Vol. 2 No. 4 October 1998

# KENTUCKY DRILLER QUARTERLY

Division of Water, Groundwater Branch

## Well Construction Trends from the Groundwater Database

### THE GROUNDWATER DATABASE

Information from the well construction forms submitted by Kentucky drillers is incorporated into the Department for Environmental Protection's Consolidated Groundwater Database. The database was set up in 1985 under mandate of statutes passed in 1984 that established certification of water well drillers. KRS 223.440 and the subsequent regulation (401 KAR 6:310 Section 3) require the driller to submit a report to the Division of Water (DOW) for each well constructed. In 1991, the regulation was revised to include monitoring wells.

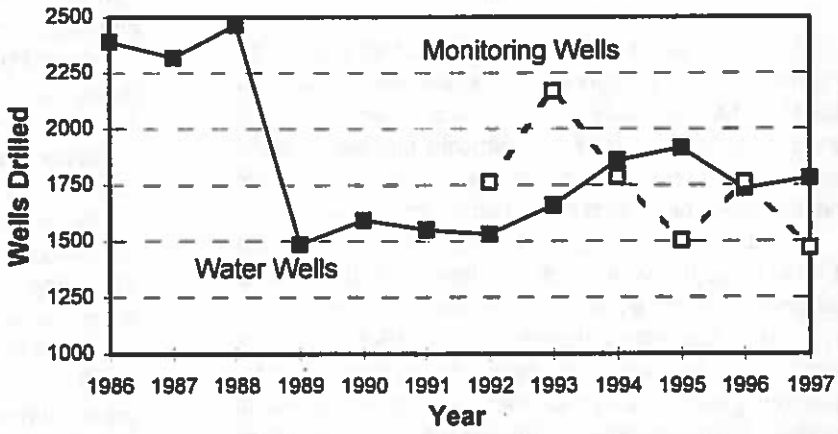


**Figure 1: New Well Construction in Kentucky 1986-1997**

The groundwater database at present contains information about nearly 42,000 Kentucky wells. Of these wells, about 27,000 are water wells and 15,000 are monitoring wells. Most of these wells represent new construction that has occurred since the certification of well drillers. A significant number of wells in the database, however, predate driller certification and the information about them was obtained through inspections by field personnel of various state and federal agencies. These "pre-law" wells include nearly 1,600 water wells and more than 1,800 monitoring wells. The database also includes information for nearly 1,200 natural springs.

Analysis of information in the groundwater database allows a number of trends to be examined. Data from 1985 for water wells and 1991 for monitoring wells are not included because certification programs were begun in midyear for these two programs respectively.

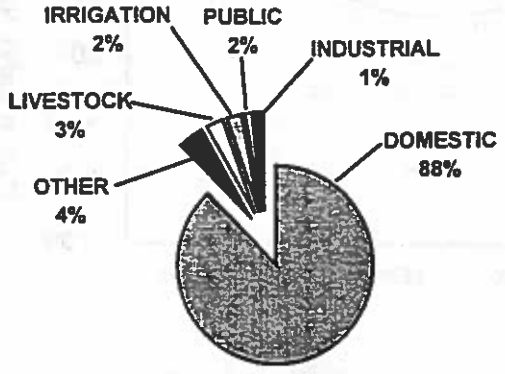


**Figure 2: Construction of Water Supply Wells by Type Well**

### NEW CONSTRUCTION

Figure 1 illustrates the number of newly constructed water and monitoring wells reported to the Division of Water. On average, approximately 1,850 water supply well and 1,750 monitoring well records were submitted to DOW each year.

Figure 2 shows a breakdown of water supply wells constructed by category of use, for those wells where the intended use was reported by the driller. Almost 9 out of every 10 water supply wells were drilled for domestic (household) use. The category "other" consists primarily of well records for which no use was indicated, but also includes wells drilled for open loop heat pump systems.

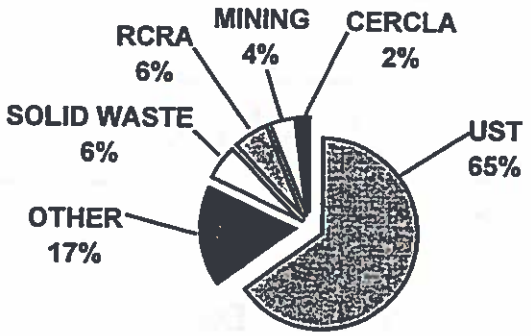


**Figure 3: Construction of Monitoring Wells by Program Class**

Figure 3 shows a breakdown of monitoring wells by program. Most monitoring wells are associated with facilities having underground storage tanks. The category "other" includes a significant number of wells used for site assessment, usually to assess possible contamination on a property or facility prior to sale.

Reexamination of Figure 1 reveals that construction of water supply wells and monitoring wells exhibits distinctly different trends. New water well construction, aside from the abrupt downturn from 1988-1989, has been relatively stable, whereas the number of new monitoring wells shows wide variations from one year to another. Different factors influence the frequency of the two types of construction. The demand for new water supply wells is mainly consumer driven, while demand for monitoring wells is mainly program driven.

Consumer demand for water supply wells is influenced by a combination of variables that include precipitation patterns (dry years vs. wet years); the proportion of rural to urban population; extension of public water systems; and the number of new housing starts. The trend in Figure 1 shows that construction of new water supply wells peaked in 1988 with nearly 2,500 wells. Well construction dropped abruptly the next year, by nearly half, to less than 1,500 wells in 1989. Since that time, new water well construction has shown a slow but steady growth to a current level of about 1,750 wells per year. Unfortunately there are no data for new well construction prior to 1985 to indicate whether the higher rate from 1986 to 1988 depicts a "normal" rate of new well construction, or whether the new and lower plateau from 1989 to the present is more representative.

Annual precipitation is probably the most significant factor contributing to the decline in water well construction after 1988. Although data are not available to demonstrate this, the peak shown from 1986-1988 may be an abnormality reflecting the prevailing drought condition during the mid-1980s. Falling static water levels and well failure would stimulate the need for both deepening of existing wells and construction of new water supply wells. Adequate rainfall in 1989 that recharged groundwater aquifers, combined with the large number of wells constructed during the preceding dry years, may account for the abrupt drop in 1989 well construction.

Figure 4 compares new water supply well construction to the Palmer Drought Severity Index (PDSI) for the Bluegrass Region of Kentucky. The PDSI

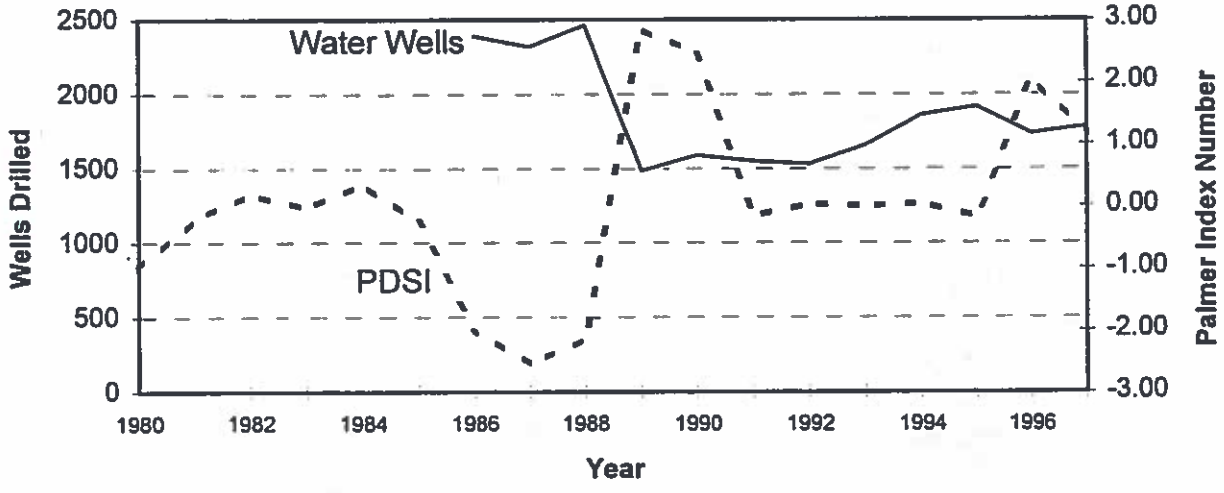


**Figure 4: New Water Supply Well Construction Compared to Palmer Drought Severity Index 1980-1997**

is an indication of prolonged relative wetness or dryness, based on general regional conditions and not local variations caused by isolated rains. Increasing magnitude of positive numbers on the Palmer Index scale indicates a greater relative wetness for the period; and, conversely, greater negative numbers indicate greater severity of drought (normal moisture conditions lie within a range of about -0.5 to +0.5). The PDSI seems to indicate an inverse correlation with the number of new water wells constructed in Kentucky from 1986 to 1997. This appears to support the proposition that the demand for new water wells is much higher during drought years than when precipitation is plentiful.

The statistics for new water wells may be somewhat erroneous due to the existence of an unknown number of uncertified drillers and also underreporting of construction by drillers who fail to submit paperwork on all wells. A graph of well records, however, submitted by three drillers known to be conscientious in their paperwork exhibits almost precisely the same trend as Figure 4.

The rate of monitoring well installations is primarily controlled by federal and state program mandates. The most significant of these to monitoring well construction is the Underground Storage Tank (UST) program. Figure 3 shows that nearly two-thirds of all monitoring wells are installed under the UST program. Accordingly, changes in the requirements of the UST program are likely to have a strong effect upon the number of wells constructed. The large peak in UST wells built in 1993 was probably stimulated by anticipation of new regulations scheduled to go into effect early in 1994. Similarly, given that the final form of the UST regulations became effective January 1, 1996, the low number of monitoring wells constructed in 1995 may indicate a "wait and see" attitude on the part of regulated facilities.

## GEOGRAPHICAL DISTRIBUTION OF NEW CONSTRUCTION

Distribution patterns for water supply wells and monitoring wells are nearly in complete opposition, since factors that drive construction are very different for each type. The location of water wells in the state largely depends upon public water system infrastructure. Where public supply systems are absent, in many rural areas of the state, wells are necessary to provide the population with water. Recent census figures show that more than 90 percent of rural self-supplied households depend on groundwater sources. Closer to urban centers, domestic well use declines although farms with access to "city water" may find it more cost effective to use wells to water livestock and fill irrigation ponds.

Figure 5 is a dot map that shows the concentration of the 27,000 water supply wells in Kentucky. Two major regions of concentrations are immediately apparent: the Eastern Kentucky mountain region and the Jackson Purchase. These two areas account for more than 65 percent of all the wells that have been drilled in the state since driller certification was implemented, but less than a third of the land area of the state. Secondary areas of concentration include the Inner Bluegrass, the Meade/Breckinridge/Hardin County area, and the Pulaski/Russell County area.

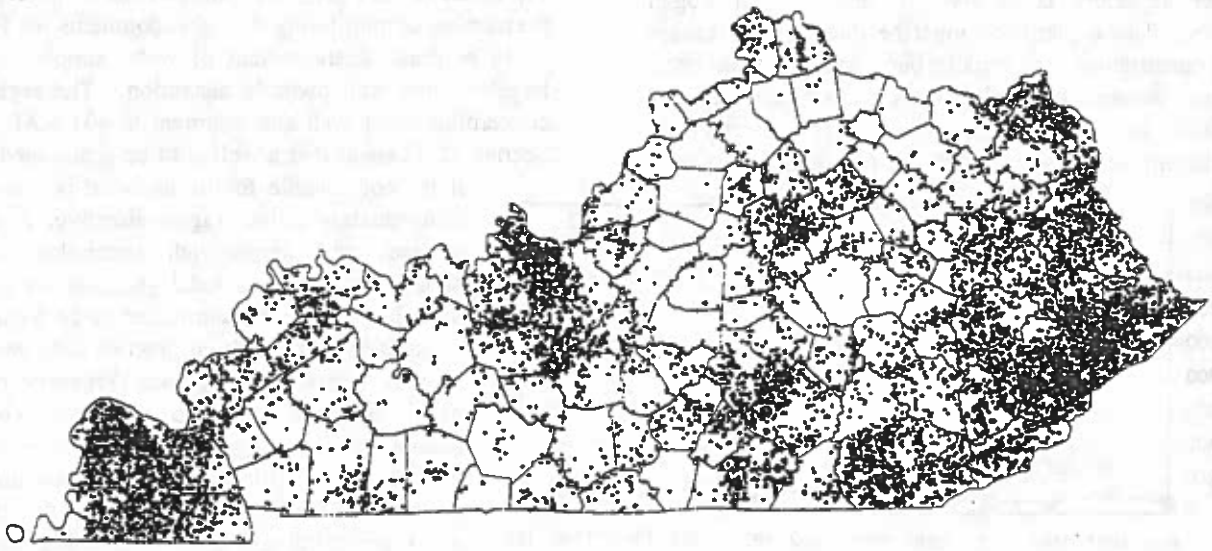

**Figure 5: Distribution of Water Wells in Kentucky**

The extent of public water system service can be approximated through use of 1990 US Census data on household water source. For Meade County, which Figure 5 shows as an area of concentration of wells, 57 percent of households were on public systems in 1990. In contrast, where Figure 5 shows few wells in the area including Logan, Simpson and Warren counties, public systems served more than 93 percent of the population.

Although public system coverage is the most important controlling factor to explain distribution of water supply wells, other factors related to local geology and groundwater quality are also significant. For example, few wells have been constructed in the Outer Bluegrass counties of Grant and Owen, yet only 61 percent of households are on public systems. Scarcity of wells in the Outer Bluegrass is probably due to lack of groundwater aquifers in the shale belt having sufficient yield for household use. In the western coalfield area, possible degradation of aquifers due to extensive coal mining and oil and gas drilling may have forced self-supplied residents to seek alternatives to groundwater.

Unlike water supply wells, monitoring wells tend to be concentrated around urban areas and are relatively sparse in rural parts of the state, except where associated with landfills, Superfund sites or industrial sites located in the countryside. Since the majority of monitoring wells constructed in Kentucky are associated with underground fuel storage tanks, one would expect to find the greatest numbers of these wells in and around major population centers. Such a trend is indicated in Table 1.

Several anomalies, however, are also present in the table. McCracken and Boyd counties are not among the top ten in population but rank fourth and sixth respectively for number of monitoring wells. An even greater departure is observed in the case of Logan County. The explanation must be due to other causes than construction for underground storage tank sites, because demand for fuel is directly tied to population density. In Logan County, for example, nearly 150 monitoring wells were installed at one gasoline service station as part of an experimental remediation procedure. If these wells are omitted from the total, Logan County would rank at 25th in number of wells, a figure more consistent with its population.

| COUNTY | PRIMARY CITY | POPULATION RANK | % OF TOTAL MONITORING WELLS |
|---|---|---|---|
| Jefferson | Louisville | 1 | 17.0 |
| Fayette | Lexington | 2 | 8.5 |
| Hardin | E-town | 5 | 3.5 |
| Boyd | Ashland | 16 | 3.2 |
| Kenton | Covington | 3 | 3.2 |
| McCracken | Paducah | 12 | 3.2 |
| Daviess | Owensboro | 4 | 2.5 |
| Logan | Russellville | 42 | 2.3 |
| Boone | Florence | 8 | 2.2 |
| Franklin | Frankfort | 18 | 2.1 |
| Rest of State | | | 52.4 |

**Table 1: 1991-1998 Top Ten Counties for New Monitoring Well Construction Compared to County Population**

## WELL ABANDONMENTS

Figure 6 shows well abandonments reported since 1986. The great difference between the numbers of water supply wells and monitoring wells abandoned is due simply to the difference in the nature of the two types of wells. Water supply wells are intended for long-term usage, whereas monitoring wells are generally installed to monitor water quality for a relatively short and specific period of time or until a contaminant problem is resolved. Most state or federal programs which regulate monitoring wells require that the well be properly abandoned when its purpose has concluded. The effect of UST program mandates can be observed by the number of monitoring well abandonments for 1996.

In contrast, abandonment of water supply wells is largely at the well owner's discretion. The regulation concerning water well abandonment in 401 KAR 6:310 Section 12(1) states that a well is to be abandoned when it is "not suitable for its intended purpose," an unfortunately rather vague directive. Although unused and unplugged boreholes are a significant hazard to local groundwater quality, allowing surface contamination to be introduced to aquifers, apparently in practice such wells are seldom properly abandoned. Property owners often do not wish to pay the cost of abandonment. Plugging of wells may also be underreported. Most water well abandonment reports received by DOW are from a few drillers and represent plugging of wells within the right-of-way of new road construction or expansion, contracted by the state Department of Highways.

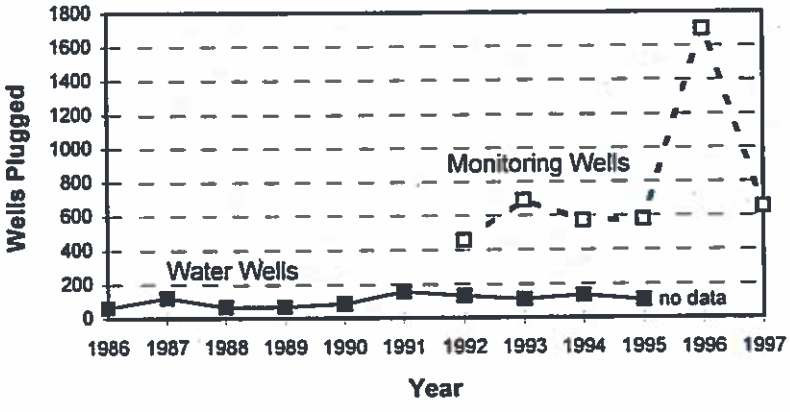


**Figure 6: Well Abandonments 1986-1997**

## COMPANY SHARES OF DRILLING MARKET

Figure 7 shows 1997 statistics that compare drilling company size and competitiveness. For both water and monitoring wells, most were constructed by only a few companies. In 1997 there were 101 companies with drillers certified for water supply well construction in Kentucky and 118 for monitoring wells (many drillers are certified for both construction types). Nearly a third of all water supply wells were constructed by only five companies. For monitoring wells, the bias is even more pronounced: the five leading drilling companies (in terms of number of wells drilled) were responsible for half of all monitoring wells installed in the state.

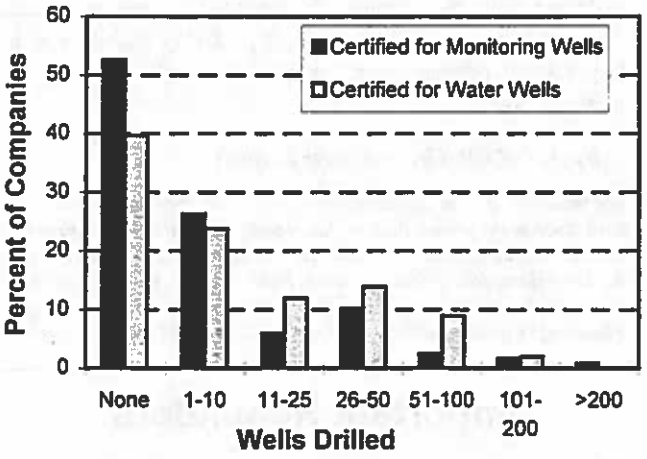


**Figure 7: Company Shares of 1997 Drilling Market**

Dominance in one area did not confer dominance in the other. None of the top monitoring well companies (in terms of number of wells constructed) were among the top water well companies. The most prolific water well companies were certified for both types of construction but constructed few monitoring wells. Of the monitoring well companies that built the most wells, only two were certified to drill water wells also. Only three companies, with a construction rate in the middle of the pack, installed significant numbers of both well types.

The most significant evidence from the data depicted by Figure 7 is that only about half of the companies with certified drillers reported constructing one or more wells in 1997. Put another way, half of the companies did not construct any wells at all in Kentucky last year. Although underreporting may account for some of this, an important factor not shown by the chart is that most of the drilling companies who did not submit records for well construction are located out of state. It seems likely that, in many cases, the majority of their business is conducted elsewhere: certification is maintained for those occasions when they contract a job in Kentucky. More than 98 percent of all water supply wells and 82 percent of monitoring wells in 1997 were constructed by companies with the home office in Kentucky.

## FORECASTING THE FUTURE???

*Disclaimer: This section is speculative, based upon assessment of existing regulations and apparent trends. Because these factors are subject to change in unpredictable ways, caution should be used in applying this evaluation to business decisions!*

The accelerating rate of public water line extension is the most likely factor to affect water supply well construction in the near and long term. Kentucky's water-supply goal, stated by Governor Paul Patton, is to have every household provided with potable water by the year 2020. In many areas this will be accomplished by extension of lines from existing public water systems; for some areas, however, creative solutions may be required. Alternative solutions may include linking of individual private wells or installation of well clusters for community systems.

Regardless of how Kentucky's water-supply goals are met, it appears that the demand for individual household water-supply wells is likely to decline in the new century. Since domestic wells represent by far the greatest segment of well demand, overall the water well business is likely to decline. Depending upon how the potable water program is implemented by future administrations, groundwater sources may or may not be given significant roles in local and regional water-supply. In a worst-case scenario (from the drillers' point of view), new water well construction 20 or 30 years hence may be required only for a limited number of community wells and those where groundwater is viewed as a more economical alternative for livestock watering and crop irrigation.

If so, reduced demand will probably weed out drilling companies that are less efficient or less aggressive in seeking contracts. Since the demand for monitoring wells is likely to remain fairly steady over the long run or to slightly decline (see below), drillers whose business has depended in the past on water supply wells may not be able to shift operational focus into a market that is already dominated by a few companies.

Because new construction of monitoring wells is mainly driven by program requirements, changes in programs often affect demand for new wells. The effectiveness of a regulatory program in addressing a particular environmental problem is also significant. For example, if all existing hazardous waste contamination sites are cleaned up, then the only need for new well construction will be that required as new sites are discovered and for newly permitted sites.

An additional factor of significance might be called "targeted enforcement." This might be a push by a regulatory agency to clear a backlog, or a crackdown on sites not in compliance. In either case, the result might be an upswing in new well construction. The recent program to achieve closure of UST sites is an example.

State regulators in the programs under which most monitoring wells are constructed were queried for their evaluation of possible trends in their particular program:

***CERCLA (Superfund):*** Little change is anticipated in the near future in terms of the number of wells required. The use of data from direct-push wells, however, may increase, possibly at the expense of permanent monitoring well sites.

***RCRA (hazardous waste):*** Most RCRA wells are "permanent" installations, with an expected utilization of 5-30 years. Because the regulations have been effective in identifying all RCRA facilities, there are fewer new facilities coming into the program. The demand for 5-year utilization wells is expected to remain fairly steady; the need for long-term (30+ years) wells may show a slight decline in the future. There has been limited direct-push work associated with RCRA.

***Solid Waste:*** Most wells in the solid waste program are "permanent" wells, intended to last for many decades of post-closure monitoring. Very little direct-push data is collected. An increase in the number of wells needed under this program may occur during the next few years as older, closed landfills are brought into compliance. At present, only about half of these sites have installed the required wells. Following this, demand for monitoring wells should remain steady, with installations generally made only for expansions of existing landfills. Few completely new landfills are planned.

***UST (underground storage tanks):*** Over the near term, there will probably continue a strong demand for UST wells as facilities rush toward achieving compliance with the December 1998 federal deadline. Once this initial surge has ended, 2-3 years hence, there should be a decrease in the number of new wells needed. The demand for new UST wells will probably stabilize at a lower level representing the need for leak detection at new facilities.

*Gary A. O'Dell, Groundwater Branch*

*Appreciation is due to many individuals for their comments and assistance in the preparation of this report. From the Department for Environmental Protection: Mike Brandenburg (Solid Waste); Dale Burton (Hazardous Waste); Janna Faith (UST); Peter Goodmann (Groundwater); Jeff Grow (Superfund); Dave Morgan (Water Supply Planning); Vicki Ray (Drinking Water); Billy Yarnell (Groundwater).*

## Training Opportunities

The National Ground Water Association is offering the following training opportunities in 1998:

December 8-10 at Tempe, AZ
**Principles of Ground Water:**
**Flow, Transport, and Remediation**

December 13 - 16 at Las Vegas, NV
**NGWA 50th Anniversary Convention & Exposition**

If you are interested and want more information, contact

The National Ground Water Association
601 Dempsey Road, Westerville, OH 43081.
Phone (800) 551-7379
E-Mail *h2o@h2o-ngwa.org*

## Well Owner Newsletter

The American Ground Water Trust has developed a newsletter geared toward private well owners. *The American Well Owner* is a quarterly publication intended to provide facts about ground water, private water supply and well maintenance. One-, two- and three-year subscriptions are available at $5, $9 and $12, respectively. For more information, contact the American Ground Water Trust at (603) 228-5444.

Source: *Environmental and Natural Resources Issues*, July/August 1998

## Important Reminders

☞ According to 401 KAR 6:310, Section 3 (5), certified drillers are required to display their certificate number on all drilling equipment used at construction sites:

> "Numbers shall be at least three (3) inches in height and of a color that is easily distinguishable from that of the equipment. This number shall be removed if equipment is scrapped, sold, or otherwise changes ownership or if the driller's certificate becomes invalid."

☞ The 40-hour OSHA safety course will serve for the three (3) hours of continuing education for renewal but the eight (8) hour refresher course will serve for only one (1) hour.

## Chester is Back!

Chester Bojanowski had triple bypass surgery in August. He is recuperating nicely and has returned to work for a few hours a week and should be back to work full time in a few weeks. Chester appreciates all the cards and phone calls of encouragement.

## New Board Member

Ms. Cheryl W. Bersaglia of McKee has been appointed to the Kentucky Water Well Certification Board representing the public at large. Ms. Bersaglia is originally from the Cincinnati area. She holds a Bachelor's degree from Eastern Kentucky University in paralegal sciences and has her Accounting I-II Certification from the Madison County Vocational School. She is currently employed as a substitute teacher for the Jackson County Board of Education. She was previously employed by Citizens Fidelity Bank as a loan services review clerk, served as a paralegal intern for the Legislative Research Commission, and worked for the Ohio Department of Public Welfare. Ms. Bersaglia volunteers her time as PRIDE Coordinator for the Jackson County Fiscal Court, the Jackson County Water Watch Coordinator, and the Supervisor for the Kentucky River Watershed Watch of Jackson County.

Ms. Bersaglia replaces Mary Martha Mueller, whose term has expired. During her three-year term she served the board and the citizens of Kentucky with care, grace and real interest. We will truly miss working with her.

Board members reappointed are: Jerry D. Jones, West Paducah (representing rotary tool drilling method); Pat Mackey, Burlington (cable tool); Gerald Ferguson, Williard (cable and rotary tool); and James S. Dinger, Lexington (hydrogeologist from Kentucky Geological Survey).

## Board Meeting

The next scheduled meeting of the Kentucky Water Well Certification Board will be on December 18 starting at 9 a.m.at the Division of Water in Frankfort.

## John U. Hamm 1908-1998

John U. Hamm, 90, passed away on October 19, 1998, at his home near Mount Vernon in Rockcastle County, Kentucky. Hamm was one of the first drillers to be certified when the state implemented a registration program in 1985. He began his drilling career more than 60 years prior to this, however, as a 17 year-old helper to a local driller in 1925. In a short time, Hamm went into business for himself, installing wells throughout a region that included Rockcastle, Madison, Lincoln, Garrard, Jackson and Laurel counties.

In 1994 John Sullivan of WKYT-TV in Lexington produced a short special feature on Hamm, a tribute to his many years in the drilling business. The television piece showed Hamm at work installing a well with his cable rig. Hamm remained active in the well drilling business until 1996, when a minor stroke led him to conclude that perhaps it was time to retire. Following his retirement, John was presented a certificate of recognition by the Kentucky Water Well Certification Board and the Kentucky Division of Water for his contribution in providing citizens of the Commonwealth with fresh water for more than 70 years. Hamm's achievements were reported in the local newspaper, the Mount Vernon *Signal*, and in the *Lexington Herald-Leader*.

Hamm was very knowledgeable about the profession of obtaining water and enjoyed relating many interesting stories about the old days in the drilling business. He will be missed by his many friends and colleagues.

**Kentucky Driller Quarterly is a publication of the Kentucky Division of Water. Inquires should be made to: Harold Lee, Kentucky Driller Quarterly Editor, Division of Water, Groundwater Branch, 14 Reilly Road, Frankfort, KY 40601; (502) 564-3410**

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