (4) make the assessments available to the public. While previous legislation was mostly reactive measures regulating drinking water at the tap, SWAP is highly proactive in that its goal is to minimize threats to water supplies, thereby protecting the water and public health for future generations. However, the success of SWAP will ultimately be determined from the ability of the states to draft and implement efficient, rigorous, and consistent assessment plans in a timely manner.

> *. . . researchers and political analysts will argue that the current dichotomy of regulation standards is an unacceptable compromise because it treats different sources of drinking water unequally*

SWAP IMPLEMENTATION OBSTACLES

Legacy of Previous Policy

The SDWA – and subsequently the SWAP amendments – regulate both Community Water Systems (municipal and other-than-municipal networks) and Noncommunity Water Systems (nontransient noncommunity and transient noncommunity networks). The definition of Community and Noncommunity Water Systems by the Wisconsin Department of Natural Resources (WDNR) are:

Community Systems serve at least 15 service connections used by year-round residents or regularly serve at least 25 year-round residents.

- A municipal system is a community system which is owned by a city, village, town, town sanitary district, or utility district; or a federal, state, county, or municipally owned institution for congregate care or correction; or a privately owned water utility serving any of the above.

- An other-than-municipal system is a community water system that does not fit the definition of a municipal system. Examples are mobile home parks, condominiums, apartments, or subdivisions.

Noncommunity Systems are public water systems that are not community water systems.

- Nontransient noncommunity systems regularly serve at least 25 of the same nonresident persons per day for at least six months of the year. Examples are schools and businesses.

- Transient noncommunity systems serve at least 25 different nonresident persons per day for at least 60 days of the year. Examples include campgrounds, roadside rest areas, gas stations, restaurants, taverns, and motels (WDNR, 1999).

Community systems were previously regulated with more strict health standards than noncommunity systems to prevent chronic illnesses from repeated exposure to contaminants. It was formerly believed that year-round residents needed a higher level of protection than part-time residents and transitional travelers; therefore noncommunity systems could afford some relaxation in contaminant standards (Scheberle, 1997). This practice has recently changed, and nontransient noncommunity systems must now meet the same regulations as community systems for both chronic and acute exposures. However, regulations for transient noncommunity systems remain less stringent than standards for community systems and focus primarily on preventing acute effects caused by bacteria, turbidity, and nitrates. This practice, although labeled as an economic and logistic compromise resulting in no increased risk to human health, remains in dispute.

SWAP is a relatively young program and is still in the implementation phase. As the program progresses, it is receiving praise because of its attempt to integrate human health with environmental protection. However, despite this recognition, various researchers believe that the dichotomy of health regulations between transient noncommunity systems and the other water networks is a deficiency of ground water protection because it creates a potential for the public to value and treat water sources differently and does not grant equal protection under the law (Segerson, 1994). Furthermore, because transient noncommunity wells are the vast majority of ground water systems in the United States (USEPA, 2001), this dichotomy has also led to many states implementing reduced regulations for transient noncommunity systems in their SWAPs, which could ultimately reduce the effectiveness of the processes of delineating water boundaries and determining susceptibility to contamination for such systems. Potential concerns include less sophisticated, smaller delineation areas and the exclusion of volatile organic compounds monitoring.

Logistic Constraints – Wisconsin Case Study

The WDNR has the laborious task of assessing approximately 11,900 ground water systems before a May 2003 deadline. Of these 11,900 systems, only 1,140 are community systems, 1,020 are nontransient noncommunity systems, and the remaining 9,720 systems are transient noncommunity wells. Outlined in the Wisconsin plan (WDNR, 1999), community systems and nontransient noncommunity systems are listed with the highest priority even though they are in the minority of registered systems. These systems will be delineated with larger assessment areas and will develop more rigorous susceptibility analyses than transient noncommunity systems. This may be justified because these types of systems serve water to approximately 84 percent of the state's population.

Municipal ground water systems will be delineated using available ground water flow models and aquifer geology, transmissivity, well construction features, and other unique regional characteristics. Municipal systems will be delineated with a fixed 1200-foot radius if flow model data is lacking. Nontransient noncommunity systems will also be delineated with a fixed 1200-foot radius. This is based, although subject to levels of uncertainty, on existing flow models of contaminant transport and aquifer recharge using very conservative model assumptions. Transient noncommunity wells, however, will only be delineated with a fixed 200-foot radius. WDNR justifies this technique based on the assumptions that the EPA requires a SWAP to account for, at a minimum, nitrates and bacteria for transient noncommunity systems. Transient populations are not likely to achieve repeated contaminant exposures that cause chronic health problems, such as cancer, but they can encounter acute health problems caused by nitrates and bacteria. Flow models suggest that pathogens are unlikely to propagate more than 155 feet a year within unconfined aquifers (MDH, 1998). Furthermore, bacteria often do not survive more than 30 days without a host medium. In addition, most transient noncommunity wells in Wisconsin are rural and privately owned; the owners of such systems often lack jurisdictional control off of the property, which limits the scope of protection programs implemented by the WDNR. This, and the large number of wells the WDNR must assess in a limited time have led to the decision to use less sophisticated delineations.

Susceptibility-to-contamination assessments are also less rigorous for transient noncommunity systems. The surveying and listing of potential contaminants is essentially the same for all of the water systems, but it is how these data are used that greatly affects any susceptibility determination. Assessments for community and nontransient noncommunity systems will be developed from the physical, biological, and hydrogeological characteristics of the well setting, descriptions of the system integrity including well construction, extensive sampling of contaminants within the recharge area, and reviews of water quality including results from monitoring wells. Transient noncommunity wells, however, will not be considered susceptible to contamination if one or more of the following conditions are present: (1) geologic barriers; (2) mitigation of hydraulic conditions related to pumping, well construction, and aquifer composition; or (3) absence of potential sources of pathogens and nitrate in the recharge area. These differences in assessment comprehensiveness are also relics of logistic restraints, but, once again, are thought to be acceptable compromises without any increase in danger to human health as per reasons previously listed.

QUESTIONS UNANSWERED

The general goals of SWAP mandate that each state must determine where their public drinking water supplies originate and determine the degree to which each system may be adversely affected by potential sources of contamination. The success of SWAP ultimately depends on the integration of these two components; a susceptibility analysis is only as effective as the delineation and potential contaminant survey. That is, an appropriate SWAP is only valuable if detected sources of contamination originated from within the delineation boundary. How effective can a fixed radius be in delineating an aquifer? Aquifers typically transcend arbitrary and political boundaries, and contaminants can often travel great distances. The 1200-foot delineation radius is considered a conservative measure because pollutants often do not travel more than several hundred feet in a year. Bacteria typically do not either, but how effective is the smaller 200-foot radius used to delineate transient noncommunity wells? Furthermore, how effective is the susceptibility analysis for these systems based on the 200-foot radius? A transient noncommunity well will be not be considered susceptible to contamination if no potential sources of contamination reside within the 200-foot radius. Will this prove to be effective for SWAP?

The fixed 200-foot radius is applied to each transient noncommunity well without regard to aquifer geology and recharge. This one-size-fits-all strategy has the potential to exclude potential, and actual, sources of contamination. This is especially true in Door County, Wisconsin, where the unique fractured Silurian dolomite aquifer system presents the ability for a contaminant to travel relatively quickly over great distances. Door County has very shallow depth-to-bedrock in many areas; once bacteria can reach the saturated zone in fractured dolomite they can travel long distances with little attenuation. Sherrill (1978) measured the transport of contaminants through the fractured dolomite aquifer between monitoring wells at a rate of 323 feet in two minutes. Furthermore, Blanchard (1988) demonstrated that coliform bacteria, nitrate, chloride, and sulfate could travel through the fractured dolomite with continuity up to 4000 feet. The geology of Door County may be an exception, but these data demonstrate a potential deficiency of the fixed 200-foot delineation radius in areas with unique geologies requiring more rigorous delineation processes.

Aside from the more unusual case of Door County, what does this implementation of SWAP portend for rural areas in general? Rural areas depend on ground water, and land use is intimately tied to ground water quality. Since ground water quality affects public health, it is illogical that transient noncommunity water supplies would be assessed differently for the following reason. Not everyone drinking water from transient noncommunity wells are passers-by. Employees at these locations would have as much exposure to drinking water pathogens as people drinking from nontransient noncommunity wells (Laurel E. Phoenix, 2001, personal communication). Shouldn't they have equal protection under public health laws? According to the less rigorous assessment standards for transient noncommunity systems, land use and potential contamination sources beyond a 200-foot radius are of no concern. This sends the wrong message to rural landowners as well as rural planners. Since the intent of SWAP is to minimize threats to water supplies, both the 200-foot radius and its application to sites employing full-time, long-term, staff are disputable.

CONCLUSION

Logistic constraints threaten to undermine the success of SWAP. Wisconsin is not alone in sharing the implementation obstacles of this federally mandated program. The large number of transient noncommunity wells that need to be assessed in a limited period of time has resulted in reduced standards being implemented to protect those sources of drinking water. The smaller, fixed radii used to delineate transient noncommunity wells may or may not prove to be effective when state agencies and independent researchers evaluate the progress of SWAP. In the meantime, however, many researchers and political analysts will argue that the current dichotomy of regulation standards is an unacceptable compromise because it treats different sources of drinking water unequally. The compromise may be based from a logistic and economic standpoint, but it may be a compromise we regret if it proves to unequally protect public health.

LITERATURE CITED

Blanchard, M. C., 1988. Investigation of the Shallow Fractured Dolomite Aquifer in Door County, Wisconsin. M.S. thesis, University of Wisconsin, Madison, Wisconsin.

MDH (Minnesota Department of Health), 1998. Pumping Effects of Transient Noncommunity Wells on a Fixed Radius Approach to Delineating Wellhead Protection Areas. Minneapolis, Minnesota.

Pye, V. I. and R. Patrick, 1983. Ground Water Contamination in the United States. Science 221:713-718.

Pye, V. I., R. P. Patrick, and J. Quarles, 1983. Groundwater Contamination in the United States. University of Pennsylvania Press, Philadelphia, Pennsylvania.

Scheberle, D., 1997. Federalism and Environmental Policy: Trust and the Politics of Implementation. Georgetown University Press, Washington D.C.

Segerson, K., 1994. The Benefits of Groundwater Protection: Discussion. American Journal of Agricultural Economics 76: 1076-1081.

Sherrill, M. G., 1978. Geology and Ground Water in Door County, Wisconsin, With Emphasis on Contamination Potential in the Silurian Dolomite. United States Geological Survey Water-Supply Paper 2047.

USEPA (U.S. Environmental Protection Agency), 2001. Factoids: Drinking Water and Ground Water Statistics for 2000. EPA 816-K-01-004.

WDNR (Wisconsin Department of Natural Resources), 1999. Wisconsin's Source Water Assessment Program Plan. Madison, Wisconsin.

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RURAL MUNICIPAL WATER SUPPLY PROBLEMS: HOW DO RURAL GOVERNMENTS COPE?

Laurel E. Phoenix

INTRODUCTION

Rural areas have experienced profound changes in the last 50 years. Their ability to adapt to these changes can affect rural economies, public health, and the natural resource base on which those communities are located. Little is known about the variability of rural areas, or how they choose to deal with devolutions of responsibilities and increases in service demands. Local needs are increasing as recent immigrants to rural areas add their service demands to the pre-existing, and quite different, demands of long-time locals. The most recent Safe Drinking Water Act (SDWA) surface treatment rules, as well as existing *E. coli* standards, are extremely difficult for most rural public water systems (PWSs) to meet without assistance (e.g., fiscal, informational, and technical), yet little is known about how they are addressing their drinking water problems.

Providing rural public drinking water is an area of particular concern that highlights the convergence of several factors: (1) local administrative and financial capacity in dealing with unfunded federal mandates, (2) highly technical engineering processes, and (3) prescriptions calling for collaboration or consolidation as the best strategy for local governments to solve their drinking water problems. Collaboration or consolidation are strategies for dealing with such complexity, and are prescribed by federal and state agencies – but will these strategies work for every community?

This study looks at the circumstances and municipal water supply decisions of several small rural communities in the Tug Hill area of New York State in response to drinking water regulations, and explores the utility of collaboration to solve their drinking water problems. First it introduces the problems of rural PWS operation and the difficulties states have overseeing rural drinking water quality. Next, it briefly discusses how local PWSs are created and then describes the Tug Hill region and several case studies of villages and towns dealing with public water supply problems. Finally, it offers an analysis of what motivates these rural municipalities to improve their public drinking water, and whether collaboration with other local governments were viable options to address drinking water problems.

RURAL PUBLIC WATER SUPPLY OPERATION AND MANAGEMENT

Small systems face a host of problems. Many were built over 50 years ago for smaller populations and in an era of no treatment mandates. Old pipes are hazardous, as their life expectancy is about 30 years. Consequently, aging underground pipes cause carriage losses (water leaks) and contaminants can enter through cracks. Temperature fluctuations can cause pipes to break, as can stress from overlying pavement or other structures. Internal corrosion releases metals into the drinking water, and tuberculation (deposits built up in pipe) lowers water pressure. Many miles of underground distribution lines in each community make it prohibitive to check lines for deterioration. Systems built for historically smaller populations now have inadequate intake pipe diameters; increasing pumping costs to keep water pressure up and meet local demand. Current operators of small PWSs may not even know what kind of distribution system pipes they have until forced to dig them up when lines break. Other parts of the system (e.g., storage tanks and pumps) suffer from deferred maintenance and contribute to inefficient operations and ultimate system breakdown. Carriage losses increase as cracks increase, necessitating greater pumping that increases energy costs. For old systems built without shutoff valves to individual residences, locals can "free-ride" and not pay their water bill; leaving the supplier unable to shut off their water but still bearing all the operating costs.

> *As rural communities struggle to provide an increasing array of services . . . federal policy must reassess conceptions of the equity, efficiency, & effectiveness of SDWA regulations & funding to see what course adjustments would be wise*

Small systems also may lack certified operators who understand how to manipulate water chemistry to maintain current standards. Essentially, this means that many small systems are managed by someone with no engineering expertise, contributing to improper or total lack of water quality testing.

STATE ADMINISTRATION

Oversight of public water supplies is a critical part of protecting public health. Small, rural systems create disproportionate workloads for state drinking water quality agencies, and states are unable to adequately monitor and enforce this many systems. There are tens of thousands of small community systems across the country serving less than 500 people, with many serving less than 25. In Pennsylvania, systems serving less than 500 people comprise 60 percent of the public water systems in the state, but only serve 2.2 percent of the state's population (Marrocco *et al.*, 1993). In New York, out of approximately 10,000 community water systems, 9,850 serve 13 percent of the population (NYSDOH, 2000).

Small systems across the country had more incidences of poor water quality before the SDWA 1996 rules were promulgated, and continue to have a high noncompliance rate today. Small community systems violate federal requirements for safe drinking water as much as three times more often than cities. However, shutting down noncompliant small systems and forcing people back to individual systems (e.g., unregulated private wells) would be contrary to the intent of the SDWA: to protect public health through drinking water quality monitoring. If small, public systems are unable to treat water up to a minimum standard, how much less likely is it that individual well-users can or will test or treat their water? Studies across the country already show that many private, individual water supplies do not meet the pre-1996 drinking water standards for public systems.

RURAL WATER DEVELOPMENT

To understand rural water development in the Tug Hill region of upstate New York, I will first define two types of municipal governments found only in the Northeast and Midwest states.

A *town* is a subdivision of a county varying in importance as a unit of government. Towns are general purpose local governments that vary from providing minimal services such as road repair to more complex services like public schools. A town has no power to annex land from a village, city, or bordering towns.

A *village* is a small, general purpose, local government that bounds a concentration of buildings and is found within counties that are subdivided into towns. Some villages can annex land from a town and others cannot, depending on state regulations. The relative power between villages and the towns in which they are situated varies among states.

Because of closer proximity of buildings, villages tend to develop public drinking water supplies before towns do. As a result, once a town is interested in supplying drinking water, it will often simultaneously approach a village if it knows they have the capacity, and then create a water district so the village only has to deal with and charge one additional entity. Villages generally do not want to supply water outside their boundaries otherwise, because they do not have the leverage of property taxes to force outside individuals to pay their bills. Water districts are able to bill households for their water through property taxes, so the district is guaranteed payment.

TUG HILL REGION

The Tug Hill region is in the northern part of New York State – west of Adirondack Park and east of Lake Ontario. Its 21 villages and numerous hamlets are found within 41 towns spreading through Lewis, Jefferson, Oswego, and Oneida Counties. Sparsely populated (<100,000 persons) with a densely wooded inner core, Tug Hill is a tilted plateau consisting of farmland, forests, wetlands and waterfalls. Relatively remote from urban centers, the Tug Hill region has evolved from an extractive economy to a service-dominated one for all counties but Lewis, which is presently classified as diversified (Kreahling *et al.*, 1996).

Tug Hill is known for its heavy snowfall – a typical winter provides 20 feet of snow with a heavy winter producing 40 feet. Ironically, this heavy precipitation does not produce adequate ground water supplies for many of its sparsely populated communities.

The following case studies are from some of the small villages and towns within the Tug Hill Region that were recently facing water supply problems.

TUG HILL VILLAGE AND TOWN CASE STUDIES

Lacona-Sandy Creek

The villages of Lacona and Sandy Creek have had their own public water supplies (wells) ever since they were incorporated in the 1890s. They are still using the original water main constructed in 1898, and will continue to use it until it breaks. The shallow and sporadic aquifer in their area was being drawn down in summer below the well pumps, requiring conservation measures. These problems were exacerbated by a failure to meter individual homes, which encouraged individuals to waste water. They are now looking for a new supply to increase reliability of water delivery. In addition, their current well field is right next to and under an active rail line, so they hope to obtain another well field in a more protected environment. To encourage water conservation, they are installing metering to every building. Unlike the other communities in the study, Sandy Creek-Lacona recognizes the cost/benefit of spending additional money to install meters and thus, lower water demand while charging their customers closer to the true cost of water treatment and delivery. There is an informal "gentleman's agreement" with some surrounding houses outside of village boundaries for drinking water provision. These outsiders are charged twice as much as villagers for their water, and are responsible for their own water main maintenance. The villages are looking for new ground water sources to avoid the expenses incurred with surface water treatment rules. The villages have no sewer system and do not plan to create one because of the prohibitive expense of a sewage treatment plant and potential billing problems with customers getting sewer service but not paying the bills. Unlike drinking water provisions, where service can be shut off to metered homes if bills are not paid, there is no way to shut off acceptance of sewage from a particular building into the main receiving lines. The villages' long history of providing public drinking water has educated their officials about the highly technical aspects of contaminant testing and well drilling costs. They recognize that their citizens naturally do not understand these issues and persist in thinking that water should be delivered to their doors as a citizen's "right," and should be relatively cheap.

Village of Adams in Town of Adams

This village's water supply problem is a reliability issue, since its source water is from a shallow aquifer that dries up in the summer. Over the last 15 years, it instituted emergency water conservation measures during most summers. "Like clockwork," said one village official, "every July and August we have a water emergency. Can't mow the lawn, wash your car, or take a nice long shower." The village of 750 homes also supplies water to the town of Adams water district, which includes the hamlet of Adams Center, consisting of 345 homes. The hamlet had an additional problem with having to remove all the lead paint from its water tower, and perform the long overdue maintenance the tower required. The town wanted to expand water service to more houses within the town. Since an unreliable water supply was causing emergency rationing in summers as well as restricting growth in the village and town of Adams, the village applied for State Revolving Fund (SRF) money and built a new water plant with new wells. It was unable to apply for grant monies since it had responsibly been saving money each year out of the general fund toward a new water supply. Having money in savings makes a village seem too well-off to qualify for grant money, so it must borrow the money instead. It is still paying on a 20-year-old debt from construction of a village sewer system. Previous local officials did not save money for the sewer projects, and grant money was not available at the time the village was forced to build the sewer system. "It just don't seem fair," said one official, "sometimes you have a problem when there isn't grant money being offered, so you're out of luck and have to borrow. We were responsible and planned and saved money to pay for our new wells, so now the state says we're too rich to need their grant money. Too rich, hah!"

Village of Holland Patent

Holland Patent, a village of 500, and bedroom community for Utica, buys its drinking water from Utica, specifically the Upper Mohawk Valley Regional Water Board. It had originally started its own surface water supply treatment in 1907, but was forced to hook up to Upper Mohawk water in 1976 because of floods knocking out some transmission lines and an alleged *Yursinia* bacteria problem. Although the children sickened from this bacteria were later found to have been infected through chocolate milk produced in Buffalo, and not the local water supply, the change to Utica water was complete and contracts were already signed. Before 1976, Holland Patent water was a "cash cow" for the village, helping to fund other services. "I wish we still had our own water," said one official, "when we had a break, it got fixed right away, and Utica is so slow." "Also," he said, "our transmission lines have exterior seams that are easier to fix and less likely to contaminate the water, but Utica's lines have interior seams."

Village of Barneveld

Barneveld supplements its wells with a connection to Utica that it can tap into during summers when the water level in the aquifer falls too low. They have found that their own maintenance was far superior to that of the Upper Mohawk. To date, they have never received typical maintenance promised by the Upper Mohawk (e.g., flushing mains and checking old transmission lines). "Our fire department always flushed the mains on schedule," said one official, "but the new water board just won't bother, no matter how many times we call them."

The town of Trenton (within which Holland Patent and Barneveld are situated) has no water supply, but does have a sewer district.

Village of North Bay and Nearby
Residents in Town of Vienna

The North Shore Water District was petitioned by homeowners to expand their water supply service area after some North Shore communities experienced water shortages in recent summers when well yields would drop until they lost pressure. The North Shore Water District, serving 160 households, buys its water from Onondaga County Water Authority (OCWA). The village of North Bay relies on two springs for drinking water, which are unreliable in summer. The village was forced to hook up to OCWA through a main from Sylvan Beach to augment its supplies. Last year, the village bought a private well system from a local campground owner, but it still was not enough to avoid using OCWA water. "Consolidation is good if it works, but forced collaborations are only superficially collaborative ... but struggles remain" said one official. "We shouldn't be forced to filter our spring water," said another, "it's just a waste of money and lines the pockets of the engineering firms."

The village of North Bay has sewers. Unlike other small communities in the Tug Hill area, these small villages have both sewers and water supplies since heavy development next to the shallow waters of Oneida Lake required sewage systems around the lake to prevent eutrophication problems. Since the north shore of Oneida Lake has attracted wealthy residents willing to commute to Utica, Rome, and Syracuse while enjoying the amenities of lakeshore living, these north shore communities can more easily afford both drinking water treatment and sewer systems than other rural communities in the Tug Hill region. "We want to pass all of the DOH testing so we can attract more tourists" said one official. "We've got Rails-to-Trails, ice fishermen, and snowmobilers. With more water, we can get more of them to spend their money here,"

Town of Martinsburgh

The town of Martinsburgh is searching for a ground water source to replace its current surface water supply. In the last few summers they have experienced water shortages in the summer, and they anticipated that new surface water rules requiring a sand filtration system would be costly, as well as wasted money on an unreliable surface supply. The town is primarily looking for this water to supply the village of Martinsburgh and a few outlying neighbors of that village. The village of Glenfield within the town has an excellent and abundant surface water source and deep wells. However, the town has not purchased water from Glenfield since the pumping costs from lower elevation Glenfield would make the water too expensive. Lack of a reliable water supply constrains the growth Martinsburgh would like to attract. The town hoped to start development of a new well in 2001. "The village of Martinsburgh is ignoring the problem," said one town official, "and the villages won't bother to work with each other, so we [the town] do it [look at options to provide water]." "Since the town wants growth, we have to be proactive and look for it [water]. The less the state is involved, the better. The higher the level of government, the less you get from them." One official noted that there were state disincentives to plan for an efficient PWS system. Another said, "We need more water and reliable water to grow. We get lots of tourism, mostly ATVs, snowmobilers, and anglers, and we'd like to have more bed and breakfasts, motels, and restaurants to serve them." "These surface water standards are overkill. They make a surface water supply way too expensive" said one official. "Well exploration is costly too. Cost us $15,000 to drill a 600 ft. well. Once we find a couple of good sites, we'll need five acres of land surrounding that well. The minute we sink a test well, the landowner starts talking about the outrageous amount of money the town will have to pay him for his five acres. They like to pick a figure about ten times the current price per acre. Then what do we do? Taking it [their land] through eminent domain makes everyone hate you, so you end up paying way more than the land is worth." In addition, a new water supply will raise water rates, so locals constantly complain to the town council. Once council member said, "You certainly have to have a thick skin to do this job ... they'll bring up your recent divorce in a public meeting as proof that you're not fit to manage the town."

Village of Turin in Town of Turin

The village of Turin had a spring-fed water supply that would have to comply with surface water rules, so they were looking for ground water supplies instead to avoid the filtration requirements. In addition, they were having some water distribution problems with their aging infrastructure. The village has only septic systems. They were not able to receive state financial help because they started saving money to address their surface water problems a year before SRF money became available. They found that there was no way to be reimbursed for work done the previous year, since the state reasoned that having accomplished it on their own proved they did not need financial help. "We feel punished for being responsible" said one official. "Communities around us are getting free money for their water supplies, and we had to pay every nickel."

Town of Watertown

The town of Watertown was experiencing sprawl as the city of Watertown attracted more jobs. Wells were unreliable and some were contaminated with *E. coli*. The town approached the city of Watertown to buy their finished (surface) water at a price of 2.1 times the rate paid by city residents. One official noted, "This is the easiest way. We get the water sooner than if we had built our own plant, and they have the headaches and paperwork of complying with government standards."

Village of Constableville

This village needed to improve its water quality, and faced the choice of risking money to drill test wells and sink a public well, versus the obviously high costs of filtering their current surface sources. When the Environmental Protection Agency (EPA) told them that new surface rules were coming and they had better build a filtration system or go to wells, Constableville ignored the problem. When the EPA finally threatened Constableville with fines, they first went to engineering firms, but were overwhelmed by the complexity of the problems. They then went to the Tug Hill Commission (a state-funded agency created to assist Tug Hill communities) for help to figure out how to deal with their water supply. One village official remarked, "Why would anyone expect us to know how to get ourselves a new water treatment plant?" Why, indeed? Of all of the municipalities in this study, Constableville was least able to cope with its water problem and wanted Tug Hill Commission to solve the problem for them.

WHAT MOTIVATED RURAL GOVERNMENTS TO ADDRESS THEIR WATER PROBLEMS?

Crisis, a common motivator in policy studies, here in the form of regulation deadlines or unreliable supplies, moved all these communities to action.

Local governments in this study were concerned primarily with water access: either initial access (no previous PWS and recent problems with reliability) or sustained access (reliability problems), but they also knew that impending federal regulations might declare their current water quantity, quality, or treatment methods substandard. All communities preferred ground water sources in anticipation of the new surface water rules, even if their previous sources had been springs or surface water. Some communities used both sources, one acting as backup for the other.

Although several governments desired growth, this was not an incentive in itself to improve their water supply, but was promoted to citizens as an additional benefit once they felt forced to act due to the above regulatory or reliability issues. All of the communities understood the link between attracting growth and improving their water supply.

The two most important motivators to action (impending federal regulations and unreliable water supplies) can be classified as "crisis." Impending federal regulation threatened fines if new standards and deadlines were not met. Unreliable water supplies caused crisis conditions with every dry spell. Communities desiring growth wanted to solve their local unemployment problem or expand their tax base (financial crisis). Crisis is one of the precursors to collaboration that Cigler mentioned (Cigler, 1999) and is a common motivator to action in policy studies.

Local government action varied in the speed with which they acted to solve their water supply problems. Some started saving money right away toward upgrading their water supply, others looked into grants and loans but did not allocate any budgetary resources, and Constableville did nothing until EPA fines were imminent.

Delaying action until crisis looms and external penalties are imminent is consistent with the observation (Browne and Reid,1990; Mattson, 1997) that rural governments often use the technique of "government by default" to shift blame for expenditures to higher levels of government in order to maintain local friendships.

In sum, coercion through regulation was positively correlated with action. However, speed of action varied according to financial capability, historical constraints (e.g., previous debt) and personal expertise of council members.

WHEN AND WHERE DOES COLLABORATION WORK?

A rural government's need to address a drinking water quality or access problem does not always result in collaboration, although the majority of these communities collaborated in some way. Collaboration is affected by a variety of issues beyond mere need to improve a water supply. Reliability or quality problems alone did not correlate highly with collaboration. Collaboration was not the only mechanism available to communities to obtain or improve their water supply, nor would it always result in a more economical water supply or equitable arrangement. Collaboration was not required for SRF funding and because of disincentives, may have reduced the grants they received. In several cases, collaboration would not have been a viable option because of the existence of too many constraints beyond their control (e.g., topography).

The study revealed that collaboration between communities exhibited three distinct forms of interlocal agreements:

1. Involuntary: "Alliance Through Necessity" – A community is forced to hook up to a larger, more powerful local government (e.g., water authority) when crisis looms and the community does not have the money or the time to access their own new water supply. The result of this type of collaboration is poor service provided to the community buying the water, and a kind of serf and landlord relationship between the community and the water provider.

2. Purchase Agreements: "Alliance for Reward" – Buying finished water from another rural government or water district avoids large initial expenditures for a treatment plant but loses some autonomy to the water supplier who can limit increases in water provided or raise rates in the future (with approval from the state public utilities commission). Rates are typically double what ratepayers within the water district's boundaries pay. Purchase agreements may or may not be initiated by a crisis requiring immediate action. With few marginal costs to the purchasing party, this type of agreement is similar to a cooperative partnership, where there is little marginal cost to the partners, can be staffed by lower level personnel, and agreements can be informal or formal (Cigler, 1999). The result of this type of collaboration is generally agreeable to both parties, but creates some uncertainty for the purchasing party as to available quantities of water in the future and future costs.

3. Collaboration Between Equals: "Alliance of Parity" – Two or more rural governments in roughly equal positions of power with enough time and money to cooperate for their mutual benefit. This type of collaboration has much higher marginal costs for both parties, but gives both parties the time to craft an agreement suitable to both. With higher marginal costs (resources, autonomy, participation by highest officials) to the purchasing party, this type of agreement is similar to a collaborative partnership, where marginal costs are high, process and desired outcomes are formalized through legal documents, and there are strong linkages and stable memberships necessary for complex, long-term issues (Cigler, 1999). The result of this type of collaboration is satisfaction on both sides with the agreement and with their control over future issues related to the agreement.

In sum, these three types of collaboration illustrate a range of autonomy resulting from different types of collaborations. This autonomy is founded on the source of the water, the current and future cost of the water, and the provision and quality of the related services associated with the water (e.g., water testing, flushing of mains, and fixing breaks). In addition, these types of collaboration are related to the time and money available to each community.

CONCLUSION

How will rural America provide safe drinking water with its aging and historically underfunded infrastructure, low institutional capacity, and underfunded federal mandates? This survey of various rural water supply problems demonstrates the forces pressuring rural systems and the limited alternatives available to solve their drinking water problems.

Rural water supply decisions are shaped and constrained by numerous forces beyond their control. New SDWA surface water rules made surface water supplies noncompliant unless they added costly filtration systems or searched for new ground water sources. Many risked drilling test wells in regions already experiencing unreliable ground water supplies. Crisis situations limited their choices further in terms of the financial help available and whether adjacent communities were interested in collaborating with them to solve their water problem.

Outcomes resulting from these water supply decisions demonstrate that operating a small rural public water supply is not only difficult, but has implications for rural communities that federal and state governments may not have considered. All of these communities could ill-afford the costs of improving their water systems, and often this meant reallocating budgets and reducing services elsewhere. Thus, a forced reallocation of their meager budgets improves capability in one area by decreasing it in another. Which rural subpopulations (e.g., children, elderly, and poor) are most affected by such a shift?

Rural Municipal Water Supply Problems: How Do Rural Governments Cope? . . . cont'd.

States are trying to streamline administration of the numerous small water systems, but does the drive for efficiency (e.g., prescribing collaboration) recognize the drawbacks of forced collaborations? As rural communities struggle to provide an increasing array of services, either through local demand or federal mandate, federal policy must reassess conceptions of the equity, efficiency, and effectiveness of SDWA regulations and funding to see what course adjustments would be wise.

LITERATURE CITED

Browne, William P. and J. Norman Reid, 1990. Microconceptions, Institutional Impediments, and the Problems of Rural Governments. Public Administration Quarterly 14:265-284.

Cigler, Beverly, 1999. Pre-Conditions for the Emergence of Multicommunity Collaborative Organizations. Policy Studies Review 16(1):86-102.

Kreahling, Kathleen S., Stephen M. Smith, and A. E. Luloff, 1996. Economic Restructuring in the Nonmetropolitan Northeast: Adaptation to Transitions. Research Report No. AERS 253, Pennsylvania State University, University Park, Pennsylvania.

Marrocco, Frederick A., Thomas M. Franklin, and William J. Sedlak, 1993. Short-Sighted Policy Impacts on the Long-Term Viability of Public Water Systems. *In:* Water Resources Administration in the United States: Policy, Practice, and Emerging Issues, Martin Reuss (Editor). American Water Resources Association and Michigan State University Press, East Lansing, Michigan.

Mattson, Gary, 1997. Small Community Governance: Some Impediments to Policy Making. *In:* Handbook of Local Government Administration, John J. Gargan (Editor). Marcel Dekker, Inc., New York, New York.

NYSDOH (New York State Department of Health), 2000. Capacity Development Strategy Report. NYSDOH, Albany, New York.

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AGRICULTURE AND WATER DECISION-MAKING BY COUNTY BOARDS IN THE WESTERN UNITED STATES

Kate A. Berry and Nancy L. Markee

Over a decade ago Born (1989) pointed out that water matters would increasingly become a concern of local governments. Born's prediction has proven true as local governments are more prominent than ever in both those water issues that provide economic opportunities locally and those perceived as threatening. It is not uncommon for local government officials to address water resource issues, such as procuring residential and commercial water supplies, maintaining water quality concerns, mitigating impacts to wetlands, or diverting water between watersheds (Berry *et al.*, 1996).

Actions by local governments, including actions on water issues, are generally supported by a notion that in government "local is better." In the U.S. the significance of being "local" has ideological appeal to a wide variety of groups. This predilection towards localizing issues coupled with generalized distrust of higher levels of government has resulted in a resurgence of actions and rhetoric to decentralize federal and state bureaucracies and localize government. Water matters have also gotten caught up in this tendency to localize issues, and the proliferation of watershed-based councils may be one of the most conspicuous examples of recent years. County governments, however, are also involved in water issues and draw legitimacy both from their designation as local-based entities and their status as representative governments.

But why research the context of decision-making on water issues for county governments, rather than state or federal policymaking? It is our premise that county governments are active in shaping how local interests in water matters are defined, represented, and acted upon. County governments sometimes have proprietary interests to water but may often find themselves in a position to mediate between their citizenry and other levels of government in water conflicts (for example, in court cases or negotiations or informally) or when water opportunities avail themselves (for example, funding initiatives through federal or state legislative actions).

> *In many places in the West, water and agricultural interests historically became so intertwined as to be virtually synonymous*

Of the people who make up county governments, county commissioners (or county supervisors as they are called in some states) are the elected representatives of local government who are in a position to make policy decisions and take other direct actions on water issues. As is true with other local political bodies, counties have become increasingly involved in complex policy discussions and decisions, including intervening in federal and state water laws and programs on matters related to water and agriculture that they see as encouraging, stabilizing or discouraging local development (Favero and Alter, 1986). While county commissioners are clearly not the only local representatives involved in water issues, they are in instrumental positions to shape the agendas as well as the solutions for local issues, whether these involve conflicts between aggregate mining and farming over water in central California or water-related disputes between environmentalists and private rights groups in western Washington.

County commissioners, however, do not operate in a vacuum. Influenced by an array of internal and external forces, commissioners confront a wide variety of situations, many of which are outside their range of experience and others that are not of their own choosing. In selecting which issues to address, commissioners make choices that help define the characteristics of local water issues and contribute to the ways in which they are represented. Such decisions simultaneously exercise commissioners' autonomy and sustain the social relations that support them.

AGRICULTURE AND WESTERN COUNTY COMMISSIONERS

Agriculture has been one of the most significant forces that shapes social relations within which commissioners operate in the West. Agriculture has shaped how westerners embarked on colonization, how time was spent, and how individuals conceived of themselves and their places. Agriculture continues to influence how places are defined and represented, even in recent decades. Thus, we are interested in examining how the influence of agriculture extends to the perceptions and actions of county commissioners on water issues.

During 1995 and 1996, surveys and interviews were conducted with county commissioners in 11 western states (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming) to examine how experiences and perceptions of agriculture have influenced county commissioners' understanding and actions on water matters. A modified random sampling technique was utilized to determine for each state the counties from which commissioners would be surveyed. Counties were added to the sample until 35 percent of the state's population was represented. This process resulted in a total of 139 counties in the sample, one or more commissioners responding from 125 of the counties, and 288 returned self-administered questionnaires.

Counties typically had from three to five county commissioners, with a few counties having up to 13 commissioners. Follow-up interviews were done with 68 commissioners who volunteered to provide additional information.

Two key questions from the survey were used to assess the type of agricultural influences on commissioners. The first question addressed commissioners' view of themselves as political representatives of agricultural communities, by asking whether farming and/or ranching played an important role in the communities s/he represented. Commissioners responding yes to this question were identified as political representatives of agriculture because they operated under the assumption that agriculture was significant to their constituency. Overall, 83 percent of the commissioners agreed that farming or ranching was important to the communities they represented.

Figure 1 shows the patterns of responses to this question for each of the counties in this study. In 97 counties (78 percent) all respondents within a given county agreed that agriculture was important to the communities s/he represented, thus, the county was labeled as an "agricultural county." These agricultural counties were broadly distributed throughout the West. In only ten counties (8 percent) did everyone within a county identify that agriculture was not important to the communities they represented. These "nonagricultural counties" were limited to densely populated counties and surrounding suburbs (such as Denver, Salt Lake City, Los Alamos, San Francisco, and Los Angeles) as well as smaller population counties where other types of resource industries dominate such as logging, mining, or outdoor recreation (e.g., Lincoln, Oregon; Jefferson, Washington; and Socorro, New Mexico). Perhaps the most intriguing aspect of Figure 1, however, is the 17 counties (14 percent) in which commissioners had differing views about the importance of agriculture to their communities. In each of these counties, labeled as "differing views," commissioners disagreed about the significance of farming or ranching.

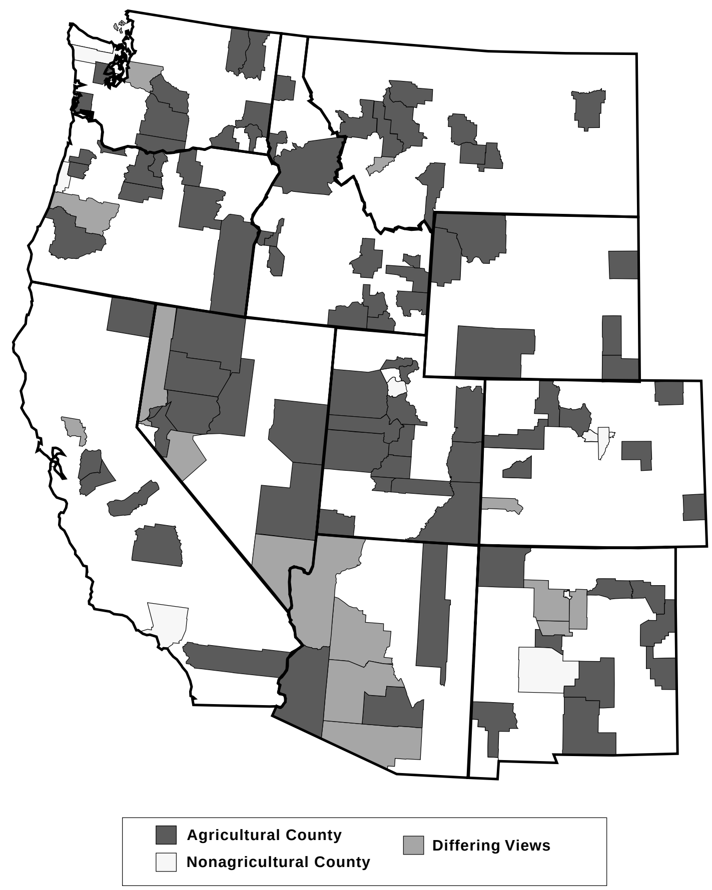

Figure 1. Counties Were Labeled According to Commissioners' Responses. Counties were labeled as agricultural if all commissioners agreed that they represent farming or ranching communities and nonagricultural if all commissioners responded they did not. Counties in which there was not agreement among multiple commissioners were labeled as differing views.

The second key question about agriculture in the survey asked about personal experience in farming or ranching, in order to establish which commissioners had ever worked in agriculture themselves. More than half (58 percent) of the commissioners indicated they had personal work experience in agriculture. This seems an exceptionally high number, particularly when considering that average farm employment within the eleven-state area (the percentage of employment in farming and farm-related jobs) was 16 percent in 1994 (ERS, 1998).

Commissioners were divided into three groups based on responses to these two key questions – each group with a different relationship to agriculture. The first group of commissioners identified themselves as representing agricultural communities and also having personal work experience in agriculture, so this group was considered to have the strongest connections to agriculture of our three groups and are referred throughout the rest of this paper as "agricultural commissioners." The second group answered yes to one of these two questions but not to the other (that is, they identified themselves as either representing agricultural communities or having agricultural work experience), thus they were considered to have moderate connections to agriculture and are referred throughout the rest of this paper as "mixed commissioners." Because the third group answered no to both questions, they were considered to have weak or nonexistent connections to agriculture and are referred to as "nonagricultural commissioners."

The majority of the respondents to our survey were agricultural commissioners. One-hundred and fifty-two commissioners (53 percent of the respondents) responded that they both represented farming/ranching communities and had personal experience working in agricultural enterprises. These agricultural commissioners not only came from traditionally rural counties but also from large counties that contained both agricultural lands and rapidly urbanizing centers (e.g., Ada, Idaho, and Yolo, California). Ninety-six commissioners (34 percent of the respondents) were mixed commissioners. Only 36 respondents (13 percent of the respondents) were nonagricultural commissioners.

Farming and ranching were much more common in the communities where agricultural commissioners were raised than in their counterparts' home communities. Agricultural commissioners raised in an agricultural setting or surrounded for long periods of time by agricultural operations and ideologies would have a high level of familiarity with agriculture as well as insiders' perceptions of agricultural norms, including those related to water.

CONNECTIONS BETWEEN AGRICULTURE AND WATER ISSUES

In many places in the West, water and agricultural interests historically became so intertwined as to be virtually synonymous. Often it was water rather than land that proved to be the limiting factor for raising crops and livestock. While agriculture continues to affect water politics, economics, and law even today, it has been the subject of much debate. Practitioners, scholars, and activists have pointed out that many contemporary western water management practices, institutions, and ideologies are obsolete relics of a past time when agricultural dominance was a given (Sims, 1987; Wilkinson, 1992). We found that county commissioners connected their experiences in agriculture to their experiences with water issues in a variety of ways.

When asked about water in the interviews, two-thirds of the agricultural commissioners volunteered information about work or family experiences with farming or ranching. The following comments, excerpted from interviews with agricultural commissioners, indicate some of the associations made between a community's dependence on agriculture and their need for water:

> *Water is lifeblood; without water, even with such good soils, there would be no agriculture.*

> *Water is very important. The county needs to consider how important agriculture is in rural areas. If agriculture isn't here, industry isn't here.*

> *I see this as an agricultural state. Water is a concern for irrigation, raising livestock, and other agricultural activities.*

Other agricultural commissioners commented about the lasting influence of agricultural experiences on their perceptions of water use:

> *Being born and raised on a ranch, water was one of the most important things.*

> *I have lived with water issues all my life; without water we could not farm.*

> *I've spent many hours working in and around irrigation ditches. This has given me hands-on experience.*

> *As a farmer, I built my own reservoir for the farm that soon was supplying water for 300 people.*

> *Direct experience working in the soil has influenced my ideas about water issues.*

Analyzing commissioners' involvement in organizations was another approach we used to examine how agriculture was connected to water issues for county commissioners. In particular, each respondent was asked to list water-related organizations in which s/he had been a board member or played a leadership role. This analysis underestimates the sheer numbers (because more commissioners participated as members than served in leadership positions), but is useful in identifying patterns in formal associations made by commissioners in linking water and agriculture.

One-hundred and one commissioners provided the names of public, quasi-public, private, professional, and trade organizations related to water on whose boards they had served. While no numerical differences showed up between the three groups of commissioners (40 percent of respondents overall reported having served on the board of a water-related organization) there were differences in the types of organizations each group participated in. Table 1 shows the types of water-related organizations in which agricultural, mixed, and nonagricultural commissioners held leadership positions.

Commissioners from each of the three groups were involved in flood control, wastewater, water quality, and state/regional water coordination organizations, most likely because of the need for managing these kinds of water issues in a wide variety of counties. Nonagricultural commissioners were much more likely to have been board members in organizations oriented toward municipal water issues, including urban drainage districts, municipal water boards, and professional municipal organizations organized at the state level (such as the Nevada Association of Cities). Agricultural commissioners, by contrast, were involved in a wide variety of boards and were more likely to be involved in organizations oriented towards protecting, developing or distributing irrigation and agricultural water supplies, (including local or multicounty water users groups; water conservation or conservancy districts; irrigation districts; reservoir, ditch, acequia or canal associations; resource conservation and development councils – formerly SCS districts). Mixed commissioners were also involved in a wide variety of organizations, including both municipally-oriented and rural, agriculturally-oriented groups.

Mann (1983) noted that throughout the western U.S. the relationships between public entities and private water organizations have traditionally been so close that the distinction between public and private becomes almost meaningless. Almost two decades later, this seems borne out in our findings that the majority of agricultural commissioners served both as public figures and provided leadership in a number of private and quasi-public water organizations that are agriculturally-oriented. Such agriculturally-oriented water organizations often associate themselves with the notion of the independent,

TABLE 1. Comparison of Board Membership (related to water issues) of the Agricultural, Mixed, and Nonagricultural County Commissioners.

Type of Water Organization	Agricultural Commissioners	Mixed Commissioners	Nonagricultural Commissioners
Flood Control Districts	**	••	••
Urban Drainage Districts		**	**
Boundary and Water Commission			**
Sewer and Wastewater Districts	**	**	**
Health/Water Quality Agencies	**	**	**
Municipal Water Boards			**
Community Water Boards	**		**
Professional/Trade Water Organizations (national/state level organizations)	**		**
Professional Municipal Organizations (regional/state level organizations)			**
Appointed/Elected State or Regional Water Commissions	**	**	**
Local Water Users Groups	**	**	
Multicounty Water User Associations	**	••	
Water Conservaton Districts*	**	**	
Irrigation Districts	**		
Reservoirs, Canal, and Acequia Associations	**	**	
Resource Conservation and Development Councils	**	**	
PUD and Hydropower Districts	**	**	
Watershed Councils	**	**	
River Advisory Committees	**	**	
Ground Water Commissions	**		

*Includes water conservancy districts as well, both of which are instrumental in water project development and assuring water suppies are available to irrigation districts and other water users.

small farmer/rancher who epitomizes traditional agricultural values, and also draws upon the grassroots nature of their organizations. Relationships between members in the farming and ranching sector, who may constitute a formidable voting and economic block, and agriculturally-oriented industry interests, such as agricultural suppliers, financial institutions, and marketing firms, enhance organizational power, allowing these groups opportunities to play significant roles in electoral politics (Mann, 1983). Commissioners' leadership in these types of organizations may reinforce, through shared experience and exchange of ideas, the notion that agricultural productivity is closely related to protection of water for agricultural uses. In supporting agriculturally-oriented organizations, commissioners may also directly or indirectly serve to connect local government to agricultural interests.

WATER POLICY ISSUES FACING WESTERN COUNTY COMMISSIONERS

In an effort to determine the types of water policy issues they faced, county commissioners were asked to specify whether they had discussed or voted on seven types of water policy issues (municipal water supply, water importation projects, wetlands/riparian issues, agricultural water supply, water quality or wastewater issues, flood control projects, and water demand and conservation) while serving in their capacity as a local elected official. Statistical comparisons were made between the three groups of commissioners (agricultural, mixed, and non-agricultural) to determine if differences existed between the types of water policy issues discussed (in their role as commissioner) or if there were differences in the types of issues they had voted on.

There were only two policy areas where no statistically significant differences existed between the three groups of commissioners. These were water importation projects (42 percent of all commissioners had either voted on or discussed) and wetland/riparian issues (76 percent of the all commissioners had either voted on or discussed).

Agricultural commissioners throughout the West were significantly more likely to have discussed agricultural water supply issues as compared to nonagricultural and mixed commissioners. When asked about their major water policy issues, agricultural commissioners often volunteered issues concerning the protection or maintenance of water supplies for agriculture or the development of additional water infrastructure (wells, reservoirs, canals, etc.). This pattern held true even for those agricultural commissioners who did not live in arid counties. For example, one agricultural commissioner from western Washington, noted in his interview that he had regular policy discussions about the need to maintain water supplies for cranberry farmers and that these discussions occurred frequently, as often as once a month, during the growing season.

For agricultural commissioners, policy discussions on water issues such as flood control and water demand/conservation also took place more frequently as compared to their mixed and non-agricultural counterparts, but these discussions apparently often did not result in the formulation of or need to vote on specific policies. In interviews, many agricultural commissioners mentioned that specific policies were developed and voted on for these types of water issues only when there was an immediate or pressing concern, for example after a flood or when water conservation requirements were about to be imposed by the state or federal government. Our interviews with mixed and agricultural commissioners suggested that there may be a tendency towards crisis management on many types of water issues. This was evident in the frank statement by a mixed commissioner from central New Mexico: "Our county is very much of a reactive legislative body. I find it difficult to get any interest because we aren't in crisis yet." In such cases, commissioners are activated to defensive postures when crises threaten what are perceived as important, local interests. Quite frequently, the local interests defended by county commissioners are, in fact, agricultural interests.

Nonagricultural commissioners were more likely to have had policy discussions or voted on issues that had a high impact in urban areas (e.g., municipal water supply) and did not address agricultural issues frequently. Interviews with nonagricultural commissioners suggest that when agricultural water supply issues came up they were often translated into other types of issues, such as contamination of water resulting from agricultural practices or the future potential of agricultural water supplies becoming sources for municipal water supply.

CONCLUSIONS

There were many more agricultural commissioners than mixed or non-agricultural in this study; a clear majority of the commissioners in this study had personal work experience in agriculture and over four-fifths saw themselves as representing agricultural communities. These commissioners were distinct in many respects from their mixed and nonagricultural counterparts. Agricultural commissioners were more likely to have been raised in agricultural communities and typically had lived for a very long time in the county they represented. Agricultural commissioners were more likely to have been board members of organizations that protect, develop or distribute agricultural water supplies, and they may use their positions to defend local water interests, particularly those of agriculture. Agricultural commissioners were also less likely to have discussed or voted on municipal water supply, water quality, and wastewater issues, but were more likely to have voted on agricultural water supply issues.

We believe that these findings were not aberrations, but fairly represent the strength of county commissioners' ties to agriculture throughout the western U.S. Our results cannot be explained through the sample selection procedures, since measures were taken in the sample design to ensure that more heavily populated and urbanized counties were not excluded from our sample. One explanation may be found in the nature of counties as places in the West. Counties are an areal-based unit of local government, without territorial overlap. Western U.S. counties have uneven patterns of population dispersal and concentration as well as widely differing areal bases. Nevertheless, the great majority of counties in the West contain vast amounts of agricultural lands. Farm lands alone average 27.5 million acres per state, constituting 39 percent of the average land base of each state (ERS, 1998). The large numbers of agricultural and mixed commissioners reflect in part the nature of the places that encompass vast amounts of land dedicated to agriculture and politicians' visions of how to represent these places.

The enduring ideology of agriculture in the West provides another explanation for the fact that the majority of commissioners in our study had strong ties to farming and ranching. The ideal of the western U.S. as an agricultural heartland may not only serve to sustain the credibility of rural institutions such as local government, but also supports the legitimacy of local political representatives with agrarian values and experiences. While this study did not specifically investigate commissioners' elections or campaigns, it may be that commissioner candidates gain credibility among voters if they have actual work experience in farming/ranching or promise to represent the interests of agricultural communities.

Commissioners were quite conscious of the importance of water and had been involved in policy discussions and decisions about a variety of water issues. As one mixed commissioner stated: "Water in the West will be the most valuable currency in the next century, especially as the demand increases with population growth." Agricultural commissioners took this particularly seriously, readily defending state and local interests to water, as one agricultural commissioner stated: "Water is the life line of the western states."

Western county commissioners not only have strong ties to agricultural interests, they are also less likely to discuss or vote on municipal water supply issues. Two possible explanations for rural western municipalities emerge. One, the unified nature of water and agriculture in the West persists to the present day, so that ensuring local agriculture has enough water is synonymous with supplying enough water for the small municipalities within these counties. Or, small municipalities in western counties are still small enough so that their historic water supplies (public or private) have remained adequate, and that growth pressures have not yet depleted their drinking water resources.

LITERATURE CITED

Berry, K. A., N. L. Markee, M. J. Stewart, and G. R. Giewat, 1996. County Commissioners' Water Knowledge. Water Resources Bulletin 32(5):1089-1099.

Born, S. M., 1989. Redefining National Water Policy. *In:* Redefining National Water Policy, S. M. Born (Editor). AWRA Special Publication 89-1, pp. 1-10.

ERS (Economic Research Service), U.S. Department of Agriculture, 1998. Fact Sheets for the States of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. *Available at* http://www.econ.ag.gov/epubs/other/usfact/.

Favero, P. and T. R. Alter, 1986. Defining Your Niche: Strategies for Local Government Programs. Journal of Extension Fall 1986, pp. 23-25.

Mann, D., 1983. Institutional Framework for Agricultural Water Conservation and Reallocation in the West: A Policy Analysis. *In:* Water and Agriculture in the Western United States: Conservation, Reallocation and Markets, G. D. Weatherford (Edi--tor). Westview Press, Boulder, Colorado, pp. 9-50.

Sims, J., 1987. Ideology: A Worried Analysis. *In:* The Role of Social and Behavioral Sciences in Water Resources Planning and Management, D. D. Baumann and Y. Y. Haines (Editors). ASCE, New York, New York, pp. 58-64.

Wilkinson, C. F., 1992. Crossing the Next Meridian: Land, Water, and the Future of the West. Island Press, Washington, D.C.

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INTERESTED IN MORE MUNICIPAL WATER ISSUES IN THE DRY WEST?

For rural water, you might find it interesting to look at several reports available on the CLIMAS web site – the one on the Middle San Pedro River Valley, and the one on sensitivity of urban water resources to climate variability (includes assessment of the small rural community of Benson Arizona, and links with the Middle San Pedro Study, but each report has its own emphasis). There is one due out soon on the Sulphur Springs Valley of Arizona. It will show up on the web site probably within the next couple of months.

CLIMAS Web Site
http://www.ispe.arizona.edu/climas/archive.html

▲ Future Issues of IMPACT

MAY 2002
TOPIC TO BE ANNOUNCED

JULY 2002
HISTORICAL ASPECTS OF WATER RESOURCES-II
RICHARD H. MCCUEN
(rhmccuen@eng.umd.edu)

SEPTEMBER 2002
DISTANCE LEARNING IN WATER RESOURCES
FAYE ANDERSON
(fayeanderson2@aol.com)

NOVEMBER 2002
INTERNATIONAL TRANS-BOUNDARY WATER DISPUTES
CLAY J. LANDRY
(landry@perc.org)

If you want to submit an article for any of the above issues, contact the designated Associate Editor or the Editor-In-Chief N. Earl Spangenberg (espangen@ uwsp.edu)

▲ AWRA 2002 Meetings

MAY 13-15, 2002
NEW ORLEANS, LOUISIANA
SPRING SPECIALTY CONFERENCE
"COASTAL WATER RESOURCES"

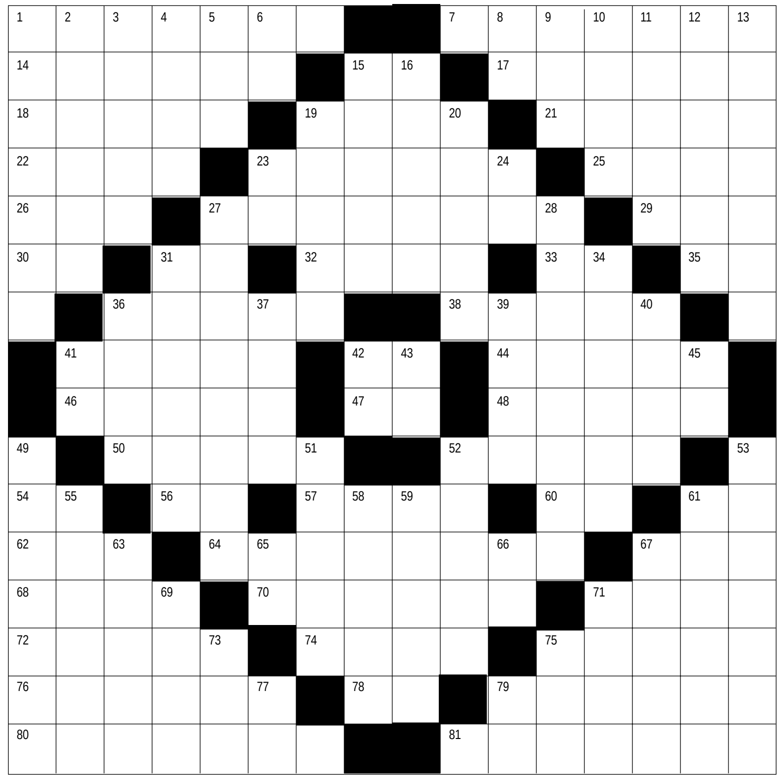
JULY 1-3, 2002
KEYSTONE, COLORADO
SUMMER SPECIALTY CONFERENCE
"GROUND WATER/SURFACE WATER INTERACTIONS"

SEPTEMBER 17-18, 2002
WASHINGTON, D.C.
"AWRA WATER RESOURCES POLICY DIALOGUE"

NOVEMBER 4-7, 2002
PHILADELPHIA, PENNSYLVANIA
"ANNUAL WATER RESOURCES CONFERENCE"

For additional information
info@awra.org

▲ Water Resources Puzzler (answers on pg. 36)



Nero and Caesar agree that 42 Down is the product of 42 Across and 43 Down, while 47 Across is three times larger than 42 Across

ACROSS

1 lake in Minnesota
7 river in Oklahoma
14 passes
15 folios (abbr.)
17 think out
18 Elvis and Elton
19 sicknesses
21 apportion
22 Ed or Leon
23 acting group
25 part of graph or gram
26 Baxter or Brown
27 water previously below freezing
29 _______-four (radio slang)
30 symbol for thallium
31 location of James River
32 compass points
33 location of Congaree River
35 giver of TLC
36 found in bowling alleys
38 goads
41 aurifies
44 _______ Gay
46 Mediterranean island
48 cut wood
50 a summer staple?
52 covered by a hemispherical roof
54 Coney or Rhode (abbr.)
56 _. _. Tittle, qb
57 Presque _______
60 location of Priest River
61 follows mu
62 self (Scot.)
64 pretentious displays
67 neither's partner
68 wire-drawn
70 pinnacle
71 German mister
72 Daisy Mae's beau
74 Reagan and McDonald
75 musical symbol
76 closer
78 letter abbreviation
79 Dodge City native
80 threefold
81 gift

DOWN

1 fine
2 glossy paint
3 makes defective
4 finishes a cake
5 parts of a dollar (abbr.)
6 locaton of Pago Pago (abbr.)
8 location of Ouachita River
9 Red or Black
10 stop
11 a little island
12 machinist
13 aerial
15 runs
16 an artificial channel
19 presses
20 disgorges
23 location of Clinch River
24 map abbreviation
27 golfer's hazard
28 waves
31 glen
34 boasted
36 fabricator
37 birthright seller
39 monetary unit of Mexico
40 winter transportation
41 auto maker (abbr.)
45 tennis term (abbr.)
49 remote
51 West African river
52 indentations
53 river in Missouri
55 Navy construction engineer
58 Spanish title
59 Frankie _______
61 lake in North Carolina
63 followed by caustic or month
65 location of Gila River
66 symbol for thorium
67 New Bern's river
69 a sea bird
71 egg layers
73 New Deal administration
75 Scottish 'no'
77 Union Pacific
79 symbol for krypton

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Water Resources Continuing Education Opportunities

MEETINGS, WORKSHOPS, SHORT COURSES

APRIL 2002

7-10/Floodplain Mgmt. Planning. San Diego, CA. **Contact** L. Hromadka. Conf. Planning Coordinator, Floodplain Mgmt. Assoc., Exec. Dir., P.O. Box 2972, Mission Viejo, CA 92690-0972 (949/766-8112; f: 949/459-8364; e: fmalaura@home.com)

8-9/Water Rights Law and Regulations in the Eastern United States. Madison, WI. **Contact** Howard Rosen (800/462-0876; e: rosen@engr.wisc.edu) or Ruth McDowell (e:custserv@epd.engr.wisc.edu)

18-19/Mediation Training: Negotiating Effective Environmental Agreements. UC-Berkeley, CA. Contact CONCUR (510/649-8008; e: concur@concurinc.net; w: www.concurinc.com

21-24/National Hydropower Assoc. 2002. Washington, DC. **Contact** (816/931-1311 x105)

23-27/World Aquaculture 2002. Beijing, China. **Contact** (760/432-4270)

MAY 2002

13-15/AWRA's Annual Spring Conf. – "Coastal Water Resources." New Orleans, LA. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org)

19-24/Aquatic Weed Control Short Course 2002. Ft. Lauderdale, FL. **Contact** Beth Miller Tipton (352/392-5930; f: 352/392-9734 e: bmiller-tipton@mail.ifas.ufl.edu)

22-24/Intertech 6th Intern'l. Conf.: Coagulants and Flucculants. Chicago, IL. **Contact** Charles Spear, Intertech, 19 Northbrook Office Park, Portland, ME 04105 (207/781-9612; f: 207/781-2150; e: chuck@intertechusa.com; w: intertechusa.com/floc.html)

29-31/Ninth International Conf. on Hydraulic Information Management – HYDROSOFT 2002. Montreal, Canada. **Contact** Lucy Southcott, Conf. Secretatiat, HYDROSOFT 2002, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Sjouthhampton, SO40 7AA, UK (+44(0)238-029-3223; f: +44(0)238-029-2853; e: lsouthcott@wessex.ac.uk; www.wessex.ac.uk/conferences/2002/hy02

JUNE 2002

2-5/9th Intern'l. Sym. on Society and Resource Mgmt. Bloomington, IN. **Contact** Alison Voight (812/855-3095; e: issrm@indiana.edu)

10-14/American Society of Limnology and Oceanography Summer Meeting. Victoria, BC. **Contact** http://aslo.org/victoria2002/index.html

11-14/Allocating & Managing Water for a Sustainable Future: Lessons From Around the World. Boulder, CO. **Contact** Natural Res. Law Ctr., 401 UCB, University of Colorado Law School, Boulder, CO 80309-0401 (303/492-1272; fax: 303/492-1297; e: NRLC@spot.Colorado.edu; web: www.colorado.edu/law/NRLC/2002Conference.html

JULY 2002

1-3/AWRA's Annual Summer Conf. – "Ground Water/Surface Water Interactions." Keystone, CO. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org)

23-26/Integrated Transboundary Water Mgmt. Traverse City, MI. **Contact** EWRI of ASCE, 2002 Conference (UCOWR), 1015 15th St., NW, Ste 600, Washington, D.C. 20005 (202/789-2200; f: 202/ 789-0212; e: ewri@asce.org; w: www.uwin.siu. edu/ucowr)

28-Aug. 1/2nd Federal Interagency Hydrologic Modeling Conf. Las Vegas, NV. **Contact** Don Frevert, Co-Tech. Prog. Chair, USBR, P.O. Box 25007, M/C D-8510, Lakewood, CO 80225 (303/445-2473; f: 303/445-6351; e: dfrevert@do.usbr.gov)

AUGUST 2002

4-10/132nd American Fisheries Society Meeting. Baltimore, MD. **Contact** Betsy Fritz (301/897-8616; e: bfritz@fisheries.org)

11-17/12th Stockholm Water Sym: Balancing Competing Water Uses – Present Status and New Prospects. Stockholm, Sweden. **Contact** Stockholm Intern'l. Water Inst., Stockholm Water Sym., Sveavagen 59, SE-113, Stockholm, Sweden. (+46 8 552 139 61; e: sympos@siwi.org)

12-15/StormCon™ – The North American Surface Water Quality Conf. & Exposition. Marco Island, FL. **Contact** Janice Kaspersen (805/681-1300 x12; e: sweditor@forester.net)

SEPTEMBER 2002

22-26/Rocky Mountain Summit: Sustaining Ecosystems & their People. Whitefish, MT. **Contact** RMS 2002, Attn: Julia Rodriguez, 130 Mumford Hall, Columbia, MO 65211-6200 (573/882-7458; f: 573/884-2199; e: CARES@Missouri.edu; w: www.cares.missouri.edu/rms2002

30-Oct. 4/6th Intern'l. Conf. on Diffuse Pollution. Amsterdam, The Netherlands. **Contact** www.nva.net/agenda/conference.htm or Govert Verstappen at G.G.C.Verstappen@riza.rws.minvenw.nl or r.r.kruize@inter.nl.net

OCTOBER 2002

8-10/Changing Faces of Conservation & Agriculture: The Future of Working Lands. Moline, IL. **Contact** Chris Murray (e: chrism@agribiz.org)

13-17/Hydrologic Extremes: Challenges for Science & Mgmt. AIH 2002 Annual Meeting. Portland, OR. **Contact** AIH, 2499 Rice St., Ste. 135, St. Paul, MN 55113 (651/484-8169; f: 651/484-8357; e: AIHydro@aol.com; w: www.aihydro.org)

NOVEMBER 2002

4-7/AWRA's Annual Water Resources Conf. Philadelphia, PA. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; f: 540/687-8395; e: info@awra.org)

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President's Message . . . Kenneth J. Lanfear, AWRA President, 2002

AWRA INTERNATIONAL?

At AWRA's January, 2002 Board of Directors' meeting, we were joined by two international experts on water issues: Ron Hoffer, Senior Advisor for Federal and International Programs, U.S. Environmental Protection Agency, and Anna Lenox, Deputy Chief, International Water Resources Branch, U.S. Geological Survey. We talked with them about a number of ways that AWRA could increase its global activities. Our meeting on "Globalization of Water Resources" in Dundee, Scotland, was a great start, and we're considering a repeat performance. We also have a meeting coming up in New York in Summer 2003, "International Conference on Watershed Management for Communities." As always, watch the AWRA website for announcements.

The Dundee conference covered one "hot" international issue: the privatization of water systems. Some think privatization is the best idea since sliced bread for efficiently managing an infrastructure. Others call it a disastrous give-away to private industries. In ensuring a sustainable water infrastructure, we need to consider the rights of all people to a safe and secure supply of water for living. Of one thing you can be sure: AWRA will try to cover all these issues fairly and impartially in *IMPACT* and *JAWRA*!

The electronic version of *JAWRA* opens up new opportunities to serve the international community. AWRA recently established an "International Associate" membership class, with a dues of $20 per year, open to those who are both citizens and residents of developing nations (as defined by World Bank criteria). These members will get immediate access to the electronic versions of *JAWRA* and *IMPACT*, the AWRA on-line membership directory, and other electronic services. If you're working in the international arena, this might be a great opportunity to give a foreign colleague a gift membership that will advance their knowledge.

The AWRA International Technical Committee has a new chair, Dr. John Dracup, of the University of California, Berkeley. We're looking forward to him continuing the active discussions of this committee to involve AWRA in world water affairs. Thanks to outgoing Chair David Moody for all his work, and, in particular, for keeping AWRA connected with South and Central America through the Water Information Summit.

So, keep looking for AWRA to keep you abreast of the latest international and domestic water issues. Enjoy this issue of *IMPACT*, and check out the AWRA International Technical Committee on our website.

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February 2002 JAWRA Papers (Vol. 38, No. 1)

- Diagnostic Approach to Stream Channel Assessment & Monitoring
- A Model to Enhance Wetland Design & Optimize Nonpoint Source Pollution Control
- Evaluation of Light Detection & Ranging (LIDAR) for Measuring River Corridor Topography
- Water Level Fluctuations in an Urban Pond: Climatic or Anthropogenic Impact?
- Stream Restoration in the Vicinity of Bridges
- Application of Rosgen Analysis to the New Jersey Pine Barrens
- A Revised Version of PnET-II to Simulate the Hydrologic Cycle in Southeastern Forested Areas
- Soil Salinity Prediction Using Artificial Neural Networks
- Soil Erosion and Ground Water Pollution Tradeoffs for Nonirrigated Farming Systems
- Modified Falling Head Permeameter Analyses of Soils From Two South Florida Wetlands
- An Economic Assessment of Ground Water Recharge in the Tucson Basin
- Water Quality in Shallow Alluvial Aquifers, Upper Colorado River Basin, Colorado, 1997
- Use of Incised Channel Evolution Models in Understanding Rehabilitation Alternatives
- Precipitation Changes From 1956 to 1996 on the Walnut Gulch Experimental Watershed
- Flood-Stage Forecasting With Support Vector Machines
- Dam-Induced Modifications to Upper Allegheny River Streamflow Patterns & Their Biodiversity Implications
- Evapotranspiration & Canopy Resistance at an Undeveloped Prairie in a Humid Subtropical Climate
- Regional Characteristics of Nutrient Concentrations in Streams & Their Application to Nutrient Criteria Development
- Spatially Explicit Hydrologic Modeling of Land Use Change
- The Lodging Velocity for Emergent Aquatic Plants in Open Channels
- Fecal-Indicator Bacteria in Streams Along a Gradient of Residential Development
- Modification of Neill's Equation for Storm-Tide Design Flow Analysis
- Application of the BASINS Database & NPSM Model on a Small Ohio Watershed
- Atrazine & Metolachlor Occurrence in Shallow Ground Water of the United States, 1993 to 1995: Relations to Explanatory Factors

Vol. 3, No. 6, pp. 20-23, Nov. 2001 – "Long-Term Experimental Watersheds and Urban Stormwater Management" – James P. Heaney

I am writing to concur with Professor Heaney's recommendation to establish a suite or network of experimental watersheds in urban areas. Articles published by AWRA indicate that state supported and land grant institutions of higher learning such as Michigan State University and Shippensburg University have established on-campus experimental watersheds for water resources education and research purposes.

More recently, we here at the First State's land-grant college have established the University of Delaware Experimental Watershed as an on-campus water resources education and research site (http://www.ipa.udel.edu/research/publications/expwatershed/). Since the experimental watershed is on-campus we are able to draw from a critical mass of water related faculty, staff, and students from the Colleges of Agriculture, Engineering, Geography, Geology, and Public Policy to participate in the project. Participation in the UD Experimental Watershed is multidisciplinary, serving as the focus for field courses and research projects in Regional Watershed Management from the School of Urban Affairs and Public Policy, Water Resources Engineering in the College of Engineering, and Teachers in the 7th Grade Watershed Training Module from the UD Math and Science Education Research Center. Our experience with the experimental watershed as a way to teach and research about water resources has been promising.

It makes sense that Professor Heaney's recommendation should be explored in more detail perhaps at a future AWRA conference. If a network of experimental watersheds were created, the campuses of our universities and colleges would serve as logical settings given the proximity of water resource's brain power at the faculty, staff, and student level.

REFERENCES

Kauffman, G. J., J. Campagnini, M. Corrozi, and J. Bowers, 2001. Development of the University of Delaware Experimental Watershed Project. Proceedings of the American Water Resources AWRA/UCOWR Conference, pp. 81-86.

Witter, S. G., R. Kline-Robach, F. Poston, and M. J. Lang, 2000. MSU-WATER. Michigan State University. Water Resources IMPACT 2(6):19-22.

Woltemade, C. J. and W. L. Blewett, 2000. Development of an Interdisciplinary Watershed Research Laboratory for Undergraduate Education, Shippensburg University. *In:* Water Quantity and Quality Issues in Coastal Urban Areas, AWRA Annual Water Resources Conference Proceedings, pp. 229-232.

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(*Editor's Note:* This sounds like an interesting idea. To get things started, the Education Technical Committee of AWRA will sponsor a session (or sessions) exploring the past and potential of urban experimental watersheds at the 2002 Annual Conference. If you are interested in helping and/or particpating, let me know.)

The following information from Associate Editor Charles Slaughter is also pertinent to Dr. Heany's article . . . *IMPACT* has previously emphasized long-term data needs and opportunities, specifically including experimental watersheds (July 2000 issue). I certainly concur with [Dr. Heany's] call for long-term data bases, including the experimental/representative watershed model, for urban or urbanizing areas. As "wildland hydrologists" many of us have purposefully stayed in the woods and not wanted to deal with cities, stormwater management, etc., but the data needs are parallel, and watershed conditions may be changing more rapidly and permanently where the people are concentrated.

Charles W. Slaughter (cslaugh@uidaho.edu)

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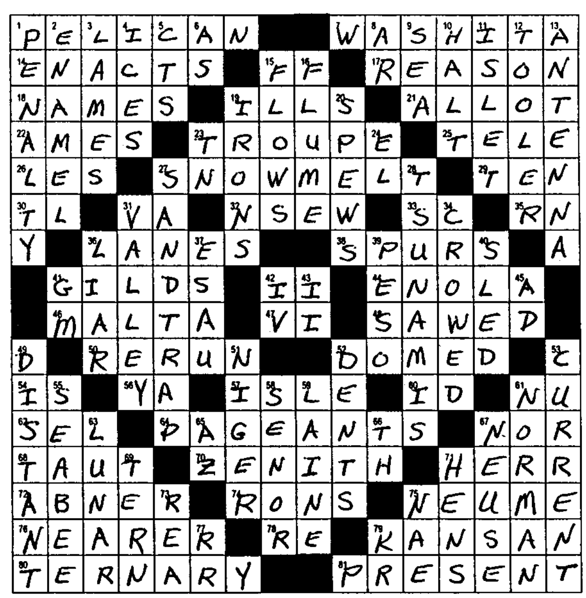
Solution to Puzzle on pg. 33



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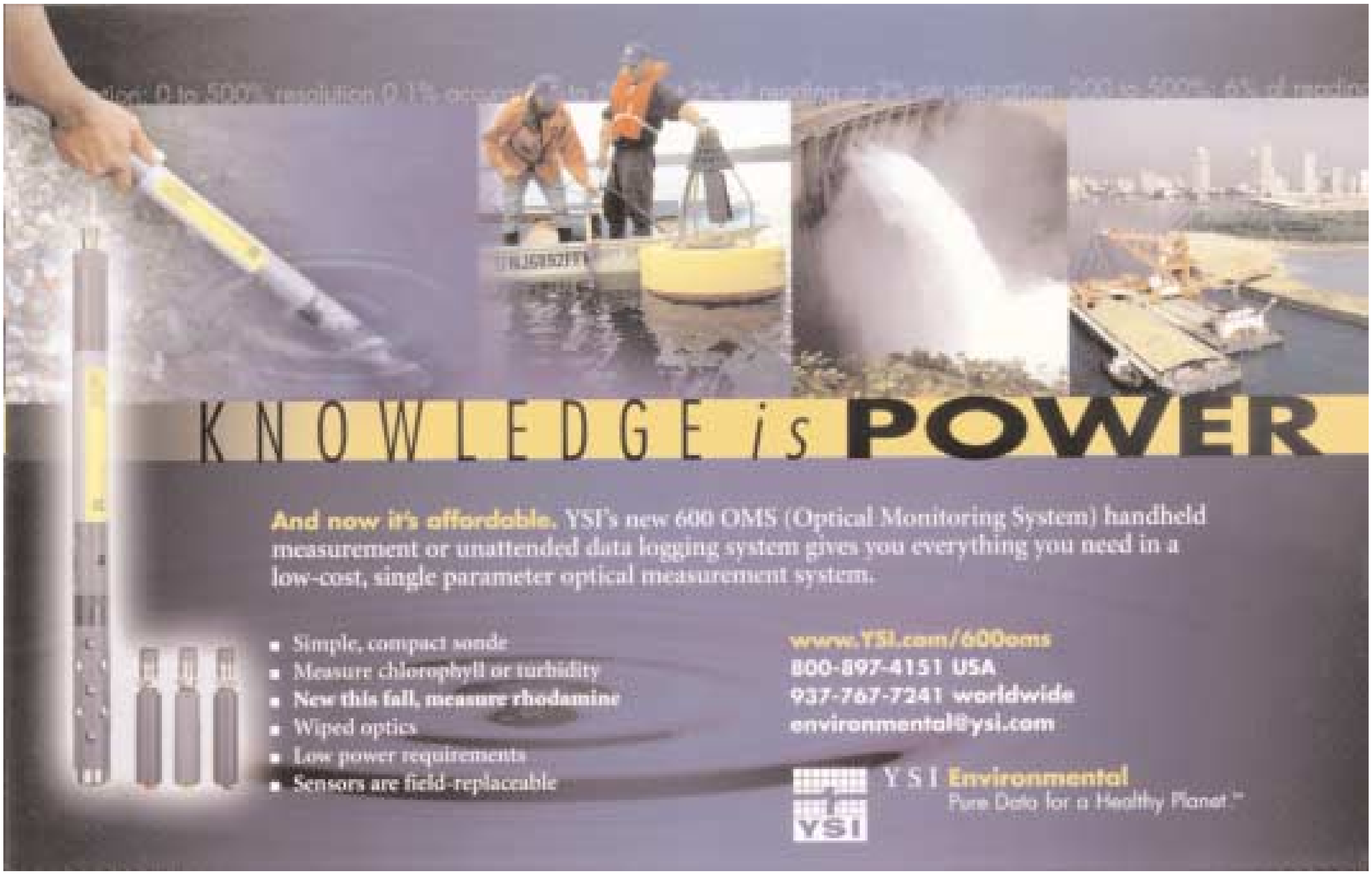

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