Mandatory operator certification and recertification are among the most significant changes to come through the Safe Drinking Water Act (SDWA) Amendments of 1996. Although the U.S. Environmental Protection Agency (EPA) is not expected to publish its final guidelines for operator certification until February 1999, many states are preparing for the inevitable.

According to EPA, “ensuring the knowledge and skills of public water system operators is widely considered one of the most important, cost-effective means to strengthen drinking water safety. To that end, the amendments require all states to carry out a program of operator certification.”

Idaho Develops Program

In Idaho, mandatory operator certification will be something new. “Idaho never had a mandatory operator certification program prior to the reauthorization of the SDWA,” says Steve Tanner, program supervisor for Idaho’s Department of Environmental Quality (DEQ). “Certification has always been voluntary. However, most of our operators are already certified according to the voluntary certification guidelines.

“In November, we developed an operator certification exam for very small systems with the Water and Wastewater Operator certification board,” Tanner continues. “We’ve had a very good response to the test. We also have a contract with Brown and Caldwell, an engineering design...” Continued on page 12

Computer Models Help Small Water Utilities

A graphical computer model is a scaled representation of a water utility superimposed on an appropriate map and includes pipes, pumps, tanks, regulators, valves, hydrants, etc. It can be easily changed to incorporate actual or proposed water utility modifications and can quickly carry out hydraulic calculations (e.g., pressures, flows, etc.) and water quality calculations (e.g., chlorine residuals, etc.).

Whatever the size of a water utility, an accurate graphical computer model will result in more efficient operation, management, and planning. Because of budget and technical limitations, most small utilities have not acquired this important technology. However, recent advances in water utility modeling technology will enable small water utilities to acquire and utilize this technology. Inexpensive and, more important, easy to use computer models for water distribution systems that perform the required hydraulic and water quality calculations are available.

Models are available that are particularly appropriate for use by small water utilities and include some special features for rural water systems. These require only a standard microcomputer and printer to utilize their full range of capabilities.

By extensively employing graphics, the use of these models has been simplified to the point that they can be effectively used by the water utilities of all sizes and by the people that need them the most—the operators and managers of the water utility. The time has come for the small water utilities to gain the great benefits of using this important technology. Continued on page 15
On Tap Welcomes New Employees

We cover a wide variety of topics in the Summer On Tap, including regulatory updates as well as a fairly large section that will interest operators, beginning with a cover story “SDWA Requires Operator Certification,” a look at small system technical assistance in South Dakota (See page 9) and Kathy Jesperson’s third operator safety article—this one deals with confined spaces. (See page 10.)

Many thanks to Don J. Wood, Ph.D., and his associates from the University of Kentucky who introduce us to a very important technology in “Computer Models Help Small Water Utilities.” (See page 1.)

As usual, Mohamed Lah lou, technical assistance specialist, compiled our tech brief. The subject for our eighth fact sheet is lime softening. (See middle pages.) Salam Murtada, technical assistance specialist, wrote the Q&A this time. The primary difficulty he encountered with the topic—septic system leaching—is narrowing the vast amount of information. (See page 18.)

Changes are taking place at the National Drinking Water Clearinghouse (NDWC). Two of our research assistants—Babu Madabhushi and Salam Murtada—have been hired as technical assistance specialists. Madabhushi has a master of science in environmental engineering and Madabhushi has a master of science in environmental engineering and economics and wrote his dissertation on water demand management. Emerson, who has a master of science in journalism from WVU, was a reporter and student news editor for WVU’s News and Information Services before coming to the NDWC in 1995. She has won prizes for writing and in April was awarded one of 10 WV 1998 Fellowships for Literature.

Laurie Klappauf, founding editor of NDWC’s financial newsletter Water Sense, left us in June to spend more time with her two young children. Established in 1994, Water Sense has grown into a respected publication with more than 5,000 subscribers.

The NDWC has also hired Mark Kemp-Rye, who will serve as editor of Water Sense. Kemp-Rye, who has a degree in geography, has been a senior institutional research analyst for WVU for the past seven years and was founding editor of WV’s first online newspaper, The Sunspot.

Judy Clovis, a long-time university employee who most recently worked as an information assistant for the Environmental Services and Training Division, has been hired as a program assistant. Our administrative secretary Sheila Anderson, who has been with the NDWC since 1991 when the clearinghouse opened, has been promoted to program assistant.

Congratulations to Lah lou and On Tap Editor Harriet Emerson. Lah lou, who has held his position with the NDWC since 1994, has a master of science in civil engineering, as well as a master of business administration from WVU. He just earned his doctoral degree in natural resource economics and wrote his dissertation on water demand management. Emerson, who has a master of science in journalism from WVU, was a reporter and student news editor for WVU’s News and Information Services before coming to the NDWC in 1995. She has won prizes for writing and in April was awarded one of 10 WV 1998 Fellowships for Literature.

New Drinking Water Clearinghouse employees (from front to back) Babu Madabhushi, Jamie Knotts, Judy Clovis, and Mark Kemp-Rye take a sunny break from drinking water research. (Salam Murtada is missing from photo.)
The National Drinking Water Clearinghouse (NDWC) recently completed its third survey of *On Tap* readers since its initial publication in 1992. Other surveys were undertaken in 1993 and 1995. There were approximately 370 responses received to the survey. Results and comments were overwhelmingly positive and suggestions insightful.

**Who reads *On Tap*?**

The greatest number of responses to this survey (17 percent) were from water plant operators. The second highest percentage of responses came from individuals working in health offices (15 percent) and local government officials (15 percent), with state government officials next with 13 percent; engineers and consultants, 12 percent. We estimate that drinking water operators comprise approximately 10 percent of readers; however, this group consistently indicates a greater interest in and need for the information we provide.

Whereas the highest number of responses in the 1995 survey came from those living in areas with a population of more than 50,000, the highest percentage this time (15 percent) came from those living in areas with 501–3,300. The National Drinking Water Clearinghouse concentrates on providing information to communities with fewer than 10,000 people.

**What do readers want to know?**

When asked which types of articles they are most likely to read, readers responded with the same interests as in the 1995 study. Technical, regulatory, and short informational news articles ranked highest, with operation and maintenance information close behind. Readers are also interested in resources. In this survey, 77 percent of those who responded said that they read the technical articles while 67 percent read regulatory articles.

In response to suggestions in the 1995 survey, we have attempted to increase the amount of technical and regulatory information. We’ve added our “Tech Brief” fact sheets as well as producing a special Safe Drinking Water Act (SDWA) theme issue and introducing a series tracking implementation of the 1996 SDWA Amendments. Most readers rate the Tech Brief series as quite useful. Approximately 70 percent of readers like the single-theme concept. *On Tap* produces at least one theme issue a year. Our next theme issue (Winter 1998) will look at water conservation.

**More Readers Order Products**

There appears to be a clear increase in readers’ ordering NDWC products now than when last surveyed. Only 25 percent of those who answered the 1995 survey had ordered a product from us, although satisfaction was high among those who ordered. In this survey, 41 percent of survey respondents said they have ordered a NDWC product. Again, satisfaction with the products ordered was very positive.

Of those who responded to the survey, 63 percent save their issues for reference, while 46 percent pass it along. These numbers are up from the last survey in which 56 percent indicated they save their newsletters, and 42 percent said they pass them along. Since about 10 percent recycle or toss the publication, there may be cross over among the savers and passers.

Comments from a number of readers indicate that they copy articles to send to others in the field or use *On Tap* articles and information in local or state drinking water publications. We invite you to make good use of all our information. And we very much appreciate reprints for our records.

**What about Water Sense and the Internet?**

Seventy-two percent of survey respondents have not had a chance to see the NDWC’s financial publication *Water Sense*—approximately three quarters of those individuals requested a sample copy.

Few of us dreamed Internet use would become so widespread, although many universities have provided Internet access for their scientists since the 70s. This survey is the first in which we have asked about readers’ Internet access.

Forty percent of respondents said they have Internet access at home, and 41 percent have access at work. Certainly there is much cross over, with many of the same individuals having online access both at home and at work. Of those who do have Internet access, almost three quarters have accessed our Web site at http://www.ndwc.wvu.edu.

*On Tap* may be downloaded from our Web site; however, when those with Internet access were asked if they’d like their names removed from the *On Tap* mailing list, there was not a single positive response. There’s still something about having a hard copy in hand.

If you missed the readership survey deadline but have suggestions for us, please send comments to Harriet Emerson, NDWC, P.O. Box 6064, Morgantown, WV 26506-6064 or e-mail hemerson@wvu.edu.
ETV Offers Technology Testing

The U.S. Environmental Protection Agency (EPA) Environmental Technology Verification (ETV) program may present a significant opportunity—technologically and financially—for water systems interested in evaluating packaged technologies to advance their treatment capabilities.

Inconsistencies in demonstrating and receiving state approval for technology—site-to-site and state-to-state—has been an ongoing concern for equipment manufacturers introducing new technologies.

The EPA’s ETV program, managed by EPA’s office of Research and Development, is a direct response to this concern and provides third party verification testing of “packaged technologies” to properly demonstrate performance capabilities as well as to document operation and maintenance costs.

Approved in late 1995, the packaged drinking water project is just one track of ETV’s 12 pilot projects. The program is aimed at establishing the quality and integrity of data and advancing the application of new environmental technologies. ETV is an equipment verification project in which manufacturers use various technologies and package them into pre-engineered equipment for producing drinking water.

The EPA and the NSF International, formerly the National Sanitation Foundation, are cooperatively organizing and conducting the packaged drinking water treatment systems pilot.

In order to encourage initial testing, the EPA is making available $1 million in funding for fiscal year 1998. Manufacturers may receive up to 75 percent reimbursement or a maximum of $75,000 for an approved verification. The program could offer a small community a faster state approval at lower overall cost as well as the potential for reduced capital costs from a manufacturer.

Program objectives include:

• fewer requests or shorter run times for pilot testing,
• consistent and technically appropriate evaluation methods that allow direct product to product comparisons, and
• reliable and independent test results.

According to Bruce Bartley, NSF’s Engineering and Research Services and the ETV Manager of the drinking water treatment systems pilot, a committee comprised of industry, regulatory, and engineering representatives has developed a number of protocols for technologies and is in the process of developing more. Sanjay Saxena, National Drinking Water Clearinghouse program coordinator, serves on this committee. Bartley said that emphasis has been placed on the performance and cost of specific packaged plants that address microbials, particulates, and disinfection byproducts (DBP).

Test plans to evaluate specific filtration technologies (microbial reduction) have been written for membrane, bag and cartridge, diatomaceous earth, sand, backwashable depth, and coagulant filtration products.

Test plans for disinfection technologies (microbial inactivation) have been written for ultraviolet (UV) radiation, and soon will include advanced oxidation and on-site halogen. Additional protocols and tests plans are available for DBP, arsenic, and nitrate technologies.

Manufacturers who wish to participate in the program need to select a field testing organization (FTO) qualified by the NSF. These organizations have been evaluated for proper engineering and lab qualifications. (See FTO list on next page.)

The FTO and manufacturer identify an appropriate site and develop a field operations document (FOD), which is submitted to NSF for review. If approved, verification is initiated and conducted by the FTO. Verifications take from three to 10 months depending upon the technology and the test plan. Then the FTO prepares a report for EPA/NSF review and a performance verification statement is issued.

“We have a number of manufacturers that are very interested in our program, but are having difficulty in locating appropriate sites,” Bartley said. “An example might be technologies, such as bag and cartridge or membrane, where we would envision ETV offering interested systems an opportunity to evaluate performance concerns through third party testing at substantially reduced costs than it would see under a conventional pilot arrangement.”

In March, the first official ETV pilot project was initiated with Calgon Carbon Corporation, Pittsburgh, Pennsylvania, at a test site in Ontario, Canada. That pilot is evaluating a UV technology under the microbiological inactivation protocol and is being conducted by the FTO of Cartwright, Olsen & Associates, Minneapolis, Minnesota. Several more are expected to start over the spring and summer.

Public water system personnel or equipment manufacturers interested in learning more about the program are urged to contact the NSF International Web site at http://www.nsf.org or to contact any approved FTO.

For further information, contact Greg McKelvey at (724) 543-6547 or Bruce Bartley at (800) 673-6275.
Has your community suffered natural disasters that drained municipal coffers? Towns in areas that periodically flood, endure tornadoes or hurricanes, or face earthquakes or wildfires may reduce their losses by preparing for the worst before it happens.

The Federal Emergency Management Agency (FEMA) encourages planning before disaster strikes. “Project Impact” is a FEMA campaign to raise awareness that communities can reduce nature’s destructive forces through foresight and planning. The initiative includes a guidebook to help community leaders outline their own plan of defense against natural disasters.

As part of the project, FEMA selected seven pilot communities to serve as models of proactive strategies that can be taken to lessen heavy disaster losses. Following the massive flooding of 1993, Des Moines, Iowa, for example, acted to assure that their water system would still provide clean water even in flooded conditions. That Midwest city learned that the cost of losing their water supply was much greater than just repairing the physical damage. Not only did customers have to go without water service for 11 days, but businesses also were devastated by the loss—whether or not they depended on water for production.

The Project Impact Guidebook is available to businesses and communities and outlines a formula to follow in preparing for possible disasters. The book features case studies of communities that have taken positive actions for their own protection. It includes lists of examples of potential hazards and how to identify them. Project Impact emphasizes the importance of partnerships within the community to maximize local involvement, using people and organizations who know the area best.

Instead of waiting for disaster to strike, Project Impact can help you decide your community’s future instead of letting nature decide it for you.

To obtain a copy of the Project Impact Guidebook or to receive a brochure with general information about Project Impact, contact FEMA Publications at (800) 480-2520.

Field Testing Organizations (FTO) for the EPA/NSF ETV Package Drinking Water Treatment Systems Pilot Project

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<th>Name of FTO</th>
<th>Contact Name</th>
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<tr>
<td>University of New Hampshire</td>
<td>Dr. Robin Collins</td>
<td>phone: (603) 862-1407 fax: (603) 862-2364</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:robin.collins@unh.edu">robin.collins@unh.edu</a></td>
</tr>
<tr>
<td>Cartwright, Olsen, and Associates</td>
<td>Mr. Philip Olsen</td>
<td>phone: (612) 434-1300 fax: (612) 434-8450</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:p.olsen@ix.netcom.com">p.olsen@ix.netcom.com</a></td>
</tr>
<tr>
<td>CH2M Hill, Inc.: Corvallis, OR office</td>
<td>Dr. Mark Carlson, P.E.</td>
<td>phone: (541) 758-0235, ext. 3501 fax: (541) 752-0276</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:mcarlso1@ch2m.com">mcarlso1@ch2m.com</a></td>
</tr>
<tr>
<td>Gannett Fleming, Inc.</td>
<td>Mr. Gene Koontz, P.E.</td>
<td>phone: (717) 763-7211, ext. 2548 fax: (717) 763-1808</td>
</tr>
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<td>e-mail: <a href="mailto:gkoontz@gfnet.com">gkoontz@gfnet.com</a></td>
</tr>
<tr>
<td>ARCADIS Geraghty &amp; Miller, Inc.</td>
<td>Mr. Michiel Doorn</td>
<td>phone: (919) 544-4535 fax: (919) 544-5690</td>
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<tr>
<td></td>
<td></td>
<td>e-mail: <a href="mailto:mdoorn@acurex.com">mdoorn@acurex.com</a></td>
</tr>
<tr>
<td>Montgomery Watson-Herndon, VA office</td>
<td>Dr. Joseph Jacangelo</td>
<td>phone: (703) 397-0372 fax: (703) 478-3375</td>
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<td></td>
<td></td>
<td>e-mail: <a href="mailto:joe.jacangelo@us.mw.com">joe.jacangelo@us.mw.com</a></td>
</tr>
<tr>
<td>Environmental Health Laboratories &amp;</td>
<td>Mr. Paul Bowers</td>
<td>phone: (219) 233-4777 fax: (219) 233-8207</td>
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<tr>
<td>Associates</td>
<td></td>
<td>e-mail: <a href="mailto:bowers@mas-tech.iag.net">bowers@mas-tech.iag.net</a></td>
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The Safe Drinking Water Act (SDWA) requires the U.S. Environmental Protection Agency (EPA) to develop a set of interrelated regulations to strengthen control of microbial pathogens, disinfectants, and disinfection byproducts (DBP).

These standards, referred to collectively as the microbial and disinfectant byproducts (M/DBP) rules, will address risk tradeoffs between two types of contaminants: microbial pathogens and DBP. Also, these are the first rules to address the problem of Cryptosporidium in drinking water.

Why are these rules needed?

According to EPA’s Office of Water, microbiological contaminants, such as bacteria, protozoa, and viruses, are likely the greatest remaining health risk management challenge for drinking water suppliers. Control of microbiological contaminants is complicated because commonly used disinfection processes may themselves pose health risks. For instance, if chlorine is added to water that contains organic compounds, the disinfectant may combine with these compounds to form potentially harmful DBP.

Water suppliers are faced with a dilemma that requires a delicate balance: inactivating microbiological contaminants while at the same time minimizing DBP risks. And, Cryptosporidium is so resistant to disinfection that even a well-operated plant cannot ensure that drinking water is completely free of this parasite.

Analysis shows that M/DBP rules could prevent several hundred thousand cases of gastrointestinal illness as well as several thousand cancer cases annually.

Which rules address M/DBP?

These rules include:

- The Interim Enhanced Surface Water Treatment Rule (IESWTR) and Stage 1 D/DBP Rule—final versions of both rules are to be promulgated by November 1998 and finalized in November 1999. Implementation begins in November 2001.
- The Filter Backwash Recycling Rule is due to be promulgated by August 2000.
- Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) is due by November 2000.
- The Stage 2 DBP Rule is to be finalized by May 2002.

Stage 1 DBP applies to systems of all sizes. The IESWTR applies only to systems serving more than 10,000; however, the LT1ESWTR will strengthen microbial controls for systems serving fewer than 10,000. The regulation governing recycle of filter backwash applies to public water systems regardless of size.

Who formulates these rules?

In February 1997, the M/DBP Advisory Committee was established. It consists of 17 members representing EPA, state and local public health and regulatory agencies, local elected officials, drinking water suppliers, chemical and equipment manufacturers, and public interest groups. The goal of this group was to collect, share, and analyze new information and data, and to build consensus on the regulatory implications of this new information.

What is the proposed Stage 1 D/DBP Rule?

The Stage 1 D/DBP Rule will strengthen control of chemical disinfectants and their potential cancer-causing byproducts in water. EPA is considering making the following revisions to the 1994 proposal:

- Revising the Maximum Contaminant Level Goal (MCLG) for chlorite from 0.08 milligrams per liter (mg/l) to 0.80 mg/l and the Maximum Residual Disinfection Level Goal (MRDLG) for chlorine dioxide from 0.3 mg/l to 0.8 mg/l;
- Revising the MCLG for chloroform from zero to 0.30 mg/l; and
- EPA is considering a new approach for estimating the potential upper bound cancer cases that can be attributed to exposure from DBP in chlorinated water.

What are the goals of these rules?

Major goals of the 1994 proposal include setting public health goals and enforceable standards for a number of DBP. Public health goals—MCLGs and MRDLGs—are not enforceable. MRDLGs and MCLs are enforceable standards. MRDLG set limits on residual disinfectants in the distribution system.

The proposal sets MCLGs for chloroform, bromodichloromethane, bromofrom, bromate, dichloroacetic acid, dibromochloromethane, trichloroacetic acid, chloral hydrate, and chlorite. It lowered the existing MCL for total trihalomethanes (TTHMs) and set an MCL for five haloacetic acids (HAA5). It also set MRDLGs and MRDLs for chlorine, chloramine, and chlorine dioxide. For the first time, EPA proposed MCLGs for two inorganic DBPs, bromate and chlorite.

The rule also identifies Best Available Technologies for compliance with the MCLs for...
Who is at most risk from Cryptosporidium?

by Michelle Moore
On Tap Contributing Writer

Why all the worry about Cryptosporidium? A parasite that lives in lakes and rivers—it is estimated to be in up to 95 percent of surface waters—Cryptosporidium parvum is most often found in waters that are contaminated with sewage or animal wastes. The microorganism is highly resistant to elimination by municipal water treatment methods, and even very efficient systems may not be able to completely eliminate it from their drinking water supplies. A major outbreak in Milwaukee, Wisconsin, in 1993 sickened 400,000 and killed 104 people. Since then, much attention has focused on reducing the risk of Cryptosporidium contamination in community and municipal drinking water supplies.

Controlling this and other harmful microbes is complicated by the additional health risks that may be posed through commonly used disinfection practices. (See the facing page for more about microbial and disinfection by-products rules.)

The single-celled Cryptosporidium organism can cause cryptosporidiosis, a disease whose symptoms range from mild stomach cramps or a slight fever to more severe problems of weight loss and dehydration. In healthy people, symptoms can last one to two weeks and disappear on their own. However, in people with suppressed immune systems, infection by this organism may become life threatening. Individuals who are HIV-positive, cancer patients undergoing chemotherapy, or those who have had a recent organ or bone marrow transplant are particularly at risk. Some medications can reduce the symptoms of cryptosporidiosis, but there is no effective cure for the illness.

Imuno-suppressed people should take extra precautions to avoid possible infection by Cryptosporidium and should contact the local health department and water utility to learn more about the area’s drinking water supply.

Three extra measures may be taken to make sure water is safe: boil the water, use NSF approved home filters, or drink bottled water that has been deemed safe. For those at greater risk, these extra measures should be used all the time, not just at home. Studies show that people who used precautions only part of the time risked infection as much as if they never used them at all.

Boiling is the most effective method of killing the microorganism. Water should remain boiling for one full minute. Remember that ice cubes should also be made from boiled water, since freezing does not kill the microorganism. “Point of use” or in-home water filters also can help reduce the risk of infection. The filter should have the following information included on the label to be certain that Cryptosporidium organisms will be removed:

- Tested and certified by NSF Standard 53 for cyst removal,
- Tested and certified by NSF Standard 53 for cyst reduction,
- Reverse osmosis, or
- Absolute micron size of one micron or smaller.

A list of filters that remove Cryptosporidium is available from NSF International at (800) NSF-MARK or see their Web site at http://www.nsf.org. Ask for their “Standard 53 Cyst Filters” list.

Bottled waters should have “reverse osmosis treated,” “distilled,” or “filtered through an absolute one micron or smaller filter” on their labels to be sure that Cryptosporidium has been removed.

For more information on Cryptosporidium contamination, see the Spring 1996 issue of On Tap, Volume 5, Issue 1. The NDWC also offers several products that discuss Cryptosporidium. Contact the National Drinking Water Clearinghouse at (800) 624-8301 or (304) 293-4191 to order. You may also order via e-mail at ndwc_orders@ndwc.wvu.edu. See the Product Section of the NDWC Web site at http://www.ndwc.wvu.edu for further information on Cryptosporidium.

For a U.S. Environmental Protection Agency and Centers for Disease Control and Prevention guidance for people with severely weakened immune systems, go to http://www.epa.gov/ogwdw000/crypto.html.

What progress is being made?

Continued from previous page
TTHMs, HAA5, bromate, and chlorite; and with the MRDLs for chlorine, chloramine, and chloride dioxide. In addition, the rule proposed a treatment technology that would require surface water systems and groundwater systems under the direct influence of surface water that use conventional treatment or precipitative softening to remove DBP precursors by enhanced coagulation or enhanced softening.

For more information, see http://www.epa.gov/OGWDW/mdbp/noda2.html.
The Safe Drinking Water Act Amendments of 1996 require the Environmental Protection Agency (EPA) to establish a list of contaminants that are known or anticipated to occur in public water systems but are not presently regulated. EPA published a draft of this Drinking Water Contaminant Candidate List (CCL) in the October 6, 1997, Federal Register. Comments were gathered—EPA received 71—and a final CCL was published in the March 2, 1998, Federal Register (63 FR 10273).

EPA has divided these contaminants into three sections:
- those that are priorities for additional research,
- those that need additional occurrence data, and
- those that are priorities for consideration for rule making.

The EPA will select five or more contaminants from the Regulatory Determination Priorities list and by 2001 will decide whether or not to regulate them. If it’s determined that the first five contaminants need to be regulated, proposals must be submitted by August 2003 and promulgated by February 2005.

**How were contaminants identified?**

In December 1996, EPA formed an advisory working group under the National Drinking Water Advisory Council (NDWAC), the Working Group on Occurrence and Contaminant Selection. Stakeholders and the Working Group included representatives of public water utilities, environmental and public interest groups, state regulatory agencies, public health offices, and others. EPA and the Working Group developed criteria to identify contaminants for the CCL and to address these two questions:
- Does the contaminant adversely affect public health?
- Is the contaminant known or substantially likely to occur in public water systems with a frequency and at levels posing a threat to public health?

**What’s the next step?**

EPA needs to select the first contaminants it will look at and outline plans of action for making regulatory decisions. This involves developing short- and long-term research plans on health, treatment, and analytical methods.

An Unregulated Contaminants Monitoring Regulation proposal needs to be developed for gathering occurrence data and planning occurrence studies. This proposal is expected by August 1998. The SDWA requires that EPA establish a National Drinking Water Contaminant Occurrence Database and an Unregulated Contaminant Monitoring Regulation by August 1999.

For more information, see http://www.epa.gov/OGWDW/ccl/cclfs.html.
Within South Dakota’s 77,123 square miles, attractions such as Mount Rushmore, the Black Hills, the Badlands, and Devil’s Tower draw visitors from all over the world. And the state is also the home of the Great Sioux Nation, whose people call themselves “friends” in three different dialects: Lakota, Dakota, and Nakota.

Because of its friendly atmosphere, South Dakota’s 699,999 residents adopted the Native American greeting, “How Kola!” which means “Hello Friend!” as their own state salutation.

Friends Make the Difference

And when you’re among friends, finding technical assistance—even if you’re a small water system—may soon be a mere phone call away. The state has approximately 740 water systems. Most of them are small, rural water systems. And those systems that have problems they cannot resolve may want to turn to the South Dakota Association of Rural Water Systems (SDARWS) for their technical assistance needs.

The U.S. Environmental Protection Agency (EPA) has authorized technical assistance funds to enable small systems to comply with drinking water regulations.

Two Proposals Were Submitted

“We actually submitted two proposals,” says Denny Davis, SDARWS director, “one for operator certification and the other for technical assistance.

“As far as technical assistance, we will be hiring a full-time person to go out and help systems that have problems,” explains Davis. “We want longer contact times with systems with problems. Our technical assistant could spend one to two weeks with these systems. This person would also help with prioritizing loan applications to help get money to the systems that need help right away.

“Often, systems going after money will realize that with better operation and maintenance they can get themselves into a position to run more efficiently and may not even need loan or grant money,” says Davis.

“We also have other qualified staff with specific training, such as groundwater technicians, who the technical assistant can rely on for back up,” Davis continues.

Davis also cautioned that EPA has not yet stated exactly what it expects from a technical assistance program. “Until that’s decided, we won’t be sure of what level of technical assistance will be needed. The agency has used several different terms when discussing technical assistance. If they’re [EPA] talking about capacity, then we’ll make sure they [water systems] have the financial, managerial, and technical means to stay in business.”

Systems must demonstrate financial, technical, and managerial capacity to be eligible for Drinking Water State Revolving Fund (DWSRF) loans, unless the loan is to be used to ensure capacity, according to EPA guidelines. Technical capacity refers to the physical infrastructure of a system, such as water quality, the actual condition of the system, and the operator’s technical knowledge. Managerial capacity refers to ownership accountability, staffing, and the overall organization of the system. And financial capacity refers to the system’s revenues, credit worthiness, and fiscal controls.

Operator Certification Is a Must

Because drinking water treatment operators must be certified as well as participate in continuing education programs under the reauthorized Safe Drinking Water Act (SDWA), Davis says that SDARWS also submitted a proposal for operator certification training. “Drinking water operator competency is critical for the protection of public health and the maintenance of safe, optimal, and reliable operations of water treatment and distribution facilities,” notes a March 17, 1997, EPA project plan.

South Dakota has had a mandatory certification law in place since 1970. What will change for this state is training opportunities. Currently, SDARWS, and other training organizations offer from 18 to 27 training sessions throughout the state each year. While that number may not change, the type of training will.

“We want to provide one-on-one training for some of our state’s operators,” says Davis. “We will be selecting 10 drinking water operators from around the state who have difficulty passing the exam. They are usually from small communities and are likely the town’s only operator and have difficulty getting to a training session. We plan to go to them and get them schooled.”

Davis also says that SDARWS will concentrate training on the math portion of the certification exam. “Math seems to be a real stumbling block for many operators,” Davis explains. “They may do well on basic treatment, but then fail an exam because of the math. We’d like to train them in smaller groups to give more individualized attention prior to their taking the test. With more attention, it should really help when it counts.”
Staying Out of a Jam
Confined Spaces Require Safety Measures

by Kathy Jesperson
NDWC Staff Writer

If your job takes you into such places as a pipeline, pumping station, storage tank, or similar enclosure, you may work in a confined space. Working in these areas can be dangerous or even fatal if proper precautions are not taken.

“Confined spaces may be encountered in virtually any occupation; therefore recognizing them is the first step in preventing fatalities,” notes a National Institute for Occupational Safety and Health (NIOSH) publication, Preventing Occupational Fatalities in Confined Spaces by Ted Pettit, quality assurance specialist.

For example, on July 1, 1985, an Ohio water meter reader was found face down in a meter vault that contained water lines and an industrial water meter. The vault, which was installed in May 1985, had been inspected for compliance of city regulations.

After the meter reader was found dead, however, city inspectors noted that the manhole cover did not contain ventilation holes. According to the victim’s supervisor, he may have had difficulty opening the manhole because the hook used to pull the lid open was straightened out and a sledge hammer was lying next to it.

Upon inspection of the inside the vault, inspectors noticed the faint odor of natural gas. The gas company was notified and a leak was found in a line approximately 34 inches from the vault. Inspectors sealed the vault and tested the atmosphere periodically. They eventually determined that the atmosphere contained 17 percent oxygen, 15 percent methane, and less than 600 parts per million of carbon monoxide. (Normal atmosphere typically contains 20 percent oxygen, 78 percent nitrogen, and trace amounts of other gases.)

According to the coroner, the cause of death was directly related to the inhalation of toxic fumes: methane and carbon monoxide.

NIOSH notes that dangerous gases such as hydrogen sulfide, methane, and carbon monoxide can build up in confined spaces. Breathing hydrogen sulfide or carbon monoxide fumes may be fatal. Further, methane is explosive, so torches or other flames must never be used near the opening of a septic tank, sewer, or other opening that may be seeping this gas.

What is a confined space?

Because working in confined spaces can be hazardous to the health or life of the employees who must enter and work in them, the Occupational Safety and Health Administration (OSHA) released its final rule regarding working in confined spaces on April 15, 1993. This rule (29 CFR 1910.146) includes a permit system to help ensure that workers are able to work safely in such a situation.

OSHA defines a confined space as “any space having limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere.” A confined space, such as a storage tank, may have any one of the following characteristics:

• limited openings for entry or exit,
• unfavorable natural ventilation, or
• a design unsuitable for continuous worker occupancy.

“Confined space regulations require that facilities be audited to identify confined spaces that require permits, identify employee training needs, control who enters permitted spaces, and implement emergency mechanisms,” notes Cathy S. Dixon, communications specialist for Operations Forum in the September 1994 article “The Ins and Outs of Confined Spaces.”

Dixon further stated that a facility requiring employees to enter confined spaces must have a confined space safety program that includes:

• a written plan,
• documentation of confined spaces,
• a permit system,
• atmospheric monitoring,
• warning signs,
• employee training,
• protective equipment, and
• an emergency response plan.

What makes it dangerous?

OSHA notes that this permit system is important to employees who work in confined spaces because they risk exposure to serious hazards. In some cases, confinement poses entrapment hazards or keeps employees closer to other hazards, such as asphyxiating atmospheres or moving machine parts.

In addition, OSHA states that confined spaces, by their very nature and configuration, are dangerous to life and health. “Many confined spaces are poorly ventilated—a condition that is favorable to the creation of an oxygen-deficient atmosphere and the accumulation of toxic gases,” notes OSHA. “Furthermore, a confined space is not designed for continuous employee occupancy; hence, little consideration has been given to the preservation of human life within the confined space when employees need to enter it.”

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“Confined spaces may be classified into two categories: open-topped enclosures with depths that restrict the natural movement of air, and enclosures with extremely limited openings for entry and exit,” notes a NIOSH article, Professional Safety: Workers/Rescuers Continue to Die in Confined Spaces by Ted Pettit.

The article also states that the hazards characteristic of any confined space are determined by the materials being stored or used inside the space, the process taking place inside the space, and possible effects of the external environment.

How does it affect workers?

“Since deaths in confined spaces often occur because the atmosphere is oxygen-deficient or toxic, confined spaces should be tested prior to entry and continually monitored,” states the NIOSH publication. Two things make an atmosphere flammable:

- the amount of oxygen in the air, and
- a flammable gas, vapor, or dust in the proper mixture.

Different gases have different flammable ranges. If a source of ignition—such as a spark or electrical tool—is introduced into a space containing a flammable atmosphere, an explosion may result.

An oxygen-enriched atmosphere (i.e., one above 21 percent) will cause flammable materials, such as clothing and hair, to burn violently when ignited. Therefore, never use pure oxygen to ventilate a confined space. Always ventilate with normal air.

On the other hand, an oxygen-deficient atmosphere should not be entered without a self-contained breathing apparatus (SCBA). The oxygen level in a confined space can decrease because of work being done, such as welding, cutting, or soldering. Certain chemical reactions can also decrease the oxygen level, including rusting or fermentation.

The oxygen level can also decrease if it is displaced by another gas, such as carbon dioxide or nitrogen. Total displacement of oxygen by another gas, such as carbon dioxide, will result in unconsciousness, followed by death.

“Because these atmospheres can bring on immediate death, never trust your senses to determine if the air in a confined space is safe,” warns NIOSH. “You cannot see or smell many toxic gases and vapors, nor can you determine the level of oxygen present.”

It is important to understand that some gases or vapors are heavier than air and will settle to the bottom of a confined space. Conversely, some gases are lighter than air and will be found at the top of a confined space. Therefore, it is important to test all areas with properly calibrated testing equipment to determine exactly what gases are present.

Proper Testing Can Save Lives

If testing reveals oxygen-deficiency, or the presence of toxic gases or vapors, the space must be ventilated and re-tested before workers enter. If ventilation is not possible and entry is necessary (in an emergency rescue, for example) workers must wear a SCBA.

Under certain conditions where flammable gases or vapors have displaced the oxygen level but are too rich to burn, forced air ventilation may dilute them until they are within the explosive range and should be tested before workers enter the area. Also, when inert gases, such as carbon dioxide, nitrogen, or argon, are used in the confined space, the space should be well ventilated and re-tested before workers enter.

Ventilation by a blower or a fan may be necessary to remove harmful gases and vapors from confined spaces. Several methods can be used for ventilating a confined space. The method and equipment chosen are dependent upon the size of the openings, the gases present, and the source of the air.

A common method of ventilation requires a large hose, one end attached to a fan and the other lowered into a manhole or opening. For example, a manhole would have the ventilating hose run to the bottom to blow out all harmful gases and Continued on page 17
"Systems with less than 1,000 connections are new to having a certified operator—even though the state has had a voluntary operator certification program in place for 25 years," says Stanford. “We held six or seven classes last year that were specially tailored to new operators so they can pass a certification exam as well as knowing about the operation and maintenance of a system.”

Stanford also noted that there seemed to be a niche developing in Idaho for contract operators. “Since there are so many small systems within the state, there seems to be an opening for operators to become certified then operate half a dozen or so systems. Often in small communities, the system operator works only part-time or is a volunteer. Contract operators would take direct responsibility of system operation away from the townspeople. “As we move toward mandatory certification, we may be hiring the certification board to be the record-keepers while we take control of the regulatory part. This seems to be a comfortable alternative. We want to make the most use of what’s already in place,” concludes Stanford.

**Pennsylvania Plans Training**

Pennsylvania’s drinking water operators are accustomed to a certification requirement, and system operators across the state feel comfortable with the new SDWA requirement. “We’ve had mostly a positive reaction from the state’s operators in favor of the new requirements,” says Matt Milliron, Centre County. “They agree that training is necessary, but they also want to be sure that training opportunities will be available. They don’t want training to be required and then have nothing out there.”

Milliron says that the state’s drinking water operator licensing board is working to develop training programs tied to the new requirements. “We hope that within the next year, we’ll have a number of programs ready for drinking water operators,” he says.

“Pennsylvania Rural Water Association will be involved in presenting these training sessions as well as the Water Works Operators Association of Pennsylvania (WWOAP), the American Water Works Association (AWWA), and many manufacturers,” Milliron notes.

“Operators will receive points for the training programs they attend, which will be applied toward continuing education units (CEUs). CEUs will be important when they apply for recertification. They will need to prove they had the training when they apply for their certificate. And they can do that by sending CEU documents along with their application.

“Retesting will likely be required only if they allow their certificate to expire for more than two years,” Milliron says. “Very small systems may apply to have their training expenses reimbursed,” he continues. “So it won’t be a burden to the system to pay for a part-time operator to travel to a training session that may be miles away and require overnight stays.”

However, Milliron notes that most changes are still in the proposal stages, and nothing definite has been decided.

**Oklahoma Is Already On Board**

Gene Whatley, director of Oklahoma Rural Water Association (ORWA), says that his state has had a stringent drinking water operator certification program in place since 1970. It requires all drinking water treatment operators to be certified, including those who operate very small water systems.

“We [ORWA] feel that DEQ [Department of Environmental Quality] has done an excellent job with operator certification thus far. We do, however, see some additional need for training. Right now we require four hours of CEUs for annual renewal. There was a proposal to triple that requirement. But that’s still on the table,” he says. “The state really hasn’t explored the issue to any degree yet,” Whatley continues. “We [ORWA] would like to expand on what we’ve been doing. Right now we do training for C and D class certification, which is the lowest certification level in Oklahoma. We are looking to get approval for some advanced training, which would include classes A and B.

“We’d like to add another trainer to our staff,” he says. “And we’re looking to the state legislature for funding to add this person. Right now we do a lot of math and chemistry training sessions. We would like to add lab work training to what we currently do. But with limited staff, it will be difficult.”

*For more information about the SDWA operator certification requirement, visit EPA’s Web site at http://www.epa.gov/OGWDW/. Information may also be found by calling the Safe Drinking Water Hotline at (800) 426-4791.*
The Safe Drinking Water Act (SDWA) Amendments of 1996 direct the U.S. Environmental Protection Agency (EPA), in cooperation with the states, to publish guidelines specifying minimum standards for operator certification and recertification. These regulations apply to operators of all community and nontransient, non community public water systems.

**What’s going on with operator certification?**

The work groups discussed key certification issues, including baseline standards, grandparenting of operators, operator testing, operator training, renewal, size categories of systems, exemptions, and Indian tribes.

1. **Baseline standards**—After considerable debate, the work groups decided to consider training and coverage as elements within other baseline standards. It was decided that reciprocity between states will not be a requirement; however, states will be encouraged to develop reciprocity procedures.

2. **Grandparenting of operators**—In this context, the term grandparenting means exempting existing operators from initial certification requirements, such as having a high school education or passing an exam. Consensus of the work groups is that grandparenting may be necessary during the transition to allow the many competent operators already working to have time to meet requirements. It was suggested that it may not be legal in some states to impose requirements that could result in someone losing a present job. Whether to allow grandparenting will be left to individual states.

3. **Operator Testing**—Will operators need to pass a written exam? Some group members argued written exams should be required; others felt the written form would present a disadvantage to those with disabilities, such as dyslexia. The work group consensus is to allow states to decide what type of exam is most appropriate—written, oral, performance-based, or a combination of several—as long as the exam demonstrates that the applicant has necessary skills, knowledge, ability, and judgment.

4. **Operator Training**—The group consensus is to leave decisions about type and amount of training to the discretion of individual states.

5. **Renewal Period Certification**—Group members agreed that there should be a fixed cycle of renewal not to exceed three years.

6. **System Sizes**—There was discussion as to whether national uniform system sizes...
**Operator Certification Product Is Available**

The National Environmental Training Center for Small Communities (NETSCC) has developed a booklet to assist operators in locating certification resources, agencies, and training centers. The information may be used to contact certifying agencies for state-specific requirements, training centers that may offer exam preparation courses, and organizations that offer study resources.

Information about numerous training resources is presented, including:

- Small Water System Operation and Maintenance: Field Study Training Program,
- Water Distribution System Operation and Maintenance: Field Study Training Program,
- Operator Certification Study Guide: A Workbook for Treatment Plant Operators and Distribution System Personnel, and
- Water Treatment Plant Operations: Study Guide and Need-to-Know Skill Inventory for the Operators of Water Treatment Plants.

To order a copy, contact the NETSCC at (800) 624-8301 or (304) 293-4191 and request item #TRBLOM02. The cost is $2.60 plus shipping and handling.

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**OCT Offers Training Videos**

One of the problems facing operators of small water and wastewater systems is how to get good training information without incurring undue expense. An Oregon company, Operator Certification Training, Inc. (OCT), has developed a series of videos to help meet this need.

The first seven videos in what OCT calls their video distance learning program cover mathematics for water and wastewater operators. Forthcoming subject tapes, available on VHS video, will include such topics as Cross-Connection, Small Water Systems, Pumps and Pumping, and Chlorine Disinfection. The videos are between one-and-a-half and two hours in length and cost from $106–$135 per tape.

OCT is planning to use these videos in conjunction with an education program that offers Continuing Education Units (CEUs) in six states. OCT also offers a number of self-study manuals and practice examinations for small systems operators in addition to the videos mentioned.

To learn more about the OCT video distance learning program or their other educational products, call (888) 863-8916 or write to P.O. Box 332, Gladstone, OR 97027.

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**What’s going on with operator certification?**

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should be established. Work group consensus is that definitions of system size should be left to individual states. All states currently have a method for categorizing systems and imposing national standard categories might be disruptive.

7. Exemptions—There was discussion as to whether certain systems, such as those 3,300 or fewer people, should be exempt from certification requirements. Historically, these are the systems that violate drinking water regulations most often.

The work groups believe it was Congress’ intent that small systems be covered by operator certification guidelines, as evidenced by the SDWA reimbursement provision for training and certification costs of operators serving this size system.

However, the consensus is that states should have the flexibility to decide what is the appropriate level of training and type of examination for certification. The draft guidelines include the example of a small groundwater system with no treatment and only onsite plumbing whose operator needed to be trained in minimal procedures.

8. Indian Tribes—The working groups found that the SDWA does not include guidelines for Indian Tribe operator certification. They state that all users of public water supplies are entitled to safe water and believe operator certification programs are a means of ensuring this basic need. Thus, they ask that EPA seek clarification and resolve this omission, a recommendation EPA is currently pursuing.

For general information about operator certification or for copies of draft guidelines, contact the Safe Drinking Water Hotline at (800) 426-4791. You may also view the guidelines at http://www.epa.gov/OGWDW/opcert/opcertfs.html.

For technical inquiries, contact Richard Naylor, Implementation and Assistance Division, Office of Ground Water and Drinking Water, US EPA, 401 M St., SW, Washington, DC 20460. You may also call him at (202) 260-5135 or e-mail to naylor.richard@epamail.epa.gov.
Computer Models Help Small Water Utilities

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**How can computer models and GIS assist?**

Most large water utilities have come to recognize the benefits of developing a Geographic Information System (GIS) for their distribution systems. Although GIS software provides a range of features, the principal benefit to most water utilities is combined mapping and record maintenance capability which can be readily updated.

Data for a computer model has much in common with a water utility GIS database, and, if available, this important source of water utility information can be readily used to develop a computer model. Although useful, it is not necessary to have a full blown GIS developed prior to setting up a graphical computer model of a water utility. In fact, graphical computer models are already available that provide accurate mapping capabilities and incorporate utility inventory and maintenance records.

In many cases, such models can provide many of the same operational benefits normally associated with a comprehensive GIS but at a fraction of the cost. These models serve a dual purpose—maintaining a computer map and current GIS data for the water utility while also performing the important hydraulic and water quality calculations necessary to manage and operate the water distribution system.

**Example Demonstrates Modeling**

A graphical computer model of the Bracken County Water District (Bracken County, Kentucky) is shown. (See figure 1.) This system has approximately 1,400 customers and serves most of the county. It has 127 miles of pipes ranging in size from 2–12 inches with five elevated storage tanks and one treatment plant/pumping station. Several typical computer screen images are illustrated using the KYPIPE-Total Modeling Package (KYTMP) software.

The rural water system models are best represented using a familiar map as a background, as shown. In this case the background map is a Kentucky Department of Transportation (KYDOT) map, which is familiar to all Kentucky rural water systems. Nearly all of these utilities currently have their pipe systems drawn on these maps.

The use of the map background illustrates how modern computer graphics capabilities allow water utility modeling technology to be used by managers and operators. All operations use a mouse to point to the features on this scaled map representation of the water utility.

The graphics make it easy to zoom in on any portion of the system and see additional details such as precise locations of valve and hydrants. Pipes, tanks, valves, hydrants, regulators, pumps, etc., can be easily added to the model using the scaled background map as a reference for locations. High quality printouts can be obtained using standard black and white laser printers or bubble jet color printers.

**What does the model do?**

A comprehensive hydraulic and water quality model allows the user to instantly evaluate anything associated with the system hydraulics and water quality:

- the pressure and fire flow available to a proposed customer,
- the fire flow available while a pipe is out of service, which valves to close to isolate a break,
- the benefits of a new pump or a new tank, and
- the chlorine residuals at the taps, etc.

The models can calculate fire hydrant rating. Twenty-four hour simulations can be set up to model tank and pump operations. With some models, special hydraulic calculations can be made for rural water systems that allocate requirements based on peak demand curves. The more useful models provide facilities management capabilities by interacting with inventory and maintenance records for pipes, valves, hydrants, and other devices and providing graphical displays of information and graphical access to these records.

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Choosing Modeling Software Is Important

Water utility modeling software is available from a variety of sources and at widely varied costs ranging from very low cost public domain software to expensive high end packages that usually require special hardware and software. The model data can be easily transferred into GIS at any time. An important consideration is that small utilities can probably use one package for modeling, GIS mapping, and records maintenance. Many utilities look to a consulting engineering firm to acquire, set up, and train them to use appropriate software. Others find that with adequate software support, they can do this themselves.

It is particularly important for the small water utility to acquire modeling software meeting the following requirements:

1. The software operates in an appropriate graphical, user friendly environment. Since it is not practical for most small water utilities to maintain a separate GIS, the software should include comprehensive mapping, modeling and facilities management capabilities.
2. Comprehensive technical support is readily available. This should include special support for small water utilities for setting up and maintaining models.
3. The software can be operated using normally available PC hardware and software. It should not require expensive auxiliary hardware (plotters, etc.) or software (CAD packages) which may not be currently available to the water utility.

All packages provide similar modeling capabilities but differ in their capability to maintain records and do facilities management. For more information, you may contact the Civil Engineering Software Center, University of Kentucky, Lexington, KY 40506. Wood, Lingireddy, and Ormsbee are part of an experienced group at the University of Kentucky, which has been developing water utility modeling software for more than 25 years. Their models are used worldwide and have greatly influenced development of water utility modeling technology. You may also reach them by calling (606) 257-8005 or fax them at (606) 323-4996. You may view their Web site at http://www.kypipe.com.

Other sources of information about water utility models include EPANET, developed by the EPA, at http://www.epa.gov/docs/RREL; and WATERCAD, developed by the Haestad Methods, Inc. at http://www.haestad.com.

Computer Models Help Small Water Utilities

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It is possible, for example, with the click of a mouse to instantly identify valves to be closed to isolate a break or maintenance site. The list goes on, and the many uses and potential benefits of modeling your water system and using this model on a daily basis are far too numerous to present in detail here.

Who needs a hydraulic and water quality model?

The simple answer to this question is that if you manage or operate a water utility, you need a hydraulic and water quality model of your distribution system. In addition to the obvious benefits of graphically maintaining records and aiding daily operations, the model capabilities are required time and time again to evaluate proposed uses or to investigate options for solving your problems.

No amount of experience can provide all the accurate information and ease of evaluating the alternatives required to manage and operate the water system hydraulics and water quality. With a well calibrated hydraulic model, one can instantly check to see if a proposed user can be properly serviced, calculate the fire flow available, evaluate a proposed addition, and perform a variety of other important tasks. The model will enable users to make efficient choices and will surely save considerable time and money. It is also a very useful and effective tool to support and present recommendations or responses to regulating bodies.

Water quality issues, while always important, take on even more significance because of the Safe Drinking Water Act, which states that all community water supplies must meet Maximum Contaminant Levels (MCLs). Some of these requirements apply at the tap.

A U.S. Environmental Protection Agency (EPA) official stated that, “The application of water quality modeling is the only mechanism that I am aware of which can be systematically applied to evaluate the variables that can affect a utility’s ability to comply with the MCLs. If you ever have any water quality problems, then you will have to have a hydraulic model to effectively address your water quality problems.” This statement reinforces the fact that a model is a necessary tool for your water utility.

Figure 2
This graphic provides a profile of water usage and head over a 24-hour period.
Drinking Water Discussion Is Underway

The National Drinking Water Clearinghouse’s (NDWC) discussion group is now reaching more people than ever who have drinking water-related questions. And you too can join the discussion if you have Internet access.

Discussion topics may be of any nature related to drinking water issues facing small communities. Recent posts explore items, such as tank rehabilitation procedures, filtration, high manganese levels in municipal wells, possible health effects associated with bromide, and “black water” problems, among other topics.

NDWC Technical Assistance Specialist Mohamed Lahlou reviews forum postings several times a week; however, he notes that answers to questions come from other readers who have similar experiences and are willing to respond. There is no guarantee of a response. Lahlou says that with the ability to post questions at any time of the day, discussion group participants have a great way to make contacts, share experiences, and find answers to questions.

Confined Spaces Require Safety Measures

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vapor. The air intake should be placed in an area that will draw in fresh air only. Ventilation should be continuous where possible because in many confined spaces, the hazardous atmosphere will form again when the flow of air is stopped.

Often the atmosphere or other circumstances require that a confined space be inaccessible. Isolation of a confined space means that it is removed from service by either:

- locking out electrical sources at the switch,
- blanking and bleeding pneumatic and hydraulic lines,
- disconnecting belt and chain drives, and
- securing mechanical moving parts, such as latches, chains, or other devices.

Make a Rescue Plan

In every situation where employees must work in confined spaces, a rescue plan is required. According to NIOSH, a standby rescue person should be assigned to remain outside the confined space and be in constant contact with the workers inside. This person should have no duties other than standby responsibilities, which includes knowing who to notify in case of an emergency.

Standby personnel should never enter the confined space until help arrives, and then only with respirators, life lines, or other necessary equipment. More than 36 percent of the workers who die in confined spaces are attempting to rescue other workers. Rescuers must be trained in and follow established emergency procedures and use appropriate equipment and techniques.

Rescue should be well planned and drills should be frequently conducted on emergency procedures. Unplanned rescue, such as when someone rushes in to help a co-worker in trouble, can easily result in a double fatality or multiple fatalities if there is more than one would-be rescuer.

To ensure that rescues run as smoothly as possible, employers are responsible for the training rescue personnel. Each member must be trained to:

- use protective equipment,
- perform assigned rescue duties, including entering a confined space,
- participate in mock rescues, and
- perform basic first aid and cardiopulmonary resuscitation (CPR)—at least one member must be CPR-certified.

For more information about confined spaces, contact NIOSH at (800)-35-NIOSH. To report life-threatening situations, call OSHA at (800) 321-OSHA.
Septic Systems

How can leaching into wells be prevented?

Domestic wastewater treatment by septic systems can be effective and efficient, particularly in small and sparsely located communities where sewers are non-existent. The system treats the wastewater onsite by first retaining it in a holding tank where the wastewater undergoes clarification as the solid portion and grease are separated from it to form sludge and scum, respectively. The grease and sludge are called septage and should be pumped out periodically. The clarified wastewater then travels to the soil absorption drainfield where it is dispersed into the soil for further treatment.

Septic tank systems are very common. According to 1990 census data, approximately 25 percent of the U.S. population rely on septic system disposal. Furthermore, approximately 22 million septic tanks discharge nearly one trillion gallons of wastewater annually.

In order for a septic system to function properly, it needs to be properly sited, designed, installed, and maintained. Otherwise, the untreated effluent may leach directly into the saturated zone and possibly contaminate the groundwater; a vital source of drinking water to many well owners.

According to an article in a 1984 EPA Journal, “Sources of Groundwater Pollution,” by David Miller, septic disposal ranked the highest in total volume of wastewater disposal and is the most frequent source of groundwater contamination. This article addresses the necessary steps and precautions the well owner should take to ensure a safe drinking water supply.

How do septic systems contaminate wells?

The problem emerges when the inadequately treated effluent rapidly infiltrates through the unsaturated or vadose zone and reaches the water table without getting thorough soil treatment. After mixing with the groundwater, the contaminant can then travel along the aquifer slope due to the hydraulic gradient created by the water head difference between the point of recharge (where precipitation seeps into groundwater) and the point of destination.

A pumping well in the vicinity can cause the hydraulic gradient to further increase as a result of the water table drawdown created by pumping. Once the wastewater plume reaches the well’s radius of influence—the maximum horizontal distance at which the contaminant is influenced by the pumping well—it may contaminate the well.

The risk of contamination depends on several factors, including:

- the well pumping rate,
- the aquifer slope,
- the distance between the soil absorption trench and well location, and
- the hydrogeological properties of the soil formation.

Investigating these factors can determine the risk of contamination.

How can we detect contamination?

The following signs may indicate well water contamination by nearby septic systems:

- water tests prove coliform presence;
- unexplained illnesses surface in the household, such as acute gastrointestinal problems, hepatitis A, or typhoid; or
- neighbors find septic system contaminants present in their water.

Septic system effluent containing nitrates may pose a health hazard to infants if it reaches a well water supply. Both nitrates and nitrites have been known to cause methemoglobinemia known as the “Blue Baby Syndrome” at concentration levels of 10 parts per million (ppm) and 1 ppm respectively. Therefore, it is recommended that drinking water be tested more frequently in the vicinity of septic systems when children or pregnant woman are present.

It is difficult to prove that a well is contaminated by a septic system. Furthermore, litigation can be costly. In order to ensure that both the septic system emplacement and well construction practices comply with existing...
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regulations and laws, the following steps are recommended.

How can the septic system owner comply?

The well owner should notify the septic system owner that the system may be contaminating a well. This should prompt the septic system owner to verify compliance with the local health department and remedy the situation if necessary.

The homeowner should verify with the local health department that the septic system complies with all existing codes, such as the required subdivision ordinances; site plan review; design standards and operating standards. This will ensure that the septic system disposal does not outspace the minimum lot allocated to it.

Design and operating standards ensure that the septic system should not malfunction and that the septage is pumped out every three to five years, depending on the tank size. The minimum lot size per typical household septic system varies from 0.5 to 5 acres, depending on the state or locality. The minimum separation distance between the well and the soil absorption field ranges from 25 feet to a recommended 100 feet. The distance may increase should limiting factors exist, such as the presence of limestone, karst, or fractured bedrock in the soil formation. Furthermore, the septic system owner should inspect the system annually to make sure the system is operating properly.

How can the well owner comply?

Well owners can protect water sources by complying with recommendations for well location and design. Locating the well upslope from the septic system typically poses a lower risk of contamination than locating it downslope. However, surface contours do not always reflect aquifer slope. Therefore, the homeowner should consult with the nearest U.S. Geological Survey office to find out about groundwater movement and surface drainage in the vicinity of the well.

The well owner should ensure that the well casing is not cracked and that the well cap is well sealed from surface water runoff since surface water can contain contaminants such as coliform and nitrates. According to well construction practices, it is recommended that the well casing extend to a depth greater than 25 feet or 10 feet below the static water level in sand and gravel formations. In bedrock, a depth of 30 feet is recommended for sandstone and 40 feet for others. However, it is imperative that the well owner consult with the county health department for design before installing the well.

According to David Pask, engineering scientist with the National Small Flows Clearinghouse (NSFC), should the homeowner find that the well supply is contaminated by an existing or new septic system despite compliance with existing codes, it may be possible to alleviate the problem by installing additional well casing to extend the depth of pumping to below any shallow septic effluent. Alternatively, if the well casing is sufficiently below the static water level, it would be advisable to reduce the flow of the well pump by a throttling valve, or more efficiently, to install a pump of lower capacity. A water storage tank may be needed to allow for sporadic high water demand under constant low pumping rate.

If the results of the water tests persistently detect the presence of coliform and other contaminants, then the homeowner may want to install filtration and disinfection devices in the well system for proper treatment.

For more information about septic system leaching into water wells, call the National Small Flows Clearinghouse at (800) 624-8301 or (304) 293-4191. You may access their Web site at http://www.nsfc.wvu.edu

For more information regarding well-head protection and well construction practices, call the National Drinking Water Clearinghouse at the above numbers or access our Web site at http://www.ndwc.wvu.edu. Several items listed below as references may be ordered from either the NDWC or the NSFC.

References


Groundwater Protection: Helping America’s Small Communities Meet Their Wastewater Needs. NSFC. Available through NSFC.


NDWC 1997 Indices Are Available

Note: The free items listed below are limited to one of each per order. Call (800) 624-8301 or (304) 293-4191 to order products. Please allow three to four weeks for delivery. Actual shipping charges are added to each order. NDWC products also may be ordered via e-mail at ndwc_orders@ndwc.wvu.edu. Products are subject to availability. Please verify prices when ordering.

1997 On Tap Index
Item # DWBLIN08
This index lists each article that appeared in four issues On Tap in 1997 and includes a short summary of the article’s content. Articles focused on such topics as operator and training resources, regulation issues, various technologies, the progress of “Water 2000,” safety issues, and educational items. The Index also may be downloaded from the NDWC’s Web site located at http://www.ndwc.wvu.edu.
Cost: $0.00

1997 Water Sense Index
Item # DWBLIN09
This index includes abstracts of all articles appearing in Water Sense in 1997. Articles cover regulations and legislation issues, funding resources, assistance sources, and privatization. You may also download the Water Sense Index from the NDWC’s Web site located at http://www.ndwc.wvu.edu. 
Cost: $0.00

Benefits of Water and Wastewater Infrastructure
Item #DWBLRE06
This 14-page booklet documents that the health and well-being of the American public, as well as the environment, the economy, and the future, depend on continued support and funding of water and wastewater infrastructure at all levels: federal, state, and local. Through a review of current literature, this report prepared by NDWC and the National Small Flows Clearinghouse, briefly outlines the necessity of having the federal government continue to support water and wastewater infrastructure.

Water 2000 Information Packet Available

Water 2000, the Clinton administration’s sweeping initiative to provide drinking water to rural America by the turn of the century, was announced in August 1994. Since its inception, the program has provided millions of dollars in grants and loans to America’s rural communities to help to the estimated 7.1 million rural households in need of safe drinking water.

The National Drinking Water Clearinghouse’s (NDWC) publications, On Tap and Water Sense, cover the program and provide updates about its progress. The NDWC now offers a compilation of the articles. The Water 2000 Information Package provides a good overview of the program, including an assessment of the serious and most critical needs for all 50 states.

To obtain your copy of the Water 2000 Information Package, call the NDWC at (800) 624-8301 or (304) 293-4191 and request item #DWBLGN35. The cost is $1.90 plus postage. Orders for the package may be placed via e-mail at ndwc_orders@ndwc.wvu.edu.

National Drinking Water Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064

ADDRESS SERVICE REQUESTED