Texas On-Site Insights
Information about On-Site Wastewater Treatment Systems in Texas
Volume 4, Number 2, Spring 1995

1995 Conference Provides Information for On-Site Professionals

More than 350 participants gathered in Austin in February for the Texas On-Site Wastewater Treatment Research Council's annual conference.

The meeting featured presentations dealing with such issues as existing and proposed state regulations and programs that affect the industry; management of local and regional on-site programs and systems; pretreatment; and disposal alternatives. Keynote speakers included Sherwood Reed of Environmental Engineering Consultants, Inc., in Vermont; Stephen Dix of Infiltrator Systems, Inc., in Connecticut, and Patricia Miller of the EPA Small Flows Clearinghouse in West Virginia.

The meeting featured a workshop on pumps, summaries about the progress of Council-funded projects, updates on issues facing industry professionals, and a presentation on how the Texas Natural Resource Conservation Commission (TNRCC) provides regulatory assistance to small businesses. The workshop featured exhibits from many agencies and companies, as well as a hands-on demonstration of a computerized bibliography about on-site issues that was funded by the Council.

Significantly, the Council provided increased opportunities for individuals to provide input about how Council funds should be used (see related article, below).

"We feel this meeting was very successful because of the large number of people that attended and the quality of the speakers and exhibits," said Council Chairman Bill Harris of the Texas A&M University Soil and Crop Sciences Department. "We hope the people who attended took away some valuable information they can use in their own areas."

Conference attendees received a 238-page proceedings, *We're Creating Solutions*, as part of the registration fee (see related article on page 2). In this and future issues of the newsletter, we will feature many of the presentations made at this Conference.

Proposed Rules Changes Will Affect How Council Operates

New rules have been approved that will affect how the Texas Onsite Wastewater Treatment Council operates and awards grants for research and technology transfer projects. The changes affect Chapter 286 of the Texas Natural Resource Conservation Commission (TNRCC) rules, which are part of Title 30 Environmental Quality standards.

The main purpose of the rules changes is to clarify the structure of the Council, and to more plainly spell out the process the Council uses to award grants. Subchapter A revises Council procedures, while Subchapter B covers the granting process.

Some of the more important changes include the following items. The objectives of the Council in considering projects that may be funded are now to determine the regional suitability and effectiveness of on-site wastewater treatment alternatives, and to demonstrate and evaluate appropriate on-site wastewater technology in various geographic and climatic regions of Texas.

The rules changes would require the Council to discuss grant applications at the first quarterly meeting after proposals are received. The changes require the Council to write to those whose proposals are not funded, informing them why their projects were not selected.

These changes were published in pages 2276-2783 of *the Texas Register* on March 28, 1995. For more details, contact Warren Samuelson of the TNRCC at (512) 239-4799.

TOWA Elects New Officers; Announces Plans to Oppose HB 1781

The Texas Onsite Wastewater Association (TOWA) has elected officers for 1995 and its president says the group plans to be active in issues now facing the Texas Legislature.

Newly elected officers include president Frank Aguirre, a consultant from San Antonio; vice president Burt Carter of the Lower Colorado River Authority in Austin; Treasurer Rick Goldberg of Wastewater Systems of Texas, Inc., in Austin, and Secretary Sherry Kincer, a site evaluator in Conroe.

Aguirre says TOWA has hired Barbara DuBose to lobby for the organization at the State capitol. He also says that TOWA is launching an "aggressive campaign" to object to House Bill 1781. That bill would transfer many of the on-site wastewater programs from the Texas Natural Resources Conservation Commission to the Plumbers Board.

Articles about this and other issues affecting on-site wastewater treatment are available from a newsletter, *TOWA Insider*, that is sent to organization members. For more information about TOWA or the newsletter, call Burt Carter at TOWA at (210) 509-6465.

Council Uses Conference to Conduct Survey on Research Needs

One of the most important products to come out of this year's Conference will be the results of a survey that participants completed on research and technology transfer issues.

At the Conference, participants were given a set of 12 color-coded dots, representing the geographic region they live in. Each Conference participant was then able to use up to three dots to identify the subject areas that they felt needed to be funded by the Texas Onsite Wastewater Treatment Research Council.

Participants were able to choose from a wide range of potential research and technology transfer topics that covered such broad areas as conventional and alternative on-site systems, and technology transfer. Some of the specific items under the research categories included soil types, trench dimensions, septic tank construction and design, alternatives to gravel and crushed rock, aerobic treatment units, reed rock filters, and leaching chamber systems. Individual items in the technology transfer component included newsletters, workshops, demonstration projects, training, and computer databases.

At the end of the Conference, participants met in a special session where they were grouped according to geographic regions. In these sessions, they discussed the topics again and identified research priorities.

"The priority setting process is important," said Council Chairman Bill Harris, "because we as a Council need feedback from people working in the field about what we should be doing. It will not only help us do a better job, but it reassures professionals in the field that the Council is listening to their needs, responding to them, and using their money wisely."

Although much information was gathered from the surveys that were distributed at the Conference, it was obvious that some areas like the Lower Rio Grande Valley and the Panhandle were under-represented. As a result, the Council is gathering more information through a written survey that is being targeted to those areas. Ultimately, the Council will use these survey results to help decide which projects it will support.

The Council is working on summarizing those survey results now. As soon as they are available, they will be published in the newsletter. For more details, call Harris at (409) 845-2425.

Proceedings from 1995 Texas On-Site Conference Published

The Proceedings from the 1995 Texas On-Site Wastewater Treatment Conference has been published. The 238-page proceedings, titled *We're Creating Solutions*, contains papers dealing with such issues as state regulations, programs, and proposed regulations that may affect the industry; management of on-site programs and systems; pretreatment; and disposal alternatives.

Some of the papers by Texas authors in the Proceedings include "The Texas On-Site Program," by Lemarcus Johnson of TNRCC; "Administering an On-Site Program in an Urban County," by John Blount of the Harris County Engineering Department; "Maintenance or Failure: The Responsibility is Ours," by Bo Burroughs of Leaching Chamber Systems of Amarillo; and "Intermittent Sand Filters," by David Vennhuizen, a consultant from Austin. Other presentations by Texas authors include "Issues of On-Site Aerobic Treatment Systems" by Dudley Burton of Baylor University; "Nitrogen Removal in On-Site Systems" by Andrew Kruzic of the University of Texas at Arlington, and "Integrated Water Management and Monitoring at the Miller Springs Nature Center," by Dennis Hoffman of the Texas A&M University Blackland Research Center at Temple.

For more details on the availability of the proceedings, call Barbara DuBose at (512) 230-8898.

1995 TWRI Proceedings Includes Papers about On-Site Research

The Texas Water Resources Institute (TWRI) has published the Proceedings from the 1995 Water for Texas Conference. The 726-page proceedings, *Water for Texas: Research Leads the Way*, was edited by Ric Jensen. Some of the papers in the book include "Potential of Constructed Wetlands Systems for Onsite Wastewater Treatment" by Bruce Lesikar; and "Innovative Aeration Retrofit of Existing Failed Septic Systems Around Lake Livingston" by Terry Hoage. Other papers deal with related topics including wastewater treatment and monitoring water quality. The proceedings is for sale for $30 and can be ordered by calling TWRI at (409) 845-1851.

TNRCC Publishes OSSF Newsletter

The Texas Natural Resource Conservation Commission has begun publishing a newsletter that contains information about its on-site sewage facility (OSSF) program. The *OSSF Newsletter* contains useful information for regulators, professionals, and others interested in on-site issues.

The April 1995 issue contains information on TNRCC's reorganization of its OSSF program, summarizes program changes, a list of TNRCC-approved aerobic treatment units, and provides a list of TNRCC staff people can contact for more information. For more information, call the TNRCC Water Program office at (512) 239-0400.

UT-Arlington Engineer Designs Innovative Ways to Remove Nitrogen in On-Site Systems

Andrew Kruzic, a researcher at the University of Texas at Arlington (UT-A) Civil Engineering Department, is investigating different pathways that nitrogen can be removed from on-site wastewater systems, and is developing innovative on-site systems based on those findings.

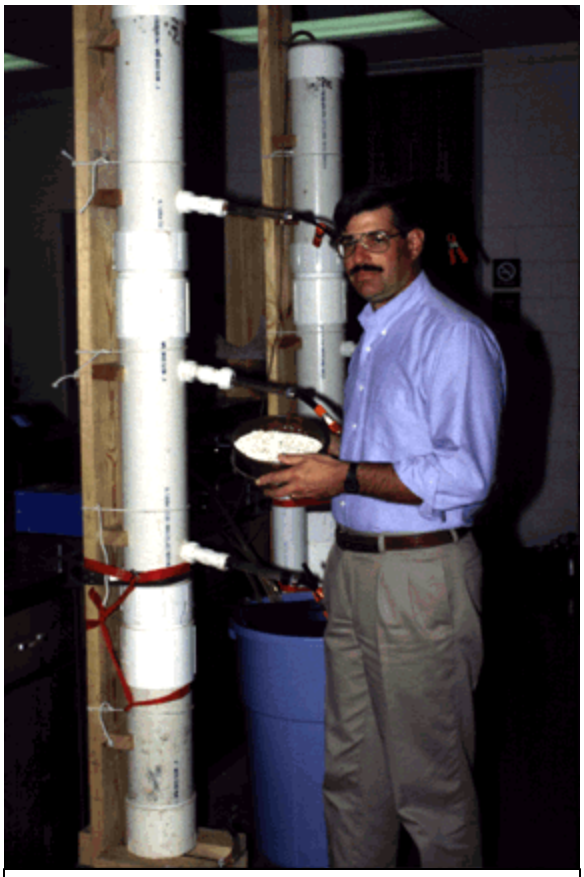
Kruzic presented a paper, "Nitrogen Removal in On-Site Systems," that was published in the proceedings of the 1995 Texas Onsite Wastewater Treatment Research Conference.

Much of Kruzic's previous work has focused on the use of overland flow systems for wastewater treatment. He feels that his findings about these overland flow systems have important implications for individual and small community on-site systems.

In the presentation, Kruzic identified the major ways that nitrogen is removed in on-site systems, explained why nitrogen removal can be limited in some systems, and proposed innovative and economical ways to enhance nitrogen removal in on-site systems.

Nitrogen Removal in Overland Flow Systems

In basic terms, overland flow systems consist of treating wastewater by using it to irrigate large areas that are covered with vegetation. In concept, overland flow systems are similar to trickling filters because wastewater is treated by microbes that are attached to surfaces. Typically, overland flow systems are operated in cycles. Effluents are applied 6 to 12 hours per day and the systems rest the remainder of the time. Operating these systems in cycles often removes more nitrogen than can be achieved by applying wastewater continuously.



Andrew Kruzic of UT-Arlington uses these laboratory column studies to compare nitrogen removal in gravel based systems and those that use zeolite compounds. The studies simulate what happens in a drainfield.

There are many mechanisms that remove nitrogen in overland flow systems, but the major pathways are nitrification, denitrification, and adsorption of ammonium on materials with cation exchange capacity (CEC). Ammonium in incoming wastewater effluents is removed in the overland flow process when ions are absorbed onto materials with a CEC. During subsequent resting and drying periods, absorbed ammonium is converted to nitrate through nitrification. This conversion also replenishes the CEC for the next wastewater application. After the resting period, when more wastewater is applied, nitrate generated during the drying period is converted to nitrogen gas by denitrification.

Kruzic observed that high rates of nitrification, and low rates of dentrification are often found in conventional on-site systems with septic tanks and drainfields. Typically, 70% of the nitrogen in effluents from a septic tank is comprised of ammonium, while the rest is organic nitrogen. Kruzic believes that, as wastewater flows through the biologically active zone of the soil, organic matter with a strong biochemical oxygen demand (BOD) is converted to carbon dioxide and water by aerobic heterotrophic bacteria that require oxygen- and organic carbons for metabolism. Meanwhile, ammonium in the influent is oxidized to nitrate by autotrophic nitrifying bacteria (they need carbon dioxide, oxygen, and inorganic nitrogen for metabolism). Because these nitrifying autotrophic bacteria cannot compete effectively with heterotrophic bacteria for oxygen, nitrification may occur deeper in the soil profile after most of the organic matter is oxidized. By the time nitrate is produced, there is not enough organic matter or proper anaerobic conditions for dentrification to occur and nitrates continue to percolate through the soil toward groundwater supplies.

Innovative On-site Wastewater Systems

As a result of his work with overland flow systems, Kruzic has proposed that a natural mineral called clinoptilolite be used to completely or partially replace gravel in disposal field trenches. Clinoptilolite is part of the zeolite family. Zeolites are silicon-based materials that occur in lava cavities and have been used for many years for ion exchange, water softening and as absorbents. Clinoptilolite has a significant capacity to exchange ammonium (NH4+) and potassium (K+) cations. Kruzic believes it can capture ammonium cations before they can move into the active biological zone of drainfields. This would accelerate nitrification before most of the organic matter is oxidized.

Kruzic says that biological nitrification processes will replenish the capacity of the clinoptilolite and that chemical regeneration should not be necessary. Because clinoptilolite will capture and concentrate the ammonium, nitrifying bacteria should be able to compete efficiently for oxygen and nitrify the ammonium. Once the ammonium is converted to nitrate, it will percolate into the active biological zone and be denitrified by heterotrophic bacteria.

Kruzic says the process works best if aerobic conditions are maintained in the trench. This can be done by placing vents above drainfields, by using dosing siphons, and by alternating flow between trenches.

Innovative On-Site Wetlands Systems

Kruzic suggests that the results of his research into nitrogen transport processes may have implications for the design of constructed wetlands used for wastewater treatment. He suggests that wetlands be operated with intermittent wetting and drying cycles. Drying times should be equal to the time wetlands are flooded. Kruzic believes an advantage of this strategy is that nitrate generated during the drying cycle could be denitrified before it could be flushed from the system. Kruzic is also investigating placing clinoptilolite at sites where wastewater flows into the system to promote cation exchange.

NOTE: For details call Kruzic at (817) 273-3822.

Managing and Enforcing On-Site Regulations in Harris County

Harris County contains more than 47,000 on-site wastewater treatment systems in a 1,778 square mile area. John Blount, who administers the on-site wastewater program for the Harris County Engineers Office, says his office faces some special challenges because there are so many on-site systems, many of which are older, inadequately sized and/or improperly designed, and because problem soils are prevalent.

Major Issues Facing Harris County

Some of the major problems facing Harris County's on-site program involve older systems, problem soils, and enforcement.

Blount says the County began issuing licenses for on-site systems in 1978 and has since processed and approved licenses to install and operate 14,409 on-site systems. Many

systems that were built on very small lots (25 feet x 100 feet or less) in the 1940s and 1950s may pose potential environmental problems.

Other challenges that make it hard for conventional on-site systems to function properly include the rainy climate and poor soils. Reports from the U.S. Department of Agriculture show that more than 85% of the soils in the county are unsuitable for conventional septic systems. Many areas have seasonally high water tables (groundwater is often less than a foot beneath the soil surface) and the county is soaked with an average of 46 inches of rain annually.

Phil Cortez (left) and Leonard Lee of the Harris County Engineers' Office discuss whether this system should be cited for violating on-site regulations.

When the County first began operating the program in the late 1970s, it required homeowners to present a site plan and the results of a percolation test. That information was used to help design a system and to issue a license. At first, the County required that "unconventional" systems (those other than gravity systems) be designed by a registered engineer or sanitarian. Eventually, they required that all systems be professionally designed.

The County stopped relying on percolation tests in 1994 because the results were often conflicting. It now uses a standard site evaluation process that includes information on slope and topography, whether the area is in a 100-year floodplain, groundwater conditions, soil evaluation, and effluent loading data. The County requires that designers attend training classes and submit a site evaluation with each design.

Because conventional septic systems won't work in much of the County, many alternative systems are being installed. For example, alternative systems comprised 60% of the 900 systems installed in 1994. The most common alternative systems were spray irrigation systems (27%), and pressure dosing systems (24%). Other systems being used in the county include holding tanks and portable toilets, leaching chambers, absorption beds, absorption evapotranspiration trenches, greywater systems, and pressure dosed sand filters.

The County requires 24-hours advance notice prior to inspecting systems. County inspectors use a checklist to see if a system meets all standards. If it does, they mark it with a green tag. If it fails, they leave a red flag and send a letter to the person seeking a license telling them what needs to be corrected and how to do it. Inspectors also make a scale drawing of each system.

Enforcement: Making Sure Systems Work Properly

Last year, Harris County received nearly 700 complaints that failing on-site systems were causing nuisances. When complaints are investigated, the County can take a number of steps.

If quarterly inspection reports for aerobic systems are not submitted to the County (as required by the Texas Water Code), fines of up to $500 per day can be levied. If the parties refuse, the County can refer the matter to the Justice of Peace Court where more fines can be imposed. Failure to comply with on-site regulations is a misdemeanor.

The County can act on its own or in response to complaints when on-site wastewater systems are not being properly operated. A yellow tag is left at the site and a letter is sent to property owners telling them that repairs must be made. The County can file a complaint with the Justice of the Peace Court if problems are not corrected promptly. Owners of systems that discharge effluent from on-site systems into ground or surface waters can be fined up to $500 .

If systems are installed without being properly inspected and approved, or if systems don't meet County standards, complaints can be filed, fines can be levied, and more reinspections can be required.

In 1991, the County implemented a permit management system to automate record keeping for fee collection, the printing of permits and licenses, and inspections. Because of the automation, the County has been able to take on expanded duties without significantly increasing its staff size.

NOTE: Blount presented a paper on this subject at the 1995 Texas On-Site Wastewater Treatment Conference. He can be reached at (713) 956-3000.

Managing On-Site Wastewater Programs at Eagle Mountain Lake

At Eagle Mountain Lake near Fort Worth, people with the Tarrant County Water Control and Improvement District (WCID) are taking many steps to make sure that the 2,500 local on-site wastewater systems don't pollute the water.

Mark Ernst, David Jensen, Gary Keil and Barbara Click operate the District's program to deal with on-site wastewater at the lake and are stationed there. They oversee many programs, including conducting random inspections to identify failing systems, working with lakeside residents that may want to install a new system or replace an old one, and monitoring water quality in coves and open lake waters to test for fecal coliform and other contaminants. The District samples creeks that run into the lake and inspects boats to make sure they are plumbed properly so that they can't dispose of wastes while on the lake.

Background Information

Eagle Mountain Lake is northwest of Fort Worth near the towns of Saginaw and Azle. It was built in 1929, has a 200-mile shoreline, covers nearly 9,000 acres, and can store

roughly 178,000 acre feet of water. Tributaries of the West Fork of the Trinity River provide most of the flow into the lake. Watersheds surrounding the lake are still mainly rural and not heavily developed, though there are some lakefront areas that are intensively built up.

On-site wastewater systems within 2,000 feet of the lake were originally regulated by the Tarrant County Health Department. That authority was transferred to the Tarrant County WCID in the 1970s. The District now regulates most of the on-site systems near the lake, except for those that fall under the jurisdiction of incorporated communities. Many of these small towns still rely on the District for technical assistance because they don't have the staff size or expertise to deal with complex on-site issues.

Although water quality in the lake is generally good, there are concerns about higher than normal levels of total suspended solids and blooms of blue green algae that occurred last summer.

Working with Homeowners

One of the biggest challenges facing the District is the variety of homes and on-site systems near the lake. Many of the homes in the area are old, built on small lots, and in areas where residents don't have a lot of money to make needed improvements.

"We have quite a few situations where weekend homes were built on small lots before lakeside regulations took effect," Jensen says. "Now, many of these are being occupied year-round and it's difficult to provide adequate treatment."

To prevent that problem from occurring in the future, the District requires that on-site systems for all homes (even ones designated for weekend use only) be designed to be large enough for full-time use.

The District has an ongoing program to spot check neighborhoods to detect systems that are obviously malfunctioning. Once they find a problem, they work with homeowners to help them make their systems usable again. For example, Jensen gave guidelines to a homeowner who couldn't afford to professionally rehabilitate his system, but was willing to do much of the work himself.

Larger, newer homes can also pose challenges. Often, the issue involves unsuspecting buyers that purchase lots and homes before making sure that lot sizes and soil types will support on-site systems. Another problem is that almost everyone wants to build as close to the lake as possible, thus limiting their on-site options.

The District checks groundwater wells for total and fecal coliform bacteria levels when property changes hands and requires that problems be corrected before the transaction can be finalized.

Jensen says that in many cases creative solutions can be found if homeowners want to be resourceful and if they can afford systems suited to their circumstances. He explained that

one couple wanted to build on a particular site with a steep slope and not much area for a drainfield. Although a traditional system would not work, an engineer was located who designed a system that provided more treatment in the front and side yard areas.

Using new technologies

For many years, traditional septic tanks and drainfields have been the main systems used near the lake. One reason is that the District does not allow the use of aerobic systems with surface irrigation (drip irrigation is OK) because of potential impacts on lake water quality.

Dave Jensen helps install an infiltrator near the Eagle Mountain Lake Volunteer Fire Department. These systems feature a series of interlocking plastic panels and form a leaching chamber. They provide effective treatment but require a much smaller drainfield than conventional systems.

Recently, there have been 12 leaching chamber systems installed in lakeside lots. Jensen says that leaching chambers make sense because they eliminate the need for gravel, allow users to decrease system sizes because they provide a greater surface area, are price competitive, and easy to install. A large leaching chamber system is now being installed at the Eagle Mountain Volunteer Fire Department to treat wastes from mobile homes used by firefighters.

Protecting Water Quality on the Lake

The District also has a number of programs to protect water quality on the lake. Recreational boats must be inspected before they go on the lake's waters to make sure they don't improperly dispose of wastes. Lake users are urged to report instances where they observe that others are dumping wastes on the lake.

Tarrant County WCID staff go out on a regular basis to sample lake waters for fecal coliform bacteria and parameters including water clarity, nutrient buildup, and others. The District has calibrated the WASP (Water Analysis Simulation Program) computer model for Eagle Mountain that can be used to assess potential impacts by running "what if" scenarios.

The District is also working with the Lewisville Aquatic Ecosystem Research Facility to introduce native wetland plants at the upper end of the lake to increase filtration of sediment and nutrients prior to entry into the lake.

Summary

The issues facing water quality managers at Eagle Mountain Lake are typical of those throughout Texas. Main issues involve dealing with older and improperly designed systems, rehabilitating those systems, working with new construction, and monitoring water quality on the lake. However, comprehensive programs like this one can help assure that lake waters can be protected from potential problems involving on-site systems.

NOTE: For details, contact David Jensen at Tarrant County WCID at (817) 237-8585.

David Jensen and Barbara Click of the Tarrant County WCID sample fecal coliform levels on Eagle Mountain Lake.

Impact of On-Site Systems on Fecal Bacteria on the Guadalupe River: Implications for Contact Recreation

Background Information

In the beautiful hill country in Kerr County, making sure that waters of the Guadalupe River and its tributaries are safe for recreation is a big job. The County is home to roughly 25,000 visitors annually who come for swimming, canoeing, fishing, jet skiing and other water-based recreation, including many youths who come to camps along the river.

A challenge facing those who safeguard and regulate water quality here is to monitor and make sure that the rivers are free of fecal wastes and other contaminants. Most of the

camps in the region treat their own wastes using on-site wastewater systems. Some of these systems are located near the floodplain and in soils that may not provide adequate treatment. In other cases, the drainfields may simply be too small or old.

Kerr County uses a team approach to permit, license, and monitor on-site systems used by commercial recreation establishments. For example, the Kerr County Health Department inspects systems and issues permits. The Upper Guadalupe River Authority (UGRA) monitors water quality at sites that may contaminate groundwater, streams, and rivers in the region.

"Our goal is to promote regional wastewater systems where they are the best solution, but to also recognize that on-site systems can be appropriate in many cases," said Robert Hall, who directs water quality efforts for the UGRA.

The Upper Guadalupe River is heavily used for contact recreation including swimming and boating.

Monitoring Water Quality

Recently, there have been concerns that some of the waters in the region may be polluted by fecal bacteria that potentially could originate from failing on-site systems.

In the summer, the number of visitors to campgrounds increases dramatically, and rivers in the area are filled with campers and tourists. Fecal coliform (fc) counts in the Upper Guadalupe River have been as high as 400 fecal colony forming units per 100 milliliters of water (fcu/100 ml), which is well above Texas' stream standard of 200 fcu/100 ml for waters used for contact recreation. These high concentrations of fecal coliform suggest that those who swim and boat in the waters are at risk of becoming ill from fecal bacteria.

In 1993, UGRA began a study to monitor levels of fecal coliform bacteria and Eschericia Coli (EC) bacteria. Sampling sites were established far upstream in undeveloped areas, and at sites upstream and downstream from several heavily used campgrounds.

Control sites were established at two undeveloped sites that were not typically used for recreation to establish natural or background fecal bacteria populations. These sites were 2 to 6 river miles upstream from camp s on the North and South forks of the Guadalupe River. Upstream sites were located immediately above the camps, and the downstream sites were just below the camps. Samples were collected Monday through Thursday each

week from June through August. No efforts were made to drill test holes in or near septic system drainfields to collect samples at any of the camps.

Robert Hall of the UGRA tests for fecal coliform bacteria in the Guadalupe River near Ingram.

UGRA staff members Robert Hall, Renee Moore, Charles Wiedenfeld, and Scott Loveland collected and analyzed samples. Paul Jensen and Yu-Chen Su, from Espey Huston and Associates, and Hiro Imagawa of Osaka Gas Engineering of Japan, analyzed the data.

UGRA compared the use of the mTEC/Urea method to a faster technique called the Nutrient Agar/MUG (NA/MUG) in side-by-side comparison tests to measure EC levels. The mTEC/Urea method has been approved by the U.S. Environmental Protection Agency (EPA), while the NA/MUG technique has not. In the mTEC/Urea procedure, samples are first filtered and placed on a special medium and pre-incubated at 95deg. F for two hours to resuscitate injured EC bacteria. They are then incubated at 111deg. F for 22 hours. Afterwards, the filter pad is removed and placed on an absorbent pad that is saturated with urea. After 15 minutes, colonies that contain the EC bacteria turn bright yellow and can be counted. To use the NA/MUG test, samples are first analyzed for fecal coliform bacteria. A filter pad is removed and samples are placed on plates containing nutrients and are incubated at 95deg. F for three hours. An ultraviolet light beam is then used and colonies that contain EC bacteria fluoresce.

In addition to campers, many people use the Kerrville area for boating and contact recreation.

Data were classified into four types of stations, based on whether they were located near rivers or tributaries or at natural or urban sites. Sampling sites were also characterized based on the amount they are used for recreation. Grab samples were collected monthly.

What is the best testing method?

Hall says that a major concern of UGRA is that the human health risks be accurately measured, without needlessly closing areas that may be safe for recreation. Hall says that UGRA and other agencies are using EC bacteria as an indicator organism. Indicator organisms do not cause diseases, but are usually found along with disease-causing

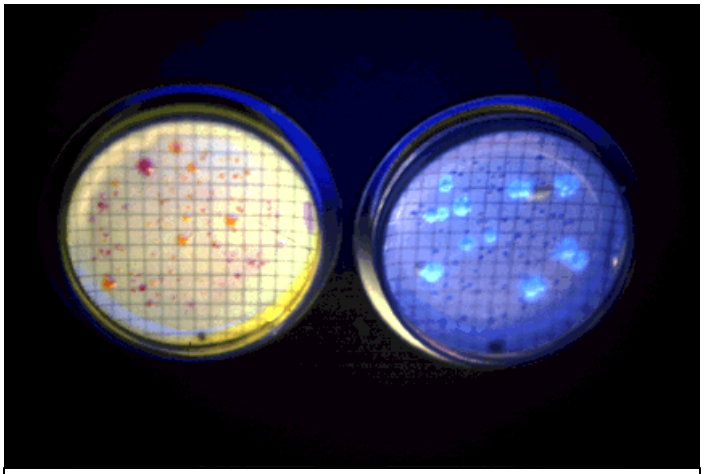
organisms. Hall says that EC may do a better job of assessing health risks than fecal coliform bacteria tests.

Renee Moore of the UGRA (above) gathered water quality samples from rivers in the region to test for fecal coliform and other wastes.

"The problem is that the fecal coliform test will pick up a number of organisms that have life spans that do not closely follow the life span of disease causing bacteria," Hall says. "As a result, it's very hard to know whether a given number of fecal coliform bacteria will pose a health risk."

During the course of the fecal coliform/ EC studies, UGRA worked with many of the campground operators in the region to collect data on the number of campers in the area, how long they had camped there, and whether any water-related illnesses were reported. None of the camps reported any water-borne illnesses, despite the fact that fecal coliform counts were routinely higher than Texas standards for contact recreation.

Using EC data provides a dramatically different picture than relying on fecal coliforms. When traditional fecal coliform testing was used, 5 of 11 of the natural or undeveloped sites and all 7 urban or developed sites failed the Texas standard. When EC testing was utilized, only 2 of the undeveloped sites and 5 of 7 urban sites would have failed.



In the nutrient agar/MUG test (na/mug), fecal coliform bacteria turn bright yellow. In the mTEC/ urea test, fecal coliform bacteria become a fluourescent bright blue. UGRA officials prefer to use the na/mug test because it is simpler and less expensive.

Results suggest that the NA/MUG test performs similarly to the mTEC/urea method, even though it is much simpler and less expensive to use. As a result, UGRA now uses the NA/MUG method to test for EC bacteria. UGRA is also working to evaluate how the use of rosalic acid may influence the number of fecal and EC bacteria that are detected and whether it would be more accurate to not include rosalic acid in their testing protocol.

Conclusions

Areas that rely on high quality water for contact recreation must be able to assess whether levels of fecal coliform in rivers pose a human health risk. This includes investigating if on-site wastewater systems near rivers may be failing and increasing the amount of human wastes and fecal bacteria in the watershed.

Preliminary data from the UGRA's fecal coliform and EC studies suggest that camps near the river and recreational users are not the source of fecal coliform bacteria in the river. The findings also show that although high numbers of fecal coliform bacteria have been found, they have not been related to cases of water-borne illnesses.

Results in Kerr County and elsewhere suggest that the current fecal coliform test methods now being relied on to assess and enforce human health risks in recreational waters may not be accurate. The fecal coliform test may be flawed because it measures several strains of bacteria, many of which are not good indicator organisms. The NA/MUG method was shown to be as effective as the mTEC/Urea test, but it is easier to use and less expensive.

NOTE: For more details, contact Hall at UGRA at (210) 896-7478.