ANNUAL REPORT FOR FY 2002

WATER QUALITY MANAGEMENT PROGRAM

KANSAS CITY DISTRICT LAKE PROJECTS

1. INTRODUCTION

a. Authorization

This report summarizes the Water Quality Management Program for Kansas City District lake projects within the boundaries of the Northwestern Division. It outlines the program objectives, describes ongoing water quality management activities, organizational and laboratory capabilities, major water quality problems, special studies and significant activities of 2002. This report is prepared in accordance with requirements outlined in ER 1110-2-8154.

b. Objectives

The objectives of the Kansas City District Water Quality Management Program are:

(1) Ensure the impounded waters and releases from each lake project are of suitable quality for the established project uses and are in compliance with applicable Federal and state water quality standards.

(2) Define pre-project (pre-impoundment) and post-project water quality conditions at each lake project to establish baseline conditions.

(3) Quantitatively identify and assess the magnitude of existing and potential water quality problems associated with project waters. Detect changes over time, which may be either beneficial or degrading.

(4) Evaluate land use and other activities in the watershed that may constitute potential water quality problems.

(5) Maintain adequate water quality monitoring programs and databases for the purpose of achieving water quality management objectives and to evaluate project performance and water quality needs.

(6) Incorporate the program findings with reservoir control and operations elements to optimize reservoir water quality where possible.

(7) Maintain coordination and communication with Region and District elements involved in environmental and water quality matters.

(8) Maintain close coordination and, where possible, collaboration with all interested

governmental and non-governmental entities with regard to activities that may affect or be affected by the water quality or water management decisions associated with Corps projects.

(9) Use an interdisciplinary team approach to develop objectives, establish priorities, and execute the water quality management program.

(10) Develop an understanding and continuing awareness of the water quality factors and processes in the project, in the watershed, and in the area influenced by project operation.

(11) Where degraded conditions exist, develop a plan for restoration that will restore the aquatic environment to a desirable, biologically diverse, productive, and robust condition. This plan should normally be coordinated with appropriate local, state, and other Federal agencies.

(12) Ensure that the project and its operation offer the lowest stress possible to the aquatic environment.

(13) Ensure that Corps projects are managed to accentuate their potential to play a positive role in the conservation and preservation of natural and cultural resources.

(14) Document the water quality management activities of the program and individual projects to record trends, identify problems and accomplishments, and provide guidance to program managers.

(15) Recognize that some problems and opportunities are of short duration and demand rapid response. The District water managers should be empowered to react in a time frame commensurate with the event and with best available information and judgment. Long-term situations provide for more comprehensive study and refined response.

(16) As appropriate, promote and develop cost-sharing partnerships in accordance with authorities such as Section 1135 of the Water Resources Development Act (WRDA) of 1986, Section 204 of WRDA 1992, and Section 216 of the Flood Control Act of 1970.

The Kansas City District has met or partially met all of the above water quality management objectives in 2002. The District's Water Quality Unit (PM-PR-W) was directly involved in achieving seven of the objectives (2, 3, 6-8, 10, and 16). Objectives 1, 4, 5, and 14 were met to some degree by PM-PR-W; the remaining objectives are beyond the scope and mission of PM-PR-W. The one staff member and two detailed staff members during July-September are limited in their ability to annually perform seasonal surveillance, special studies, analytical procedures, data management, modeling, and report preparation for the District's 18 lakes. Objectives 9, 11-13, and 15 were met by other elements within the District.

2. WATER QUALITY ISSUES AND PROBLEMS IN THE KANSAS CITY DISTRICT

Identified problems are presented by specific parameters and project areas in the attached table labeled "Water Quality Issues and Problems in Kansas City District Lakes, 2002". In many cases, the identified problems involved watershed non-point contaminants. This type of problem is being currently addressed through the multi-agency, watershed oriented Hillsdale, Rathbun, and Smithville special studies described later in this report. Issues of general importance for future research and development within the District and problems receiving special study in 2002 follow:

a. Contamination

Contaminants from non-point sources continued as major causes of decreasing water quality. Nutrient loading (nitrogen and phosphorus) into most District lakes occurred at elevated levels, which can accelerate eutrophication. The latter was indicated by the elevated chlorophyll a concentrations present. Most of the District lakes also had elevated concentrations of heavy metals. Soil erosion within the watershed and the natural trapping function of stratifying reservoirs were the primary contributors to these problems. Elevated total suspended solids (TSS), turbidity, and anoxia associated with high inflow periods were major parameters influencing the water quality of District lakes.

b. Epilimnetic Oxygen Depression

(1) Decreased dissolved oxygen (DO) concentrations not only in bottom strata (hypolimnion), but, at times, also in the surface strata (epilimnion) continue to be a concern. Oxygen uptake from decomposition increased because of organic loading by inflows. Turbidity restricted photosynthetic activity by dilution-thinned algal communities and slowed oxygen recovery. Epilimnetic oxygen levels below 5 mg/L have been measured at many of the District lakes during the summer when turbidities are high and during fall destratification.

(2) Truman Reservoir has frequently shown a reduction in the epilimnetic oxygen level below that required by Missouri Water Quality Standards for the protection of the warmwater fisheries (5 mg/L). The extent of the anaerobic conditions suggests that fish populations in the uplake, main channel reaches and tributaries are at risk. Reduction of the oxygen level has occurred in the epilimnion of the downlake area despite atmospheric resupply and in the shallow uplake surface waters even though stratification was absent during many periods due to wind-caused mixing. Truman has a mean depth of about 5 meters. This relief creates a relatively greater surface area of contact between the upper water stratum and the silted bottom. Secondarily, wind and the resulting wave action tend to increase turbidity and the resuspension of deposited materials over the shallow flats. Sediment resuspension accelerates the release of oxygen-demanding, reduced chemical species to the water column. Conversely, the lack of wind mixing in combination with cloud cover can adversely affect surface DO levels in the clearer downlake areas. Data suggest that epilimnetic oxygen depletion downlake was not affected by inflow related oxygen-uptake factors though turbidity could still affect downlake oxygen production. Releases for flood control may play a major part in the downlake epilimnetic oxygen reduction by increasing

turbidity. During storm inflow events, heavy withdrawals from the reservoir at a time when the uplake waters are very turbid pull this water downlake, often causing light-limiting conditions for photosynthesis through much of the Osage and/or Grand arms. The smaller arms, which do not drain prairie regions, are somewhat less affected. However, even they have reduced DO levels in their upper halves during many periods, probably due to the sediment oxygen demand (SOD). Downlake algal populations also could be reduced as spillway releases draw off the epilimnion. Similar reductions could occur as the skimming weir withdraws the lake's more highly oxygenated epilimnetic waters.

c. Pesticides in Drinking Water

Atrazine continues to be the most prevalent pesticide found in District lakes. The herbicide is a major water quality concern, since it adversely affects the designated use of drinking water supply. National primary drinking water regulations promulgated by the Environmental Protection Agency (EPA) in January 1991 set 3.0 ug/L as the maximum contaminant level (MCL) for atrazine in finished drinking water. Studies begun in 1988 showed concentrations in raw water commonly occurring above that level and gave evidence that atrazine is not completely removed by normal treatment processes. A 1992 study of quarterly contaminant concentrations in five lakes, Clinton, Melvern, Perry, Pomona, and Tuttle Creek, and incidental sampling of Harlan County, Long Branch, and Rathbun yielded similar findings. Monthly sampling during 1996-2002 continues to reflect high atrazine concentrations during the post-application runoff periods at many District lakes. Historically, atrazine levels in Perry, Milford, Clinton, Pomona, Melvern, Long Branch, Rathbun, Smithville, and Tuttle Creek Lakes have exceeded 3.0 ug/L during many periods.

d. Bacterial Densities at District Swimming Beaches

Past studies conducted by PM-PR-W on the fecal coliform densities at swimming beaches, marinas, and inflow streams have indicated that most projects did not have continuing bacterial contamination problems. Most elevated densities were the result of high inflow levels in storm runoff, high goose populations at swimming beaches (Smithville), ruptured holding tanks at floating marinas (Truman), improper discharge of sewage lagoons by lessee (Truman), and beaches located too close to existing sewage treatment plants (Milford and Harlan County). In 2002 there were no reported instances of prolonged contamination based on fecal coliform sampling conducted at each of the District's 18 projects by approved local contractors.

e. Pesticides in Fish

(1) Pesticide concentrations in fish flesh may have a direct effect on the designated project uses of fisheries and wildlife enhancement and recreation (through banning of fishing and consuming fish). The State of Kansas has reported violations of the National Academy of Science's predator protection guideline for chlordane in Perry and Tuttle Creek Lakes. In addition, based on EPA and Food and Drug Administration (FDA) criteria, Smithville Lake had a channel catfish consumption advisory for several years issued by the State of Missouri because of elevated chlordane levels.

(2) A comprehensive survey of pesticide concentrations in fish flesh was performed in 1990 by PM-PR-W on 13 District lake projects to supplement sampling being carried out by state agencies. A scan for 39 toxicants (metals, PCBs, and pesticides) detected a total of 13 in the edible fish tissue (fillet) samples though substantial variation existed in pesticide concentrations in samples within a lake and

between lakes. Generally, maximum concentrations of nine pesticides and one metal exceeded EPA criteria, but no samples exceeded FDA action levels. Subsequently, most state agencies within the District have developed routine sampling programs, and, as a result, PM-PR-W has not initiated any further work in this area.

f. Fish kills

No significant fish kills were reported to PM-PR-W in 2002. The last significant fish kills occurred at Truman, Pomme de Terre and Smithville in 1994. Truman had a paddlefish kill in the outlet due to the large spillway releases of stored floodwater. The fish kill at Pomme de Terre affected multiple species in the lake during October while Smithville's kill affected only the black bass population during the late summer. The causes for the latter two fish kills were attributed to bacterial infections associated with prolonged high water temperatures.

3. PROGRAM ORGANIZATION AND COORDINATION

a. Organization and Assigned Responsibilities as of FY02

(1) The Missouri River Region, located in Omaha, Nebraska, monitors the Water Quality Management Program, provides guidance on Corps policy, and has taken responsibility for implementation of the Program on the Missouri River within Division boundaries. The Kansas City District is responsible for the implementation of the Water Quality Management Program at the 18 lake projects located within District boundaries. Within the Kansas City District, Planning, Programs, and Project Management Division (PM) is responsible for developing the Water Quality Management Program. The Program's activities have been funded largely by Operation and Maintenance appropriations so coordination is done with Operations Division (OD). Activities are also coordinated with Engineering and Construction Division (EC), which is responsible for automated continuous water quality monitoring, as well as, water management operations. The Chemical and Materials Quality Assurance Laboratory (CMQAL, formerly MRDL) in Omaha performs most of the water quality analyses for the District and is responsible for technical supervision of water analyses performed by the Water Quality Unit (PM-PR-W) and by contracted laboratories. To do so, CMQAL has established and maintains the laboratory quality assurance and quality control (QA\QC) program.

(2) The elements within PM and EC assigned with responsibility for implementation of the water quality management program are the Water Quality Unit (PM-PR-W) within the Environmental Resources Section and the Water Management Section (EC-HC). The PM-PR-W has the primary responsibility for ambient water quality monitoring, analyses, data management, and reporting. Modeling capability has been put on hold due to workload. The EC-HC has the responsibility for automated monitoring. The automated continuous monitoring effort focuses on the water quality of reservoir releases at Truman and Stockton. Duties include automated equipment maintenance, storage of the data generated, and real-time analysis of that data for obvious problems. Project personnel at the above reservoirs cooperated with the Section in performing daily monitoring, maintenance, and calibration of equipment. Identification of problems in releases by the Water Management Section may result in its requesting special investigation of the problem by PM-PR-W. A complete presentation of EC-HC duties and personnel is presented in the 2002 Reservoir Regulation Activities Report. Grades,

job titles, degrees and years experience in water quality of the one full time staff member of PM-PR-W is as follows:

GS-11-Chemist	M.S.T.-Chemistry	13-years

(3) The PM-PR-W utilizes a mobile laboratory (above) for tests with very short holding times (fecal coliform, filtrations, etc.) and a base laboratory for chlorophyll, pesticide, turbidity, and suspended solids analyses. In addition, there has been a capability to perform algal and benthic invertebrate analyses. Historically, data collected by PM-PR-W were stored on EPA's STORET system to facilitate data management. 1999-2002 data were stored in-house, because of the unavailability of STORET. Data will be transferred to the DASLER data management system and eventually into the NEW STORET data management system as workload permits. Interpretive and summary reports or memoranda on water quality data and issues are written and placed on file in the District Office, Kansas City, Missouri. Some reports are placed on the District's web page.

(4) In addition, 13 District lake projects cooperated in the Water Quality Management Program by sampling monthly for herbicides and nutrients. Project offices participating in 2002 included Clinton, Harlan County, Kanopolis, Long Branch, Pomona, Milford, Perry, Rathbun, Tuttle Creek, Melvern, Hillsdale, Smithville, and Wilson. As part of its special studies program, PM-PR-W performed monthly herbicide and nutrient sampling of Smithville, Hillsdale, and Rathbun Lakes July thru September with Project personnel performing the sampling in April thru June. Stockton, Pomme de Terre, Longview, Blue Springs, and Truman Projects were not requested to participate in the 2002 program since their lakes have historically not had elevated herbicide levels.

Pictures depict Tuttle Creek Project personnel during a typical monthly sampling trip.

b. Coordination with Others

(1) Certain special water quality activities are conducted jointly or under contract with other agencies or groups. A summary of these for 2002 is as follows:

Agency	Project	Type of Investigation	Type of PM-PR-W Work
Natural Resources Conservation Service (NRCS)	Hillsdale	Contaminant Study	Coordination, Data Collection, Analysis, Data Management, & Report Preparation
NRCS	Rathbun	Contaminant Study	Coordination Data Collection, Analysis, Data Management, & Report Preparation
NRCS	Smithville	Contaminant Study	Coordination, Data Collection, Analysis, Data Management, & Report Preparation
Hillsdale Water Quality Project (private)	Hillsdale	Contaminant Study	Coordination & Data Reporting
Iowa State University	Rathbun	Contaminant Study	Coordination, Analysis, & Data Management
Johnson Co. Environmental Dept.	Hillsdale	Contaminant Study	Coordination & Analysis
US Geological Survey (USGS)	Smithville	Contaminant Study	Coordination & Data Reporting

4. SUMMARY OF WATER QUALITY MONITORING ACTIVITY IN THE DISTRICT

Three types of field investigations are possible on reservoir projects. They are pre-impoundment, surveillance, and special investigations. A pre-impoundment investigation is an investigation made before completion of a project to establish baseline stream conditions. A surveillance investigation is the routine sampling at fixed project locations for basic water quality parameters to establish water quality trends at an operating project. A special investigation is the study

of a specific, identified problem to provide additional information on the problem and its solution. Following is a list of field investigations conducted during 2002 with highlights of the special studies:

a. Pre-impoundment Investigations: None

b. Surveillance Investigations: Truman, Stockton, Pomme de Terre, Longview, and Blue Springs

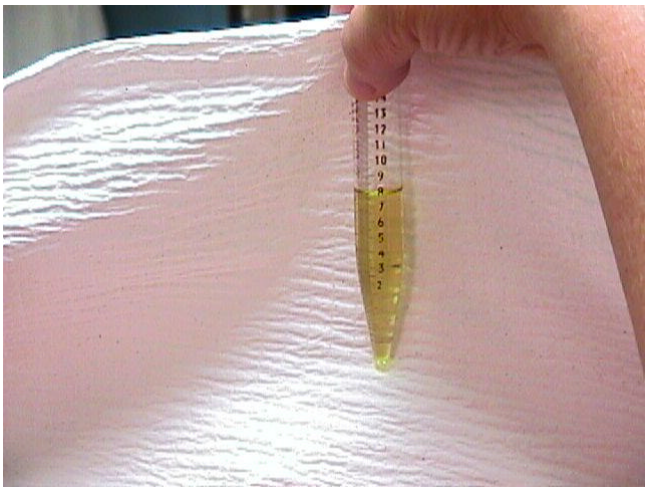
c. Special Investigations:

(1) Hillsdale Nutrient Study. Nutrient loading and accelerated eutrophication from non-point and point sources in the Big Bull Creek watershed have been documented. In an effort to slow the rate of eutrophication, a multi-agency effort continues to reduce non-point contributions and monitor water quality responses through a long-term watershed study begun in 1993. A report of findings for the first five years of the study was presented at the Corps' 1998 National Water Quality Conference. One major action taken during the study was the establishment of lake-specific water quality standards (a mean growing season chlorophyll a concentration of 12 ug/L and mean annual total phosphorus (TP) concentrations for the lake and its tributaries of 0.04 mg/L and 0.10 mg/L, respectively). The second major action taken was the design and implementation of a watershed protection plan. The District continued its monthly lake monitoring in 2002 to assess water quality changes due to these land usage modifications. The water quality unit also performed certain associated analytical work, funded the lake analytical costs not covered by Section 319 Grant money, performed the data entry/management work for the study, and analyzed 2001 data, presenting it in Part II of the 2001 Annual Report. The field and

analytical work included

samples for nutrient and herbicide analyses by the other participating laboratories. Other agencies participating in the study are the Environmental Protection Agency, the Johnson County

profiling of temperature, dissolved oxygen, conductivity, pH, and redox; analysis of chlorophyll a **(pictures depict typical chlorophyll a analysis)**, turbidity, and suspended solids; measurement of euphotic zone and Secchi depth; and collection, pretreatment, and delivery of surface water



Environmental Department, the United States Geological Survey, the Agricultural Stabilization and Conservation Service, the Natural Resources Conservation Service, and the Kansas Department of Health and Environment.

A citizen's group, the Lake Region Resource Conservation and Development Council, Inc., is also a major participant in the Hillsdale Water Quality Project.

(2) Seasonal Pesticide and Nutrient Sampling at Clinton, Perry, Milford, Tuttle Creek, Kanopolis, Wilson, Harlan County, Pomona, Melvern, and Long Branch Lakes. Project personnel sampled each of the above lakes at three lake stations (two depths), inflows (one depth), and the outlet (one depth). Nutrient analyses were performed at the CMQA Laboratory and herbicide analyses were performed at the PM-PR-W Laboratory by immunoassay **(pictures depict typical analysis run for two herbicides)**. Quality Assurance/Quality Control (QA/QC) for the herbicide samples was maintained by forwarding 10% of the samples to the CMQA Laboratory for analysis by Gas Chromatography (GC). This long-term sampling program is scheduled to continue in 2003.

(3) Rathbun Pesticide & Nutrient Study. In the sixth year of the multi-agency, cooperative study of the Chariton watershed, the PM-PR-W and Rathbun Lake Project personnel teamed to perform monthly surveys of four lake stations and the outlet July thru September. Lake Project personnel performed the surveys in April thru June. In addition, 15 tributaries were sampled monthly February thru December by Iowa State University Limnology Laboratory personnel. Chlorophyll a, turbidity, suspended solids, and water transparency parameters were examined in conjunction with pesticide and nutrient sampling. As in the Big Bull watershed studies, the Natural Resources Conservation Service (NRCS) with major support from EPA Section 319 funding assisted in obtaining the voluntary support of the agricultural community in reducing the amount of non-point source runoff. This sampling is planned to continue in 2003.

(4) Smithville Pesticide & Nutrient Study. For its part in the Little Platte watershed studies, the PM-PR-W again performed monthly surveys of

three lake stations, the outlet, and the major tributary July-September with Project personnel performing the surveys April thru June 2002. Physical, chemical, and biological analyses were performed by the PM-PR-W unit and CMQA laboratories.

5. WATER QUALITY CLASSIFICATION

Project water quality conditions have been classified by the following criteria:

a. Class I:

(1) High water quality
(2) No known problems

b. Class II:

(1) Generally good water quality
(2) Minor or suspected problems

c. Class III:

(1) Continuing water quality problems
(2) Requires close monitoring of trends and careful examination of problems

A list of lake projects evaluated according to the above classification scheme follows:

a. Class I: None

b. Class II: Blue Springs and Wilson

c. Class III: Clinton, Harlan County, Hillsdale, Kanopolis, Long Branch, Longview, Melvern, Milford, Perry, Pomme de Terre, Pomona, Rathbun, Smithville, Stockton, Truman, and Tuttle Creek

6. TECHNICAL ASSISTANCE TO OTHERS

PM-PR-W provides technical water quality assistance to other internal District elements, other Districts, other Federal, state, and municipal agencies, universities, and consultants, as well as private citizens. At times, retrieval of water quality data by selected parameters at a particular site or an overall historical data package may be requested. Other requests may be for limited investigations or data interpretation. The following is a summary of the assistance given in 2002:

a. Perry, Clinton, Melvern, Milford, Tuttle Creek, Kanopolis, Wilson, Pomona, Harlan County, Rathbun, Smithville, Hillsdale, and Long Branch Lakes. As part of a continuing

cooperative effort, the 13 Project offices were provided with the equipment and supplies to collect monthly water samples at multiple depths for pesticide and nutrient analysis. Analytical, data management, and logistical support were also provided.

b. Rathbun Special Study. The unit continued to participate in meetings to implement the watershed protection plan for Rathbun Lake. As part of the continuing cooperative effort, Iowa State University was provided with the supplies to collect samples for pesticide and nutrient analysis at 15 inflows to the lake. Analytical, data management, and logistical support were also provided for the eleven-month study.

c. Smithville Special Study. The unit provided water quality data retrievals and annual reports to several agencies and the general public.

d. Long Branch Lake. The water quality unit provided a hydrolab, training, and maintenance support to Long Branch personnel in support of their monthly profiling efforts.

e. Water Management Section's Annual Report of Reservoir Regulation Activities. The unit prepared the water quality section of the EC-HC annual report. In addition, the unit coordinated monitoring efforts with EC-HC to improve DO conditions in the Truman outlet.

f. Supply of Data to Others. Water quality data retrievals were provided to other District elements and outside entities during 2002.

7. TECHNICAL ASSISTANCE FROM OTHERS

The PM-PR-W received technical assistance from the following in 2002:

a. CMQA Laboratory - analyses of samples and QA/QC.

b. Johnson County Environmental Department - analyses of Hillsdale Lake samples.

c. HydroGeoLogic, Inc – transfer of files from old version of DASLER to the newest version of DASLER, a new data management program adopted by the Corps to provide a link for easy transfer of data to the EPA NEW STORET system.

WATER QUALITY ISSUES AND PROBLEMS IN KANSAS CITY DISTRICT LAKES, 2002

Project	Identified Contaminant Problems	Algal Blooms	Potential Problem Areas	Other Identified Problems	Criteria Exceedence
Long Branch	Atrazine	Yes	Non-point pollution, DWS, and blooms	Nutrient enrichment, high turbidity, COD, and TSS	Atrazine
Hillsdale	Atrazine	Yes	Point and non-point pollution, beach bacteriology, DWS, and blooms	Nutrient enrichment, excessive turbidity and TSS, anoxia, and euphotic zone limit	Atrazine and Total phosphorus
Rathbun	Herbicides	Yes	Point and non-point pollution, and DWS	Nutrient enrichment, high turbidity and TSS	Atrazine
Smithville	Atrazine	Yes	Point and non-point pollution, beach bacteriology, blooms, and DWS	Nutrient enrichment, high turbidity and TSS, and fecal coliform	Atrazine
Blue Springs			Non-point pollution	Nutrient enrichment	
Longview			Non-point pollution	Nutrient enrichment	
Truman		Yes	Non-point pollution	Nutrient enrichment, anoxia, high turbidity and TSS	DO

WATER QUALITY ISSUES AND PROBLEMS IN KANSAS CITY LAKES, 2002 (CONT'D)

Project	Identified Contaminant Problems	Algal Blooms	Potential Problem Areas	Other Identified Problems	Criteria Exceedence
Melvern	Atrazine	Yes	Non-point pollution, blooms and DWS	Nutrient enrichment, euphotic zone limit, turbidity and TSS	
Perry	Atrazine, Alachlor, and Metolachlor	Yes	Non-point pollution and DWS	Nutrient enrichment, excessive turbidity and TSS	Atrazine
Clinton	Atrazine & Metolachlor		Non-point pollution	Nutrient enrichment	
Kanopolis	Atrazine		Non-point pollution		
Milford	Atrazine & Metolachlor		Non-point pollution	Nutrient enrichment, excessive turbidity and TSS	Atrazine
Tuttle Creek	Atrazine, Alachlor, and Metolachlor		Non-point pollution	Anoxia, nutrient enrichment, excessive turbidity and TSS	Atrazine and Alachlor
Harlan County	Atrazine		Point and non-point pollution	Nutrient enrichment, fecal coliform, excessive turbidity and TSS	
Pomona	Atrazine	Yes	Non-point pollution	Nutrient enrichment, euphotic zone limit, turbidity and TSS	Atrazine
Stockton		Yes	Point-source pollution	Nutrient enrichment	
Pomme de Terre		Yes	Non-point pollution	Nutrient enrichment	
Wilson			Non-point pollution		

KCD ANNUAL WATER QUALITY ACTIVITY SUMMARY

YEAR: 2002

No. of WQ Monitoring Stations	No. of WQ Studies (Ongoing) & Completed for the Purposes of	No. of WQ Reports	WQ Staff & Contract Work	No. of Outside Assistance (+=rec'd, & -=given)
Reservoir 60	Planning (13) 0	In Progress 7	FTEs	HEC/WES +0, -0
Riverine 42	Operations (0) 0	Completed 10	Full Time 1.3	Other Dist. +0, -0
Other (Outlet, etc.) 18	R&D (0) 0		Part Time 0 Seasonal 2	Others +3, -15
	Other (0) 0		$Contract 4.1k	

Kansas City District

The three most important water quality issues/concerns in 2002:

- Non-point source pollution induced anoxia and excessive turbidity, suspended solids, nutrients, and heavy metals.
- Pesticide contamination limiting drinking water supply.
- Algal blooms creating taste and odor problems in drinking water supply.

List of significant accomplishments during the year:

- Participated in the tenth year of the Big Bull Creek watershed study, which includes implementation of point and non-point source pollution reduction measures to enhance the water quality of Hillsdale Lake.
- Participated in the sixth year of the Chariton River watershed study, which will implement pollution-reduction measures to enhance the water quality of Rathbun Lake.

- Participated in the sixth year of the Little Platte River watershed study, which will implement a watershed protection plan to enhance Smithville Lake water quality. Prepared a report on the first five years of the study.

- Coordinated seasonal pesticide and nutrient sampling at 10 additional lakes. Performed immunoassay analyses on monthly samples and prepared reports on the first six years of this seasonal study.