

Water Conservation in Florida

FSAWWA Water Conservation Committee

FSAWWA Water Conservation Committee 1998 Awards of Excellence

Norman Davis

Seven awards were conferred at the Florida Water Resource Conference in April by the FSAWWA Water Conservation Committee. These are those winners and the submitted abstracts:

City of Tampa—First Place, Public Education/Relations

Water Conservation Calendar & Book Cover Project

This in-school education and public awareness program consisted of a Calendar and Book Cover Project for fifth and sixth grades and a Poetry Project for sixth through eighth grades. Some 25,000 calendars and 30,000 book covers were distributing to schools and to the community. Teachers provided hands-on learning to prepare students for creating a proactive conservation poster or poem, which helped the children understand and retain the conservation message as they studied the water cycle, water use, and water supply. Each of the elementary and middle schools within the school district of Hillsborough County and Tampa's private schools received detailed guidelines to help teachers. Project Manager: Mary Margaret Hull, 813-274-8121.

Pinellas County Utilities—Second Place, Public Education/Relations

The Wet Gazette: Conservation Activity Booklet

Introduced in 1998, Pinellas County Utilities activity booklet, *The Wet Gazette*, features Dewey (the Utilities water Mascot) as a water conservation consultant ready to teach youth: what is water and where is it found, the fundamentals of the hydrologic cycle, and a myriad of fun facts. (See article below.) Project Manager: Irma Reinpoldt 813-464-3438.

City of Plant City—First Place, Reclaimed Water

Reclaiming Our Resources for the Future "Reclaiming Our Resources for the Future" describes an ambitious, innovative, and model treated-wastewater reuse program developed and implemented by the City of Plant City. The program centers around a new state-of-the-art "Public Access" reclaimed water production facility. The success of the program is directly attributed to a close partnership between the city, SWFWMD, the Hillsborough River Basin Board, and DEP.

The results of the project are impressive. Since March 1997, treated wastewater discharge into Lake Thonotosassa has been completely eliminated, while the city of Plant City conserved an average of 2,017,000 gal-

lons of potable water per day. Other direct benefits of the project include water wellfield regeneration, availability of reuse water for sanitary sewer line cleaning, agricultural irrigation, and additional revenue for the city's utilities fund through the sales of reuse water. Robert Bedell 813-757-9288.

Hillsborough County Water Department—First Place, Conservation Measure

Water Conservation Work Study/ Internship Program

Hillsborough County has developed an annual work study/internship program to compensate eligible college students for assisting in the water conservation efforts of the county. The program is funded solely through the interest earnings of the fund-accruing payments from citations for water use restrictions violations. This reserves the principal to effectively make the program self-sustaining. (See article below.) Norman Davis 813-272-5977.

Pinellas County Utilities—Second Place, Conservation Measure

Interactive Media and Environmental Education Kiosks

Pinellas County's interactive environmental kiosk delivers information about the county's water, sewer, and solid waste programs in a cost effective, fast paced, entertaining and user friendly format. (See article below.) Project Manager: Irma Reinpoldt 813-464-3438.

Pinellas County Utilities Honorable Mention - Water Conservation Ordinance

Reclaimed Water Ordinance

The development and use of reclaimed water helps Pinellas County conserve its fresh water supplies by developing a reliable new source of water for outdoor irrigation, especially in areas like beach communities where shallow irrigation wells are not possible. Project Manager: Irma Reinpoldt 813-464-3438.

Wendy L. Nero Individual Achievement Award

Wendy Nero was recognized for her twelve years of work in conservation, including initiating SWFWMD's water conservation activities, establishing Tampa's award-winning conservation program, and continued professional work with CH2M Hill and Hill and Knowlton. She has published and/or presented more than 20 papers on conservation and is widely recognized for her work in planning, implementation, and evaluation of educational efforts, research, rebates, regulatory, and delivery-canvass programs. She has provided leadership, vision, groundwork, and foundation for many utilities to build upon, demonstrated savings potential of conservation, and has long been a vocal

supporter of aggressive, voluntary, well-planned water conservation programs across the state. A founding member of the Florida Water Wise Council, she is personally committed to excellence in conservation and moving towards the level of sophistication needed for it to be viewed as a viable resource to help meet future water demands.

Norman Davis is the water conservation coordinator for Hillsborough County and serves as the chair of the FSAWWA Water Conservation Committee.

Community Water Counselor Program

Steven Haag

The beauty that is Florida comes in many forms, but much of the Florida we enjoy, and what attracts so many visitors, centers around the environment and water. If the environment and Florida's beauty are to survive for tomorrow, we all need to conserve water today. SWFWMD, like the other four water management districts in the state, has on-going programs designed to educate the public on the need to conserve water and ways to do it.

SWFWMD's Community Water Counselor (CWC) program takes public education one step farther. The action-oriented program answers the question: "I know that I need to conserve water, and I know installing a low-volume showerhead or Xeriscaping my yard is a good way to conserve, but how do I actually do that?"

Specifically designed for neighborhood and homeowners' associations, the CWC program teaches hands-on water conservation techniques to association representatives. After completing the course, the representatives return to their communities with the information and knowledge to teach the techniques to their neighbors. The hands-on activities reinforce on-going water conservation messages and increase the number of people implementing the various conservation measures.

Topics covered during the CWC course include:

- Florida's Water World: Why we need to conserve water;
- Indoor Efficiency Techniques: Conducting a home water audit;
- Retrofitting for conservation — installing a low-flow showerhead and toilet, and their proper maintenance;
- Fixing that leaking faucet.
- Reading your water meter and understanding your water bill;
- Outdoor Efficiency Techniques:



- The 7 Xeriscape principles and applying them to your landscape;
- General maintenance for a residential irrigation system;
- Cistern and grey water for outdoor irrigation.

The program's curriculum was developed in cooperation with the public utilities of St. Petersburg, Tampa, Hillsborough County, and Pinellas County, and the Hillsborough and Pinellas County Cooperative Extension Service offices. These agencies will also help teach the course.

Training sessions for the CWC program are scheduled for two consecutive Saturday mornings starting in late July. One program will be taught in Pinellas County and one in Hillsborough.

Funded by SWFWMD's Alafia River, Hillsborough River, Northwest Hillsborough and Pinellas-Anclote River Basin Boards, the pilot program is focused on associations in Hillsborough and Pinellas counties. SWFWMD plans to expand the Community Water Counselor program into other counties in 1999.

Steven Haag is a public education specialist with SWFWMD. He can be reached at 800-423-1476 (Florida only) or 352-796-7211, extension 4776.

Conservation and Customer Service On The Internet

Stuart Feinglas

Utility managers know that conservation and customer service are essential components to operations. A part of customer service is being able to provide customers with information in a prompt, cost-effective manner. Such information may relate to starting or ending service, billing, reporting, or specific efficiency recommendations. Utilities also need to collect specific customer data to develop a more accurate profile of their customer base. This information can effect utility decisions on demand management, resource development, and operations.

Water use evaluations can be an effective tools for providing information to both sides of the demand equation. Utilities may offer on-site water audits, geared toward different customer classes, for interior and exterior uses. These audits help the utility provide exceptional customer service while working towards conservation goals and developing a customer profile database. Unfortunately, on-site audits may not be cost effective tools for residential customers when viewed strictly on a cost-versus-direct-benefit basis. This is not to say that there are not intangible benefits to the utility or some customers where significant savings potential does exist. Utilities must constantly be on the lookout for new, innovative, cost effective ways to provide customers comprehensive service.

A new tool available to utilities is the on-line water audit and Website. Using state-of-the-art technologies such as the Internet,

water agencies and utilities can provide improved and expanded customer service. Benefits include the ability to reach and communicate new conservation programs and services to residential customers in "real time." Also, on-line residential audit programs are available that deliver audits at the fraction of the cost of traditional on-site audits. Customers benefit from the ability to access their utility 24-hours a day for money-saving recommendations, on-line billing data, water efficiency programs, and other useful information. However, before plunging ahead with developing a Website and on-line program there are things that need to be considered.

You first need to define your goals. What are your expectations? Are you using the site primarily for public relations and community outreach? Or are you looking for a low-cost way to deliver audits? If conservation and public relations are your goals, then perhaps both departments can share the cost of the site and/or Internet services.

What are your alternatives? Would you still achieve your goals using traditional means such as bill inserts and flyers? Depending on the size of your customer base, it may still be more cost-effective to use print media or other methods to provide and collect data. You may decide that on-site audits offer your utility and customers a level of service for a cost you are willing to pay.

There are companies that offer access to on-line, utility-branded residential water and energy audits. Two examples are the Los Angeles Department of Water and Power (www.ladwp.com) and the Salt River Project (www.srp.gov). This might be a more cost-effective approach for some agencies. A major benefit of an on-line audit is the valuable customer data that is captured. This information can be used in the development of other conservation programs or as an evaluation tool.

Another concern is what percentage of your customers has Internet access? While the number of people on-line is growing daily, lack of Internet access is not a block to customer participation in some Internet programs. Customers who are not on-line can receive data collection forms by mail and return them to a central point for processing. Final results and recommendations are then sent to the customer. Also, consider target groups other than bill payers, such as school children and libraries. Using an on-line, interactive program might be an effective tool in reaching your educational goals.

On-line audits can be linked to Websites for additional information availability. In that case, Website maintenance is a key issue. The chief benefit of a Website is the ability to provide customers with up-to-date information, including items as basic as contact names and phone numbers to assist customers with reaching the right people when the need arises, or as dynamic as listing upcoming events and services of benefit to your customers. Therefore, having available resources in terms of manpower and budget dollars to keep the Website

current is very important.

Studying other Websites, like the Waterwiser site (www.waterwiser.org), can give you design ideas. You may want to incorporate features such as email that would allow your customers the ability to communicate 24 hours a day with your agency. There are also companies that provide bill presentation on the Internet. An example is the CheckFree Corporation whose website is www.checkfree.com.

The numerous possibilities for greater customer interaction and satisfaction that the Internet offers makes it worthwhile to study. Although the initial cost may be higher than traditional communication means, in the long run it might be more cost-effective in terms of meeting water conservation goals.

Stuart Feinglas (813-288-0792) is a senior project manager with Volt VIEWtech in Tampa.

Water Conservation Month

*Ron Hamel and Karen Drolet
Snowman*

Congratulations are due to the Florida Water Wise Council for succeeded in making history for water conservation in Florida. Last March Governor Lawton Chiles and the Florida cabinet issued a resolution, sponsored by Agriculture Commissioner Bob Crawford, designating April 1998 as Florida's inaugural "Water Conservation Month". A delegation composed of Florida Water Wise Council officers, directors, members, and guests traveled to Tallahassee to accept the resolution and witness history in the making. It was extremely satisfying for promoters of water conservation. It was an event that each of us will remember and build on.

In addition to the statewide resolution, the South Florida, Southwest Florida, St. John's, and Suwannee Water Management Districts also passed board resolutions declaring April as "Water Conservation Month," and various counties and municipalities also designated April within their jurisdictions. The water management districts featuring "April Water Conservation Month" and "Earth Day" created a special water conservation poster. Copies of the poster were distributed throughout the state as part of the campaign.

April was selected because it is usually the last month of the dry season when water needs are most acute.

During Florida's first "Conservation Month," several programs, activities, and projects were scheduled by many organizations. The Florida Association of Conservation Districts and the Florida Cooperative Extension Service scheduled workshops and demonstrations of Mobile Irrigation Labs and also sponsored speaking contests and other activities. The Orange County Utilities Water Department reached approximately 8,500 students and adults during April with three different scheduled events: the "Blue Thumb Junior Detective Program,"



(L to R) Secretary of State Sandra Mortham, Agriculture Commissioner Bob Crawford, Governor Lawton Chiles, Attorney General Bob Butterworth, Insurance Commissioner Bill Nelson, and Education Commissioner Frank Brogan present the "official" proclamation to GCGA Executive Vice president Ron Hamel, who also serves as Florida Water Wise Council president. Other participants include Bruce Adams, SFWMD; Karen Snowman, Orange County Utilities; Andrew Fendrick, Architectural Accents; Kristi Latimer, SJWMD; Don Brandes, SJWMD; Chris Arcand, Florida Water Services; Richard Machek, SFWMD Board; Carl Loop, Florida Farm Bureau; Anthony Fleming, Fleming Plumbing Contracting; Frank Williamson, SFWMD Board; Michael Minton, SFWMD Board, and Larry Arrington, University of Florida IFAS.

"Citizen's Academy," and "Earth Day." For its first conservation month, Orange County's effort was tremendously positive.

The Florida Water Wise Council Inc. is an organization of both public and private partnerships. The Florida Xeriscape Committee created the council in 1993 to encourage all aspects of water conservation. The council consistently promotes water conservation by establishing educational networks, supporting research for water use efficiency, developing water wise guidelines, disseminating water conservation information, serving as a resource for the development of statewide partnerships, and advocating water management practices which are com-

patible with economic growth. If you are interested in additional information about the Florida Water Wise Council or Water Conservation Month, call Karen Snowman, 407-836-6840 or Ron Hamel, 941-675-2180.

Landscape Water Budget Pilot Project: Year One

Betsy Davis

The Landscape Water Budget Pilot Project was developed through an initiative of the Green Industry Advisory Committee of SWFWMD and managed by the West Coast Regional Water Supply Authority and the

cooperative extension offices in four west central Florida counties in cooperation with the U.S. Department of Agriculture, Natural Resource Conservation.

The three-year pilot project was developed to test the hypothesis that "increased water savings will be achieved by allowing irrigation operators to manage their own systems using water budget or allocation strategies as compared to mandatory water restrictions schedules."

A water budget was derived for each of the 24 participating project sites, which were chosen to include single and multi-family residences, schools and educational centers, parks/botanical gardens, medical centers/cemeteries, and commercial/institutional properties. The sites provided historical water use data (meter readings or derived annual water schedule) and committed to audit participation and a subsequent three years of data collection and reporting. The cooperators agreed to meet on a quarterly basis with a landscape maintenance monitor. They were encouraged to implement landscape and/or irrigation system recommendations. Annual water budgets were determined based on annual allotments equal to 46 irrigations per year, which were determined to be more than adequate, but a reduction in water use volumes for the participants.

Implementation

Following the irrigation/landscape audit and written report, every participant re-

ceived a weather station consisting of a hi/lo thermometer, rain gauge, installed rain shut-off device, scheduling magnet/sticker, and a participation placard. Cooperators also received a variance directly from SWFWMD allowing them to vary from the two-days-per-week watering restrictions and water as needed. They received a monthly calendar of pre-addressed, stamped data collection sheets for efficient data collection, which included meter readings, day/duration of irrigation, rainfall, and weekly hi/lo temperature readings.

Data Collection

Completed data sheets were mailed by participants to the project manager at the end of each month. An active landscape maintenance professional from each region monitored sites on a quarterly basis. This procedure provided site cooperators with a "real person" with whom to communicate and coordinate on a regular basis. Annually, each site was reviewed, photographed, and if landscape or irrigation alterations had occurred which significantly affected water use-a new landscape water audit was performed and a new budget was derived for Year 2 based on 46 irrigations per year. Several sites reduced their irrigation volumes significantly and thus received reduced "Target Goals" to encourage further irrigation reductions for the second year of the project.

First Year Results

The overall water budget represented a 46% reduction over previous year irrigation water use. Actual irrigation represented a 33% reduction. Eleven of the 24 sites (46%) met or exceeded budget goals.

Insights

We know our participants were over-watering prior to the pilot project. Irrigation occurred too often, for too long a duration, and without enough regard for season, plant or soil type, or weather conditions. Irrigation systems were often mismanaged and not maintained. No surprises there, so what else can we learn from the pilot study?

Micromanagement of these sites has been intense. The first-year contact with every site participant included, at a minimum, 16 visits and/or mailings, not including phone calls. Does the necessity for intense micromanagement of a test pilot study group indicate that our hypothesis is not relevant to the general public?

As usual with any water conservation project, the educational focus of the project is extremely important. A water budget or water allocation plan would be meaningless and futile without a related educational program. The project brought five schools, the Florida House, and Marie Selby Botanical Garden in as participating sites. "Places of Learning" may serve dual purposes in projects of this type by educating other people

in the process and perhaps teaching a new generation of conservationists.

The on-site manager versus off-site manager relationship to success probably comes to play in this pilot project. After all, if there is nothing at stake for the manager-no personal gain or loss-there may be a lack of commitment or motivation. There may even be a lack of opportunity to properly manage the project. This may account for the greater success of the single-family residential water users in this project versus the multi-family residences and businesses.

What are the incentives to conserve water in a water budget project? It may be necessary to "exploit" money savings, water savings, environmentally friendly concepts, competition among the project sites, and the appeal of increased efficiency and aesthetic qualities for the landscape.

Old habits are hard to break. Some site participants continue to irrigate on regularly scheduled days despite the opportunity afforded by the variance. They just "don't get it," or it's just too easy to maintain old habits.

A 33% reduction in outdoor water use is good, but are these results long-lasting or temporary?

Working with voluntary site participants-requiring their monthly data collection and long-term participation, maintaining their commitment and enthusiasm-is a rewarding challenge.

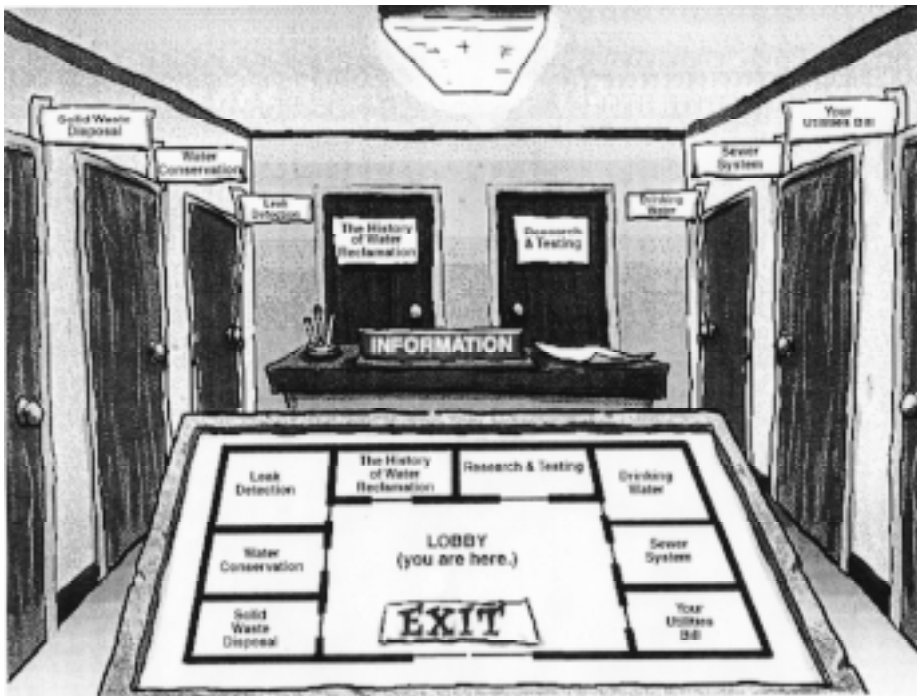
Betsy Davis (813-282-2362) is an environmental consultant with HDR Engineering, Inc., Tampa, and is the manager of the described project.

Interactive Media: A New Vehicle for Environmental Education

Irma M. Reinpoldt

In a high-tech world, those interested in spreading an environmental message need to create high-tech education and public communication vehicles. Pinellas County's interactive environmental education kiosks, and its upcoming conservation education CD, deliver information about the county's water, sewer, and solid waste programs in a cost effective, fast-paced, and user-friendly format. Appealing to audiences of all ages, the kiosk software teaches fundamental concepts about how, why, and where individual efforts can make a difference in conserving our shared resources.

Since the advent of the ATM, touch-screen computer kiosks are seen everywhere. Part of their popularity is the accessibility to information, 24 hours a day, 7 days a week. Besides providing readily available financial resources, touch-screen interactive computers can be used to convey a menu of information resources. In August 1997, Pinellas County Utilities inaugurated its first touch-screen information system. The project takes advantage of high-speed software technology especially developed for the utility and combines the power of the



Inside the Utilities Building software segment, short videos, animation, and static text are viewed as one enters each selected door. A phone rings and toilets flush in the background. Enter by knocking on door or touching selected group on the directory.

computer with the familiarity of an ATM.

Produced by the County Utilities Communications division, in coordination with the utility's video task team and Canterbury Marketing, the interactive software

features 27 different information categories encompassing water, sewer, solid waste, pollution prevention, reclaimed water, water quality, alternative sources, and many more environmental topics regarding local

utility operations and environmental management techniques and programs. It has 124 pages of information, 11,000 words of text, 102 original illustrations and photographs, an interactive ground water quiz, over 2 hours of multimedia information and education, and five original video films with animation and text screens. The total viewing time is about 25 minutes.

The programs' narrator ("guide to conservation") is Dewey, the utilities water system's animated mascot. By following the audio and touching the appropriate part of the screen, the user can find answers to questions such as why, how, and where to conserve the county's natural resources. Information is provided in several formats: a classroom setting, a landscape map displaying various facilities, and a self-read textbook. Animation, video clips, and pictures are used to make the material easier to visualize while the change of media keeps the screen exciting.

Additionally, the system records statistics of use with each use. Remote statistics are monitored and downloaded to the utility's communication division for evaluation.

Design and development of a touch-screen information system is no small task. The unit development required 40 hours of concept and design, 10 hours of expert review, 20 hours of raw video, 100 hours of digital information, 40 hours of narration, choices of hundreds of still photographs, and two years of effort.



The classroom software segment: material appears on the blackboard. Two screens are used for slides or short videos. Slides of the wastewater treatment process are shown. To exit, touch the globe.

If enthusiasm is any measure of success, the utility's interactive kiosk has made an impact, and the future of water resources may be even brighter as a result. So far over 2500 people tested the program at this year's Florida Environmental Expo at the Tampa Convention Center, and an additional 6,000 users used it as the kiosk toured the county. Their response to both subject matter and format has been very encouraging. One user, a university student, pointed out the program was interesting, easy to comprehend, and made users aware of the variety of processes and issues utilities face. He commented the things learned by participating in the program were excellent, that the program was a great tool because it was "fun and better than just listening to someone," and less time intensive than taking a facility tour.

A literature search located only one other computer interactive software program of this type: *Desdemona's Splash*, developed by the University of Nebraska in coordination with EPA Region 7. It is a CD-ROM game on water quality and the environment featuring resource protection information on three screens with a run time of about 8 to 10 minutes. The Pinellas County conservation software differs dramatically by using photographs, video, and animation to discuss the breadth of information relevant to utility operations and environmental partnership. Its run time is over 1.5 hours. It highlights 27 information categories of utility, conservation, and environmental information, making it ideal for papers, reports, or general information.

If its introduction is any indicator, the program is fast and entertaining enough to adapt to a range of settings and age groups. Pinellas Utilities foresees the use of the kiosk in schools, museums, at a government

information resource called "City Hall at the Mall," fairs and exhibitions, and Pinellas County School District's Enterprise Village, a school based curriculum reaching 12,000 fifth grade students annually. The free CD-ROM version should be completed and available to educators later in 1998.

Dr. Irma Reinpoldt, environmental planning manager, manages the Communications and Public Information Division of Pinellas County Utilities in Clearwater.

A Step Backward: Proposed Plumbing Standards Repeal

Kathy Foley and Diane Mulville-Friel

The National Energy Policy Act (NEPA) of 1992 sets the water-efficiency standards for plumbing fixtures manufactured in the United States. The passage of the NEPA has spurred the modification of the development of the 1994 Standard Building Code (SBC), which sets regional plumbing standards. All of the local governments within SWFWMD have adopted the 1994 SBC, requiring all new and remodeled development to install plumbing fixtures which meet NEPA standards. These standards are the basis for many local water conservation programs, and are often incorporated into water use projections and demand management forecasting.

Proposed legislation (HR 859) calls for the repeal of the plumbing efficiency standards of the NEPA. Although much more than toilet fixtures are at stake, the effort stems from reports of customer dissatisfaction with initial plumbing products manufactured to meet the efficiency requirements. The bill, proposed by Congressman Joseph Knollenberg (R-MI), was introduced in February 1997, and was assigned to the House Commerce Committee. As of January, it

had 33 sponsors (3 from Florida) and support appears to be growing.

Admittedly, there were problems related to toilet drain-line blockages and customer dissatisfaction with the initial models of ultra-low flow (ULF) showerheads and toilets. As with any new product, improved technology and response to customer complaints have resulted in higher-quality, higher-performance products. Customer satisfaction is high, according to participant feedback in the toilet rebate programs in the SWFWMD. Since 1992, the SWFWMD has assisted local utilities in the distribution of nearly 54,500 ultra-low volume toilets, and 498,000 plumbing retrofit kits (including water-efficient showerheads, faucet aerators and other items). The programs, which cost the SWFWMD and cooperating local governments a combined \$14.7 million, yield a savings of 6.5 million gallons of potable water per day. If the question is, "Do they work?", the answer is, "yes."

In spite of their overall effectiveness, most of the press about ultra-low flow toilets (ULFTs) has been negative, albeit humorous. The best-known examples are the *Seinfeld* episode about ULF showerheads and a black-market for high-volume models, and *Miami-Herald* columnist Dave Barry's column (July 22, 1997) on ULFTs, where he tells the public, "You have to flush them two or three times to get the job done." Humor is good, but humor coupled with accuracy is better. Not so widely circulated was Barry's column (April 12, 1998), published after a ULFT was installed in his house by a local plumbing group in order to prove the fixture's effectiveness, in which he praised the fixture. "I cannot speak highly enough of this toilet. It is an inspiring example of American ingenuity and engineering 'know-how.' It has become like a member of the family; I have affectionately named it 'Maurice.' The bottom line is this: If there is an act of Congress that Maurice cannot handle in one flush, I have no personal knowledge of it."

The repeal of NEPA would negatively impact the water resources in the SWFWMD in three major ways. First, in a worst-case scenario, its repeal could potentially trickle down to regional and local levels, leading to the dissolution of plumbing codes due to the lack of "teeth" in national requirements, which could in turn impede efforts of conservation planning. For example, a significant part of the achievable water savings identified in the Demand Management Plan of the West Coast Regional Water Supply Authority, which supplies water to the Tampa Bay Area, comes from the natural replacement of plumbing fixtures due to the enforcement of NEPA and the regulations it has inspired.

A potential second impact is the public's perception that water-efficiency is no longer a national concern. This perception may negatively impact participation in future conservation efforts.

A third concern is the possibility that the removal of such requirements will enable foreign manufacturers to gain inroads to

the industry with less efficient models, forcing local manufacturers to lower their efficiency standards as well. This opens the door for the installation of higher-volume fixtures in all new development, undermining the efforts of the water management districts, local governments and water suppliers.

Nationally and locally, water agencies, local governments and plumbing manufacturers have responded to the proposed legislation with adamant disagreement, and pleas for reconsideration. In the Tampa Bay area, the SWFWMD, the Florida Water Wise Council, and the Hillsborough County Board of County Commissioners have responded in writing to state and national legislators. The Water Conservation Division of the AWWA has played a vital role in keeping its members apprised of the bill's progress. As of late April, the bill was in committee, but hearings had not been scheduled. Unbelievably, three of the bill's sponsors are from Florida. For more information, contact Kathy Foley at the Southwest Florida Water Management District.

Kathy Foley is with the Southwest Florida Water Management District. Diane Mulville is with Friel, Ayres Associates.

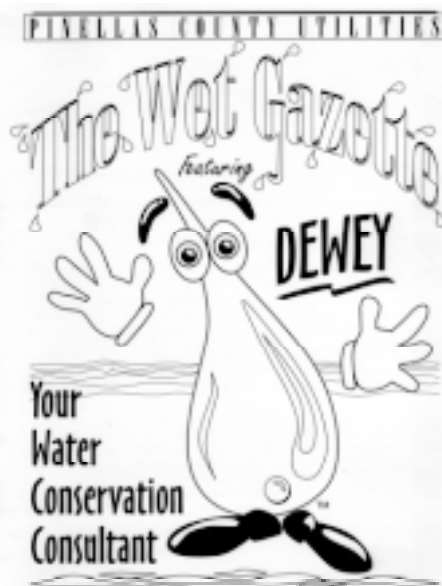
"The Wet Gazette": Reaching Into The Future

Carla Mitchell

How do you reach into the future to ensure the preservation of one the earth's most valuable natural resources? You teach the children, you encourage the youth, and you empower the next generation.

Pinellas County Utilities premiered its first activity booklet, *The Wet Gazette*, in March 1998. *The Wet Gazette* offers its readers the basics of water, water resources, and water conservation in an entertaining, interactive environment. Developed and designed by an employee of Pinellas County Utilities and brought to life by an area graphic illustrator, it features Dewey, the PCU waterdrop mascot, as "Your Water Conservation Consultant." Much to the pleasure of Pinellas County Utilities, *The Wet Gazette* is currently being used throughout the Tampa Bay area as an effective educational tool by parents, teachers, after-school programs, and summer camps. The positive feedback and the constant inpouring of requests have been overwhelming. The booklet is currently undergoing its second printing.

The *Gazette* is presented in a simplistic manner to creatively convey the fundamentals of water. It is a combination of informative and easy-to-read text, dynamic graphic illustrations, and thought-provoking puzzles and activities geared toward educating and motivating the user. It offers an elemental comprehension of water, the hydrologic cycle, and the importance of water conservation. As an example of one of the Tampa Bay area's water resources, it showcases the Floridan aquifer. The Pinellas County Utili-



ties Water Ranger pledge, along with a dot-to-dot activity, encourages readers to dedicate and commit to a way of life that incorporates conserving one of our most precious natural resources, water. Other *Gazette* activities include crossword and word-search puzzles, Fun Facts, and EYE SPY Water Waste that prompts the reader to search and find water wasting habits depicted in the animated illustration. Also, the reader can color the entire booklet, with provided colored pencils. Each paragraph of text and each activity overlap and intertwine with another, repeatedly reinforcing the water and water conservation lessons and concepts.

For a copy of *The Wet Gazette*, contact Pinellas County Utilities Public Information at 813-464-4714 or write to 14 S. Fort Harrison Avenue, Clearwater, Florida 33756 Attention.

Carla Mitchell is the senior public information specialist for Pinellas County Utilities in Clearwater

Work Study/Internship Program

Norman Davis

Since June 30, 1998, property owners in Hillsborough County have been required to do lawn and landscape irrigation during prescribed times as mandated by SWFWMD. What started out only as a prohibition of watering between 9 am to 5 pm has been further limited to twice per week, in accordance with a location's street address. The Sheriff's office was originally responsible for the enforcement of water use restrictions, treating violations as a misdemeanor.

On July 14, 1993, the Hillsborough County board of county commissioners authorized the water department to enforce mandatory water use restrictions through the issuance of warnings and citations. Citations were to be adjudicated through the civil citation process. Penalty payments are deposited to a water conservation fund for future use as approved by the board. After four years of

enforcement program implementation, and an accumulation of \$72,182 in the conservation fund, the water department was faced with identifying a use for these funds. Ideally, the funds could be used in a way that would not require burdening the board with approving each iteration.

The staff of the water department at first identified the annual interest earnings from the funds as a means of providing a scholarship program for eligible college-bound high school seniors. The students would be required to demonstrate their concern for environmental issues through the completion of an essay on environmental awareness and to document involvement in community service projects aimed at preserving or restoring the natural environment. By using only the interest earnings on an annual basis, the principal amount would be preserved, the program would be self-sustaining, and the entire program would operate much the same as a foundation and increase participation over time. It was calculated that the county would be able to offer five \$1,000 scholarships in the first year of program implementation by utilizing two years (FY96 & FY97) of interest earnings. Then, it was projected that the level would temporarily dip to four scholarships for a period of two years, but grow thereafter, based upon estimated annual deposits to the fund of approximately \$20,000.

This concept was developed for approval by the board and passed all review from affected departments. The item was placed on the regular agenda for the board meeting in August 1997. Upon agenda publication, the local newspaper contacted the water department and the assistant county attorney regarding the concept and rapidly published a positive article about the idea.

Upon final review during the agenda review meeting preceding the board meeting, the county attorney's office pulled the item from the agenda, stating that in the balance of public versus private benefit, any such program must demonstrate significantly greater public benefit. In a scholarship program, clearly more private benefit is to be gained.

That sent the water department staff back to the 'think tank' to solve their dilemma of fund utilization. The program was refashioned as a means of compensating college students for their participation in a work study/internship program. The water department gained board approval in December 1997 to fully develop the concept and to return for their ratification of eligibility and application evaluation criteria.

In March 1998, the board approved a policy to allow the water department to hire and compensate college students to assist in water conservation efforts of the county. To facilitate the expeditious hiring of candidates for the program, board policy was used as guidelines for the selection of students. The policy statement, in summary, is as follows:

It is the policy of the Hillsborough County Board of County Commissioners that the

Water Conservation Work-Study Internship Program be available on a limited basis to eligible college students meeting the following criteria:

- Applicants must be pursuing a degree related to, or otherwise show a concerted interest in the sustainability of the environment, as demonstrated in an essay of not more than 500 words.
- Applicants must maintain a Grade Point Average of at least 2.5 on a scale of 4.0.
- Applicants must be available to work during the hours necessary as required by the assigned project.
- Applicants may be required to have a valid Florida Drivers License and show proof of insurance.
- Applicants must possess the necessary computer skills to complete assigned job duties.
- Applicants must demonstrate strong interpersonal skills through a panel interview.
- Applicants must provide three letters of reference, including at least one from a sponsoring faculty member.

Completed applications will be reviewed and qualified by a committee composed of representatives of the Hillsborough County Water Department and the Hillsborough County Cooperative Extension Service. Selected candidates will be hired as temporary employees of the Water Department and will be paid at a rate not to exceed 1.5 times the minimum wage, bi-weekly on the county's payroll schedule. Temporary employees are not eligible for holiday pay, sick leave, medical insurance, or annual leave.

A primary use of this work study program will be to provide staffing needs at the future Project GreenHouse, which will be built in the fourth quarter of 1998 as an educational facility to promote sustainable development in the region. Other uses of the program may include work with the Cooperative Extension Service and the water department in furthering mutual water conservation efforts, and for assisting in the enforcement of water use restrictions during times of additional staffing needs.

Other local governments can easily emulate the program. Hillsborough County is happy to provide copies of pertinent local ordinances and resolutions, board agenda items, and advice on procedural implementation. Additional information can be received by contacting Norman Davis, ASLA, at 813-272-5977.

Norman Davis is the water conservation coordinator for Hillsborough County and serves as the chair of the FSAWWA Water Conservation Committee.

Liquid Assets

David Bracciano and Diane Mulville-Friel

The West Coast Regional Water Supply Authority, based in Clearwater, is Florida's largest wholesale water supplier. It sup-

plies potable water to six member governments that currently serve approximately 1.8 million residents in west central Florida. Residents and businesses in Hillsborough, Pasco, and Pinellas counties and the cities of Tampa, St. Petersburg, and New Port Richey used approximately 232 MGD in 1995.

Future water demands by these counties and cities will increase significantly by 2015 because of a rapidly growing population and increased business and industrial uses. Based on recent population data, it is projected that an additional 22,500 people will move into the Tampa Bay region annually, increasing usage by about 3 MGD. Based on recent projections, the authority may be unable to meet its members' water needs by 2003; therefore, additional supplies must be developed and demand management implemented in the region.

The authority is working with its member governments and SWFWMD to conserve water. To explore ways of reducing future water demands, the authority's board of directors selected Ayres Associates in February 1996 to lead a project team in developing a Regional Demand Management Plan (DMP). The goal was to evaluate how to achieve the authority's Master Water Plan goals to reduce water use through demand-side management. This approach has been used in California, but the authority is the first major water wholesaler in Florida to adopt the strategy as part of its long-range master plan.

Ayres Associates developed a water-use model which used the authority members' individual utility billing information and regional socio-economic data to forecast water demand to 2030. The model separates and forecasts each member government's total water use according to major urban categories: single-family, multifamily, commercial, industrial, and public/institutional. One of the biggest challenges was classifying six different utilities' customer billing data into the water-use sectors needed for the model.

Once the customer billing data was standardized and the water demand forecast model was completed, a benefit-cost analysis model was used to evaluate the water savings and cost effectiveness of approximately 40 water conservation measures. Conservation measures included low-volume toilets, low-volume urinals, waterless urinals, low-flow showerheads, low-flow faucets, on-property leak repairs, water efficient clothes washers, recirculating cooling systems, and irrigation system audits.

Based on the modeling results, three regional demand management program scenarios were developed for the authority. These scenarios—passive, moderate, and aggressive demand management—illustrate the potential savings, costs, and cost effectiveness of a range of programs that could be implemented in the authority's service area.

For the passive program, the water-use model estimated the reduction in demand that would occur through natural replacement of conventional plumbing fixtures with

Comparison of Water Savings.

Year	MWP Goals (MGD)	DMP Projections (MGD)	
		S2 - Moderate	S3 - Aggressive
2000	10	7	10
2005	16	16	23
2010	21	23	34
2015	26	29	42
2020	32	34	49
2025	37	37	54
2030	42	39	59

water-efficient models required by the U.S. Energy Policy Act of 1992. The moderate program attempted to accelerate the replacement of existing conventional fixtures through educational and incentive approaches, such as rebate programs and giveaways for water-saving plumbing fixtures. It also included several additional measures to reduce demand, such as industrial, commercial, and institutional water audits and irrigation conservation measures.

The aggressive program further accelerated the replacement of conventional fixtures through regulation and incentive approaches. It also included strict demand management measures such as the elimination of potable water for landscape irrigation and once-through cooling systems. The estimated project costs through 2030 for the moderate and aggressive scenarios were approximately \$55.6 million and \$78.5 million, respectively.

By 2030, the regional water savings to the authority and its members from the three scenarios ranged from approximately 29 MGD for the passive program to 60 MGD for the more accelerated programs. Ayres Associates recommended that the authority's members implement the moderate program to meet Master Water Plan demand management goals. It was estimated that the moderate program would reduce water demand by 40 MGD by 2030.

The authority is currently completing Phase I of a Demand Management Implementation Plan (DMIP) which will include a Windows-based computer application that members can use to disaggregate and forecast their demand and estimate and project impacts of future conservation programs. Phase I also will identify and evaluate methods the authority may use to facilitate and encourage (primarily through financial incentives) members to implement conservation best management practices. With the completion of Phase I, the tools will be available for members to develop and track their 5-year DMIPs.

David Bracciano is a resource conservation coordinator with the West Coast Regional Water Supply Authority. Diane Mulville-Friel is an environmental scientist and planner with Ayres Associates.



Protozoan Pathogens: A Comparison of Reclaimed Water and Other Irrigation Waters

David W. York and Nicole R. Burg

Reuse of reclaimed water for nonpotable purposes has rapidly become popular in Florida and other states. The basic premise is that potable water is not needed for irrigation of crops and landscaped areas or for use in decorative water features or for flushing toilets. As the population increases and water becomes increasingly scarce, it simply does not make sense to use precious, potable quality water for these activities.

In some portions of Florida, use of potable water exceeds 300 gallons per capita per day, which far exceeds human needs⁽¹⁾. In many of these high water use areas, the majority of the high water demand is related to demands for landscape irrigation. Provision of reclaimed water in such areas offers significant potential for conservation of potable quality water supplies.

Florida's Reuse Requirements

Florida has implemented a comprehensive program designed to encourage and promote reuse of reclaimed water^(2,3) and detailed rules regulating a wide range of reuse activities⁽⁴⁾. Florida requires that reclaimed water used to irrigate areas accessible to the public, residential lawns, and edible crops receive secondary treatment, filtration, and high-level disinfection⁽⁴⁾. In addition, reliability, monitoring, operating, and staffing requirements are imposed. High-level disinfection includes performance criteria for total suspended solids (single sample maximum of 5.0 mg/L before application of the disinfectant) and fecal coliforms⁽⁵⁾. At least 75 percent of all observations of fecal coliforms must be less than detection, and no single sample may exceed 25 per 100 mL.

These high-level disinfection requirements are based on work done by State Virologist Flora Mae Wellings⁽⁶⁾. Her work, in support of St. Petersburg's landmark urban reuse system, was based on the removal of virus by the water reclamation facilities. She concluded that reclaimed water meeting the 5.0 mg/L total suspended solids limit and having no measurable concentration of fecal coliforms would be virus-free after 15 minutes exposure (at peak flow) to a total chlorine residual of 1.0 mg/L.

Concern for Protozoan Pathogens

Until recently, little was known about the possible presence of the protozoan pathogens in reclaimed water. The 1993 outbreak of *Cryptosporidiosis* in Milwaukee, in which about 400,000 individuals became ill⁽⁷⁾, served to alert water managers to the significance of the protozoan pathogens. Wanting to know more about the fate of pathogens in water reclamation facilities, DEP contracted with the University of South

Florida to evaluate the fate of several classes of human pathogens (enterovirus, *Cryptosporidium*, *Giardia*, and helminths) in a full-scale water reclamation facility. The study^(8,9) revealed that both *Cryptosporidium* and *Giardia* may be present in low concentrations in the reclaimed water produced by a water reclamation facility meeting Florida's high-level disinfection requirements.

This revelation prompted some members of the public health community in Florida to question the adequacy of Florida's high-level disinfection criteria and the advisability of the use of reclaimed water for activities that involved potential for human contact. The possible presence of the protozoan pathogens (particularly *Cryptosporidium*) served as the focus of the debate over the adequacy of Florida's reuse requirements. Florida's Reuse Technical Advisory Committee concluded that additional regulations related to control of the protozoan pathogens were not justified at this time and recommended additional study of the fate of these pathogens in water reclamation facilities. DEP and several utilities in Florida are working with the Water Environment Research Foundation to develop the scope of follow-up studies on the fate of the protozoan pathogens in water reclamation facilities and in the environment. In addition, monitoring requirements for *Giardia* and *Cryptosporidium* are proposed for inclusion in Florida's reuse rules⁽⁴⁾.

Cryptosporidium

Cryptosporidium is a coccidian protozoan that is recognized as an important public health problem throughout the world^(10,11). A gastrointestinal infection, it results in a watery diarrhea, which may be accompanied by abdominal pain, nausea, anorexia, dehydration, and weight loss. *Cryptosporidiosis* is considered to be self-limiting and non-fatal in individuals having the normal bodily capacity to develop an immune response following exposure. Most individuals show no symptoms within two weeks. For those individuals who do not have the normal capacity to develop immunity, the symptoms are more severe. The infection is frequently fatal for patients with AIDS.

While *Cryptosporidium* was identified in mice shortly after 1900⁽¹¹⁾, it was not known

Table 1. Pathogens in St. Petersburg's Untreated Wastewater

Organism	% Positive Samples	Mean	Maximum
Fecal Coliforms (#/100 mL)	100	22,000,000	220,000,000
Enterovirus (PFU/100 L)	100	1,033	4,450
Cryptosporidium (oocysts/100 L)	67	1,456	12,200
Giardia (cysts/100 L)	100	6,890	12,500
Helminths (ova/L)	33	16.5	111

Table 2. Pathogens in St. Petersburg's Reclaimed Water

Organism	% Positive	Mean	Maximum
Fecal Coliforms (#/100 mL)	9	0.82	9
Enterovirus (PFU/100 L)	8	0.01	0.133
Cryptosporidium (oocysts/100 L)	17	0.75	5.35
Giardia (cysts/100 L)	25	0.49	3.3
Helminths (ova/L)	0	—	—

to be a human pathogen until 1976. It is spread by a fecal/oral route. Infected animals and humans represent the reservoir of *Cryptosporidium*. Calves, dogs, cats, and rodents are among the more than 40 mammals that serve as hosts. *Cryptosporidium* forms small oocysts that are resistant to chlorination.

Giardia

Giardia lamblia is a protozoan pathogen that is found worldwide^(10,12,13). It infects the intestinal tract and can result in a variety of symptoms, such as chronic diarrhea, bloating, abdominal cramps, frequent greasy and malodorous stools, fatigue, and weight loss. Symptoms typically last two to six weeks.

Giardia, which was discovered in 1681, is transmitted by a fecal/oral route. Humans represents the main reservoir. Other animals, particularly beavers, may serve as hosts. Before being excreted from the intestine, *Giardia* normally forms a chlorine-resistant cyst.

Reclaimed Water Quality

The 1992 study of a water reclamation facility in St. Petersburg^(8,9) provides data on the concentrations of pathogens in reclaimed water that meets Florida's requirements for use in public access areas (golf courses, parks, etc.) and for irrigation of residential properties and edible crops. Monthly sampling was conducted over a year at five points within the water reclamation facility. As noted in Table 1, pathogens were routinely detected in the untreated wastewater. Table 2 presents a summary of the pathogen content of the final reclaimed water, while Table 3 lists the removal efficiencies of the unit processes in the domestic wastewater treatment facility. Helminths were not detected at any point after the secondary clarifier.

Table 4 presents a summary of available data on the presence of these protozoan pathogens in untreated and treated wastewater and in reclaimed water that has received filtration.

Table 3. Removals of Pathogens in a St. Petersburg Water Reclamation Facility

Treatment Process	Log Removals (a)				
	Fecal Coliform	Enterovirus	Cryptosporidium	Giardia	Helminths
Activated Sludge & Sec. Clarifier	2.06	1.71	1.14	1.19	(b)
Filtration	0.05	0.81	1.68	2.00	—
Chlorination	4.95	1.45	0.41	0.65	—
Covered Storage	0.36	1.04	0.04	0.30	—
Entire Facility (c)	7.42	5.01	3.26	4.13	(b)

Notes: (a) 1 log removal = 90%, 2 log removal = 99%, 3 log removal = 99.9%
 (b) Helminths were not detected at any point after the secondary clarifier.
 (c) The sums of the columns may not equal the totals shown due to internal rounding.

Other Irrigation Waters

There are other waters that can be and have been used for various nonpotable purposes (irrigation, decorative water features, toilet flushing, fire protection, and other urban uses). Surface waters, groundwaters, possibly treated stormwater, and even treated drinking water could be used for these purposes.

Table 5 presents a summary of available data on the existence of *Cryptosporidium* in several alternative water supplies (groundwater, surface water, and treated drinking water). Table 6 presents similar data for *Giardia*. Data on St. Petersburg's reclaimed water is included to aid in the comparison. The tables include data on the percentage of samples that were positive for the organism, the mean concentration observed, and the range of observations. Most "averages" shown are arithmetic means, although the original investigators noted a few observations as being medians or geometric means.

The surface waters included in the tables generally are regarded as being "high quality." The surface waters include waters noted by the original investigators as being "pristine" or "high quality" waters in protected watersheds and waters that serve as sources of drinking water. While some surface waters used as drinking water may not qualify as being "pristine," they have been included in the table, since drinking water supplies generally are drawn from the "best available water supply."

The microbiological quality of other waters that can be used for irrigation and other nonpotable uses may not be regulated as

extensively as reclaimed water. In Florida, while reclaimed water essentially must meet a less than detection limit for fecal coliforms, Class III surface waters (recreation and fish and wildlife propagation) must meet an average limit of 200 fecal coliforms per 100 mL⁽¹⁴⁾. Bathing beaches also are held to a 200 fecal coliform per 100 mL limitation. Class IV irrigation waters are not subject to any coliform limits or other numeric microbiological criteria. Potable quality groundwater (Class G-II) is subject to a total coliform limit of 4 per 100 mL⁽¹⁵⁾. Groundwater is of interest because it may be used for potable supply by individuals without treatment or disinfection.

Summary and Conclusions

It is apparent from Tables 5 and 6 that *Cryptosporidium* and *Giardia* are frequently found, even in waters regarded as being "high quality." It is striking to note the similarity in prevalence, concentrations, and ranges between St. Petersburg's reclaimed water and other high quality surface waters, groundwaters, and treated drinking waters.

This comparison between reclaimed water and other high quality water sources is rather qualitative; however, one may conclude that from the viewpoint of the protozoan pathogens, reclaimed water compares favorably with other high quality waters that probably would be readily accepted as water sources for irrigation and other nonpotable uses.

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Table 4. Protozoa in Domestic Wastewater Treatment Plants

Type of Wastewater	No. of Samples	Cryptosporidium		Giardia		Ref.
		% Positive	Average	% Positive	Average	
Untreated Wastewater						
St. Petersburg (FL)	12	67	1,456	100	6,890	8
Reedy Creek WWTP (FL)	—	—	1,700	—	3,300	16
Tampa, FL	—	—	30	—	3,900	17
Ottawa, Canada	2	100	1,730	100	10,300	18
Treated Wastewater (No Filters)						
Ottawa, Canada	3	100	56	100	73	18
Arizona (2 WWTPs)	—	67	5	93	80	19
Treated Wastewater (With Filters)						
St. Petersburg (FL)	12	17	0.75	25	0.49	8
Reedy Creek WWTP (FL)	12	42	1.05	42	1.1	16
Tampa AWT (FL)	7	0	ND	—	5	17
Arizona	—	—	—	33	0.8	19

ND = Not Detected

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Table 5. *Cryptosporidium* in the Environment

Water Type/Location	% Positive	Average	Range	Ref.	Notes
Reclaimed Water (St. Petersburg, FL)	17	0.75	ND-5.35	8	12 samples
Ground Water					
Springs	—	4	—	20	7 samples
Ground water	5.5	0.3	ND-4	20	12 samples
Ground water	17	41	—	21	74 samples
High Quality Surface Water					
Source waters for water treatment plants	87	270	ND-48,400	22	66 water treatment plants in 14 states and 1 Canadian province - 85 samples
Source waters for water treatment plants	51.5	240	ND-6510	23	1991-1993, 262 samples at 72 water plants
High quality surface water supply (Northwest USA)	36	1.6	5.4	24	52 samples over 1 year
New York City's protected watersheds				25	
Catskill	46	1.4	ND-17.3		
Delaware	37	0.8	ND-15		
Malcolm Brook	52	1.0	ND-43.4		
New York City's source water	2.0	—	ND-1.38	26	203 samples
Rivers in a protected watershed (Western USA)	83	2	ND-13	27	6 samples
River in a protected watershed (Western USA)	—	8	—	28	3 samples
Rivers (pristine)	32	29	ND-24,000	20	59 samples
Lakes (pristine)	53	9.3	ND-307	20	34 samples
Tampa Bypass Canal (FL)	43	3.1	ND-11	17	7 samples
Drinking Water					
Filtered drinking water	26.8	1.52	ND-48	29	66 water treatment plants in 14 states and 1 Canadian province - 85 samples
Treated drinking water	13.4	3.3	ND-57	23	1991-1993, 262 samples at 72 water plants
Treated drinking water	17	0.1	—	20	36 samples
Filtered drinking water (Western USA)	20	0.1	—	27	10 samples
Non-filtered drinking water (Western USA)	50	0.6	—	27	4 samples

Table 6. *Giardia* in the Environment

Water Type/Location	% Positive	Average	Range	Ref.	Notes
Reclaimed Water (St. Petersburg)	25	0.49	ND-3.3	8	12 samples
Ground Water					
Springs	0	<0.25	—	20	7 samples
Ground water	0	<0.25	—	20	12 samples
Ground water	9.5	16	—	21	74 samples
High Quality Surface Water					
Source waters for water treatment plants	81.2	277	ND-6600	22	66 water plants in 14 states and 1 Canadian province - 85 samples
Source waters for water treatment plants	45	200	ND-4380	23	262 samples at 72 water plants, 1991-1993
New York City's protected watersheds				25	
Catskill	36	1.2	ND-9.3		
Delaware	29	0.7	ND-8.2		
Malcolm Brook	46	1.3	ND-23.4		
New York City's source water	3.0	—	ND-1.38	26	203 samples
Portland, OR water supply reservoir	19	0.34-2.77	—	30	A protected reservoir. Several data sets
Rivers in protected watershed (West USA)	17	0.6	—	27	6 samples
River in protected watershed (West USA)	—	0.9	—	28	3 samples
Rivers (pristine)	6.8	0.35	ND-12	20	59 samples
Lakes (pristine)	12	0.5	ND-7	20	34 samples
3 pristine river systems (near Seattle, WA)	42	6.3 median	ND-520	31	222 samples at 17 sites over 9 months
Tampa Bypass Canal (FL)	14	0.42	ND-2.9	17	
Drinking Water					
Filtered drinking water	17.1	4.45	ND-64	29	66 water plants in 14 states & 1 Canadian province - 82 samples
Treated drinking water	4.6	2.6	ND-9	23	262 samples at 72 water plants, 1991-1993
Treated drinking water	0	<0.25	—	20	36 samples

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Credits

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