



**Western Kentucky University  
Technical Assistance Center for Water Quality  
Center for Water Resource Studies**

**“Supporting Small Water Systems in  
Meeting the Goal of Public Health Protection”**

<http://water.wku.edu>  
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**Fifth Year (03), First Quarter Report  
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## Introduction

Western Kentucky University was awarded a grant by the Environmental Protection Agency (#X826659-01-0) to establish a Technical Assistance Center (the Center) for Water Quality for small public water systems. This program focuses resources and expertise toward assisting small water systems in achieving and maintaining capacity development, and meeting the primary goal of public health protection. The capacity development framework provides a forum within which this Center is working with other similar programs, federal and state regulatory agencies, and small drinking water systems. Through the Center's assistance, we are working to help small systems acquire and maintain technical, financial and managerial capacity. These capacities are needed to provide safe drinking water and achieve the public health protection goals of the EPA Safe Drinking Water Act. Likewise, the goal of public health protection is promoted through additional tasks of the Center that include a small systems circuit rider, the Utility Management Institute (UMI), Source Water Protection Program, and Information Technology.

Western Kentucky University has developed this Center with long-range goals, and a "regional" focus of projects that have a national perspective. The work plan for this Center is organized into tasks that have multi-year projects. These tasks are distinct in nature, but mutually supportive of small water systems and the provision of public health. **Administration** provides support for all other tasks, administers the grant, and works to advance capacity development of small systems; **Task 1** addresses managerial training for capacity development; **Task 2** provides for technical capacity development and identification of needs in a "circuit rider" approach; **Task 3** is a source water protection program consisting of field studies and assistance to create models, provide application of water quality tools, address unique contamination problems in karst regions, and create a forum for advancing best management practices (BMPs) for source water protection of small drinking water systems; **Task 4** is a database management system and development of information tools to receive, organize, integrate and distribute project information.

## Executive Summary

**Introduction.** Western Kentucky University has established a Technical Assistance Center for Water Quality for small water systems. The underlying goal of the Center is to assist small water systems in the protection of public health and the provision of safe drinking water. Assistance is provided to small water systems through the Utility Management Institute, a small systems circuit rider, a source water protection program, and information technology. All aspects of the Center are focused on capacity development of small water systems through the enhancement of managerial, technical and financial capabilities. Information presented in this report represents efforts during the first quarter of year five (03) of this grant.

**Synopsis.** This first quarter, fifth contract year report depicts progress in each of the aforementioned tasks, with task activities that are focusing on the ultimate goal of improved public health through the provision of safe drinking water. The Technical Assistance Center for Water Quality's efforts continue in developing and delivering management training courses for small systems; in working with Western Kentucky University to provide technical oversight for online course development and delivery in water utility management; conducting on-site technical assistance for small system compliance; providing technical assistance to develop and promote source water protection, through source water assessments, field investigations, on-site source water assistance and community relations; and developing and distributing information and information tools.

**Administration.** The primary focus of the Director in this first quarter of the fifth year has been to continue to promote safe drinking water at the local, regional and national scales. The groups of team members that make up the Center at WKU have been working at these various scales to provide unique assistance as part of the Technical Assistance Centers Network (TACNET). This network comprises a total of eight University based TACs, including the Center at WKU, that each promote public health by assisting small water systems throughout the United States. The Director has completed the following this quarter: an invited presentation at the AWWA Source Water Protection Conference BMP Workshop in Albuquerque, NM, on January 19, 2003 (Development of Agricultural Partnerships for Source Water Protection in Kentucky); an invited presentation at the Association of State Drinking Water Administrators Annual Meeting, October 2, 2002 (Managerial Training for Small Water Utilities: the Utility Management Institute); participated in the Utility Management Institute at Somerset, Kentucky; worked with the Kentucky Pesticide Workgroup to increase agricultural partnerships; worked with the American Water Works

Association (AWWA) as the Chairman of the Small Systems Committee for the Tennessee/Kentucky Section of AWWA; identified additional opportunities for productive work that fits within the mission of the Technical Assistance Center for Water Quality and the Center for Water Resource Studies at Western Kentucky University; provided oversight to a project to utilize Global Positioning Systems and Geographical Information Systems (GIS) in small water systems management; completed a Source Water Assessment susceptibility for a rural small water system in Eastern Kentucky, McCreary County Water District; and assisted in development of a media kit that can be utilized as a framework for community outreach by small water systems nationwide. The Director has had a major focus of conducting work within rural communities to assist in source water protection, developing a viable model for small systems to utilize GIS, and promoting a consortium of scientists, state primacy agency personnel, local extension providers, state agriculture personnel and other assistance providers to address agricultural nonpoint source pollution and the impacts on small rural water systems in the state of Kentucky. The consortium previously mentioned is the Kentucky Pesticide Workgroup. This Workgroup is receiving national attention as a model to address the impacts of nonpoint source agricultural contamination of source waters that impact small water systems.

The director and TACWQ staff are working with small systems in the task of source water protection and planning. We are now working with McCreary County Water District, the City of Lewisburg, West McCracken Water District, and the City of Glasgow. We have completed the susceptibility analysis of the McCreary County Water District's new intake on the South Fork of the Cumberland River utilizing the Kentucky Division of Water methods; results are included in Appendix B. This analysis will be expanded to include the methods utilized nationwide and those recommended by the USEPA in conducting susceptibility analyses. In this manner, our goal is to provide an assessment of the methods currently utilized throughout the nation for susceptibility analysis, report on the variations in methods that exist, and make a recommendation as to the refinement of methods that could be used under a national framework that would provide more consistent analyses from state to state. Our hope is that these results can be published and serve as a baseline to determine if a national framework is needed to provide more consistent assessments of susceptibility of small water systems. This work will be beneficial on both a regional and national level, as it will be used to produce a source water protection how-to-guide for small systems in Year 5. Lastly, this work will help the Center develop a web toolbox for source water protection that can be accessed by water systems throughout the nation.

We have completed a project to assist West McCracken Water District with the collection of geographical data to build a GIS of their infrastructure. We are working with Spatial Data Integrations (SDI), the developers of the Water Works FM software, a low cost GIS management system for water utilities. Thus far, we have assisted West McCracken Water District in collecting data using existing information and GPS technology in the field, developed the GIS of the District's system, trained the District to use the GIS, and helped the District realize the management capabilities of the system. This project has served as a demonstration to provide cost, effectiveness, and use information to other small systems considering using GIS as a management tool. The major goal of this project in Year 5 is to complete "A Guide to GPS and GIS for Small Water Systems" that will assist small water systems in increasing their technical and managerial capacities. Currently, we are preparing a presentation that will be given to the Kentucky Legislature as part of the "Posters at the Capitol" program. This paper will be presented by Trey Lyon, one of the undergraduate students working within the Center.

**Task 1: Utility Management Institute.** During the quarter, the course entitled "Utility Management 101" was presented in Bardstown, Kentucky on December 10-12, 2002. There were nineteen (19) students participating in this course. Course assessments for the December 10-12 course are included as an appendix to this report. Phillip East, Andy Lange and Ritchie Taylor made presentations on the Utility Management Institute to the Association of State Drinking Water Administrators (ASDWA) at their Annual Conference in Salt Lake City, Utah on October 2, 2002. An informational brochure, specifically developed to promote the Utility Management Institute's course of study and upcoming schedule of UMI classes, was completed during the Quarter. The brochure lists the dates and locations for each of the six course presentations scheduled in 2003. Copies of the brochure are included as an appendix to this report. The Utility Management Institute now claims a total of one hundred twelve (112) students. Thirteen (13) of our students have now completed all six of the courses in the UMI Series and have been awarded the Utility Management Professional designation. Course assessments completed throughout the year show a high level of satisfaction with the courses and the UMI. Nearly 72% of the respondents have given the courses their highest ranking of "very beneficial". Another 27% rated the courses at the second highest ranking of "beneficial". Only one (1) of seventy-nine (96) respondents rated a course as being "slightly beneficial" and no respondents rated the courses as "not beneficial".

**Task 2: Small Systems Circuit Rider.** A vacancy occurred in the Circuit Rider program early in the 4<sup>th</sup> Quarter of 2001-2002. During the 1st Quarter of 2002-2003, the Circuit Rider position was filled temporarily by existing KRWA staff who were devoting a portion of their time working with small systems outside of their regular job assignments. Joe Burns, a current KRWA employee, has transferred into the WKU Task 2 program. Joe has been employed with KRWA since 1995 and currently oversees all of our Sourcewater and Groundwater Protection programs. He also has work experience with the Kentucky Division of Water's Groundwater Branch and holds a Masters of Science in Hydrogeology from Eastern Kentucky University. Joe's experience and expertise will continue to provide great benefits to Kentucky's water and wastewater utilities, and smaller systems will now have the opportunity for increased assistance.

**Task 3: Source Water Protection.** Work on the Source Water Protection Initiative's three major existing projects, the Source Water Protection Education Project, the Demonstration Watershed Study, and the Trihalomethane Study, each achieved scheduled progress. We continued special emphasis on the pesticide problems, in this quarter particularly at Lewisburg, which we have identified as our most serious source water concern for small suppliers. We also continued to work closely with the Kentucky Department of Agriculture, Division of Pesticides regarding this work, and continued fieldwork in the agricultural Upper Iowa River watershed, Iowa, in collaboration with the Upper Iowa River Watershed Alliance. We have extended our work there to study serious agricultural impairment of water quality in karst aquifers that supply water to a number of small rural communities. Work continues on a new sampling and analysis program within the Spa Lake Watershed, in cooperation with the Western Kentucky University Department of Chemistry, to examine transport behavior of the herbicide atrazine on sediments within the catchment. Within the Trihalomethane Study work continued during the quarter on Manipulative Experiments, the Large River Survey, the Taylorsville Lake Study, and analysis of the Implications for THM Model Development and Water Management.

We continued to develop the Source Water Protection Education Project, and the initiation of the first two modules. Much of the work is preparing the first workshop in the program, *Impacts of Karst in Source Water Protection*, which we will present to a group of 50-60 water treatment operators on February 26, 2003, at the request of the Kentucky Rural Water Association. Results of these projects are described in the body of this work.

**Task 4: Database Management and Information Tools.** During this quarter, efforts by the Database Management and Information Tools group have resulted in significant accomplishments. These include further distribution of the ArcExplorer Mapping Tool with Geographic Information System data layers for water systems within each of Kentucky's 120 counties, including streams and rivers, karst (underground) drainages, 305(b) listings, roads, water lines, water tanks, water treatment plants, wastewater plants, pollution discharge points and facilities, animal and confined animal feeding operations, oil, gas, and mining operations, and related information needed by small water systems for management and planning purposes. We are working to update our ArcExplorer map layers for Kentucky small water providers, and hope to make these available to water systems next quarter. We have made additional distributions of the stand-alone Water Loss Calculator for free use by small water systems, and are working on a new Tools CD to be distributed to water systems beginning next quarter. We are also working on putting together a Tools CD that will include only nationally useful tools for distribution to water providers outside Kentucky. These products will be of direct utility to water systems and water resource managers both within and beyond Kentucky.

Last quarter we presented an initial series of 42 maps, beginning with data from the calendar year 2000, from the EPA Safe Drinking Water Information System (SDWIS) site describing drinking water Maximum Contaminant Level (MCL) violations. Additional mapping and statistical analysis is underway and will take some time to complete; we are also in the process of preparing a manuscript for publication that features these maps and analyses. We feel strongly that the national picture of water system problems that is developing will allow us to target problems and solutions more efficiently. We have also made some final modifications to the internet interface we developed for querying our database. We are now using this database interface to structure and facilitate cooperation with other researchers, institutions, and agencies on specific projects.

We have continued to participate actively in significant education and outreach opportunities, provide science advisory services, and work cooperatively with a variety of agencies and organizations concerned with water

quality; these are efforts with a potentially broad impact. Dr. Meier cooperated with teachers at a public school to obtain a grant to schools to develop curriculum focusing specifically on the relationships between karst hydrology and drinking water. Under this grant, Dr. Meier will conduct professional development workshops for teachers on this issue, highlighting the particular vulnerabilities of aquatic systems located in karst hydrogeologic environments particular to this region and similar karst regions in the US.

## **Administration (First Quarter 03)**

### **I. Work Status**

Administrative activities included technical oversight for all tasks, management of personnel, planning, budgeting, grant cost accounting, and tracking accounts for the EPA grant for the WKU TAC. Administrative responsibilities further included meetings and interaction with officials in the U.S. EPA headquarters, Region 4, and Region 6, the Kentucky Division of Water, the Kentucky Rural Water Association, the Tennessee/Kentucky Section of the American Water Works Association, the Association of State Drinking Water Administrators, the Barren River Area Development District, the U.S. Department of Agriculture, other Technical Assistance (TA) providers, and local communities. Administrative activities assessed task efforts to insure accordance with the primary goal of protection of public health through capacity development of small water systems. The Director also gave guidance to the Task Managers in order that activities were in accordance with the grant technical proposal and milestone schedules. Additionally, the Director worked with the EPA, Small Systems Program (Deborah McCray) and Source Water Protection (Steve Ainsworth), to find avenues for presenting our source water protection results.

**A. Work Progress.** We spoke to state drinking water officials at the Association of State Drinking Water Administrators annual conference, Salt Lake City, in October and to national representatives at the AWWA Source Water Protection Conference, BMP Workshop in January. Likewise, we promoted the Center throughout the state of Kentucky at local meetings.

McCreary County Source Water Protection Planning: We are working with KRWA and the Kentucky Division of Water to assess the states databases for identifying drinking water hazards in the source water protection zones. A major effort has been the development of spreadsheet tables for conducting the analysis, determining the sources of available data, and completing the Source Water Assessment for McCreary County Water District. During this next quarter we presented the final assessment (Appendix B). Throughout this process we have documented our activities and are working to develop a source water protection how-to-guide for small water systems. This will be a major focus of Year 5, the completion of the guide. Our work at McCreary County is focused to develop resources that can assist small water systems in developing technical capacity for source water protection. We will continue this effort at a national level to utilize the data collected in McCreary County to evaluate susceptibility analysis methods that are employed in other states. The results will include recommendations as to whether or not methods used by states are comparable and will a national framework produce more consistent results.

On-line UMI Courses: Western Kentucky University (WKU) has approved all six UMI courses, developed under this grant, to be offered as part of an Associates Degree in Business Technology with a concentration in Water Utility Management. Although the TACWQ will not receive program income, the Director and KRWA staff served as advisors to guide how the UMI materials can be translated to online courses. Bowling Green Community College is currently offering the Utility Management 101 course on-line. Currently, a Community College faculty member funded by a WKU education grant, Dr. Dawn Bolton, is working with Phillip East, the KRWA Education Director, to teach the on-line course. This program of study will allow TA providers, trainers, utility managers, office managers, operators and others to obtain a degree with a concentration in Water Utility Management from WKU. Our primary purpose for promoting this within the University was to establish a program that could increase the managerial capacity of small systems by allowing managers to complete a degree. The TACWQ will continue to offer free courses through the UMI. Through the development and offering of managerial courses, the UMI has continued to provide for managerial capacity development of small systems. Lastly, we have graduated thirteen utility managers through the program of tuition free UMI courses and these graduates have earned a Utility Management Professional Designation from the Center and KRWA.

West McCracken Water District GIS: We have completed data collection, development of the GIS, and implementation of the system for management of the District's infrastructure. Currently, we are working with the District to assess the personnel, financial, managerial and technological resources necessary to implement a GIS for a small water system. The outcome of this project will be to provide "A Guide to GPS and GIS for Small Water Systems" that will assist other small water systems in determining how to acquire the capacities to develop and utilize a GIS for management of their infrastructures.

**B. Difficulties Encountered.** No Difficulties Encountered.

**C. Preliminary Data Results.** McCreary County Source Water Protection Planning: the Source Water Assessment for McCreary County Water District is provided on Appendix B.

On-line UMI Courses: A grant was obtained through the University for development of the on-line UMI courses. The UMI 101 course is currently being taught on-line through the WKU Bowling Green Community College. We will be working with Community College faculty to put the other courses in an on-line format to continue the series in the fall of 2003. The series of courses will also be offered through the Kentucky Virtual University (<http://www.kyvu.org/>).

**D. Anticipated Activities.** Work will continue to assist other states in Region 4 in developing training to increase managerial capacity. The Director will continue all administrative duties and work to increase capacity development within the state of Kentucky, the Region, and the nation. To that end, the Director will be advising the WKU Community College as they will be putting all of the UMI courses into an on-line format that will allow water utility management courses to be taken remotely from throughout the United States. Finally, we will be working to become a leader in providing technical assistance for source water protection, including planning, assessment, best management practices development, and education. This is indicated by our recent involvement in the AWWA Source Water Conference, BMP Workshop on January 19, 2003.

## **II. Discussion of Expenditures**

Administrative expenditures for Quarter 1 and Year-to-Date of FY2003 were \$48,701.69.

## **III. Changes in Key Personnel**

There were no changes in key administrative personnel for this period.

## **Task 1: Utility Management Institute (UMI) (First Quarter 03)**

### **I. Work Status**

The goal of the UMI is to develop and deliver a series of courses to be included in a “Utility Management Professional” certification program. This program is available to system managers, operators, and office managers of water systems serving rural areas and small municipalities with populations under 10,000.

**A. Work Progress.** During the quarter, the course entitled “Utility Management 101” was presented in Bardstown, Kentucky on December 10-12, 2002 at the Days Inn Motel. There were nineteen (19) students participating in this course. Course assessments for the December 10-12 course are included as an appendix to this report (Appendix 1-1).

Phillip East, Andy Lange and Ritchie Taylor made presentations on the Utility Management Institute to the Association of State Drinking Water Administrators (ASDWA) at their Annual Conference in Salt Lake City, Utah on October 2, 2002.

An informational brochure, specifically developed to promote the Utility Management Institute’s course of study and upcoming schedule of UMI classes, was completed during the Quarter. The brochure lists the dates and locations for each of the six course presentations scheduled in 2003. Copies of the brochure are included as an appendix to this report (Appendix 1-2).

**B. Difficulties Encountered.** No unanticipated difficulties were encountered.

**C. Preliminary Data Results.** The Utility Management Institute now claims a total of one hundred twelve (112) students. Thirteen (13) of our students have now completed all six of the courses in the UMI Series and have been awarded the Utility Management Professional designation. Course assessments completed throughout the year show a high level of satisfaction with the courses and the UMI. Nearly 72% of the respondents have given the courses their highest ranking of “very beneficial”. Another 27% rated the courses at the second highest ranking of “beneficial”. Only one (1) of seventy-nine (96) respondents rated a course as being “slightly beneficial” and no respondents rated the courses as “not beneficial”.

**D. Anticipated Activities.** During the second quarter of 2002-2003, the UMI course entitled “Human Resource Management for Utilities” will be presented in Somerset, Kentucky on March 19-20, 2003 at the Center for Rural Development. In addition, the Internet course presentation of “Utility Management 101” is being taught during the Spring semester of 2003. This course is available through Western Kentucky University’s Community College and Kentucky’s Virtual University.

### **II. Discussion of Expenditures**

Task 1 expenditures for Quarter 1 and Year-to-Date of FY2003 were \$4,909.81.

### **III. Key Personnel Changes**

There were no personnel changes during this quarter.

## **Task 2: Circuit Rider Program (First Quarter 03)**

### **I. Work Status**

The "Circuit Rider" approach to providing a combination of on-site technical assistance and training is nationally recognized as the most effective method of assisting small public water systems to comply with state and federal environmental regulations. The Circuit Rider program works in partnership with Kentucky Division of Water (DOW) to target the public water systems serving populations under 3,300, with particular emphasis on systems serving less than 500 people. Our "Circuit Rider" approach works to target those small systems experiencing profound difficulties in complying with SDWA provisions in order to enhance protection of public health.

**A. Work Progress.** A vacancy occurred in the Circuit Rider program early in the 4<sup>th</sup> Quarter of 2001-2002. During the 1st Quarter of 2002-2003, the Circuit Rider position was filled for temporarily by existing KRWA staff who were devoting a portion of their time working with small systems outside of their regular job assignments. Joe Burns, a current KRWA employee, has transferred into the WKU Task 2 program. Joe has been employed with KRWA since 1995 and currently oversees all of our Sourcewater and Groundwater Protection programs. He also has work experience with the Kentucky Division of Water's Groundwater Branch and holds a Masters of Science in Hydrogeology from Eastern Kentucky University. Joe's experience and expertise will continue to provide great benefits to Kentucky's water and wastewater utilities, and smaller systems will now have the opportunity for increased assistance.

**B. Difficulties Encountered.** No unanticipated difficulties were encountered.

**C. Preliminary Data Results.** See Work Progress above.

**D. Anticipated Activities.** During the next quarter, the WKU Small System Circuit Rider will continue to assist systems with operational and management problems. An increasing amount of the Circuit Rider's time is expected to be spent with systems that have made specific requests for assistance through the KRWA office. Many of these requests have resulted from on-site visits. The Circuit Rider will also continue to identify systems that have computer needs in anticipation of future availability. The Circuit Rider will continue to create educational opportunities for the communities we serve. Educational activities will focus on elementary, middle, and high school children and will emphasize the role small utilities play and the importance of good source water quality. This work will be coordinated with efforts within the WKU Center for Water Resource Studies.

### **II. Discussion of Expenditures**

Task 2 expenditures for Quarter 1 and Year-to-Date of FY2003 were \$4,338.91.

### **III. Key Personnel Changes**

As detailed above, Joe Burns has taken over the Task 2 responsibilities as of January 1, 2003.

## **Task 3: Source Water Protection Initiative (First Quarter 03)**

### **I. Work Status**

#### **A. Work Progress**

Work on the Source Water Protection Initiative's three major projects, the Source Water Protection Education Project, the Demonstration Watershed Study and the Trihalomethane Study, each achieved scheduled progress. We also made progress on new initiatives including the Source Water Protection Education Project.

##### **a. Demonstration Watershed Study**

###### **Sampling at the Kentucky Demonstration Watersheds**

The Demonstration Watershed Study uses three interrelated programs to characterize each study site's source-water catchments: 1) water sampling and water analysis, 2) Geographic Information System (GIS) land use analysis, and 3) the examination of macroinvertebrates indicative of water quality. We made significant progress in programs 1) and 2), results are outlined below.

Work has continued on our quarterly sampling program at the Demonstration Watersheds (Auburn, Cadiz, Guthrie, and Marion), in order to characterize and monitor the sites' source water issues. We continue to focus on the most significant source water problems that we have identified: pesticides and bacteria. Detailed work on pesticide contamination at Lewisburg (Spa Lake) continues at Lewisburg with sampling by two students, Joey Wilcox and VJ Golla, who have completed training under graduate student Katie Seadler. Dr. Charlotte MacAlister has also joined the project and has been active in sampling and working on the development of the local stakeholder network of that we are developing for source water protection there. Task 3 groundwater dye traces are now nearing completion in the watershed. We are continuing our basin-wide sampling for atrazine at Lewisburg to a monthly interval. Work at both Spa Lake and Marion is ongoing with cooperation of the Kentucky Pesticide Work Group (consisting of Western Kentucky University, Kentucky Division of Pesticides, Kentucky Division of Water, Kentucky Department of Conservation, Kentucky Corn Growers Association, Kentucky Rural Water Association, the U.S. Geological Survey, U.S. Natural Resources Conservation Service, and the Syngenta Corporation). Dr. Groves gave a presentation on the status of the atrazine work at Lewisburg and Spa Lake to the Kentucky Pesticide Work Group in Frankfort, Kentucky, in December.

Work at Logsdon and Hawkins River (Diamond Caverns) continues with emphasis on analysis of data on the role of sediment in the transport of pesticides through karst aquifers. Graduate student Mike Anderson is completing a manuscript on this work will be that submitted to at least one refereed journal in early 2003. Task 3 will continue quarterly sampling at the Logsdon and Diamond Wells with cooperation of the National Park Service in order to continue developing source-water protection techniques and monitor effects of the newly implemented Conservation Reserve Enhancement Program (CREP).

Data from the quarterly sampling program are reported in the data section below.

###### **Agricultural Contamination of Karst Water Sources in Northeast Iowa**

During the quarter Ms. Pat Kambesis continued field and analytical work to investigate methods for identification and characterization of karst groundwater contamination by agricultural land use in the Coldwater Creek Basin of the Upper Iowa River Watershed in northeast Iowa. This work is being undertaken in cooperation with the Upper Iowa River Watershed Alliance (UIRWA), a consortium of citizen's groups, state government scientists from Iowa and Minnesota, university scientists, and others interested in the water quality of the basin. Our participation in the program has been an outreach of our source water protection experience in karst areas, at the request of the UIRWA.

Water sampling for a range of water quality parameters, including the herbicide atrazine and its metabolites, continue monthly, and the first data will be reported in the next quarterly report. Two trips were made to Iowa during the quarter. In November Ms. Kambesis continued visits and discussion with landowners to identify new springs and other hydrologic features associated with the dye tracing and sampling efforts. Also, additional reconnaissance of surface hydrologic features was made to find areas for addition dye receptor locations.

Temperature data loggers to quantify groundwater response to surface water inputs were installed and tested at four locations (three groundwater and one surface water) and found to both be operating correctly and to accurately reflect dynamic hydrologic conditions.

Examination of potential background contamination of fluorescent dyes in the Coldwater Creek area has been successfully completed. Subsequently, three dye traces have been initiated in the Coldwater Basin, each with one of the common water tracing dyes (fluorescein, Rhodamine WT, and eosine) to help delineate the recharge area of the main spring whose impact from agricultural contamination is being studied. Dye from these traces was not recovered. Subsequent fieldwork has identified two new springs, and a repeat trace was attempted in December. However, freezing conditions during the entire December visit meant that no liquid water was flowing at input points on the surface and thus dye could not be injected. Two traces will be initiated during the upcoming quarter, one with an in-cave injection point in February, to ensure flowing water into which to inject the dye, and another in March to replicate the one described above, when warmer conditions should ensure reasonable surface water injection conditions.

#### **Program on Sediment Transport of Atrazine within the Lewisburg (Spa Lake) Watershed**

During the quarter we continued an effort to better understand the transport of the pesticide atrazine by sediments within the Lewisburg (Spa Lake) Watershed. Previous efforts on the grant have shown a relationship between sediment transport by storm waters at the Hawkins River (Diamond Caverns) site, although the results have also shown that only certain fractions of the sediment appear to contribute to this transport. In cooperation with the WKU Department of Chemistry, we have begun to conduct detailed experiments with sediment from Spa Lake that will enhance our understanding of these processes. Understanding how atrazine is transported within this watershed is a key component to understanding what land use practices can be undertaken in order to ameliorate related problems here and elsewhere. The project has been undertaken as a closely supervised master's thesis research project by Mr. Tony Oakes, supervised by Dr. Eric Conte of the Department of Chemistry, along with Ritchie Taylor and Chris Groves.

#### **Program to Evaluate Atrazine Distribution Distant from Application Sites**

During the quarter we continued design work on a new program to analyze atrazine concentrations of surface, groundwater, and rainfall during the in and around Mammoth Cave National Park to evaluate transport away from application areas. The Park land area provides 23,000 hectares over which atrazine is not applied, and so to the extent that these samples are positive, atrazine is being transported away from application areas through a variety of potential pathways. During the spring 2003 application season

A graduate student has been hired to undertake rainfall, surface water, and groundwater sampling and analyses for the project, and we are working with Mr. Joe Meiman, hydrologist with the National Park Service to identify monitoring locations.

#### **b. Trihalomethane Project (Dr. Jeffrey Jack, University of Louisville)**

Work continued during the quarter on Manipulative Experiments, the Large River Survey, the Taylorsville Lake Study, and THM Model Development. Results are discussed in the data section, below.

#### **B. Difficulties encountered**

No significant difficulties were encountered.

#### **C. Data Results**

##### **Source Water Demonstration Watershed Study**

Data from the quarterly demonstration watershed project are given below in Appendix 3-1.

##### **Summary of Lewisburg (Spa Lake) Atrazine Basin Sampling**

Data from weekly sampling at Lewisburg (Spa Lake) are given in Table 3-2.

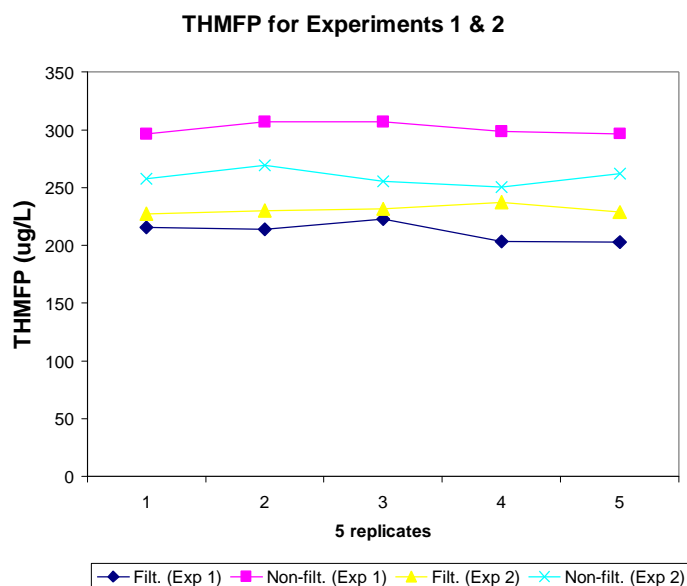
Sample Date	Raw Water Atrazine (ppb)	Finished Water Atrazine (ppb)
10/7/2002	**	1.10
10/14/2002	0.70	0.46
10/21/2002	0.74	0.51
10/28/2002	0.83	0.47
11/4/2002	0.85	0.49
11/11/2002	0.60	0.38
11/25/2002	0.16	0.11
12/2/2002	0.20	0.03
12/9/2002	0.38	0.36
12/16/2002	0.27	0.54

Table 3-1. Atrazine data from Lewisburg (Spa Lake) Kentucky.

### Trihalomethane Project (Dr. Jeffrey Jack, University of Louisville)

#### Manipulative Experiments

THMFP analysis is now complete for the Wabash project. The preliminary results suggest that filtration of water may remove some of the active precursors for THMFP. These results are different than those we have from the mainstem Ohio River, where most THMFP was in the dissolved fraction. These findings reinforce our hypothesis that watershed-scale differences are major determinants of the THMFP production.



#### Large River Survey

We are comparing THM production in two different pools of the Ohio River, the McAlpine and the Smithland. These pools differ in their geomorphology and in the tributary inputs and may provide good model systems for rivers in constricted and unconstricted rivers. We have been sampling these pools in a semi-Lagrangian fashion, with water parcel velocity determined by stage-discharge relationships. We have completed 9 surveys in the McAlpine Pool and 7 in the Smithland Pool. The data from these surveys is still being processed.

#### Taylorville Lake Study

We have completed the THMFP budget for Taylorville Lake. Preliminary results indicate that this reservoir is a net source of THMFP during the winter and a net sink during the summer. This is contrary to our expectations but

consistent with data from other reservoirs in the northeast. POC and chlorophylls were significantly correlated with THMFP in this reservoir. We are continuing small-scale work at Taylorsville to assess the reservoir as a winter source of THMFP.

**Implications for THM Model Development and Water Management**

The interpool comparison between McAlpine and Smithland will allow us to examine THM production in river basins of contrasting geomorphology. We hypothesize that the unconfined pool will show higher levels of THMFP because of higher allochthonous inputs into the pool.

**Dissemination of Results.**

Our revised manuscript “*Algal production and trihalomethane (THM) formation potential: An experimental assessment and inter-river comparison*” was published by the Canadian Journal of Fisheries and Aquatic Sciences. We have one more manuscript in preparation for submission to the North American Lake Management Society. We expect to begin work on two more manuscripts this spring.

**Source Water Protection Education Project**

Work continued on the Source Water Protection Education Project, and the first two modules, 1) *Impacts of Karst in Source Water Protection* and 2) *Developing Participant Networks in Source Water Protection Programs*. These modules communicate information about aspects of source water quality, both technical issues and the development of source water plans. These modules are being designed for dissemination in three different formats: 1) through the Internet, 2) as written and computer disk materials, such as powerpoint presentation, and 3) as site visit workshops.

We have begun designing the content and format of the individual modules. An issue that is impacting this design is the recognition that there will be different audiences with need for such information, and these could require. Some modules, such as our first one *Impacts of Karst in Source Water Protection*, may be of interest to a wide range of participants who have to deal with karst issues, including farmers and others living in impacted watersheds, water plant and other utility managers, various governmental representatives, and public groups interested in designing source water protection programs. In contrast, our second module this year *Developing Participant Networks in Source Water Protection Programs* focusses on the development of source water protection programs, and thus will be designed for the needs of groups having those responsibilities.

During the quarter we worked on the development of the workshop *Impacts of Karst in Source Water Protection* presented in cooperation with the Kentucky Rural Water Association, which will part Barren River Lake State Park, Kentucky, February 26, 2003. The outline of topics is below (Table One), and we will distribute copies of the American Geological Institute’s book *Living With Karst*, coauthored by Dr. Groves, to workshop participants, as well as specific materials that we are developing for the workshop. We will include these materials in the upcoming quarterly report.

Time	talk	speaker
9:00-9:15	introduction and outline	Chris Groves
9:15-9:45	Concepts of Source Water Protection	John All
9:45-10:15	Case Studies: Lewisburg and Marion, Kentucky	Ritchie Taylor
10:15-10:45	Karst landscapes and aquifers	Chris Groves
10:45-11:15	coffee break	
11:15-11:45	Karst related environmental problems	Alan Glennon
11:45-12:05	Source Water Protection in Karst: GIS	Mark Graham
12:05-12:25	Source Water Protection in Karst: Landuse/BMP’s	Pat Kambesis

Table 3-2. Outline for workshop *Impacts of Karst in Source Water Protection*, to be held at Barren River Lake State Park, February 26, 2003.

**II. Discussion of Expenditures**

Task 3 expenditures for Quarter 1 and Year-to-Date of FY2003 were \$7,528.50. We are approximately on schedule within Task 3.

### **III. Changes in Key Personnel**

Dr. Charlotte MacAlister has joined the project and is working on the Spa Lake project.

## **Task 4: Database Management and Information Tools (First Quarter 03)**

### **I. Work Status**

It is the responsibility of the Database Management component of this Task to provide appropriate methods and structures for reporting data and metadata to facilitate: reporting of information by other Tasks, appropriate capture and storage of data and metadata, and access to information and materials by end users. The Information Tools function of our Task works to put technology, information, and the tools to create information capacity and capability directly into the hands of water providers, and to make that technology and information as accessible as possible in order to promote the protection of public health.

#### **A. Work progress.**

During this quarter, efforts by the Database Management and Information Tools group have resulted in significant accomplishments. These include further distribution of the ArcExplorer Mapping Tool with Geographic Information System data layers for water systems within each of Kentucky's 120 counties, including streams and rivers, karst (underground) drainages, 305(b) listings, roads, water lines, water tanks, water treatment plants, wastewater plants, pollution discharge points and facilities, animal and confined animal feeding operations, oil, gas, and mining operations, and related information needed by small water systems for management and planning purposes. We have also made additional distributions of the stand-alone Water Loss Calculator for free use by small water systems. We have developed additional U.S.- wide maps of geographic and water quality information pertaining to water systems and Maximum Contaminant Level Violations from the EPA Safe Drinking Water Information System database. We have made some final adjustments to the internet interface we developed for querying our database. We have also continued to participate actively in significant education and outreach opportunities, provide science advisory services, and work cooperatively with agencies, groups, and the public.

**(1) Mapping Tools for Water Systems.** We are continuing to distribute our ArcExplorer Mapping Tool with Geographic Information System data layers for water systems within each of Kentucky's 120 counties, including streams and rivers, karst (underground) drainages, 305(b) listings, roads, water lines, water tanks, water treatment plants, wastewater plants, pollution discharge points and facilities, animal and confined animal feeding operations, oil, gas, and mining operations, and related information needed by small water systems for management and planning purposes. Many water systems were able to view for the first time the data that they and their Area Development Districts submitted to the Commonwealth of Kentucky about their water systems, including a road survey for water lines. This 2-CD set is being distributed directly to water systems that request the information. We are also working to upgrade these data layers so that a new set can be distributed to water systems with the latest information available.

**(2) Software and Information Tools for Water Providers.** We have distributed additional copies of our stand-alone Water Loss Calculator. The program calculates the volume, rate, and subsequent dollar losses due to undetected leaks, and can chart monthly production, distribution, water loss, and dollar loss values so the user can easily examine trends over time. This final, nationally distributable version includes modifications to the Water Loss Calculator's installation program so that it installs correctly and easily to a broad range of computer operating systems. A copy of the final version of this program can be downloaded from our website, <http://water.wku.edu>. A copy of the CD with this software was submitted in an earlier report.

**(3) Internet-Accessible Data Upload and Query Capability.** One of the primary missions of Task 4 is to facilitate information retrieval of a voluminous amount of water quality data. We receive data from other tasks as well as researchers working outside of Western Kentucky University. We wanted to make it easier for researchers to access their own data for query and analysis, and for our GIS personnel to pull down for mapping, so we have been developing an internet interface for uploading and querying data generated and collected by the project. In previous quarters we performed initial development and testing, and subsequent redevelopment and retesting. During this quarter, we have made some final modifications of the internet access interface. Our database is being stored in SQL Server, and the web interface crafted by Seth M. Johnson for use with this database has made it much easier for cooperating researchers to query and analyze their own data tables and additional data tables to which they may be given access, while still protecting database integrity and administrator control over the database. We are now using this database interface to structure and facilitate cooperation with other researchers, institutions, and agencies on specific projects.

**(4) Analysis and Synthesis of Data for Publication.** Last quarter we presented an initial series of 42 maps using calendar year 2000 data from the EPA Safe Drinking Water Information System (SDWIS) site describing drinking water Maximum Contaminant Level (MCL) violations. Additional mapping and statistical analysis is underway and will take some time to complete. Task 4 has also worked to map and analyze water quality data collected this spring, summer, and fall at monitoring sites throughout the Green River / Tradewater Basin of Kentucky; this analysis was presented at a citizens' monitoring conference in November 2002.

**(5) Education Outreach and Science Advisory Duties.**

Public health and small rural water systems benefit from the presence of an informed public, skilled citizens' groups who care about source water protection, and sympathetic and knowledgeable state and regional agencies. When feasible, we take advantage of opportunities to participate in educational programs, outreach events, and science advisory service to agencies and groups entrusted with protecting the streams and rivers that serve as the source water for small water systems. Dr. Meier has continued to work with a variety of agencies and organizations, including the Kentucky Division of Water's sponsored Green River Basin Management Team, the Kentucky Waterways Alliance, Watershed Watch, a multi-agency the Green River Conservation Reserve Enhancement Program – Monitoring Oversight Committee, and are working to create an Upper Green River Biological Preserve along the banks of the Green River upstream from Mammoth Cave National Park.

Public education and advocacy for safe drinking water and source water protection have been important components of efforts with a broader impact as well. As a model within a local public school, Dr. Meier and other faculty members in the Biology Dept. at WKU are implementing the second year of development of a hands-on science curriculum through weekly science labs that 350 elementary school children attend with their teachers. Many of the labs developed feature the properties of water, human treatment and use of water, public health, the ecology of aquatic systems, and the importance of informed stewardship in protecting our essential water resources. Based on teacher feedback and consultation with other educators, we are refining the curriculum to publish as a model that can be adopted and adapted by other schools. Dr. Meier also cooperated with teachers at that public school to obtain a \$7,000 EPA grant to schools to develop curriculum focusing specifically on the relationships between karst hydrology and drinking water. Under this grant, Dr. Meier will conduct professional development workshops for teachers on this issue, highlighting the particular vulnerabilities of aquatic systems located in karst hydrogeologic environments particular to this region and similar karst regions in the US.

**B. Difficulties encountered.** No insurmountable difficulties have been encountered.

**C. Preliminary data results.** Last quarter we presented a set of 42 US maps that represent a national picture of drinking water quality that, to our knowledge, has never before been available. The maps are a culmination of work spent retrieving, organizing, querying, and mapping data by our team. We have been able to take advantage of the very valuable EPA Safe Drinking Water Information System (SDWIS) database in this effort. We are now conducting further analyses to interpret the data more extensively, and are also focusing on preparing a manuscript for publication that features these maps and analyses. It is through defining problems clearly that one is able to target solutions as well; that philosophy is certainly of strategic interest in elucidating the problems and potential solutions to them for drinking water systems throughout our country.

**D. Anticipated activities.** We are working to update our ArcExplorer map layers for Kentucky small water providers, and hope to make these available to water systems next quarter. We are also working on a new Tools CD to be distributed to water systems beginning next quarter. We are also working on putting together a Tools CD with only nationally useful tools for distribution to water providers outside Kentucky. Other anticipated activities for the next quarter include analysis, synthesis, and publication of spatially distributed information and water quality data sets; use of our internet query interface with the databases; and a new website renovation. These products will be of direct utility to water systems and water resource managers both within and beyond Kentucky.

**II. Discussion of Expenditures**

Task 4 expenditures for Quarter 1 and Year-to-Date of FY2003 were \$28,852.70. Please note that this figure reflects bookkeeping corrections by WKU to account for past expenditures that by error had not been charged to Task 4.

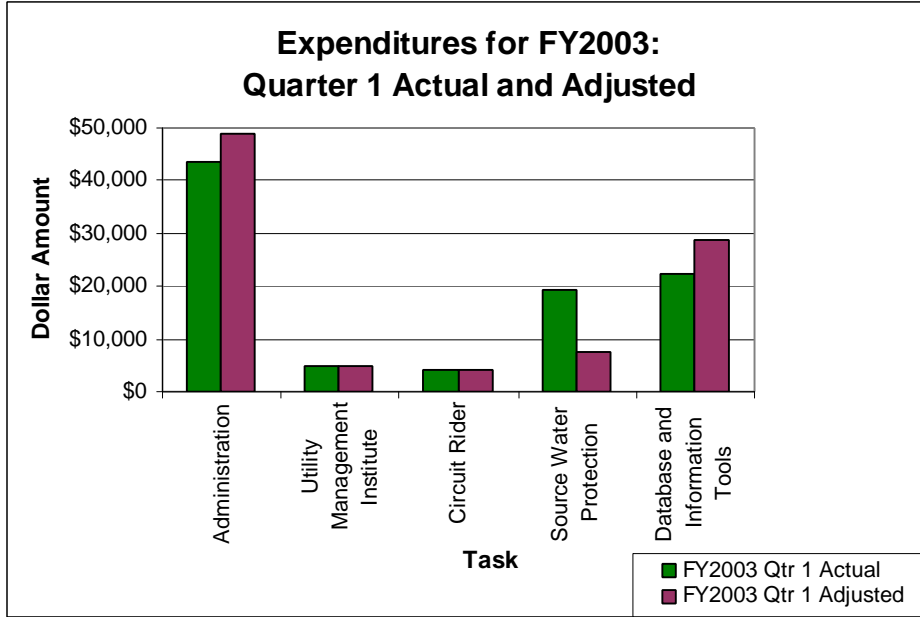
**III. Key Personnel Changes**

There have been no changes in key personnel within Task 4 during this quarter. Dr. Ouida Meier, who directs the

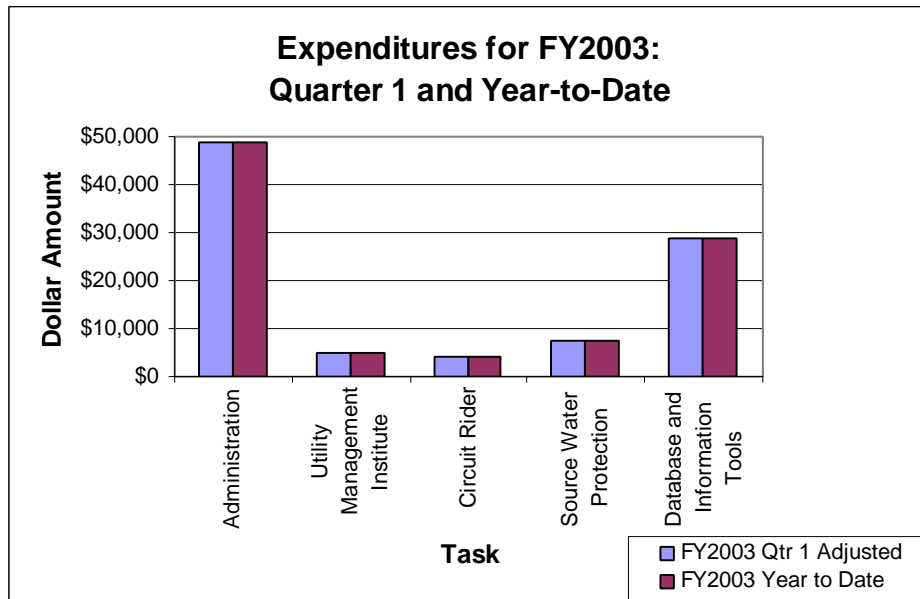
efforts of Task 4, is working on Technical Assistance Center for Water Quality business half-time rather than full-time during Year 4. The remainder of her efforts (and compensation) are invested in work on behalf of the Kentucky Center for Wastewater Research.

As always, we are grateful to our team of bright, talented undergraduate students who assist with the work in Task 4. Mr. Seth M. Johnson has completed some final polishing of the online interface with our SQL database and the download tool for the EPA SDWIS database, and has graduated. Mr. Rupesh Mamidi has done a wonderful job with our GIS efforts. Mr. Ravikanth Gurijala is working on a website renovation. The Center is very grateful for the dedicated and skillful efforts of each of these individuals. It is a goal of the Center to help educate students through applied research and to help "grow" scientists that are aware of the issues facing drinking water systems and public health protection.

**Appendix A. Expenditures:  
FY 2003 Quarter 1 and Year-to-Date.**



Note that this quarter, bookkeeping adjustments were made to some of the Task expenditures to compensate for small inaccuracies generated during the transition between two different financial record-keeping systems at WKU over the past year.



For this and future quarters for FY2003, the adjusted Quarter 1 Expenditures will be used for the quarterly and year-to-date expenditures.

**Appendix B.**

**Susceptibility Analysis for McCreary County Water District.**

**Appendix 1-1.**

**Course Assessment, Utility Management 101, December 10-12, 2002**

**Appendix 1-2.**

**Utility Management Institute Brochure**