1996
KANSAS WATER QUALITY ASSESSMENT
(305(b) REPORT)

December, 1996

Kansas Department of Health and Environment
Division of Environment
Office of Science and Support
Forbes Field, Building 283
Topeka, Kansas 66620-0001

1996
KANSAS WATER QUALITY ASSESSMENT
(305(b) REPORT)

December, 1996

Kansas Department of Health and Environment
Division of Environment
Office of Science and Support
Forbes Field, Building 283
Topeka, Kansas 66620

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF STREAM ASSESSMENT MAPS

PART I: EXECUTIVE SUMMARY

This report, the "1996 Kansas Water Quality Assessment", also known as the 305(b) Report, is the biennial assessment of the state's surface water quality as required by 33 U.S.C. 466 *et seq.,* the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act.

The Kansas Department of Health and Environment (KDHE) assessed the water quality of 19,330 miles of streams, of which 17,364 miles were monitored and 1,966 miles were evaluated. A total of 175,260 lake acres were assessed. Of these, 169,689 acres were monitored and conditions of an additional 5,571 acres were evaluated using best professional judgement. Of the 35,597 wetland acres assessed, 25,069 acres were considered monitored.

Guidance by U.S. Environmental Protection Agency (EPA) for the preparation of this report has continued to allow for wide variation in assessment methodologies. This report analyzed 1991-1995 Kansas water quality assessment data. In order to maintain a general level of consistency with the previous 305(b) reports and to allow for the analysis of trends in beneficial uses support over time, KDHE elected to examine data consistent with the beneficial use designations and water quality criteria applied to individual waterbody segments in the Kansas Surface Water Register (KDHE 1994).

The initial guidance by EPA for assessment of the aquatic life support use included only the acute criteria application. Using this approach for determination of aquatic life support, and considering only beach closures in assignment of nonsupport for contact recreation, 73% of Kansas streams did not support all designated uses. Subsequent guidance by EPA directed states to include both chronic and acute criteria for determination of aquatic life use support (ALUS) (Davies and Waygand 1995). Using this latter guidance, 97% of the assessed stream miles did not support all designated uses. All streams supported at least one designated use, and almost 40% of the "nonsupporting" stream segments supported all but one use. Using the initial EPA guidance, an assessment of cumulative designated use stream mileage revealed that 78% of the designated uses were fully or partially supported; using the more stringent chronic ALUS and noncontact recreational criteria, only 55% of the cumulative designated stream miles were fully or partially supported. The major causes of nonsupport, in order of prevalence, are suspended solids, fecal coliform bacteria (FCB) (pathogen indicator), dissolved solids, oxidizable organic wastes, and pesticides. Although these parameters contributed to widespread use impairments, they did not necessarily pose a serious local water quality concern.

Sources responsible for widespread pollutant loadings and beneficial use impairments included agriculture, habitat modification, natural sources, resource extraction, hydromodification, and groundwater withdrawal. Impairments attributable to point sources were substantially less widespread than those attributable to nonpoint sources (NPSs). However, the former often exerted highly significant water quality impacts within given stream segments, and some individual point sources caused or contributed to water quality impairments in multiple downstream surface water segments. Other factors contributing to localized pollution problems included, but were not limited to, combined sewer overflows, construction activities, surface mining activities, and failing septic systems. In a significant number of instances, factors responsible for contaminant loadings were unknown.

Of the assessed lake acreage in Kansas, almost 70% were stable over time, while slightly more than 25% appeared to be degrading over time. Very few lakes in the state showed any appreciable improvement in trophic state condition during this reporting cycle. Agriculture, municipal point sources and natural sources were the primary contributing factors to lake eutrophication.

Wetland studies were conducted as part of the state's overall lake/wetland monitoring program activities. Only public wetlands, comprising about 10% of the state's total wetland acres were assessed. The vast majority of the wetlands within the state are on private lands. The major causes of partial and/or non-support of designated uses in Kansas' wetlands were excessive nutrient load, salinity, high pH, and turbidity. The major sources associated with partial or nonsupport of designated uses were agriculture, watershed hydromodifications, and natural sources.

Kansas groundwater is generally very hard and often contains relatively high concentrations of total dissolved solids (TDS), manganese, and iron. In some areas, elevated levels of ammonia, sulfate, sodium and chloride also occur. These constituents normally pose no serious health concerns; however, they may create aesthetic problems such as scale deposits, stains, odors, and undesirable tastes. During the 1991-95 reporting cycle, high nitrate concentrations accounted for about 64% of the documented exceedences of the federal drinking water maximum contaminant levels (MCLs) in groundwater. The majority of the samples with excessive levels of nitrate were obtained from shallow wells (less than 100 feet) or in wells located in areas of sandy soil and high water tables. Other isolated concerns of groundwater contamination included the presence of volatile organic compounds, heavy metals, petroleum products and/or bacteria. The major sources of these contaminants included active industrial facilities, spills, leaking or overflowing lagoons, leaking storage tanks, mineral extraction activities, and agricultural operations.

The imposition of more stringent permit limits and the resulting upgrades of municipal and industrial wastewater treatment facilities have resulted in several notable improvements in surface water quality. As the number of point sources causing or contributing to significant water quality impairments continues to decline, future attention will necessarily shift to the remaining sources, primarily NPS related water quality problems. It is anticipated that watershed pollution control efforts, predicated on the development of TMDL's (total maximum daily loads) and on the allocation of allowable pollutant loadings among point, nonpoint and natural sources, will play an increasingly important role in the abatement of surface water pollution in Kansas. The Governor's multi-agency water quality initiative for the Kansas/Lower Republican Basin is designed to protect and restore the quality of Kansas surface waters.

Recommendations for improving water quality focus on consideration of the development of (1) surface water quality goals for all major river basins and implementation of long-term management plans to achieve those goals, (2) sediment quality standards for streams, lakes, and wetlands, and (3) ambient groundwater quality standards and groundwater clean-up (remediation) standards. Additionally, because states differ in their approach to beneficial use designations and water quality criteria development, and because methods and resources for water quality assessment and data analysis vary among states and regions, information presented in 305(b) reports should not be directly compared among states. It is recommended that EPA acknowledge this lack of consistency and take steps to discourage such potentially misleading comparisons.

PART II: BACKGROUND

Kansas comprises a land surface of 81,778 square miles. Runoff from this surface is drained by 134,338 miles of streams distributed among twelve major river basins. Surface water impoundments in Kansas are conservatively numbered at 120,000. The state's 291 publicly owned reservoirs ("lakes") represent a surface area of 175,260 acres and account for most of the state's lake acreage and volumetric storage capacity. Kansas also contains an estimated 370,000 acres of wetland. About 36,000 acres of wetland are publicly owned or otherwise open to the general public for recreational and educational purposes (Table 1).

Much of Kansas is underlain by porous geological formations containing appreciable quantities of groundwater. The largest such formations consist of unconsolidated materials (gravel, sand, and silt) deposited by streams. Some unconsolidated glacial deposits and consolidated bedrock formations also contain appreciable quantities of groundwater. The total freshwater storage in all major Kansas aquifers is estimated at 590 million acre-feet.

Table 1. Kansas Atlas

TOPIC	VALUE
State population	2,554,047
State surface area in square miles	81,778
Number of major river basins	12
Total number of interior stream miles (EPA RF3/DLG) Number of border stream miles Number of perennial stream miles Number of intermittent stream miles Number of ditch and canal miles	134,338 120 23,731 110,225 382
Number of lakes/reservoirs/ponds (publicly owned)	291
Acres of lakes/reservoirs/ponds (publicly owned)	175,260
Acres of public freshwater wetlands	35,597

Surface Water Pollution Control Program

Watershed Approach

In a letter to the EPA regional administrator dated November 12, 1993, the department committed to the development of Total Maximum Daily Loads (TMDLs) for water quality-limited surface waters in each of the state's twelve major river basins. The anticipated outcome of this effort was the development .and adoption of allowable pollution loadings for individual watersheds and/or

hydrological units, pursuant to sections 303(d) and 303(e) of the federal Clean Water Act (CWA). This effort concentrated initially on the Kansas/Lower Republican River Basin. Over the next two years, similar TMDL development efforts will focus on the Walnut, Verdigris, and Upper Arkansas basins, followed in order by the Cimarron, Neosho, Solomon, Smoky Hill/Saline, Lower Arkansas, Marais des Cygnes, Upper Republican, and Missouri basins. These efforts are intended to resolve known water quality problems and minimize the risk of over-allocating available dilution capacity in the future.

In July 1994, the department was awarded a section 104(b)(3) grant from EPA for the purpose of developing and evaluating a watershed approach to surface water quality management based on geographic information system (GIS) methodologies. Specific objectives included (1) the organization and analysis of data from compliance monitoring activities by receiving stream reach, (2) the organization of 305(b) reports and other statewide water quality assessments by stream reach, hydrological unit, and major river basin, (3) the creation of procedural tools needed to determine the effects of widely separated point sources on surface water quality, and (4) the development of conceptual models for jointly addressing the impacts of point and NPSs on water quality. The final project report is scheduled for completion in December 1997.

On October 19, 1995, Governor Graves announced a multi-agency initiative dedicated to the improvement and maintenance of water quality conditions within the state. Participating agencies included the Kansas Water Office (KWO), the State Conservation Commission (SCC), and the departments of Health and Environment, Agriculture, and Wildlife and Parks. Collectively, these agencies were charged with the development and implementation of workable pollution control strategies for point and NPSs, with special emphasis on voluntary and incentive-based strategies. Among the more important aspects of this initiative were (1) an enhancement of existing water quality and hydrological monitoring activities, (2) the acquisition of reliable, watershed-specific data on prevailing livestock and cropland management practices and pesticide/fertilizer application rates, and (3) the utilization of GIS in the identification and resolution of water quality problems. The Kansas/Lower Republican River Basin was chosen as the pilot basin for this initiative.

Several other watershed-based pollution control efforts have been implemented by the department. These include the development of a proposed site-specific phosphorus criterion and associated TMDL for Hillsdale Lake, a large multipurpose reservoir in northeastern Kansas. Based on three independent studies conducted over the past decade and on the results of water quality modeling activities conducted by the department, wasteload/load allocations have been proposed for point and NPSs of phosphorus located upstream of the lake. The department also completed an EPA-funded study of the effects of nutrient loadings from small sewage treatment facilities on watershed impoundments. The results of this study should provide the foundation for as many as seven additional TMDLs.

In the determination of permit limits for individual point sources, the department has long considered "background" pollutant loadings attributable to upstream point and NPSs and to natural (biogeochemical and hydrological) processes occurring within the watershed. Permits commonly contain limits which are based on the remaining, allocable dilution capacity of the receiving stream, as determined through the department's ongoing water quality monitoring activities (see Part III, this report). To date, 131 municipal, 125 industrial, and 6 federal facilities in Kansas have been issued permits containing such watershed and water quality-based limits.

Water Quality Standards

The Kansas surface water quality standards (K.A.R. 28-16-28b through 28-16-28f) establish water quality goals for all streams, lakes, and wetlands occurring within the state or forming a portion of the border with an adjoining state. General narrative provisions within the standards extend a basic level of protection to all such waters, irrespective of size or ownership.

Classified surface waters comprise a large subset of the waters of the state and are subjected to additional narrative and numeric water quality criteria. Classified streams include all streams with mean summer base flows exceeding 0.003 cubic meter per second (0.1 cubic foot per second) and all smaller streams wherein pooling of water during periods of zero flow allows for biological recolonization of intermittently flowing segments. Classified lakes include all publicly owned lakes and all privately owned lakes providing facilities for public recreation. Classified wetlands include wetlands owned by federal, state, county, or municipal authorities (exclusive of wetlands created for the purpose of wastewater treatment) and all privately owned wetlands open to the general public for recreational or educational purposes.

The standards also designate the beneficial uses of classified surface waters and establish water quality criteria necessary to protect and maintain these uses. At a minimum, all classified surface waters are designated for noncontact recreation and one of three categories of aquatic life support (special, expected, or restricted). Other beneficial uses recognized under the Kansas standards include contact recreation, food procurement, domestic water supply, industrial water supply, livestock watering, irrigation, and groundwater recharge. These latter uses are assigned on a case-by-case basis and only where they constitute existing uses (as defined by 40 CFR 131.10) or are otherwise deemed attainable based on studies conducted or accepted by the department.

The designated uses of all major streams, lakes, and wetlands are delineated in the Kansas Surface Water Register (KDHE 1994). This document assigns identification numbers and geographical (latitude/ longitude) descriptors to individual waterbody segments based on EPA river reach files (RF2 and RF3). Waterbody segments in the register are grouped by major river basin and hydrological unit code. Locations of all listed segments are depicted in an accompanying series of maps, which are similarly organized by river basin and hydrological unit code. By "georeferencing" waterbody segments and corresponding use designations in this fashion, the register may be expressed as a GIS coverage and used with other spatial databases in the development of water quality assessment reports, TMDLs, and appropriate water pollution control strategies.

In the amended standards (August 29, 1994), 100% of all listed streams were designated for aquatic life support and noncontact recreation, 59% for food procurement, 37-39% for domestic water supply, industrial water supply, irrigation, livestock watering and groundwater recharge, and 29% for contact recreation. One hundred percent of all lake acres were designated for aquatic life support, food procurement and noncontact recreation, 92% for contact recreation, 80-82% for domestic and industrial water supply, 15% for irrigation, seven percent for groundwater recharge, and less than one percent for livestock watering. In addition, four percent of all listed stream miles and 67% of all listed wetland acres were classified as "outstanding natural resource waters" and subjected to the highest level of protection under the antidegradation and mixing zone provisions of the standards.

Another round of public hearings on the Kansas surface water quality standards will be scheduled for the spring and summer of 1997. A series of informational meetings will be held prior to these formal hearings to encourage public participation in the standards review and revision process. Topics of particular interest will likely include (1) the beneficial use designations of intermittent and

ephemeral streams in western Kansas and selected smaller streams in eastern Kansas, (2) the feasibility of additional narrative or numeric biocriteria, and (3) the appropriateness of current aquatic life support criteria for chloride, atrazine, various metals, and temperature.

Point Source Pollution Control

The Kansas point source program was first developed in 1907 (K.S.A. 65–161 *et seq.*) and has been modified on several occasions in accordance with the Federal Water Pollution Control Act and its subsequent amendments. The federal regulations implementing this law are found in Title 40 of the Code of Federal Regulations. This program helps to protect and improve surface water quality by regulation of wastewater treatment systems for municipal, federal, industrial, and commercial sewage facilities, storm water, and certain larger livestock waste treatment facilities. As discussed later in this report, smaller livestock facilities (less than 300 animal units) and other diffuse sources of pollutants are addressed by the NPS Control Program.

Kansas administers both federal and state laws governing the treatment, reuse, and discharge of wastewater and treated effluent. The Kansas Department of Health and Environment is responsible for the review and approval of the engineering plans and specifications and for overseeing operator training and certification, pretreatment programs administered by local wastewater utilities, treatment plant compliance review, and operation of municipal wastewater collection systems (including new, upgraded, or expanded treatment facilities). Non-overflowing wastewater treatment systems are regulated by the Kansas Water Pollution Control (KWPC) permitting system (K.S.A. 65-165). National Pollutant Discharge Elimination System (NPDES) permits are required for all discharging municipal, federal, industrial, and commercial wastewater treatment facilities, and certain livestock operations. Discharges from wastewater treatment systems are authorized by KDHE pursuant to technological effluent limitations and Kansas surface water quality standards. Permits are issued for a period of no more than five years and are reviewed prior to reissuance.

Agricultural water pollution control permits are required for all structures, devices, impoundments, or other facilities used to retain wastewater generated by livestock operations or runoff resulting from rainfall upon exposed livestock facilities. Livestock facilities which do not utilize control facilities, do not currently pose a potential for water pollution problems, and are not subject to NPDES permit requirements and are issued a certification of compliance. Livestock operations which are required to be registered under the requirements of K.S.A. 65-166a, K.S.A. 65-17d, and K.S.A. 28-16-58 through K.S.A. 28-16-63 must be in conformance with the terms of an issued permit or compliance certification. The following types of livestock operations are specifically regulated by the department:

1. Any facility, regardless of size, determined by KDHE to present a significant water pollution potential including but not limited to the following:

a. all livestock operations that utilize wastewater control facilities i.e., manure pits, ponds, lagoons, or other devices;

b. open lots located across or adjacent to creeks, streams, intermittent waterways, or any other conveying channel or device;

c. any operation which cannot retain or control wastewater or waste solids upon the operator's property;

d. any operation observed to practice improper disposal of livestock wastes (liquid or solid and) which has the potential to degrade or impair the quality of any waters of the state (surface or groundwater);

e. any facility that generates wastewater and releases it on a daily or more frequent basis;

2. Any confined animal feeding facility with a designed animal unit capacity of 300 or more and posing a significant water pollution potential.

3. All facilities with design animal unit capacities of 1,000 or more, regardless of pollution potential.

4. Sale barns and collection centers with an average capacity exceeding 300 animal units or which are utilized more than once a week.

5. Any other animal feeding operation whose operator elects to come under these statutes and regulations.

6. All livestock truck wash facilities.

Table 2 lists the number of KWPC and NPDES permits issued by type of facility. The fifty-seven "major" wastewater treatment facilities in Kansas are inspected annually by KDHE district staff. "Minor" facilities, are defined as generally anything discharging less than 1 million gallons per day (actual flow). Non-discharging facilities are inspected less frequently, but at least once every five years. During federal fiscal years (FFY) 1991, 1992, 1993, 1994, and 1995, KDHE staff inspected 504, 742, 474, 715, and 394 wastewater treatment facilities, respectively.

Table 2. Number of Active KWPC and NPDES Permits, FFY 1991-1995

NUMBER OF PERMITTED FACILITIES					
Municipal and Commercial		**Industrial/Federal**		**Agricultural**	
Total Municipal & Commercial KWPC (non-overflowing)	451	Total Industrial/ Federal KWPC (non-overflowing)	132	Agricultural NPDES	384
Discharging Lagoons	275	Total Industrial (discharging)	354	Agricultural State	1521
Mechanical Treatment Facilities	204				
Total	**930**		**486**		**1,905**

Additionally, KDHE maintains its own program of compliance monitoring as required by the NPDES process (Appendix Part I. A1.) . Approximately 75 discharges are monitored each year for permit limited parameters (Figure 1; Appendix Part I. A1& I.A2.). From FFY 1991 through 1995, the department's compliance review activities for wastewater treatment facilities resulted in the issuance of 78 consent and administrative orders and in the collection of $132,156 in related penalties.

Wastewater treatment facilities (WWTFs) in Kansas have a very high permit compliance record due in part to non-overflowing waste stabilization ponds (considered to be in 100% compliance provided they do not discharge) and to discharging waste stabilization ponds (reliable and easily operated and maintained treatment systems). Table 3 presents the facility compliance record for discharging facilities for FFY 1991 through 1995. "Absolute" or 100 % compliance means a facility did not exceed an effluent limit during any monitoring period. The monitoring interval is typically one calendar month, except for municipal and commercial waste stabilization ponds which adhere to a quarterly schedule.

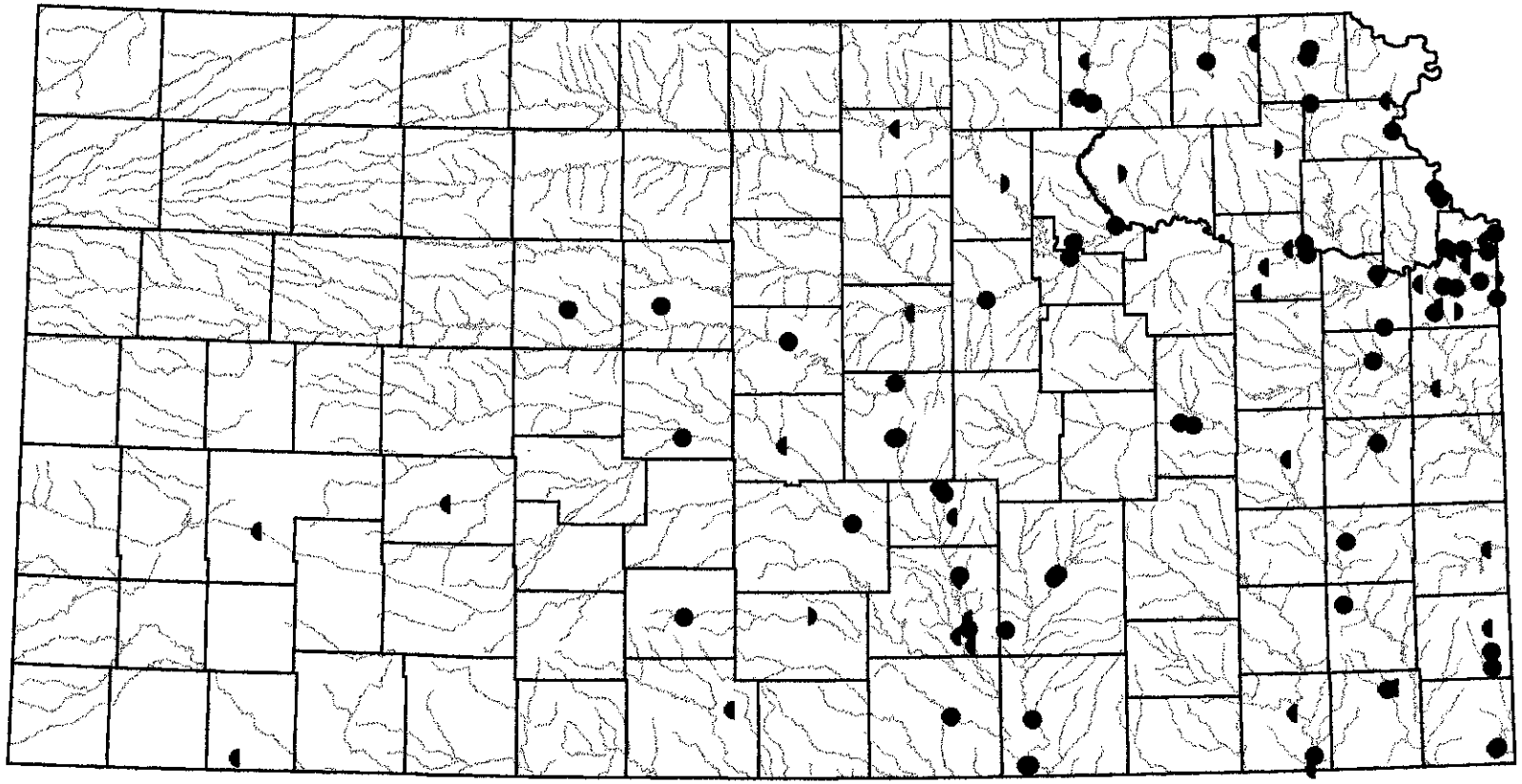
Table 3. Permit Compliance Record. "Absolute" Compliance for WWTFs Excluding Non-Discharging Lagoons.

YEAR	TYPE OF FACILITY		
	MUNICIPAL & COMMERCIAL	INDUSTRIAL	AGRICULTURAL
1991	91%	92%	NA
1992	92%	95%	NA
1993	88%	94%	97% (est.)
1994	84%	94%	97% (est.)
1995	NA	NA	97% (est.)
TOTAL NUMBER	**479**	**354**	**384**

NA = not available est. = estimated

The wastewater permit review process provides detailed evaluation of WWTFs prior to permit reissuance. The level of review depends on the type of wastewater being treated, reliability of the type of treatment process provided, and potential adverse impact on the receiving stream. Permits are reviewed for compliance with KDHE regulations to insure that design capacity is sufficient for waste flows and pollutant volume, and to review any operational, maintenance, or compliance problems. At the time of permit review, KDHE also reviews the status of operator certification.

FIGURE 1. EFFLUENT COMPLIANCE AND TOXICITY MONITORING NETWORKS



KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

◗ Toxicity Site

◖ Compliance Site

Effluent Toxicity Monitoring

The department routinely considers whole effluent toxicity in its review of municipal and industrial permits. Definitive whole-effluent toxicity (WET) tests are conducted on effluent from all major treatment facilities and selected smaller facilities (Figure 1; Appendix Part I. A 2.). Such tests involve the exposure of laboratory-reared fathead minnows (*Pimephales promelas)* and water fleas *(Daphnia pulex)* to a series of five different effluent concentrations, ranging from 100% effluent to a control of 100% biologically conditioned aquarium water. The use of multiple concentrations greatly enhances statistical confidence in the test results. If a discharge exhibits toxicity in a WET test and the toxicity has the potential to adversely affect the receiving stream at the 7Q10 low flow condition, repeated WET testing is conducted by KDHE. Failure of one or both of these initial tests generally leads to the inclusion of WET testing requirements and/or limits in the discharging facility's NPDES permit. Of the 111 definitive tests conducted by the department from calendar year 1991 through 1995, 84 (76%) indicated no significant potential for the development of acutely toxic conditions in the receiving stream.

Nonpoint Source Pollution Control

The primary goal of the Kansas NPS pollution control program is to eliminate surface water and groundwater quality impairments attributable to NPS pollution. In pursuing this goal, the program endeavors (1) to inform Kansans about the seriousness of NPS pollution, (2) to improve communication and coordination among agencies, organizations, and individuals having shared NPS pollution control interests and responsibilities, and (3) to enhance the public's willingness and ability to commit to effective NPS pollution control practices.

The Kansas program is a collaborative effort involving many federal, state and local governmental units and private sector organizations. The responsibilities of the various participating agencies and organizations are summarized in Table 4. The Kansas Department of Health and Environment and SCC are the primary agencies of this program. The department is responsible for coordinating and maintaining the Kansas NPS Management Plan and for administering the Local Environmental Protection Program (LEPP) and the NPS grant program under section 319 of the CWA. The State Conservation Commission administers the Kansas NPS Control Fund and coordinates and supports the efforts of the state's 105 county conservation districts. These districts are responsible for implementing the NPS pollution control program at the local level.

Local Environmental Protection Program -- The LEPP, administered by KDHE and funded by the KWO under the auspices of the State Water Plan, provides financial assistance to local governmental units to develop and implement a local environmental protection plan. The authorizing statute requires the local environmental protection plan to include a sanitary code and to provide plans to address subdivision water and wastewater, solid waste, hazardous waste, public water supply protection, and NPS pollution. A total of $9.3 million has been provided during the seven years of the program. Presently, 97 of 105 Kansas counties are participating in the program. Environmental code adoption has been a priority effort since the beginning of the program. Since initiation of the LEPP in 1989, the number of counties which have adopted local codes has increased from 30 to 74. The status of code adoption is shown in Table 5 and Figure 2a.

Table 4. Kansas Nonpoint Source Pollution Control Partners

ORGANIZATION	PRINCIPAL RESPONSIBILITIES
Kansas Department of Health and Environment	Administer Kansas Local Environmental Protection Program. Administer Section 319 Grant Program for technical assistance, technology development and transfer, information and education NPS pollution control demonstration projects, watershed demonstration projects, wellhead protection demonstration projects. Technical assistance with identifying NPS pollution problems, determining water quality goals, selecting appropriate pollution control measures. Maintain Kansas NPS Poliution Control Plan. Administer livestock pollution control program, including technical assistance, permit administration, and enforcement. Administer wellhead protection program. Administer water well statutes and regulations, including abandoned well plugging. Administer on-site wastewater regulations in Kansas counties with no local code. Technical assistance for riparian area management and bio-technical steam bank stabilization.
State Conservation Commission	Administer Kansas NPS Pollution Control Fund. Technical Assistance to County Conservation Districts. Administer Wetland and Riparian Area Protection Program.
Kansas Department of Agriculture	Administer Kansas Pesticide Act.
Kansas Water Office	Administer Kansas Water Planning Act.
Kansas Cooperative Extension Service	Provide information, education, and technology transfer.
Kansas State & Extension Forestry	Riparian area management technical assistance. Administer State Forestry Program
Kansas Department of Wildlife and Parks	Riparian area management technical assistance
Natural Resources Conservation Service	Technical assistance to County Conservation Districts
Local Environmental Protection Programs	Develop and implement Local Environmental Protection Plans Administer on-site wastewater treatment requirements Administer information and education program
County Conservation Districts	Coordinate development and maintenance of Local NPS Pollution Management Plans. Develop and administer NPS pollution control project work plans. Provide information, educational services, and technical assistance.
Private Sector Organizations	There are a variety of private sector organizations that provide various NPS pollution control information and educational services; examples include Kansas Farm Bureau, Kansas Rural Center, etc.

Table 5. Summary of Local Environmental Code Adoption

STATUS	NUMBER
Adopted and Being Administered	74
Approved for Adoption	6
Being Developed	11
No Action	1

Kansas Nonpoint Source Pollution Control Fund – The Kansas NPS Pollution Control Fund is established through the Kansas State Water Plan Fund and is the principal means of achieving widespread implementation of NPS pollution control. In the six years of the program, about $2.2 million has been expended to address NPS pollution problems. To be eligible to secure Kansas NPS Pollution Control Funds, the county conservation district must first prepare a Local NPS Pollution Management Plan. Sixty-one county conservation districts now administer management plans (Figure 2b). These plans identify water quality goals for a local planning area (typically the county), identify the categories of pollution sources present in the planning area, establish minimum recommended pollution control practices for each source category, identify implementation partners, and set out an implementation strategy. Once the local plan is found to be consistent with the state requirements, the conservation district may submit a project work plan to implement the local plan. The project work plan is essentially an application for funding.

Section 319 Nonpoint Source Pollution Control Grants – The KDHE is the grantee of record for CWA section 319 grants. Approximately $650,000 is used annually to maintain KDHE's NPS Pollution Control Section. The remaining funds are used to support partner sponsored projects including information and education, watershed pollution control demonstration, groundwater and wellhead protection, technology transfer, and technical assistance. The locations of current and planned Section 319 supported projects are shown in Figure 3.

Costs and Benefits of Water Pollution Control

Water pollution control programs can provide social and economic benefits to both users and non-users of water resources. Users are those who benefit directly by instream use of the resources (i.e., swimming, boating, shoreline recreation, fishing, irrigation, livestock watering, and water supply). Potential users are those who may have a potential future use, or who value the preservation of the resource as a diverse ecosystem. Non-users are those who receive no "direct" benefits; however, everyone receives an "indirect" benefit, especially in increased public health protection, decreased nuisance conditions, and a generally improved environment.

Public officials often believe a comparison of costs and benefits will determine the relative value of any investment. However, determining a cost/benefit ratio for environmental programs is no simple task. Costs can be measured, estimated, and/or extrapolated relatively easily. Program costs include regulation, monitoring, research, and development while implementation costs include administrative costs, capital investment, and operational costs for municipal, industrial, commercial, and agricultural facilities. Assignment of a monetary value to the benefits of improved water quality is much more difficult.

FIGURE 2a: COUNTIES WITH ENVIRONMENTAL CODES ADOPTED

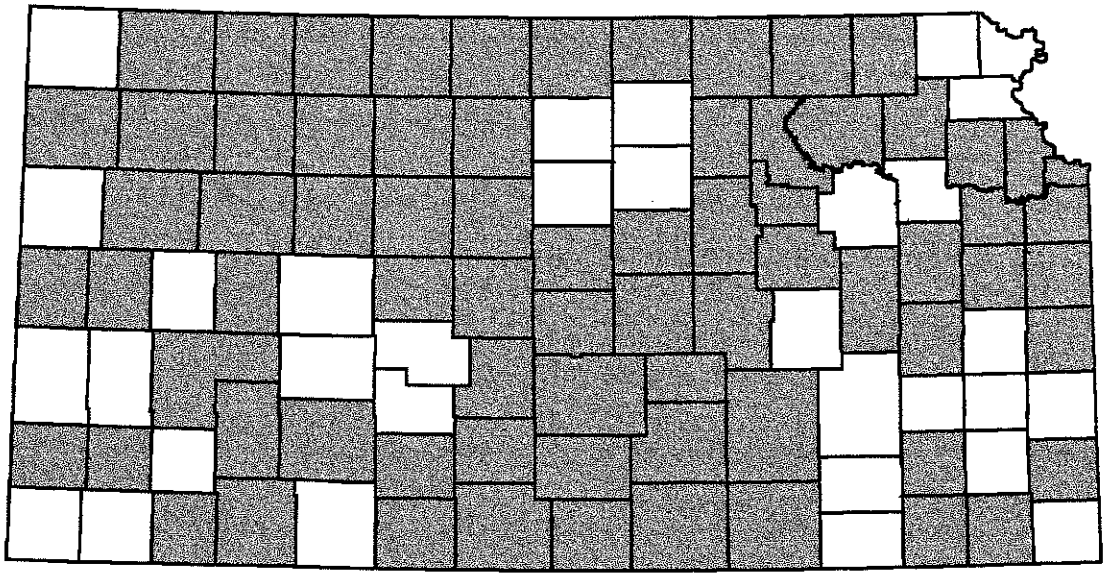
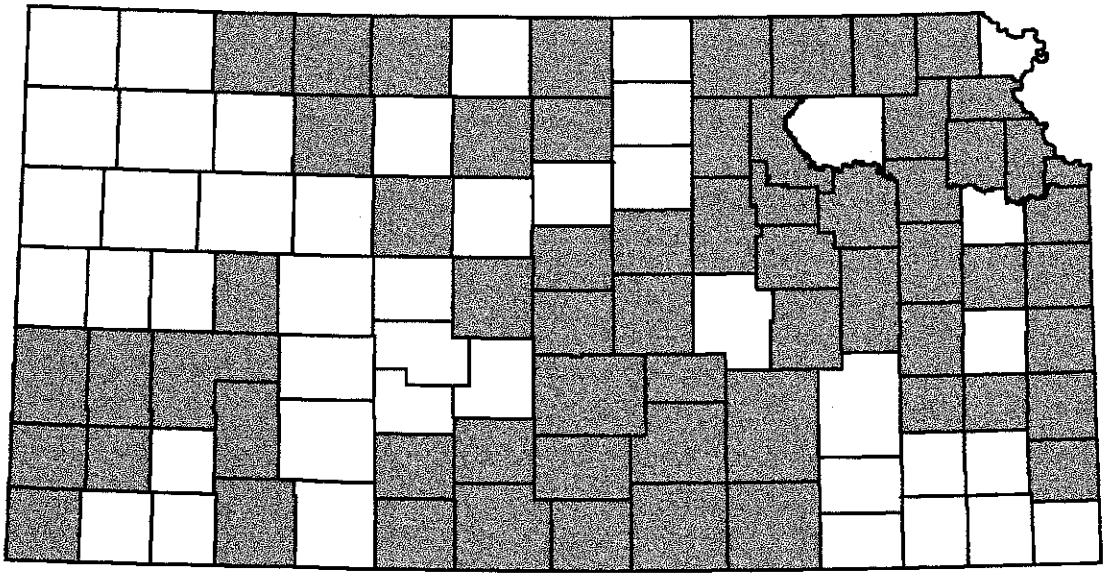


FIGURE 2b: APPROVED NONPOINT SOURCE POLLUTION MANAGEMENT PLANS*

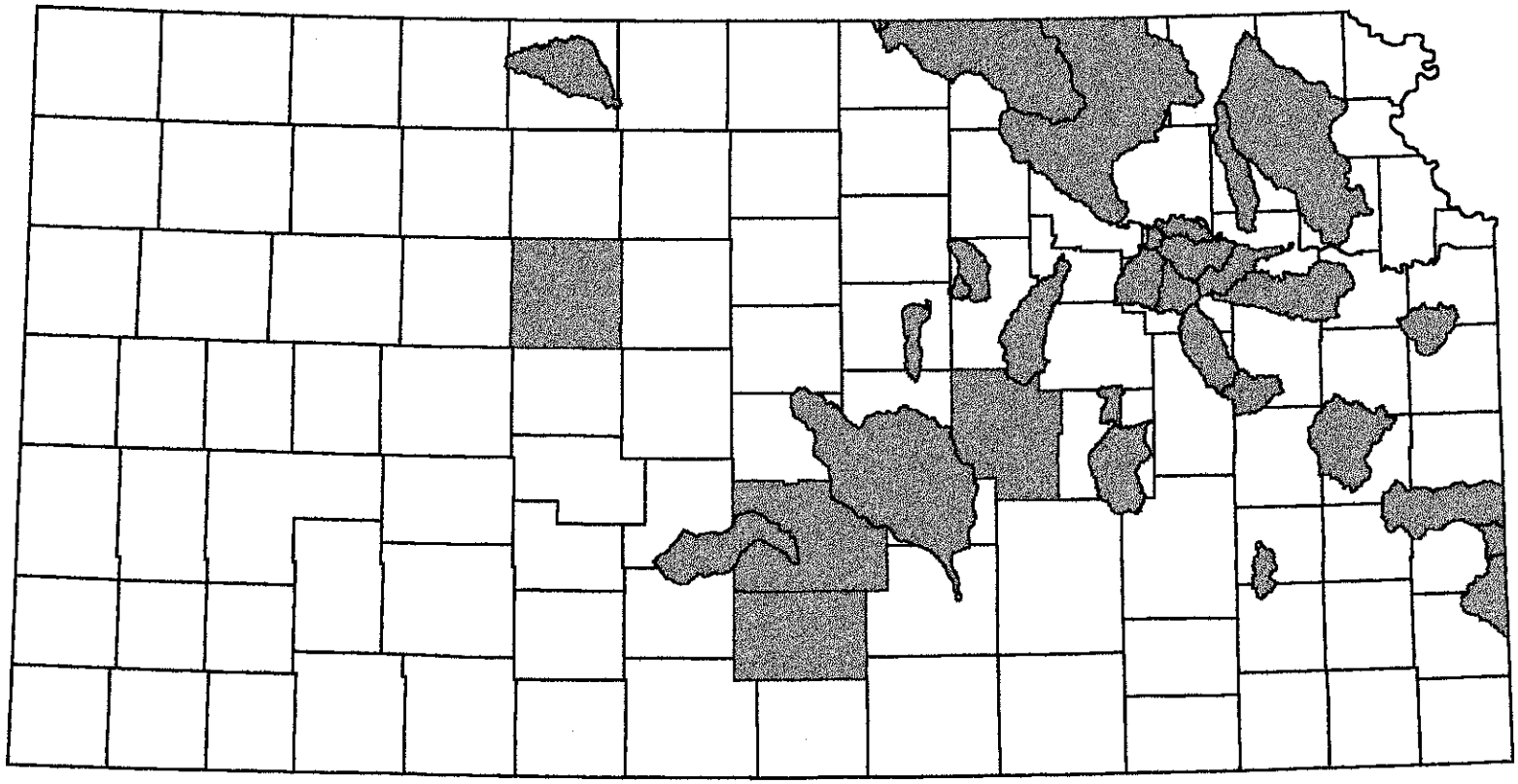


*as of 2/1996

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

FIGURE 3. CURRENT AND PLANNED 319 PROJECTS



KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

The cost of water pollution control programs can be gauged, in part, through direct capital investments made in wastewater treatment facilities. There is minimal information available to KDHE regarding the costs of privately owned industrial or agricultural facilities; however, capital expenditures associated with the upgrading of municipal facilities are well documented.

The department has been responsible for administering the Federal EPA Construction Grants Program (CG) under delegation from EPA Region VII. In the past this funding program provided grants for 55% of allowable project costs. Monies available through this program have been greatly reduced. However, KDHE also administers the Kansas Water Pollution Control Revolving Fund (KWPCRF) which provides low interest loans to municipalities for water pollution control projects. Available monies have significantly increased over the current reporting period, primarily due to KDHE's efforts in the sale of a "leveraged revenue bond" that has provided an additional $47.3M for project financing. The staff of KDHE also coordinate with the Community Development Block Grant (CDBG) program which typically provides 50% grants for projects, and the Farmer's Home Administration (FmHA, now the Rural Development Administration) which typically provides financing with both grant and loan monies for all costs of a municipal wastewater facility improvement. Facility improvements from FFY 1991 through 1995 are estimated at $145.8M including state and federal financial aid of $128.5M (Table 6).

Table 6. KDHE Cooperative Funding for Construction of Municipal Wastewater Treatment Facility Upgrades and Expansions. Monetary units given in millions of dollars, $M.

YEAR OF FUNDING (FFY)	CG		KWPCRF		CDBG		FmHA
	FEDERAL	TOTAL	BASIC	LEVERAGED	FEDERAL	TOTAL	TOTAL
1991	11.596	25.768	8.773	0	1.706	2.107	0.186
1992	1.903	3.460	19.886	0	1.425	1.933	0.203
1993	0.505	0.918	33.529	47.3	1.484	1.780	1.323
1994	1.623	2.951	6.085	0	3.517	7.672	0
1995	0.665	1.209	19.927	0	3.143	6.417	0.896
Total	16.292	34.306	88.200	47.3	11.275	19.909	2.608

There have been several notable improvements in the quality of receiving streams as a direct result of these funding programs. For example, the completion of new nitrification and disinfection facilities at the Wichita WWTF in 1990 dramatically reduced concentrations of ammonia and FCB in the Arkansas River. Comparisons of water quality data for the periods 1987-89 versus 1991-93 revealed a 10-fold reduction in the median level of ammonia and a 94-fold reduction in the median concentration of FCB. Although no detailed biological survey has been performed since the upgrading of the Wichita WWTF, Kansas Department of Wildlife and Parks (KDWP) staff have reported an overall increase in the diversity of the fish community downstream of the city. Similar improvements in water quality have been documented at several other locations in Kansas.

Examples include Indian Creek in Johnson County, the Cottonwood River below Emporia, the Walnut River downstream of El Dorado, and the Smoky Hill River below Salina.

During 1991-1993, the CG and the KWPCRF gave high priority to and directed funds toward several water quality improvement projects. These included upgrades to large facilities serving McPherson, Newton, Pittsburg, Emporia, Salina, Topeka, Hays, and Holton. Regionalization projects also were initiated to improve water quality by removing older treatment facilities from service. These involved the Salina-Schilling facility, the Forbes Field facility (south of Topeka), and seven treatment facilities within the Mill Creek regional service area of Johnson County.

Major Water Pollution Concerns

Agriculture exerts a singularly important influence on surface water quality conditions in Kansas. Erosion of croplands produces elevated concentrations of silt and other suspended materials in streams and lakes, often to the detriment of native aquatic and semiaquatic life. The presence of nitrogen- and phosphorus-containing fertilizers in stormwater runoff promotes nuisance growths of algae and detracts from the recreational uses of surface water. Stormwater runoff from feedlots, livestock wintering areas, and heavily grazed pastures introduces fecal pathogens and oxygen consuming organic wastes to nearby lakes and streams, detracting from the sanitary condition of these waters. Pesticide residues in some drinking water supply lakes and streams pose unacceptable, long-term risks to human health and add substantially to the costs of drinking water treatment. Withdrawal of surface water for use in irrigation raises concerns by eliminating the very habitat needed by aquatic life.

Discharges of wastewater from municipal and industrial WWTFs also exert a notable influence on surface water quality. Heavy loadings of inorganic nitrogen and phosphorus from some sewage treatment plants encourage blooms of filamentous or scum-forming algae in downstream waters and impair the recreational uses of many streams. Discharges of nondisinfected effluent from WWTFs release potentially harmful levels of microbial pathogens, whereas the addition of chlorine or other disinfectants to treated sewage or industrial cooling water discharges sometimes results in acutely toxic conditions in receiving streams. Bypasses of raw or partially treated sewage occur each year owing to treatment plant malfunctions, operator error, or natural catastrophes. Such bypasses often result in fishkills or other conspicuous water quality problems.

Stormwater runoff from roadways and urban areas contains a wide assortment of contaminants, such as trash, oil, grease, antifreeze, deicing salts, weed control chemicals, insecticides, solvents, paints, detergents, and high levels of silt and other suspended materials. Improper disposal or application of lawn and garden chemicals sometimes results in the complete elimination of aquatic and semiaquatic life from urban streams. Downstream of many urban areas, concentrations of bioaccumulative pesticides (e.g., chlordane) in bottom feeding fish preclude the safe consumption of these fish by humans as per published advisories and pose potential threats to wildlife.

Water quality and the aesthetic attributes of many streams in the state continue to be degraded by the illegal dumping of trash, garbage, rubbish, offal, discarded building and construction materials, car bodies, tires, wire, appliances, and other unwanted or discarded materials. The commonplace practice of discarding grass clippings into streams (and the subsequent decay of these materials) reduces dissolved oxygen levels and jeopardizes native populations of fish and other aquatic life.

Empty paint cans or pesticide containers discarded in or near streams may leach appreciable quantities of toxic materials and pose a serious threat to resident aquatic and semiaquatic life.

Physical Concerns

Erosion of farmland soils continues to impair surface water quality throughout the state by greatly elevating concentrations of suspended solids in streams and prematurely filling ponds and reservoirs with sediment. No recommendations are made below concerning this problem because it is currently being addressed through several governmental and public participation programs and through the Governor's water quality initiative.

The recent transformation of many streams of historical perennial flow into dry channels or intermittent or effluent-sustained waterbodies has resulted in a decline in dilution base and in a widespread reduction in surface water quality. Efforts to establish minimum desirable stream flows and implement other protective measures have been initiated.

There exists a concern over the widespread, illegal dumping of garbage and other solid wastes into both intermittent and perennial streams. No recommendations are made below concerning this subject because it currently is being addressed through several governmental and public participation programs.

Thick deposits of calcareous sludge continue to accumulate downstream of some urban areas from drinking water treatment (water softening) sludge disposal practices. No recommendations are made below concerning this subject because it is being addressed through existing regulations and administrative actions to eliminate these discharges.

Chemical Concerns

Use of the agricultural herbicide atrazine continues to result in detection in drinking water supply lakes and streams. This problem is most widespread in the traditional "cornbelt" region of northeastern Kansas, where surface water provides the primary source of drinking water for several hundred thousand people. Atrazine is one of three water quality parameters receiving special attention under the Governor's water quality initiative.

Bottom-feeding/bottom-dwelling fish in many urban areas contain concentrations of the insecticide chlordane which exceed the recommended federal criteria for protection of human health and predatory wildlife. This pesticide's registration was suspended by EPA in 1988, and concentrations in fish should decline to safer levels over time.

Accelerated rates of lake eutrophication are occurring throughout much of Kansas owing to heavy loadings of nitrogen and phosphorus from agricultural sources and WWTF discharges. No recommendations are made concerning this problem because it is being addressed through existing and proposed regulations and voluntary programs.

Elevated and potentially harmful levels of fluoride occur in some streams as a result of discharges from industrial point sources. This problem is being addressed through existing regulatory programs.

High levels of unionized ammonia below several major WWTFs have markedly reduced the diversity of native aquatic and semiaquatic life. No recommendations are made below concerning this problem because it is being addressed through existing regulatory programs.

There has been a gradual salinization of many central Kansas streams owing to reductions in flow, the intrusion of highly mineralized groundwater, discharges of sodium and chloride-enriched effluent from resource extraction facilities, the seasonal introduction of irrigation return flows, and salt contributions from some industrial and municipal point sources. This problem is being addressed through existing water allocation and water pollution control regulations and voluntary programs.

Biological Concerns

Nondisinfected discharges from municipal WWTFs and pathogen-enriched agricultural runoff have impaired the sanitary condition of many lakes and streams in Kansas. Municipal point sources continue to stress biological communities over substantial reaches of some major rivers, indicating that the dilution base available to dischargers has been overallocated. These problems are being addressed through existing regulatory and voluntary programs and through the Governor's water quality initiative.

General Recommendations

(1) Water appropriation actions should consider all existing and attainable uses of surface water. Attempts to improve water quality for aquatic life are meaningless if streams are effectively dewatered.

(2) Nutrient control measures are needed for the majority of the state's reservoirs and lakes. Top priority should be given to the prevention of algal-related taste and odor problems in water supply impoundments.

(3) A uniform nationwide protocol needs to be established for controlling concentrations of pesticides and pesticide degradation products in surface water and groundwater. Given that agricultural practices in upstream states contribute significantly to pesticide loadings in downstream states, interstate cooperation in this issue is imperative.

(4) More focused local involvement in litter control and garbage disposal laws should be encouraged. No specific recommendations are provided.

(5) The required EPA format of the 305(b) report should be revised to make the document more user friendly and informative. Also, because states differ in their approach to beneficial use designations and water quality criteria development, and because methods and resources for water quality assessment and data analysis vary among states and among regions, information presented in 305(b) reports should not be directly compared among states. It is recommended that EPA acknowledge this lack of consistency and take steps to discourage potentially misleading comparisons.

(6) Kansas should consider the development of surface water quality goals for all major river basins and implement long-term management plans to achieve those goals. The goals should be compatible with the provisions and criteria of state surface water quality standards and any TMDLs developed for the basins.

(7) The state should consider development of sediment quality standards for streams, lakes, and wetlands. These standards should be factored into the development of basin water quality managements plans.

(8) The state should consider development of ambient groundwater quality standards and groundwater clean-up (remediation) standards. In turn, these standards should be factored into the development of basin water quality management plans.

PART III: SURFACE WATER ASSESSMENT

Chapter One: Surface Water Monitoring Programs

The department's surface water quality monitoring programs provide information needed for identifying water pollution problems within the state and for meeting the water quality reporting requirements of the federal CWA (sections 305(l) and 319(a)(1)) and the EPA (40 CFR 131.11). Each year, departmental staff collect approximately 1,500 surface water samples, 60 aquatic macroinvertebrate samples, and 40 composite fish tissue samples from monitoring stations located throughout the state. Effluent monitoring activities also are conducted to provide data required for evaluating permit compliance under the NPDES and KWPC permit programs. Wastewater samples are collected from about 50 municipal, 20 industrial, and three federal facilities each year. Approximately 36 whole-effluent toxicity evaluations are also performed annually. Finally, about 100 site-specific water quality summaries are prepared each year at the request of private citizens or other interested parties.

Departmental staff also investigate fishkills, lake taste and odor problems, toxic algal blooms, and other special surface water quality problems. Most of the fishkill investigations are conducted in cooperation with KDWP. Both KDWP and KDHE maintain computerized inventories of pertinent fishkill information. Lake taste and odor problems and toxic algal blooms are investigated at the request of concerned citizens, lake managers, drinking water suppliers, and other interested parties. Staff participate in as many as 50 special surface water quality investigations each year.

Stream Chemistry Monitoring Program

Water quality reports published by KDHE during the past two decades document a gradual change in the function of the stream chemistry monitoring program. Prior to 1972, the protection of public drinking water supplies provided the principal impetus for surface water monitoring activities in Kansas. During the late 1970s and early 1980s, monitoring activities were geared more toward the evaluation of the effects of major reservoirs on downstream physicochemical conditions, toward the quantification of contaminant levels in streams entering and exiting Kansas, and toward the determination of the effects of municipal and industrial wastewater discharges on the functional integrity of stream ecosystems. The department has recently focused its attention on the assessment and control of NPSs of stream pollution. It is apparent that data derived from the stream monitoring program will play an increasingly important role in defining NPS related pollution abatement needs.

An evaluation of the stream chemistry network was completed prior to the 1990 sampling year. This review focused on the ability of the network to discern the water quality impacts of NPSs of pollution within the state. The evaluation revealed two primary inadequacies from a NPS pollution perspective. First, western Kansas was under represented in the network in terms of the spatial distribution and number of stream monitoring stations. Although most western Kansas streams are characterized by intermittent flow, many are classified waterbodies legally entitled to protection, and some undoubtedly contribute (at least episodically) to NPS pollution loadings in larger, downstream waterbodies. Secondly, few sampling stations were located in lower order tributaries, even though the water quality impacts of NPSs are often most clearly manifested in such tributaries (owing to the general lack of confounding, point source influences on surface water chemistry). To enhance the monitoring program's overall effectiveness in identifying NPS pollution problems, it was determined that more streams in western Kansas and more lower order streams throughout the state should be included in the sampling network.

The ambient stream chemistry network was expanded in 1990 to address these two concerns (Figure 4). The revamping of the network resulted in a 130% increase in the number of monitoring sites (from 115 to 265) and in a more equitable representation of all major physiographic, geological, and land use regions within the state. Grab samples are now collected from stations on a bimonthly basis and analyzed for a wide assortment of conventional pollutants, heavy metals, pesticides, and other parameters (Appendix Part I.B)). Monitoring station selection criteria, sample collection, preservation, transport and analysis methods, and quality assurance (QA) and quality control (QC) requirements for this program are described in a detailed QA management plan and accompanying set of standard operating procedures (KDHE 1995). In addition to day-to-day QA/QC practices, periodic audits are conducted to assess the performance of program staff and to independently determine the representativeness, precision and accuracy of the monitoring data.

The stream chemistry monitoring program endeavors to provide timely and scientifically defensible information on the physical, chemical, and bacteriological quality of flowing waters in Kansas. This information is intended for use in:

1. complying with the water quality monitoring and reporting requirements of 40 CFR 130.4 and sections 106(e) (1), 303(d), and 305(b) of the federal CWA;

2. evaluating waterbody compliance with the provisions of the Kansas surface water quality standards (K.A.R. 28-16-28b *et seq.*);

3. identifying point and NPSs of pollution contributing most significantly to documented water use impairments;

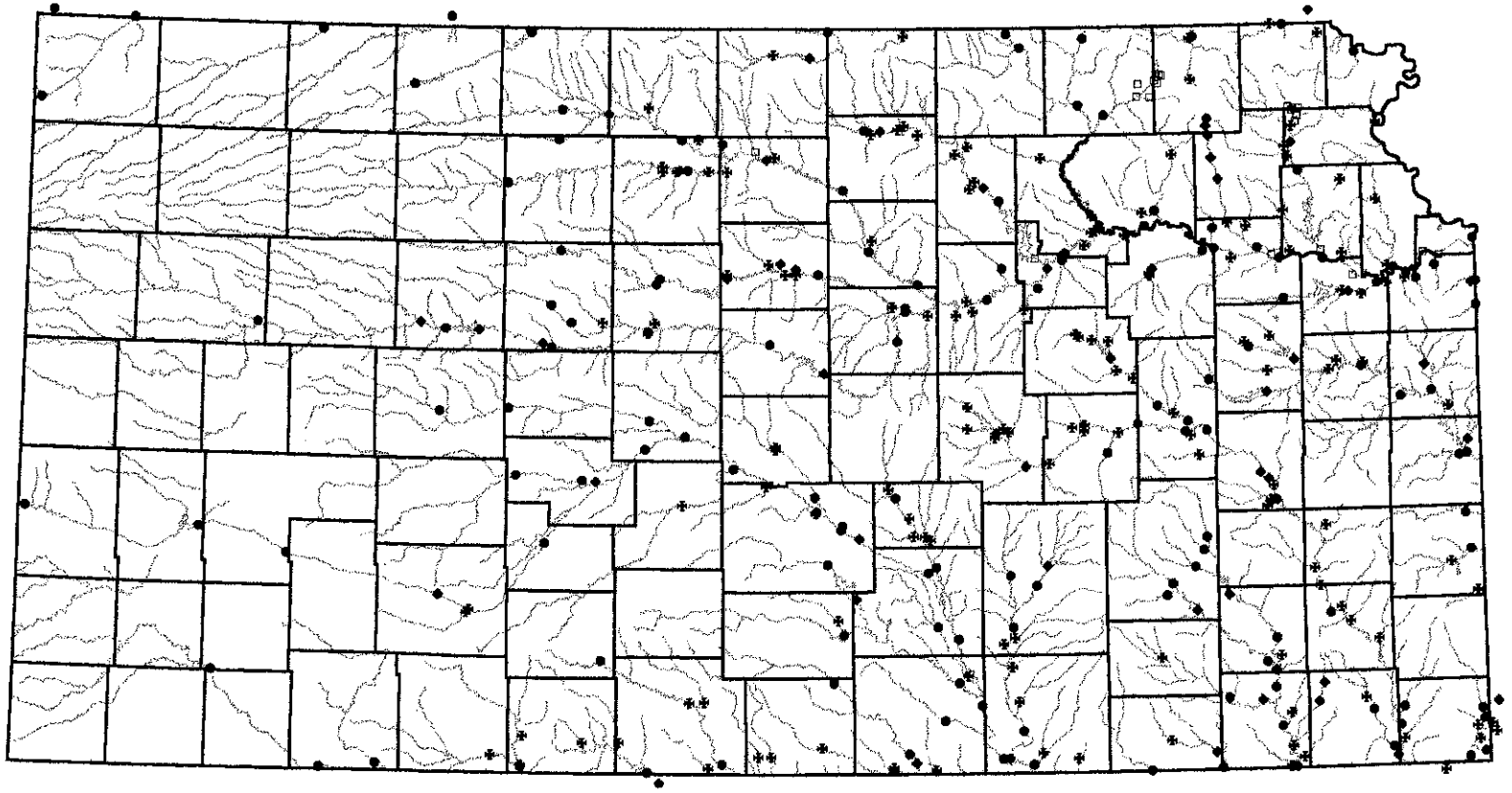
4. documenting spatial and temporal trends in surface water quality resulting from changes in land use patterns, resource management practices, and/or climatological conditions;

5. developing scientifically defensible environmental standards, waste water treatment plant (WWTF) permits, and waterbody/watershed pollution control plans and TMDLs; and

6. evaluating the effectiveness of pollution control efforts and waterbody remediation/restoration initiatives implemented by the department and other natural resource agencies and organizations.

All field and laboratory data generated from stream water quality samples are handled in an orderly and consistent manner. Time and date of sample collection, stream monitoring station identification number, and other basic information are recorded on standardized sample submission forms and submitted through a chain-of-custody procedure along with the water quality samples to the Kansas Health and Environmental Laboratories (KHEL). Upon completion of the laboratory analyses, the KHEL computer automatically downloads the data to the Kansas Water Database, which are accessed through the KDHE IBM AS-400 computer system. Hard copies of all physicochemical and bacteriological data generated by KHEL are maintained by KDHE's Office of Science and Support (OSS). These data are carefully reviewed for obvious errors or omissions. Information derived from the QC samples (duplicates, spikes, blanks, etc.) are subjected to a particularly thorough review. With the approval of the section chief, data that are deemed inaccurate, or grossly unrepresentative,

FIGURE 4. STREAM CHEMISTRY MONITORING NETWORK



KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

are purged from the electronic database. Laboratory data are electronically downloaded onto the EPA STORET database on a monthly basis. Field data are similarly loaded onto electronic spreadsheets, checked for obvious errors or omissions, and downloaded onto STORET each month. Redundant forms of data storage and backup files (EPA STORET system, Kansas Water Database, KHEL tape files, OSS hard copy files) help to ensure the long-term integrity and availability of the program data.

Biological Monitoring Program

Freshwater macroinvertebrate communities, consisting of insects, crustaceans, mollusks, annelids and other organisms which lack a true backbone and are observable with the unaided eye, have long been recognized as excellent indicators of water quality. Ongoing pollution problems, whether continuous or intermittent in nature, tend to reduce in abundance the more pollution intolerant macroinvertebrate species. Conversely, tolerant forms often achieve unusually high densities due to reduced interspecific competition for food, elimination of predators, or other factors. The predictable community-level response to environmental pollution is, therefore, a measurable reduction in macroinvertebrate species richness and an increase in the abundance of tolerant taxa. Where macroinvertebrate sampling efforts are used in conjunction with physicochemical monitoring activities, the ability to detect ongoing water quality problems is greatly enhanced, even at low biological sampling frequencies.

The stream biological monitoring program was initiated by the Kansas Department of Health (later reorganized into KDHE) in April 1972. The original monitoring network included 33 stream stations, located at widely scattered locations across the state. Initial goals of the program were to document long-term trends in surface water quality and to supplement site-specific information then being gathered through other departmental monitoring efforts. During the first six years of the program, field protocols entailed a combination of qualitative and quantitative sampling techniques at all stream monitoring stations. Qualitative methods included the collection of macroinvertebrate specimens from all accessible micro habitats using D-frame nets and other simple apparatus. Quantitative methods, focusing on the density of macroinvertebrate populations, varied depending on the predominant substrate type. A Surber sampler generally was used on coarse sediments such as cobble and gravel, whereas a petite Ponar dredge was used on finer sediments such as sand and silt. These tools were not well suited to the sampling of woody debris, tree roots, emergent aquatic vegetation, or other nonhomogeneous surfaces, even though such habitats accounted for much of the macroinvertebrate abundance and diversity in many Kansas streams. Hence, early quantitative measures of macroinvertebrate abundance and diversity employed by the agency tended to underestimate the actual size and complexity of stream biological communities.

In 1978, the monitoring program adopted a revised protocol for the collection of macroinvertebrate samples. This new protocol was "semi-quantitative" in nature, in that it measured the number of specimens collected in a prescribed (one-hour) time frame but involved the use of D-frame nets and other tools previously associated with qualitative sampling activities. Emphasis on the number and kinds of specimens collected per unit time (rather than on aerial or volumetric estimates of macroinvertebrate density predicated on the use of Surber samplers and Ponar dredges) permitted the examination of essentially all types of stream habitat. The revised protocol proved to be less resource intensive and produced a more consistent measure of macroinvertebrate abundance and diversity. Similar protocols were eventually endorsed by EPA and applied within the water quality assessment programs of several other states (see Rapid Bioassessment Protocol III in Plafkin *et al.* 1989).

From 1984 onward, monitoring activities at all stations adhered to a seasonal rotational schedule to reduce statistical bias and to provide a more comprehensive picture of the resident biological communities; i.e., samples were collected during the spring of one year, the summer of the next, and the fall of the next, a cycle which was repeated every three years. Although macroinvertebrate sampling activities at many of the original monitoring stations were eventually discontinued, new sites were continually added to the network and, over time, the total number of active stations increased. Macroinvertebrate communities were surveyed at 59 monitoring stations during the period 1990-1994, and 46 stations were sampled in 1994 alone (Figure 5). As of January 1995, a total of 78 stations had been sampled for a duration of at least three consecutive years, and 36 of these stations, known as "core" sites, had been sampled for a period of 10-22 consecutive years. A detailed description of the sampling and taxonomic methods and QA/QC practices currently employed in the program is provided in the program QA management plan and accompanying standard operating procedures (KDHE 1995).

Fish Tissue Monitoring Programs

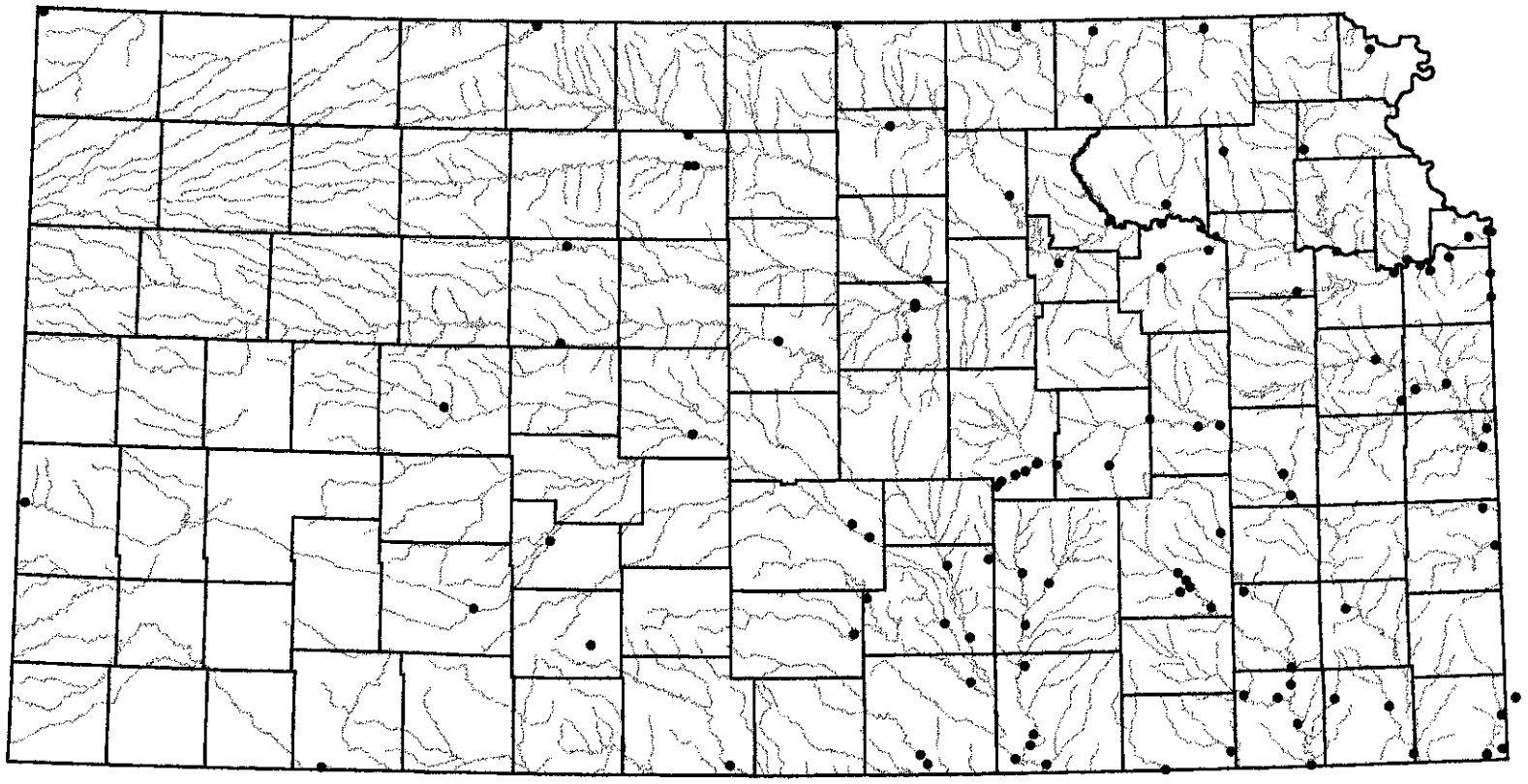
Kansas continues to monitor the impact of toxic substances on surface water quality through the analysis of contaminants in fish tissue (Appendix Part I.C.). A combination of fixed and rotating stations is used in this program to evaluate environmental trends, aquatic life support, and the human health significance of contaminants in fish. The program consists of the following subcomponents: (1) Regional Ambient Fish Tissue Monitoring Program (RAFTMP); (2) the Kansas Follow-up Studies Program (KFSP); and (3) the KDHE Fish Tissue Intensive Survey Program (FISP). Fish tissue monitoring activities are conducted at approximately 20 RAFTMP sites (only 5 sites in 1994) and 18 KFSP and FISP sites each year (Figure 6).

Regional Ambient Fish Tissue Monitoring Program: The RAFTM program is an environmental monitoring program implemented in 1980 by EPA Region VII and administered in Kansas by KDHE. Analysis of fish tissue samples is conducted by the Region VII Environmental Services Laboratory. This program endeavors to (1) monitor long-term trends in fish tissue contaminants at selected fixed stations; (2) monitor levels of fish tissue contaminants for environmental significance; and (3) screen waterbodies of the state for levels of fish tissue contaminants of potential human health concern.

The target species of RAFTMP is the common carp, *Cyprinus carpio*, because of its ubiquitous and abundant nature in Kansas waters and its bottom-feeding behavior. Analyses are conducted on composite samples of three to six whole-fish to improve the representativeness of the data. In 1994, the Region VII Environmental Services Laboratory reduced RAFTMP sample allocation by 75%.

Kansas Follow-up Studies Program: Implemented at its present scale in 1986, KFSP is a program whereby EPA, under provisions of the Kansas 604(b) work plan, provides additional laboratory capacity to KDHE for edible portion fish tissue analyses. The major goals of KFSP include: evaluation of human health significance of edible-portion (fillet) fish tissue contaminants at sites where RAFTMP whole-fish samples have indicated elevated levels of contaminants; evaluation of human health significance of fish tissue contaminants in edible portions at localities where the probability of contamination is high and where historical data are lacking; and where additional information is needed to direct more intensive surveys of local fish tissue quality. Frequently the common carp is used for this assessment; however, if more commonly eaten catfish species of appropriate size are available, then specimens of such species are preferentially collected and analyzed. Bottom-feeding fish species are preferred because they generally represent the worst case contamination scenario. Duplicate composite samples are routinely collected and analyzed.

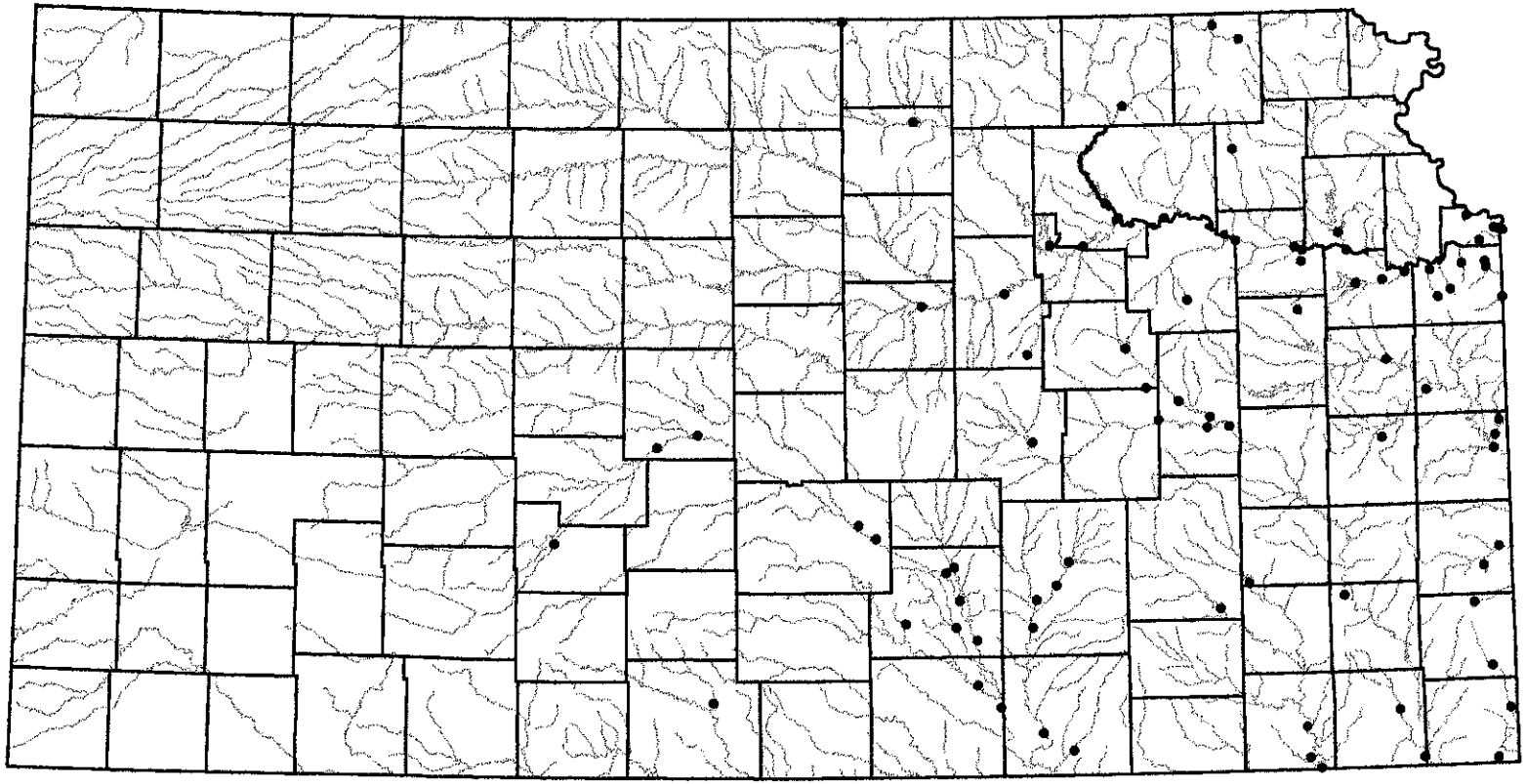
FIGURE 5. BIOLOGICAL MONITORING NETWORK



KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

FIGURE 6. FISH TISSUE MONITORING NETWORK



KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

KDHE Fish Tissue Intensive Survey Program: The fish tissue monitoring and survey program, FISP, was implemented in 1986. Analyses of fish tissue samples for technical chlordane are conducted by KDHE's Health and Environmental Laboratory. The goals of the program are threefold:

1. to define water body segments impacted by chlordane contamination of fish tissue for the purpose of delineating "safe" segments and those requiring consumption advisories or warnings,

2. to provide long-term monitoring of waterbody segments with current or past fish consumption advisories or warnings, and

3. to confirm findings of the EPA Region 7 Environmental Service Laboratory in cases where preliminary (RAFTMP/KFSP) data indicate that levels of fish tissue contamination may pose human health concerns.

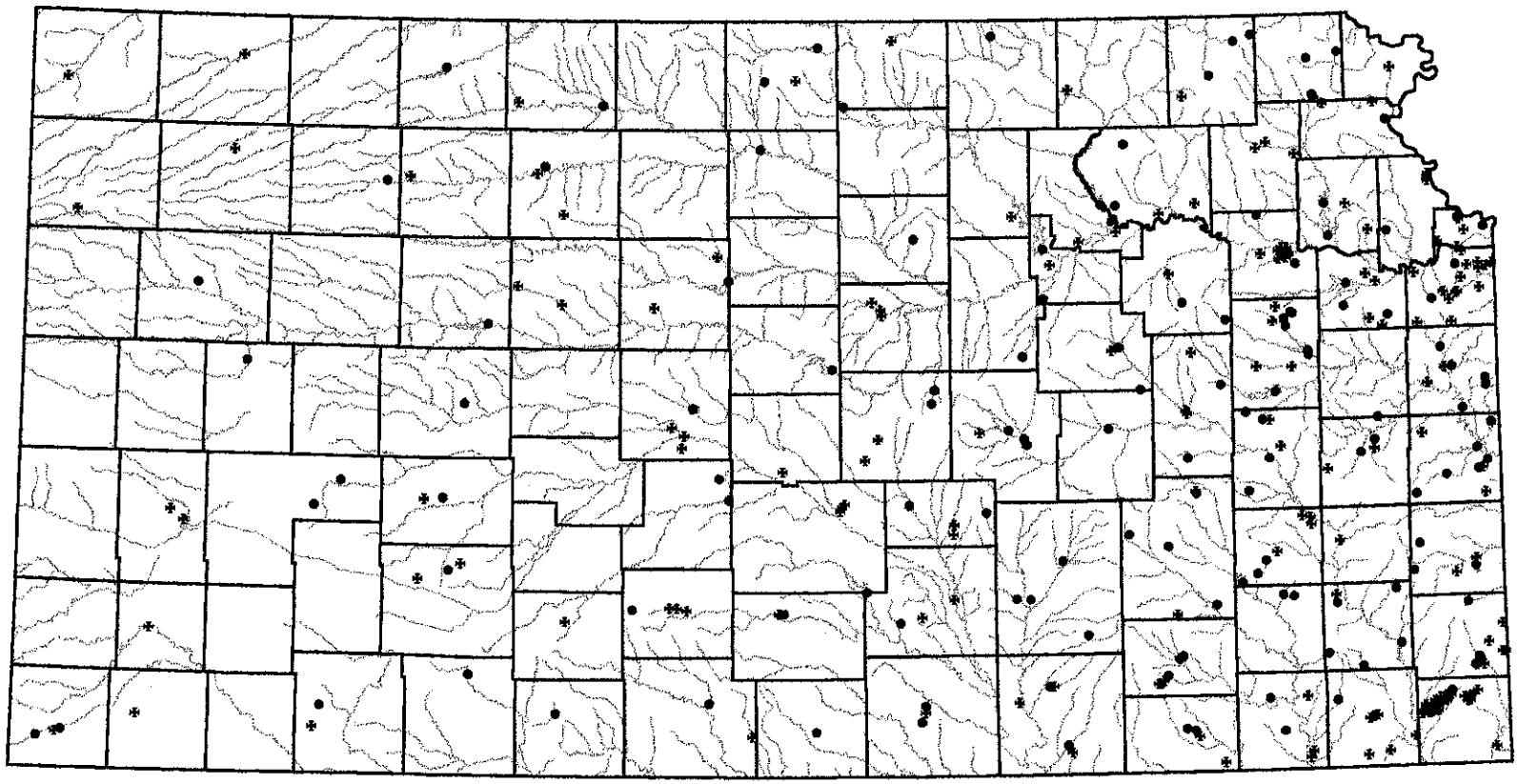
Lake and Wetland Water Quality Monitoring Program

Lake and wetland monitoring activities conducted by KDHE have significantly changed since the inception of the program in 1975. The monitoring network originally consisted of eight to ten intensively surveyed lakes. In 1985, statistical analysis of the lake database determined that KDHE's informational needs were better met by reducing the amount of work at specific waterbodies in favor of expanding geographic coverage of the state.

During 1988-1992, the network was further adjusted to include state managed wetland areas (1988) (Figure 7), and to collect data on the abundance of macrophytic vegetation in lakes (1991). Bacterial sampling was moved from open water sites to swimming beaches and other near-shore areas (1992). Since 1993, the network has consisted of approximately 120-130 monitored sites, with representative lakes in all major river basins and physiographic regions. These lakes and all major publicly owned wetland areas are sampled on a three to five year cycle for nutrients, metals, minerals, pesticides, water clarity, dissolved oxygen, temperature, algal abundance, and bacterial quality (Appendix Part I.D.). Lake/wetland selection criteria, sample collection, preservation, transport and analysis methods, and QA/QC requirements for this program are described in a detailed program management plan and accompanying set of standard operating procedures (KDHE 1995). In addition to day-to-day QA/QC practices, periodic audits are conducted to assess the performance of program staff and to independently determine the representativeness, precision and accuracy of the monitoring data.

In addition to those lakes and wetlands routinely included in this program (and regarded as "monitored" waterbodies for the purposes of this report), a number of additional standing waterbodies were subjected to less intensive investigation during the 1991-1995 reporting cycle. These "evaluated" waterbodies included lakes from which a single grab sample was collected and analyzed for major cations and anions, nutrients and chlorophyll-a. In other cases, additional physicochemical and biological data were collected and a watershed survey was conducted. In a smaller number of cases, assessment data were derived from visual surveys and the best professional judgement of either KDHE staff or other state personnel.

FIGURE 7. LAKE AND WETLAND MONITORING NETWORK



KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

In all, a total of 144 waterbodies were monitored during the 1991-1995 reporting cycle. These included all multipurpose federal reservoirs, all nine state or federally managed wetland complexes and many smaller waterbodies (Figure 7). An additional 147 lakes were evaluated during this reporting cycle for a combined total of 291 lakes and wetlands.

Special Investigations

In cooperation with the KDWP, KDHE district staff participated in as many as 60-80 fishkill investigations each year during the 1991-1995 305(b) reporting cycle. Data generated from these activities were used to support enforcement decisions and other administrative actions. Also, use attainability analyses (UAAs) were conducted on approximately 60 waterbody segments during the reporting cycle. Most UAAs focused on streams receiving effluent from NPDES permitted facilities and were performed in conjunction with water quality (section 401) certification reviews. Finally, a few site-specific water quality studies were conducted for the purpose of obtaining information required during section 401 reviews. These studies involved such diverse objectives as establishing mixing zone characteristics, determining background (upstream) pollutant concentrations, or estimating pollutant uptake or decay rates for kinetic equations used in setting permit limits.

Chapter Two: Assessment Methodology and Summary Data

Assessment Methodology

In its guidance manual for the preparation of the 1996 305(b) report, EPA encouraged all states to apply a "standardized" assessment methodology in the hope of enhancing consistency and comparability among the state use support summaries (EPA 1995a). The manual departed from previous EPA guidance in at least two notable respects. First, it recommended that all states target swimming beaches in the development of use support summaries for contact recreation. Second, it provided little indication of how chronic criteria for the protection of aquatic life were to be factored into 305(b) assessments. In a subsequent written interpretation of the national guidance, EPA directed states to consider chronic ALUS criteria and contact recreational criteria in its 305(b) assessment, as warranted by the state's monitoring methodology and current beneficial use designations (Hutton 1995). Subsequent national guidance essentially left the application of chronic ALUS criteria to the discretion of the individual states (Davies and Waygand 1995).

Despite the initial effort by EPA to standardize 305(b) assessment methodologies, it is evident that (1) significant differences in methodologies continue to persist among states and among regions and (2) use support summaries developed by the individual states continue to provide little, if any, legitimate basis for comparison. This lack of consistency and comparability is exacerbated by differences in state beneficial use designations, water quality criteria, and water quality monitoring programs. These factors should be kept in mind as the reader considers the Kansas 305(b) assessment approach described in this chapter and the Kansas use support summaries presented in Chapter Three.

Stream Physicochemical and Microbiological Data

Historically, use support summaries for Kansas streams have been based on the assumption that all monitored and evaluated streams within the state are capable of supporting a wide range of beneficial uses. In the 1992 and 1994 305(b) reports, documented water quality conditions were weighed against the most stringent possible combination of aquatic life support, food procurement, water supply, and recreational criteria, irrespective of stream classification status or actual use designation. This approach was not universally applied by other states in the nation or even within Region 7.

To maintain a general level of consistency with previous 305(b) reports, thus allowing for the analysis of trends in beneficial use support over time, KDHE has elected to incorporate chronic ALUS and contact recreational criteria into its 1996 assessment. For the first time, however, these and all other criteria have been applied only to those stream segments formally designated for the indicated uses in the Kansas Surface Water Register. This methodology may be unique to Kansas, and the reader is reminded again, that the use support summaries presented in Chapter Three are not directly comparable to those of any other state.

Table 7 summarizes the approach utilized by KDHE to distinguish between fully supporting, partially supporting, and nonsupporting stream reaches on the basis of physicochemical and microbiological data. This approach is generally consistent with the previous (1994) 305(b) report. The only differences relate to the contact recreational use and entail (1) the elimination of the "partially supporting" category for this use, (2) adherence to the water quality standards' "geometric mean" criterion for FCB, and (3) utilization of data collected only during the contact recreational season

Table 7. Guidelines for Evaluation of Use Support in Streams

DEGREE OF USE SUPPORT	PHYSICOCHEMICAL INFORMATION		BIOLOGICAL INFORMATION	PROFESSIONAL JUDGEMENT
	CONVENTIONAL	TOXIC		
Waters support designated use	Contact Recreation: Concentrations of fecal coliform bacteria during contact recreational season comply with geometric mean criterion. Other Use Categories: No criterion for any conventional pollutant exceeded in more than 10% of observations.	Aquatic Life Support: For stream segments monitored longer than three years, no more than one exceedence of any acute criterion for protection of aquatic life; for stream segments monitored less than three years, no exceedence of any acute criterion. No chronic criterion for protection of aquatic life exceeded in more than 25% of observations. Organochlorine pesticide levels in fish tissue less than National Academy of Science (NAS) guidelines for protection of predators and scavengers. Food Procurement: No fish consumption advisory in place. Domestic Water Supply: Median concentrations of all toxicants less than applicable domestic water supply criteria.	Aquatic Life Support: Average MBI value less than 4.50. Other metrics (KBI, EPT, Taxa Richness) indicate no impairment of aquatic life support use.	All Use Categories: Ancillary data (citizen interviews, fishkill records, special studies) indicate no impairment of any designated use.

Table 7. Guidelines for Evaluation of Use Support in Streams - continued

DEGREE OF USE SUPPORT	PHYSICOCHEMICAL INFORMATION		BIOLOGICAL INFORMATION	PROFESSIONAL JUDGEMENT
	CONVENTIONAL	TOXIC		
Waters partially support use	Contact Recreation: No "Partially Supported" designation for contact recreational use. Other Use Categories: Criterion for one or more conventional pollutants exceeded in 11-25% of observations.	Aquatic Life Support: No "Partially Supported" designation for aquatic life support use. Food Procurement: No "Partially Supported" designation for food procurement use. Domestic Water Supply: No "Partially Supported" designation for domestic water supply use.	Aquatic Life Support: Average MBI value between 4.50 and 5.39. Other metrics indicate some impairment of use.	All Use Categories: Ancillary data indicate at least one designated use is moderately impaired.

Table 7. Guidelines for Evaluation of Use Support in Streams - continued

DEGREE OF USE SUPPORT	PHYSICOCHEMICAL INFORMATION		BIOLOGICAL INFORMATION	PROFESSIONAL JUDGEMENT
	CONVENTIONAL	TOXIC		
Waters do not support use	Contact Recreation: Concentrations of fecal coliform bacteria during contact recreational season do not comply with geometric mean criterion. Other Use Categories: Criterion for one or more conventional pollutants exceeded in more than 25% of observations.	Aquatic Life Support: For stream segments monitored longer than three years, two or more exceedences of any acute criterion for protection of aquatic life; for stream segments monitored for three years or less, one or more exceedencess of any acute criterion. One or more chronic criteria for protection of aquatic life exceeded in more than 25% of observations. Organochlorine pesticide levels in fish tissue equal to or greater than NAS guidelines for protection of predators and scavengers. Food Procurement: Fish consumption advisory in place. Domestic Water Supply: Median concentrations of one or more toxicants greater than or equal to applicable domestic water supply criteria.	Aquatic Life Support: Average MBI value greater than 5.39. Other metrics indicate high degree of use impairment.	All Use Categories: Ancillary data indicate at least one designated use is severely impaired.

(April 1 through October 31 of each year). Table 8 summarizes the specific physicochemical and microbiological criteria employed by KDHE in this 305(b) assessment. Note that few transition metals have been evaluated with respect to the ALUS use. This is attributable to EPA's promulgation of the National Toxics Rule in 1993 (40 CFR 131.36). As applied to the surface waters of Kansas (and several other states and U.S. territories), this rule established acute and chronic criteria for metals that were based on the dissolved fraction only. During the 1991-1995 reporting cycle, data gathered by KDHE on transition metal concentrations in Kansas streams were based entirely on total recoverable levels and were not readily comparable to the criteria promulgated by EPA.

In assigning a support category to a particular designated use, the department consistently considered the "worse case" water quality parameter. For example, if a stream segment complied during the reporting cycle with all but one of the criteria for the protection of the livestock watering use, the segment was deemed either partially supportive or nonsupportive of that use (depending on the severity of the pollution problem) and assigned to the "impaired" category for overall use support (Chapter Three). Any parameter monitored on fewer than three occasions during the reporting cycle was excluded from this analysis. Similarly, monitoring stations visited fewer than three times during the reporting cycle, such as stations added to the monitoring network in the fall of 1995, were not considered in the 1996 305(b) assessment.

Several simplifying assumptions were applied by the department in the spatial application of the physicochemical and microbiological data. The foremost assumption was that each network station effectively "monitored" all unimpounded upstream (RF2 and listed RF3) segments within a 30 kilometer radius and all downstream mainstem segments within 15 kilometers. There were several exceptions to this general rule:

1. Where a stream segment originated within the "assessment reach" of a network station, but more than 50% of the segment extended beyond this reach, the entire segment was regarded as "evaluated" rather than monitored.

2. When an upstream or a downstream segment stopped at major impoundment.

3. Where a monitoring station occurred on a tributary within the assessment reach of a downstream (mainstem) station, use support determinations for the tributary were based on data from the upstream (tributary) station.

4. As provided in paragraph (4) below, use support summaries for overlapping assessment reaches were based on data from the downstream monitoring station. Such overlapping reaches generally occurred on larger (mainstem) streams, where the separation distance between stations was sometimes less than 45 kilometers.

5. Where a major (>1.0 MGD) sewage treatment plant discharged into a stream and the outfall location was closely bracketed by two network stations, the outfall location served as the delineation point between upstream and downstream assessment reaches. In the event such a facility discharged into a smaller tributary or headwater stream, and the stream was monitored only downstream of the facility, the assessment reach did not extend above the outfall location.

6. When best professional judgement was utilized to exclude segments not wholly within the assessment distance because they were known to be dry or where there were significant differences between stream order within the assessed area.

Table 8. Summary of Numeric Water Quality Criteria Used to Evaluate Use Support

CONSTITUENT (ug/L)	DRINKING WATER	RECREATION		AQUATIC LIFE		AGRICULTURE	
		CONTACT	NON-CONTACT	ACUTE	CHRONIC	IRRIGATION	LIVESTOCK
CONVENTIONAL::							
Ammonia, Total (NH_3-N)	a	a	a	c	c	a	a
Chloride	250,000	a	a	860,000	230,000	a	a
Chlorine, Total Residual	a	a	a	19	11	a	a
Dissolved Oxygen	a	a	a	5,000	5,000	a	a
Fluoride	2,000	a	a	a	a	1,000	2,000
Nitrate (NO_3-N+NO_2-N)	10,000	a	a	a	a	a	100,000
pH	a	a	a	6.5<>8.5	6.5<>8.5	a	a
Sulfate	250,000	a	a	a	a	a	1,000,000
Temperature	a	a	a	>32	>32	a	a
Total Dissolved Solids	500,000	a	a	a	a	500,000	3,000,000
Total Suspended Solids	a	a	a	a	100,000	a	a
METALS:							
Arsenic, Total	50	a	a	b	b	100	200
Beryllium, Total	4	a	a	b	b	100	a
Boron, Total	a	a	a	b	b	750	5,000
Cadmium, Total	5	a	a	b	b	10	20
Chromium, Total	100	a	a	b	b	100	1,000
Copper, Total	1,300	a	a	b	b	200	500
Lead, total	15	a	a	b	b	5,000	100
Mercury, Total	2	a	a	b	0.012	a	10
Nickel, Total	100	a	a	b	b	200	500
Selenium, Total	50	a	a	20	5	20	50
Silver, Total	50	a	a	b	b	a	a
Thallium, Total	2	a	a	b	b	a	a
Zinc, Total	a	a	a	b	b	2,000	25,000
BACTERIOLOGICAL:							
Fecal Coliform (colonies/100ml)	a	200	2,000	a	a	a	a
PESTICIDES:							
Alachlor	2	a	a	760	76	a	100
Atrazine	3	a	a	170	1	a	a

a =no criterion established b =Kansas Surface Water Quality Standards, calculated value, hardness dependent c = Kansas Surface Water Quality Standards, calculated value, temperature and pH dependent

Where listed RF2 or RF3 stream reaches were deemed either partially supportive or nonsupportive of a use, the department considered the pollutants (causes) of concern and attempted to determine the most probable sources of these pollutants. Informational materials used in this analysis were derived both from within KDHE and from various other governmental agencies and institutions and included (1) GIS coverages and related maps depicting prevaling land uses, grazing livestock densities, and the locations of major urban areas, major municipal and industrial point sources, and permitted feedlot facilities, (2) other maps and related written materials addressing regional topography, geology, soil characteristics, and the locations of major mineral intrusion areas, active and inactive oil and natural gas fields, surface mines, permitted irrigation wells, and documented groundwater and/or soil contamination sites, and (3) miscellaneous reports and publications regarding stream flow, stream channelization and dredging practices, pesticide and fertilizer application practices and application rates, brine disposal practices, and stormwater quality.

Maps presented in Chapter Three, depicting stream use impairments and related causes and sources, were produced by georeferencing water quality assessment information to a GIS coverage of Kansas streams. This coverage was based on EPA's RF2 and RF3 hydrologic databases and, therefore, included all stream segments identified in the Kansas Surface Water Register. The Kansas list of water quality-limited surface waters for this reporting cycle was similarly developed by electronically linking all classified stream reaches with their corresponding impairment ratings and causes.

Stream Macroinvertebrate Community Data

Aquatic life use support evaluations for streams also incorporated macroinvertebrate data from the stream biological monitoring network. These data were summarized using several metrics, including the Macroinvertebrate Biotic Index (MBI) (Davenport and Kelly 1983), the Ephemeroptera, Plecoptera and Trichoptera (EPT) Index, and taxa richness or total taxa. An additional biotic index, referred to as the Kansas Biotic Index (KBI), was also used (Huggins and Moffet 1988). The KBI is currently under development and testing; like the MBI, it evaluates the effects of nutrient and oxygen demanding pollutants.

Both biotic indices rate the pollution tolerances of specific taxonomic groups. The MBI rates large taxonomic groupings such as order and family. The KBI rates groupings which correspond to the level of identification, usually genus or species. Higher values indicate greater pollution tolerances. These tolerance values and the numbers of individuals within a rated group are used to arrive at a single value which characterizes the overall tolerance of the community. The higher the resultant index value the more tolerant the community is of organic pollution. The two indices have a high degree of correlation. For the purposes of this report, an MBI greater than 5.40 indicates nonsupport of the aquatic life use, an MBI between 4.51 and 5.39 indicates partial support, and an MBI less than 4.51 indicates full support of the designated use.

The EPT index is the total of all taxa in a sample belonging to the pollution-intolerant insect orders Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies). Taxa richness is a general measure of community health and is simply the total number of different species or taxa collected in the sample. Level of use support in this report was based on the average of the index values for the most recent three year period. Time trends in all metrics over the last 13 years were considered in cases where index values fell near the divisions between use support categories.

Complexity of habitat sampled was assessed using the Habitat Development Index (HDI) (Huggins and Moffett 1988). The HDI evaluates the relative quantity and quality of the three basic stream macrohabitats (riffle, run, and pool) and the significance of some of the microhabitats. The potential macroinvertebrate community in terms of habitat availability was considered during all biological assessments. Stations were not considered less than fully supporting of aquatic life if natural limitations of habitat caused an apparent use impairment.

Lakes and Wetlands

Assessments of lake and wetland water quality were based primarily on the numeric criteria within the Kansas surface water quality standards. Due to the relatively small number of samples collected in a given lake during each reporting cycle, even a single exceedence of numeric water quality criteria was equated with a use impairment.

Trophic state conditions were also considered when determining levels of use impairment in lakes. In most cases, a lake with a long-term mean designation of "eutrophic" (corrected chlorophyll-a concentration of 7.5-29.9 ug/L) was considered impaired for some use categories. Lakes experiencing "hypereutrophic" conditions (corrected chlorophyll-a concentration $\geq$ 30 ug/L) were considered non-supportive of all uses. For a small number of Kansas lakes, turbidity or macrophyte community conditions were used along with chlorophyll-a data to determine levels of impairment.

Chapter Three: Stream Water Quality Assessment

The Environmental Protection Agency's "RF3" river reach file is an electronic representation of all waterbody segments appearing on 7.5-minute quadrangle maps prepared by the United States Geological Survey (USGS). Based on this file, Kansas contains some 23,731 miles of perennially flowing streams and an additional 110,225 miles of intermittent streams (Table 1). In contrast, the Kansas Surface Water Register is predicated largely on the "RF2" river reach file, which includes the vast majority of all perennial and larger intermittent streams in the state. For the purposes of this report, the total classified stream mileage listed in the register is considered identical to the RF3 perennial stream mileage.

The department monitored 17,364 stream miles and evaluated an additional 1,966 stream miles during the 1991-1995 reporting cycle. The combined total of 19,330 miles represents 81% of the RF3 perennial stream mileage. These estimates provide the framework for the use support summaries and comparisons presented below.

Support of Designated Uses

Tables 9 and 10 present use support summaries for all monitored and evaluated streams in Kansas using the modified EPA guidance which includes both acute and chronic ALUS criteria and the Kansas water quality standards (see corresponding Tables 11 and 12 utilizing "national" guidance which includes only acute aquatic life use criteria and closure of swimming beaches as the criterion for nonsupport for contact recreation). These summaries are based on the various physicochemical, microbiological, macroinvertebrate and fish tissue-based assessments and special studies described in Chapter One and on the data evaluation methodologies described in Chapter Two. Where the findings of one assessment program or special study did not agree with those of another, the "worse case" assessment scenario was incorporated into the use support summaries.

Table 9. Summary of Fully Supporting, Threatened, and Impaired Stream Miles (based on application of acute and chronic ALUS criteria)

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED SIZE (MILES)
	EVALUATED	MONITORED	
Size Fully Supporting All Assessed Uses	11	534	545
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	*	*	*
Size Impaired for One or More Uses	1,955	16,830	18,785
TOTAL ASSESSED	1,966	17,364	19,330

* = not applicable

For illustrative purposes, assume that physicochemical monitoring data indicated a stream segment was fully supporting of the aquatic life use, whereas a biotic index rated the same segment as only partially supporting of the use. The ALUS rating for the entire segment, as reflected in the use support summaries, would be "partially supporting." Based on this approach, 97% of the stream mileage assessed during this reporting cycle did not fully support all designated beneficial uses (Table 9). Only seven percent of the assessed stream mileage fully supported the ALUS use (based on both acute and chronic criteria); in contrast, 28% supported contact recreation, 41-44% supported noncontact recreation, domestic water supply (drinking water use) and irrigation, 72% supported food procurement, and 94% supported livestock watering (Table 9; Stream Assessment Maps). Using the initial EPA guidance, which considers only the acute ALUS and swimming beach closures, and looking at the assessed cumulative stream mileages for designated uses, 78% were fully or partially supported, while using the more stringent chronic ALUS and noncontact recreational criteria, only 55% were fully or partially supported.

The reader is reminded that the EPA guidance manual for preparing 305(b) reports allows states to apply widely divergent criteria and data evaluation methodologies. No attempt is made to apply consistent uniform criteria to assess all states. If the department had literally interpreted the guidelines originally presented in the EPA manual, the summary reports for Kansas would have reflected a significantly higher level of use support. Tables 11 and 12 present use support summaries resulting from such a literal interpretation. Overall use support is increased nearly ten-fold, from 545 stream miles (Table 9) to 5,071 stream miles (Table 10). Stream mileage rated as "partially supporting" or "nonsupporting" for one or more designated uses is decreased by approximately 24%, from 18,785 miles to 14,259 miles. These changes illustrate the degree to which use support summaries may vary among states owing to differences in evaluation methodologies. This lack of consistency is exacerbated by differences in state beneficial use designations, water quality criteria, and water quality monitoring programs. Any legitimate attempt to compare use support summaries among states must take all such differences into account. Comparison with other states is not appropriate or dependable. However, if any attempt at such rough comparison is made, one must consider the values in Tables 11 and 12, rather than Tables 9 and 10. The designation of non-supporting should not be interpreted to mean the stream is totally unusable. Rather this designation may mean that the stream is impaired for one designated use. In fact, almost 40% of the "non-supporting" stream segments in Kansas support all but one use, and all streams support at least one designated use.

Table 10. Individual Use Support Summary for Stream in Miles

GOALS	USE	SIZE ASSESSED	SIZE FULLY SUPPORTING	SIZE FULLY SUPPORTING BUT THREATENED	SIZE PARTIALLY SUPPORTING	SIZE NOT SUPPORTING	SIZE NOT ATTAINABLE
PROTECT AND ENHANCE ECOSYSTEMS	Aquatic Life (acute & chronic)	19,330	1,403	0	3,831	14,096	0
PROTECT AND ENHANCE PUBLIC HEALTH	Fish Consumption	836	604	0	0	232	0
	Shell fishing	*	*	*	*	*	*
	Swimming	6,894	1,889	0	*	5,005	1,697
	Secondary Contact	19,256	8,393	0	8,310	2,553	0
	Domestic Water Supply	7,973	3,260	0	163	4,550	66
	State Defined	*	*	*	*	*	*
SOCIAL AND ECONOMIC	Agricultural**	*	*	*	*	*	*
	Cultural or Ceremonial	*	*	*	*	*	*
	State Defined 1. Irrigation 2. Livestock	 7,668 7,722	 3,139 7,260	 0 0	 182 171	 4,347 291	 66 66
CUMULATIVE MILEAGE		69,679	25,948	0	12,657	31,074	1.895

* = category not applicable
** = see state defined below
0 = category applicable but size of waters in category is zero

Table 11. National Guidance-Based Summary of Fully Supporting, Threatened, and Impaired Streams Miles (based on application of acute ALUS criteria only)

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED SIZE (MILES)
	EVALUATED	MONITORED	
Size Fully Supporting All Assessed Uses	371	4,700	5,071
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	0	0	0
Size Impaired for One or More Uses	1,595	12,664	14,259
TOTAL ASSESSED	1,966	17,364	19,330

Special Summary for Aquatic Life Use Support

Table 13 presents ALUS summaries for streams based on (1) biological/habitat (B/H) metrics only, (2) physicochemical measurements only, and (3) both B/H metrics and physicochemical measurements. This table would appear to suggest that B/H metrics are the less sensitive indicators of water quality degradation or, alternatively, that physicochemical data overestimate the degree of ALUS impairment. However, the table is potentially misleading in that the primary metric employed by the biological monitoring program is the MBI, a statistical measure best suited to evaluations of the effects of unionized ammonia and oxygen demanding pollutants on macroinvertebrate communities. In contrast, physicochemical monitoring activities consider nearly 100 individual parameters (including unionized ammonia and dissolved oxygen), thereby imposing a much broader and more stringent set of water quality criteria than the biological monitoring program.

Table 12. National Guidance-Based Support Ratings for Individual Stream Uses (in miles)

GOALS	USE	SIZE ASSESSED	SIZE FULLY SUPPORTING	SIZE FULLY SUPPORTING BUT THREATENED	SIZE PARTIALLY SUPPORTING	SIZE NOT SUPPORTING	SIZE NOT ATTAINABLE
PROTECT AND ENHANCE ECOSYSTEMS	Aquatic Life (acute only)	19,330	17,621	0	0	1,709	0
PROTECT AND ENHANCE PUBLIC HEALTH	Fish Consumption	836	604	0	0	232	0
	Shell fishing	*	*	*	*	*	*
	Swimming	*	*	*	*	*	1,697
	Secondary Contact	19,256	8,393	0	8,310	2,553	0
	Domestic Water Supply	7,973	3,260	0	163	4,550	66
SOCIAL AND ECONOMIC	Agricultural**	*	*	*	*	*	*
	Cultural or Ceremonial	*	*	*	*	*	*
	State Defined						
	1. Irrigation	7,668	3,139	0	182	4,347	66
	2. Livestock	7,722	7,260	0	171	291	66
CUMULATIVE MILEAGE		62,785	40,277	0	8,826	13,682	1,895

* = category not applicable
** = see state defined below
0 = category applicable but size of waters in category is zero

Table 13. Categories of Data Used in ALUS Assessments for Rivers and Streams

DEGREE OF ALUS	MILES ASSESSED BASED ON BIOLOGICAL HABITAT DATA ONLY	MILES ASSESSED BASED ON PHYSICAL/ CHEMICAL DATA ONLY	MILES ASSESSED BASED ON BIOLOGICAL HABITAT AND PHYSICAL/ CHEMICAL DATA	TOTAL MILES ASSESSED FOR ALUS
Fully Supporting	207	1,122	281	1,403
Fully Supporting but Threatened	0	0	0	0
Partially Supporting	31	3,193	638	3,831
Not Supporting	0	12,156	1,940	14,096

Another important consideration is that, in recent years, the biological monitoring program has expended a proportionately greater amount of effort on the assessment of candidate "ecoregional reference streams." Most of these streams drain native prairie or prairie/woodland watersheds with few or no point sources and only limited crop production. Macroinvertebrate communities in such streams would be expected to suffer from relatively few pollution-related problems. Ultimately, the data gathered from these streams is anticipated to play an important role in the development of numeric and narrative biological criteria. Inclusion of such criteria in the Kansas surface water quality standards is a stated priority of EPA Region VII but has been deferred by the department pending further study.

The department currently is subjecting an additional biological metric, the Kansas Biological Index or "KBI", to additional field testing and validation. This metric incorporates pollution tolerance scores for nearly all genera and species of aquatic insects known to occur in the state. The scores range from zero (least tolerant) to five (most tolerant) and address six different pollution categories, including nutrients and oxygen demanding substances, agricultural pesticides, heavy metals, persistent organic compounds, salinity, and suspended solids and sediments (Huggins and Moffett 1988). Utilization of this metric in the development of future 305(b) reports may enhance the apparent level of agreement between B/H- and physicochemical-based assessments of aquatic life support.

Major Causes and Sources of Stream Impairment

Pollutants ("causes") associated with the most widespread water quality problems during the 1991-1995 reporting cycle included, in order of prevalence, suspended solids, FCB (pathogen indicator organisms), dissolved solids, other inorganics, pesticides, and metals (Table 14; Figure 8a). Although these parameters contributed to widespread use impairments, often they did not pose the most serious local water quality concerns. For example, such nonconservative substances as unionized ammonia and total residual chlorine exerted much more pronounced and easily documentable impacts on aquatic life in certain individual stream segments.

Factors ("sources") most responsible for widespread pollutant loadings and beneficial use impairments during the reporting cycle included agriculture, habitat modification, natural sources, resource extraction, hydromodification, and groundwater withdrawal (Table 15; Figure 8b). Impairments attributable to point sources were substantially less widespread than those attributable to NPSs. However, the former often exerted highly significant water quality impacts within given stream segments, and some individual point sources caused or contributed to water quality impairments in several downstream mainstem segments. Other factors contributing to localized water pollution problems included, but were not limited to, combined storm and sanitary sewer overflows, construction activities, surface mining activities, and failing septic systems. In a significant number of instances, factors responsible for contaminant loadings were not known (Table 15).

The relationships (linkages) between major pollution causes and sources are not indicated in the provided tables but merit some discussion. In general, exceedences of the FCB criteria reflect runoff from animal feeding areas including pastures areas and the presence of livestock in streams and adjacent riparian zones. Discharges from mechanical sewage treatment plants and aerated lagoons greatly augment FCB levels in some streams, especially during periods of low stream flow or following accidental bypasses of raw or partially treated sewage. Elevated levels of total suspended solids (TSS) are largely attributable to the erosion of cropland soils and bank erosion. Other contributing sources of TSS include the channelization of streams, the construction and maintenance of roadways, bridges, pipelines and low water dams, and ongoing urban, residential and highway construction.

Geological formations containing gypsum, halite or other soluble mineral deposits, and naturally occurring discharges from mineralized springs and seeps, largely account for the high concentrations of TDS in some streams in central and western Kansas. Background levels of TDS and chloride are substantially augmented in some areas by irrigation return flows and the concentrative evaporation (evapotranspiration) and runoff of salts from irrigated cropland. Such problems are compounded by declines in base flow contributions from shallow freshwater aquifers (i.e., declines in dilution base) resulting from intensive irrigation withdrawals and attendant increases in depth to groundwater. Additional sources of TDS include the historical spillage and mishandling of oil field brine and salt wastes from salt mining and processing facilities. Also, the widespread use of home water softeners in some communities significantly increases TDS and chloride concentrations in sewage treatment plant effluent and downstream surface waters.

Low dissolved oxygen (DO) concentrations in some streams are associated with conditions of limited stream flow and heavy loadings of oxidizable organic wastes from agricultural NPSs and/or sewage treatment plants. In a few heavily wooded watersheds in eastern Kansas, decomposing leaf litter may increase biochemical oxygen demand (BOD) and contribute to DO violations on a seasonal basis. In areas of former mining activity in southeastern Kansas, springs and seeps may discharge

TABLE 14. Total Stream Mileage Impaired by Various Cause (Pollutant) Categories

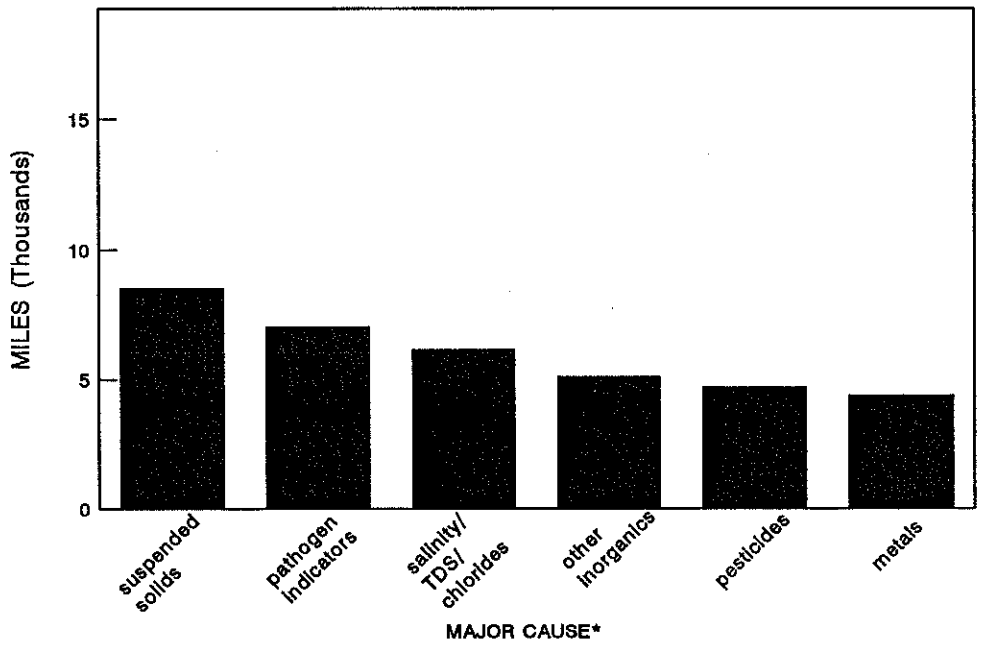
Cause Category	Stream Mileage Impacted by Cause Categories	
	Major Impact[1]	Moderate/Minor Impact[2]
Cause unknown	*	*
Unknown toxicity	*	*
Pesticides	4,665	*
Priority organics	*	*
Nonpriority organics	37	*
Metals	4,344	161
Ammonia	66	*
Chlorine	*	*
Other inorganics	5,090	801
Nutrients/eutrophication	*	*
pH	880	1,644
Siltation	*	*
Organic enrichment/low DO	1,232	3,446
Salinity/TDS/chlorides	6,132	614
Thermal modifications	3	2
Flow alterations	*	*
Other habitat alterations	*	*
Pathogen indicators	7,000	721
Radiation	*	*
Oil and grease	*	*
Taste and odor	*	*
Suspended solids	8,500	6,644
Noxious aquatic plants	*	*
Total toxics	*	*
Turbidity	*	*
Exotic species	*	*
Other (specify)	*	*

* = category not applicable

[1] = indicates nonsupport for designated use
[2] = indicates partial support for designated use

FIGURE 8a. STREAM MILEAGE IMPAIRED BY VARIOUS CAUSE CATEGORIES

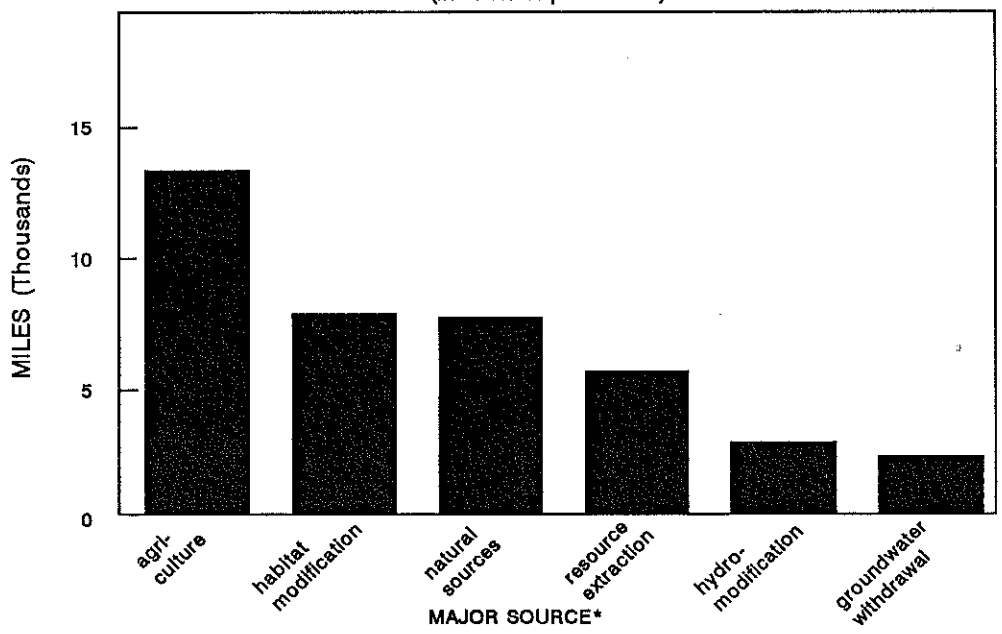
(in order of prevalence)



* more than one cause of impairment may be associated with a given stream segment

FIGURE 8b. STREAM MILEAGE IMPAIRED BY VARIOUS POLLUTANT SOURCE CATEGORIES

(in order of prevalence)



* more than one cause of impairment may be associated with a given stream segment

TABLE 15. Total Stream Mileage Impaired by Various Pollutant Source Categories

Source Category	Contribution to Impairment		Source Subcategory	Contribution to Impairment	
	Major[1]	Minor[2]		Major[1]	Minor[2]
Industrial Point Sources	497	40			
Municipal Point Sources	1,685	55			
Combined Sewer Overflows	103				
Agriculture	13,261	2,567	Nonirrigated Crop Production Irrigated Crop Production Animal Operations	9,501 5,411 7,056	3,227 394 738
Construction	94	13	Highway/Road/Bridge Construction Land Development	13 81	 13
Urban Runoff/Storm Sewers	391	172			
Resource Extraction	5,576	348	Surface Mining Petroleum Mine Tailings	324 5,245 7	27 321
Hydromodification	2,812	117	Upstream Impoundment Channelization Flow Regulation	102 371 2,441	 117
Habitat Modification	7,791	3,145	Removal of Riparian Vegetation	7,791	3,145
Highway Maintenance Runoff	151				
Natural Sources	7,658				
Salt Storage Sites	79				
Groundwater Withdrawal	2,262	117			
Other : Solid Waste Disposal	32		Septic Systems	32	
Unknown Source	1,605	134			

[1] = indicates nonsupport for designated use

[2] = indicates partial support for designated use

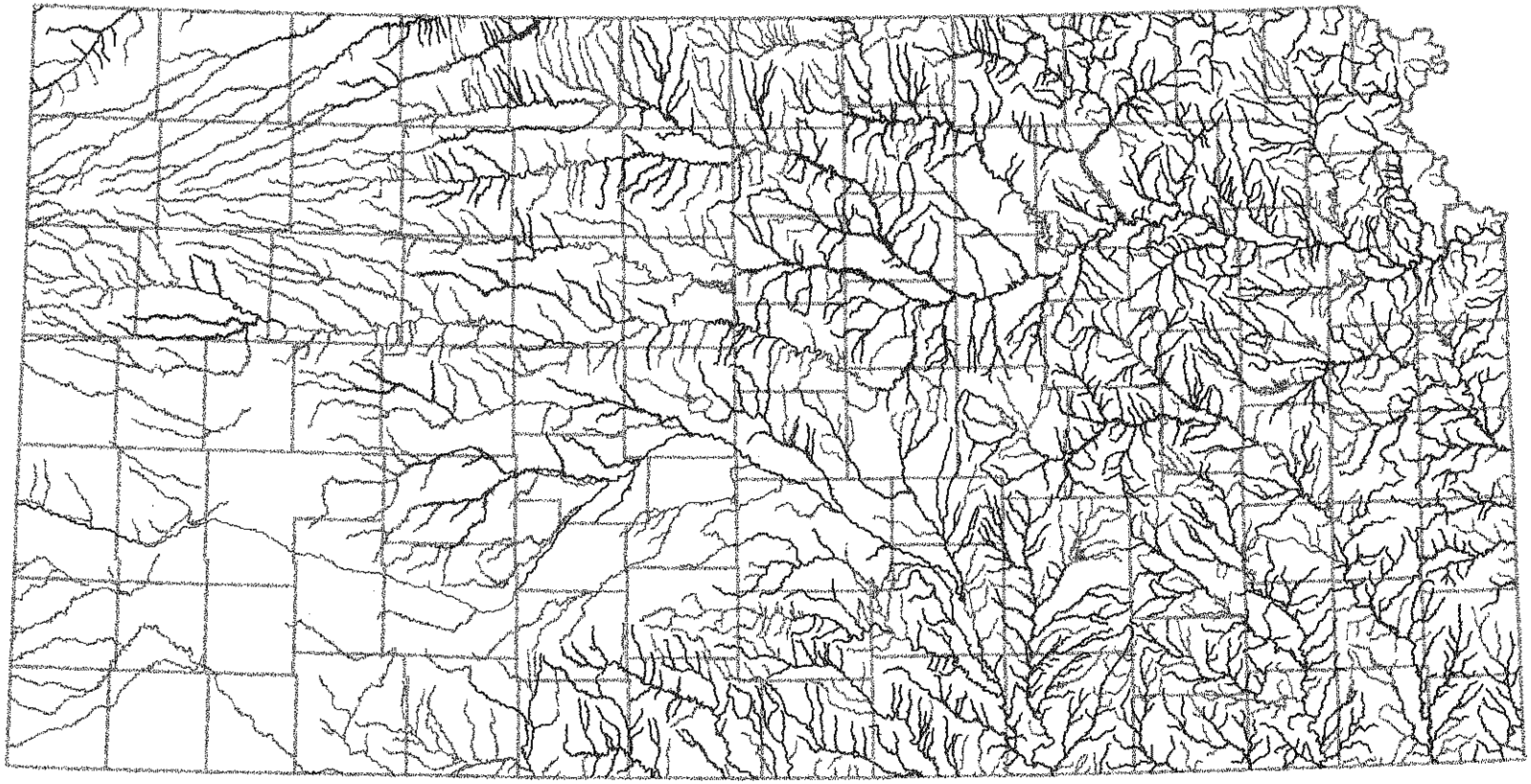
reduced sulfur- and iron-containing compounds, thereby increasing chemical oxygen demand and lowering DO levels in some streams. Throughout much of the state, high TSS and turbidity levels in streams promote the absorption of sunlight, the heating of surface water and, in turn, the lowering of DO saturation levels. Elimination of shade through the removal of woody riparian canopies exacerbates this general relationship between TSS and DO concentration.

Pesticides are routinely detected in many streams in eastern Kansas owing primarily, though not exclusively, to their widespread agricultural use and presence in rainfall runoff. The most commonly detected of these is atrazine, a widely used preplant and preemergent herbicide for row crops such as corn and sorghum. Concentrations of atrazine exceed the chronic criterion for aquatic life support in many streams in eastern Kansas. During the peak runoff period in spring and early summer, concentrations may also exceed the applicable domestic water supply criterion. This is especially true of those streams draining the traditional cornbelt region of northeastern Kansas. Levels of another pesticide, chlordane, seldom occur at detectable levels in surface water but are measured routinely in the fatty tissues of bottom feeding fish. The registration for this highly persistent and bioaccumulative pesticide, used commonly as a termiticide in rural, urban, and suburban construction, was suspended by EPA in 1988. Nevertheless, it continues to occur at levels of potential human health significance in fish collected from several urban streams. Chlordane contamination is the basis for all fish tissue consumption advisories currently in effect in Kansas.

Stream Assessment Maps

The following maps (1-7) illustrate the degree of support for the designated uses of aquatic life (acute and chronic), contact recreation, noncontact recreation, drinking water (domestic water supply), and agriculture (irrigation and livestock watering) in Kansas streams. The remaining maps (8-10) show the distribution of the three main causes of impairment of use support in streams. (Data sources for the coverages are listed Appendix Part II.)

LEVEL OF SUPPORT FOR STREAMS DESIGNATED FOR AQUATIC LIFE (BASED ON COMPLIANCE WITH ACUTE CRITERIA ONLY)

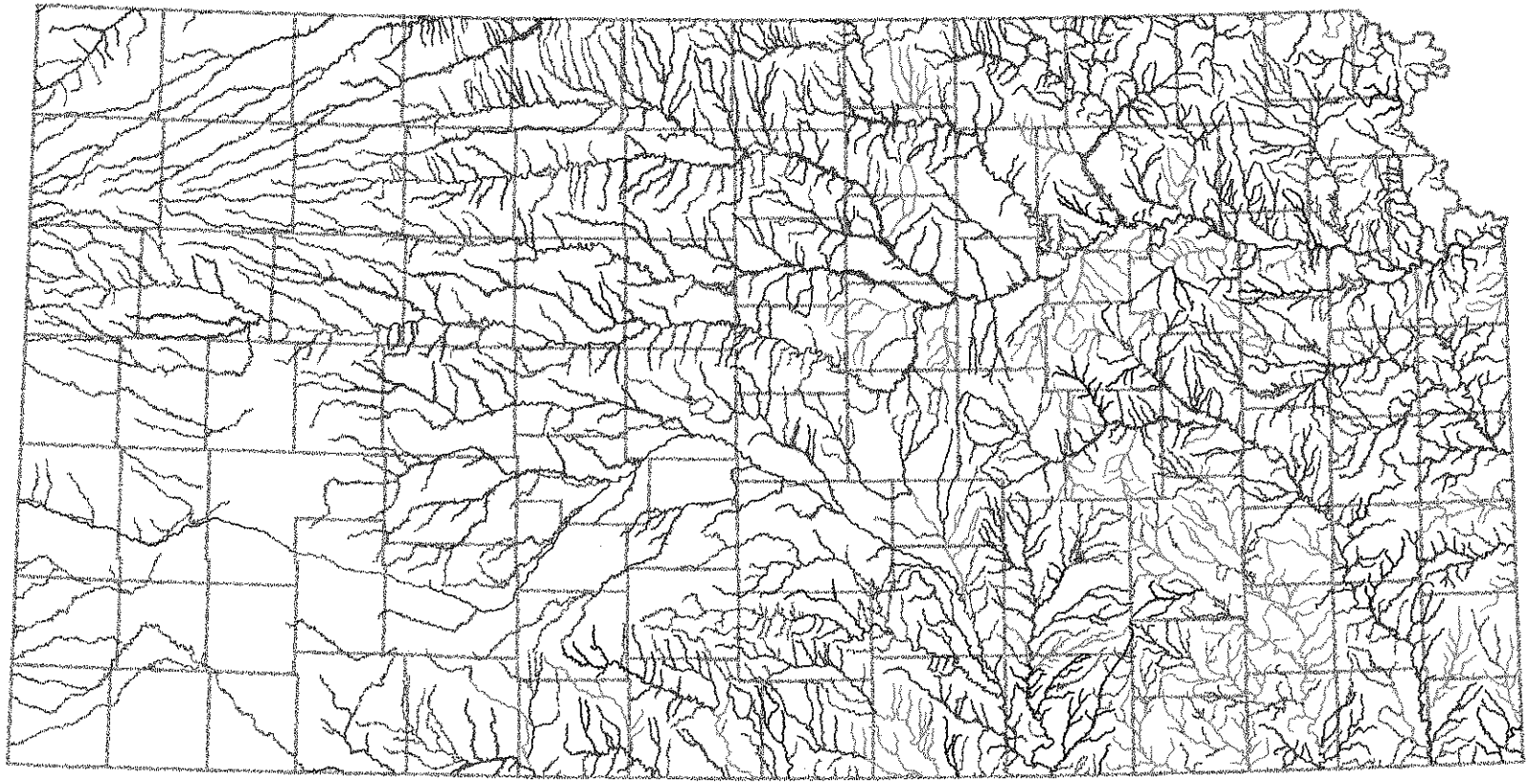


KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

LEVEL OF SUPPORT FOR STREAMS DESIGNATED FOR AQUATIC LIFE (BASED ON COMPLIANCE WITH ACUTE AND CHRONIC CRITERIA)

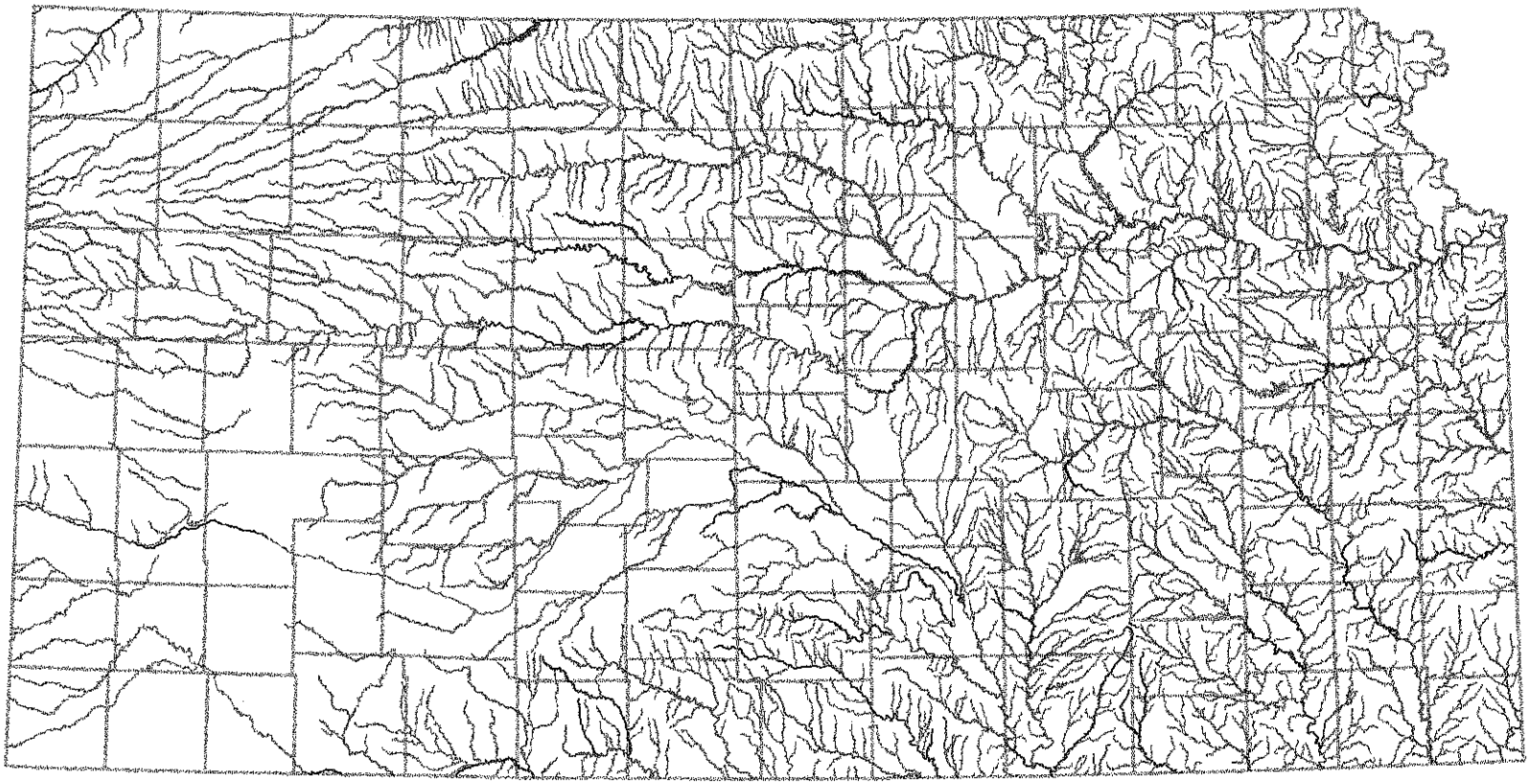


KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

LEVEL OF SUPPORT FOR STREAMS DESIGNATED FOR CONTACT RECREATIONAL USE

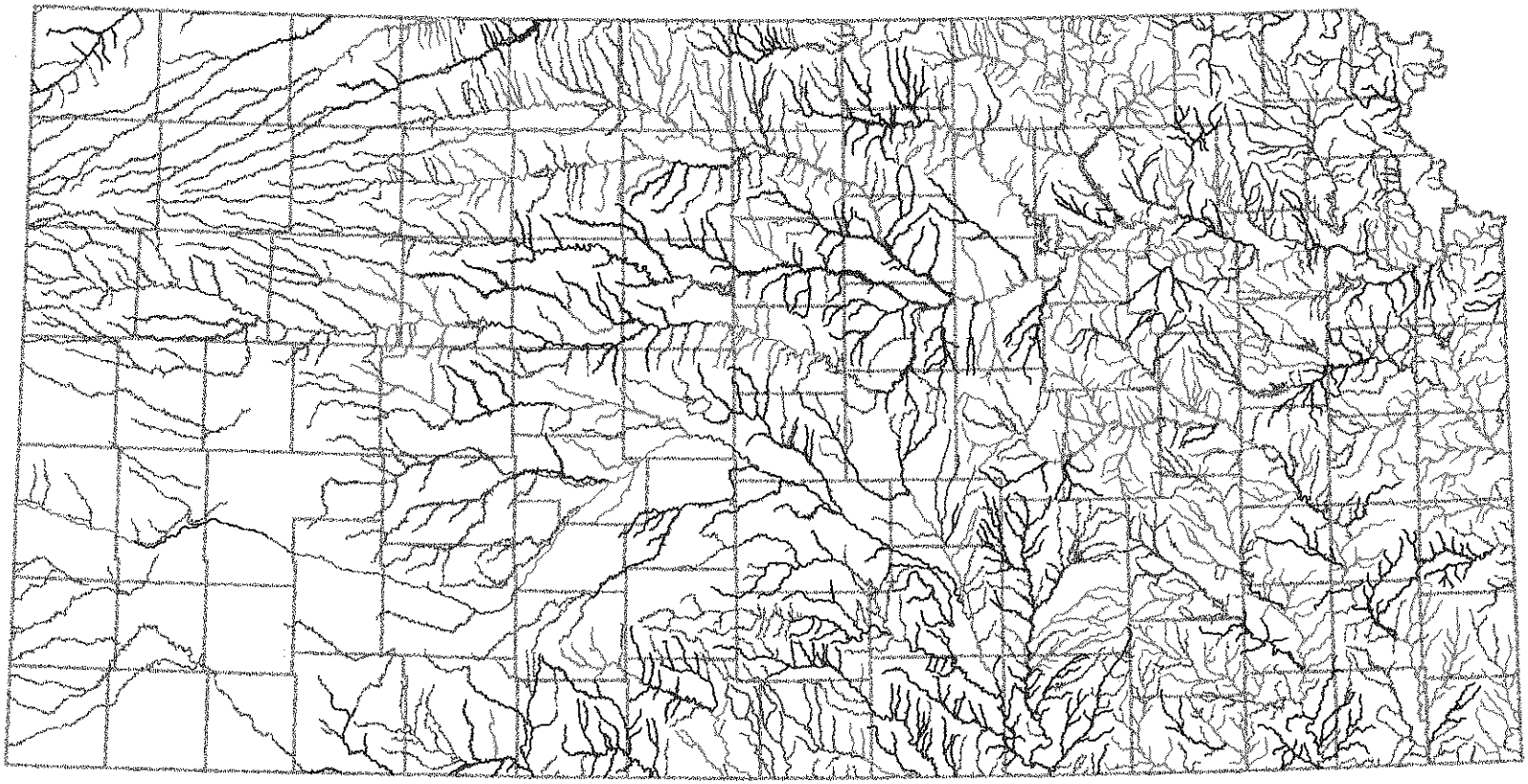


KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

LEVEL OF SUPPORT FOR STREAMS DESIGNATED FOR NONCONTACT RECREATIONAL USE

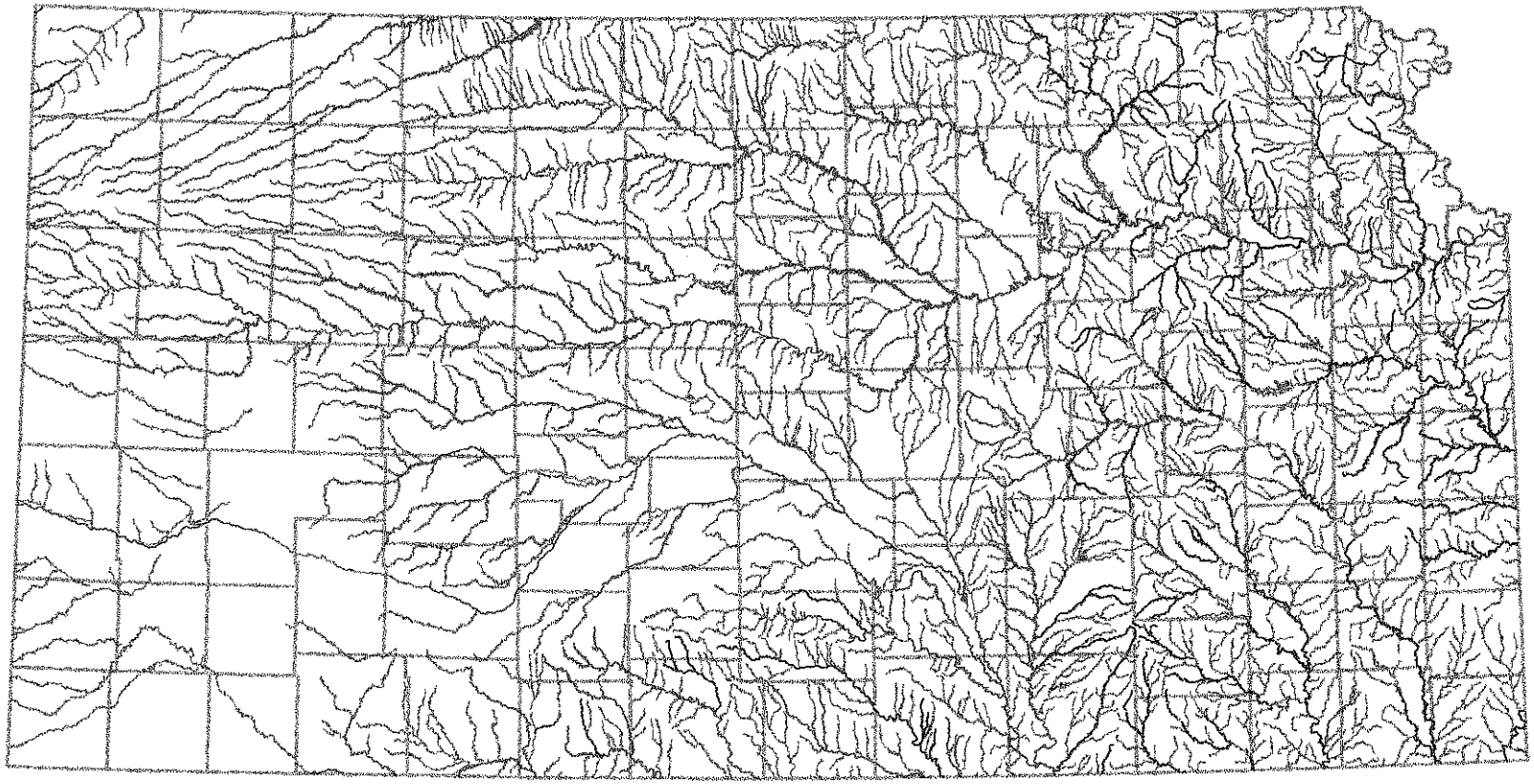


KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

LEVEL OF SUPPORT FOR STREAMS DESIGNATED FOR DOMESTIC WATER SUPPLY USE

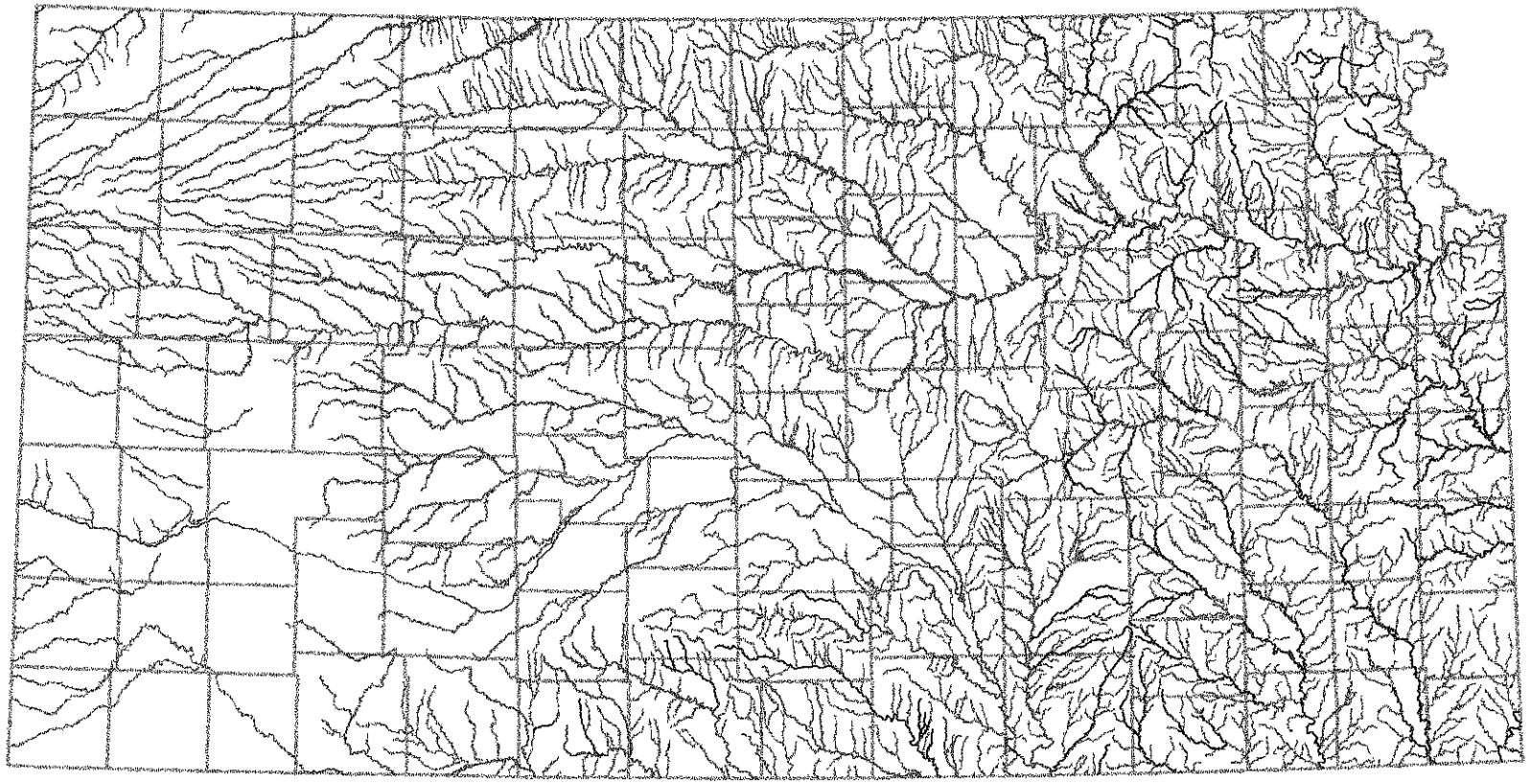


KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

LEVEL OF SUPPORT FOR STREAMS DESIGNATED FOR IRRIGATION USE



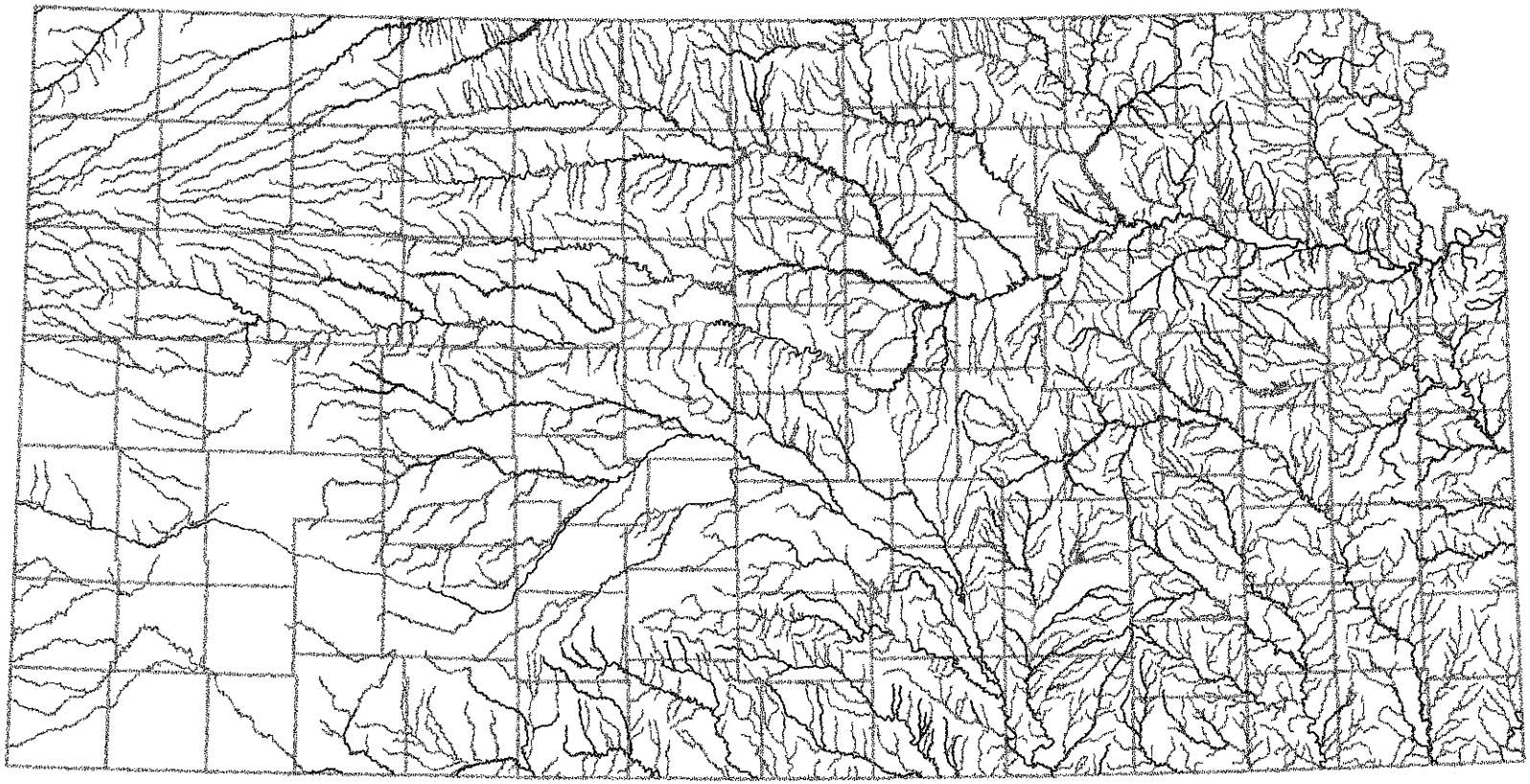
Fully Supporting
Partially Supporting
Not Supporting
Not Attainable
Other*

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

LEVEL OF SUPPORT FOR STREAMS DESIGNATED FOR LIVESTOCK WATERING USE

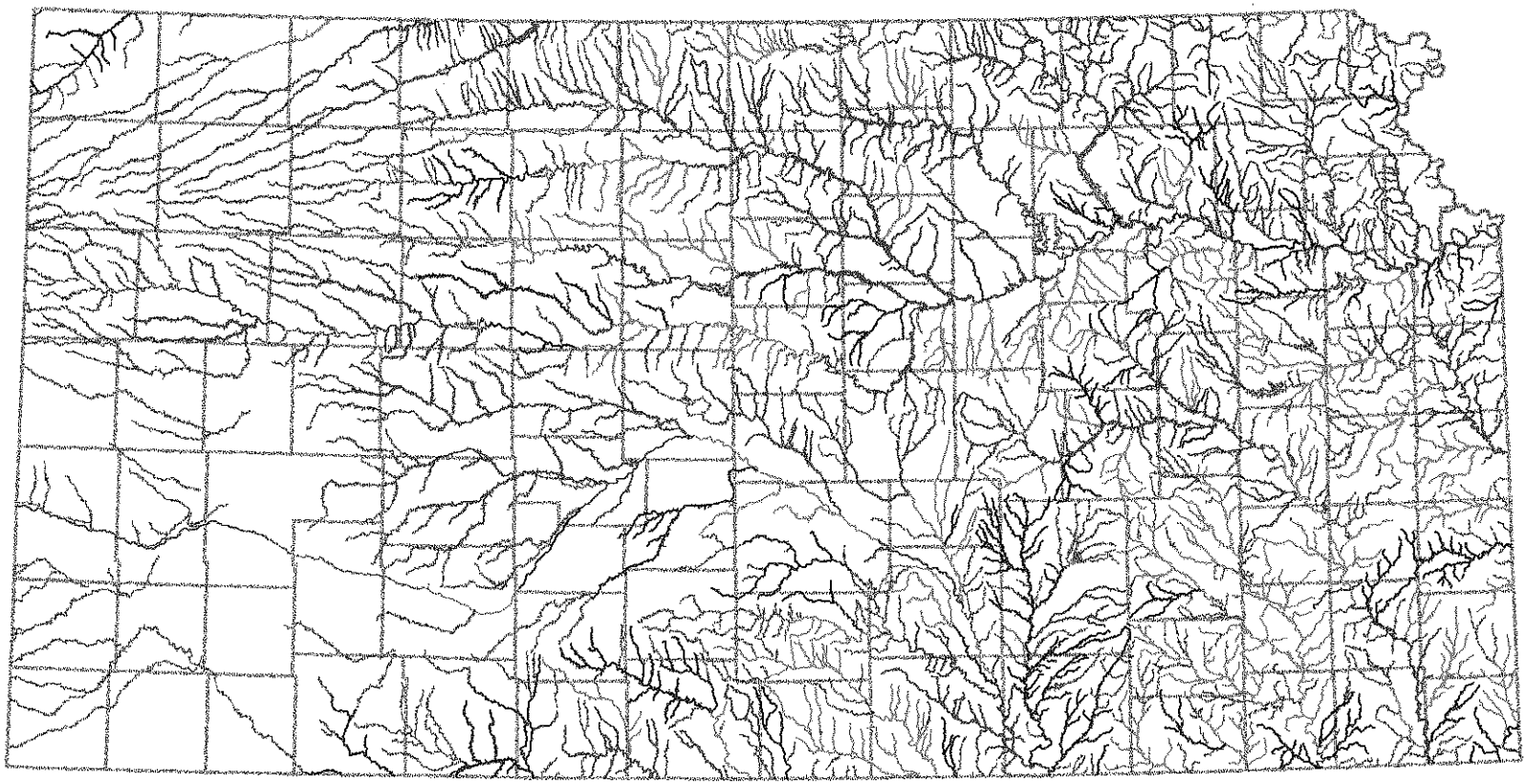


KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

STREAMS IMPAIRED BY TOTAL SUSPENDED SOLIDS



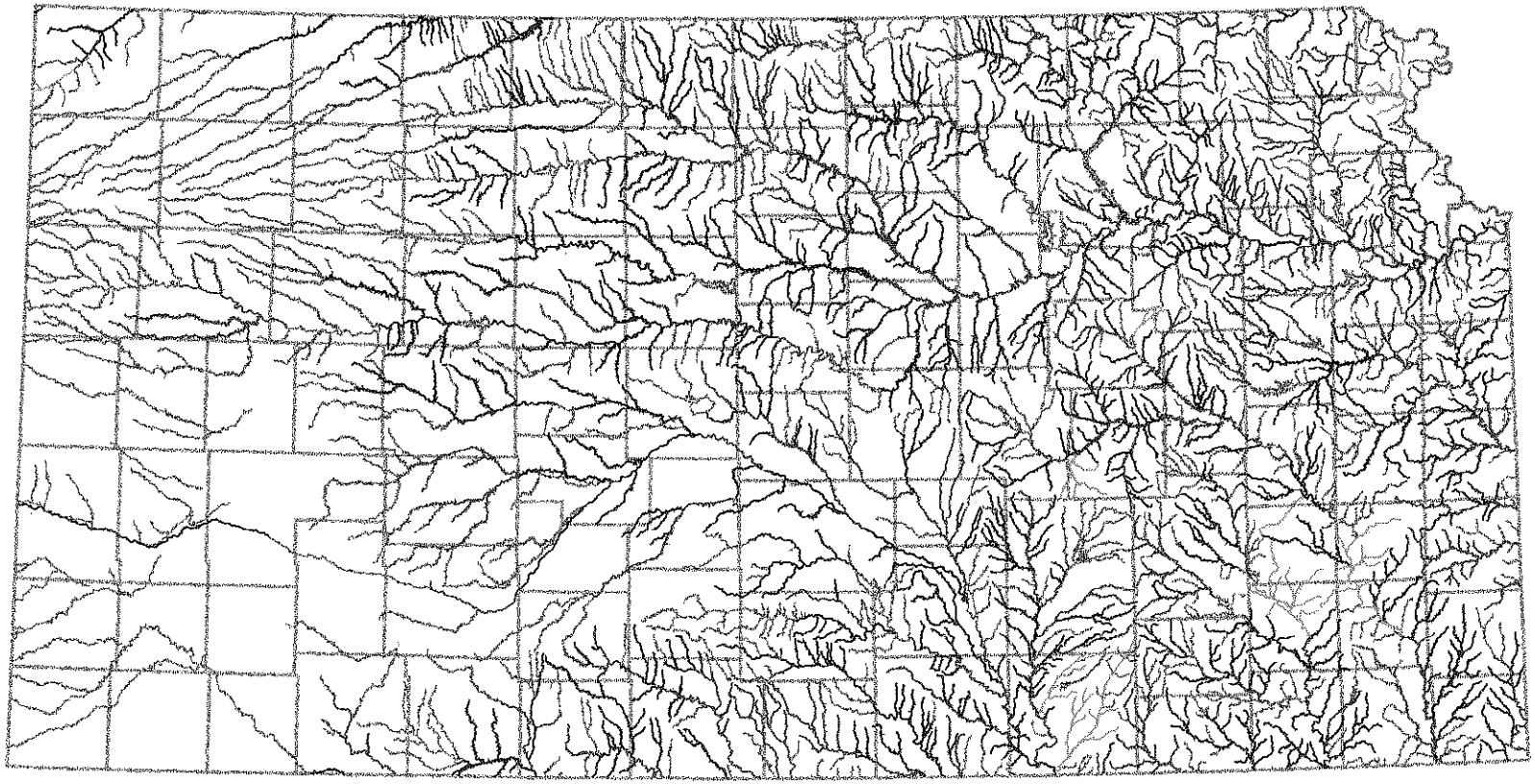
Major Impairment
Minor Impairment
No Impairment
Other*

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

STREAMS IMPAIRED BY PATHOGENS
(FECAL COLIFORM BACTERIA)

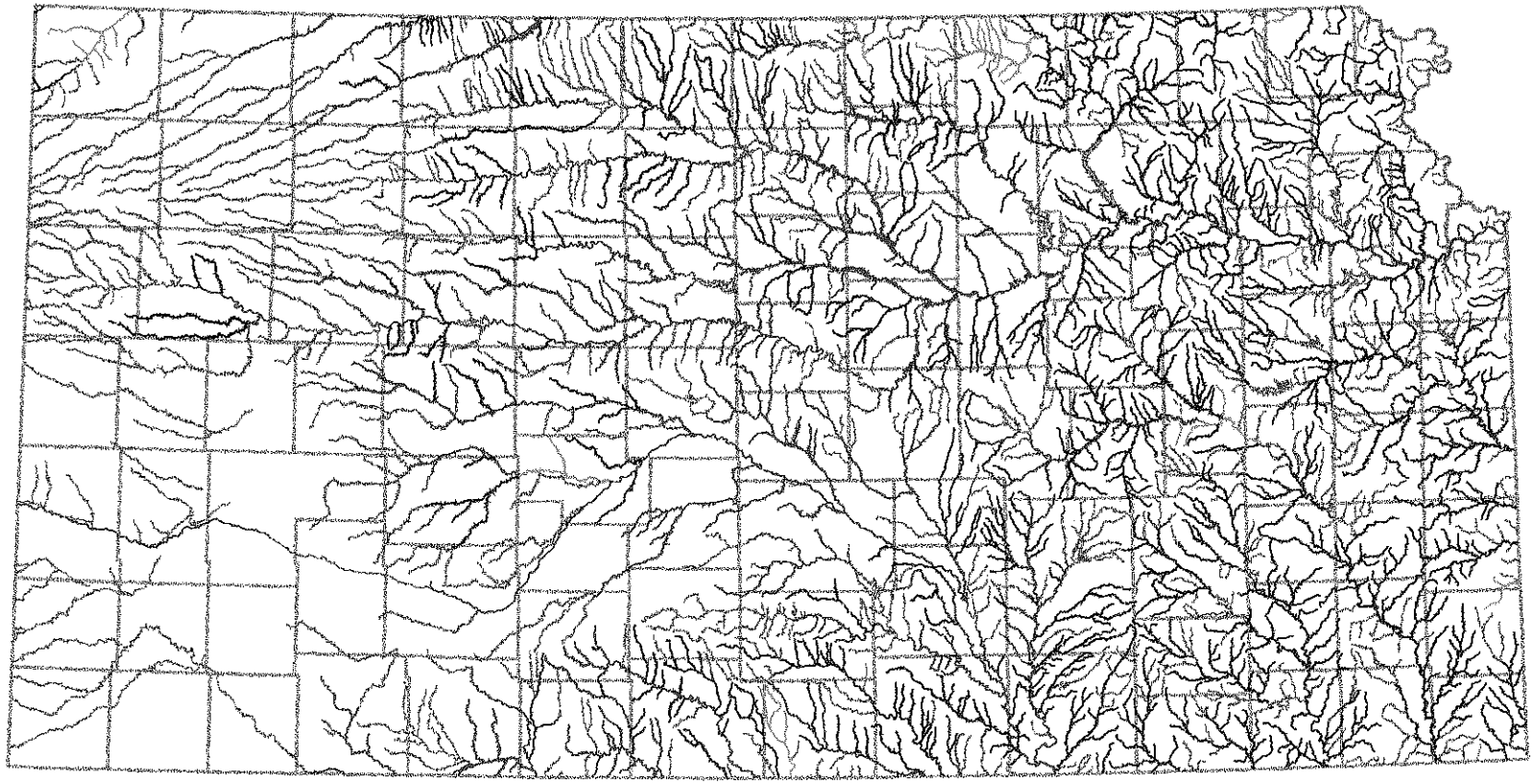


KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

STREAMS IMPAIRED BY SALINITY, TOTAL DISSOLVED SOLIDS, CHLORIDE, AND/OR SULFATE



Major Impairment
Minor Impairment
No Impairment
Other*

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

*Other includes streams not assessed, use designation unknown, lake, or wetland.

Summary Statistics

Table 16 presents a comparison of lake acreage investigated during the 1991-1995 reporting cycle through the use of biological/habitat metrics, physicochemical measurements, or both biological/habitat metrics and physicochemical measurements. Note that assessment activities at all monitored and evaluated lakes incorporated both of these assessment approaches. Table 17 lists the number of lakes and associated surface acreage impacted by identifiable point and NPSs of pollution. Although nonpoint sources impact a greater number of smaller lakes, both point and nonpoint sources influence virtually all larger lakes and, therefore, the vast majority of the state's total lake surface acreage.

Table 16. Categories of Data used in ALUS Assessments for Lakes

DEGREE OF ALUS	ACRES ASSESSED BASED ON BIOLOGICAL HABITAT DATA ONLY	ACRES ASSESSED BASED ON PHYSICAL/ CHEMICAL DATA ONLY	ACRES ASSESSED BASED ON/ BIOLOGICAL/ CHEMICAL DATA	TOTAL ACRES ASSESSED FOR ALUS
Fully supported	0	0	0	0
Fully supported but threatened	0	0	26,938	26,938
Partially supported	0	0	35,983	35,983
Not supported	0	0	112,339	112,339

Table 17. Lake Acreage With Identifiable Point and Nonpoint Source Pollution Contributions

POLLUTION TYPE	NUMBER OF LAKES*	ACRES OF LAKES
Point Sources	27	140,707
Nonpoint Sources	207	155,130
No Identifiable Pollution Sources	83	20,120

*Numbers include any level of point source inputs, and any magnitude or combination of NPSs. Due to the fact that a number of lakes have both source types within their watersheds, the numbers will not total to the acres/numbers of lakes reported in this chapter.

Clean Lakes Program

Background

A total of 291 publicly owned or publicly accessible lakes are included in this reporting cycle. This represents all such lakes known to KDHE through monitoring activities and reports published by other agencies. These lakes comprise 175,260 surface acres. Lakes with their shoreline area under common private ownership are considered to be private lakes, but are often open to members of the general public by invitation. In the future, the number of reported lakes will increase if dam construction continues under several state/federal programs.

For the purposes of this report, all publicly owned/accessible lakes, reservoirs, and ponds will be considered as "significant" waterbodies. This is based on the assumption that any lentic waterbody, which is owned by or accessible to the general public, will provide benefits to the population as a whole. These benefits may include recreation and water supply, but will certainly involve habitat for the support of indigenous aquatic and semi-aquatic organisms such as fish and migrating waterfowl.

Unless specifically identified as wetlands, all lentic waterbodies will be referred to as "lakes" within this report, regardless of size or origin. This is done in order to avoid the semantics involved in determining the characteristics that divide ponds from lakes and/or natural from human-made.

Trophic Status

Trophic state classification in lakes and wetlands is based primarily on the observed chlorophyll-a level (corrected for phaeophytin-a.) The rationale is based on the idea that algal biomass, as represented by chlorophyll-a, comprises the base of the lacustrine food web.

The observed level of chlorophyll provides an estimate of overall lake productivity. In addition, higher levels of algal biomass produce correspondingly lower aesthetic appeal and general recreational opportunities, increased problems and cost in treatment of drinking water, and increased problems with using water for livestock and irrigation. Because of this, the trophic state estimate also becomes valuable for assessing overall use support of lakes.

While high levels of sedimentation are often concurrent with the eutrophication process, current KDHE monitoring does not allow more than a rough indication of sedimentation problems. When sedimentation problems are visually obvious, they are utilized in "weighting" assigned trophic state classifications.

Chlorophyll-a values are converted to Trophic State Index (TSI) values using the formula in Carlson (1977). These TSI numbers are then used to assign a trophic state classification based on the following scale for lakes in the KDHE Lake and Wetland Monitoring Program:

Oligo-Mesotrophic	= TSI of <40,
Mesotrophic	= TSI of 40 to 49.99,
Eutrophic	= TSI of 50 to 63.99,
Slightly Eutrophic	= TSI of 50 to 54.99,
Fully Eutrophic	= TSI of 55 to 59.99,
Very Eutrophic	= TSI of 60 to 63.99,
Hypereutrophic	= TSI of >= 64.

The eutrophic classification is further broken down into three sub-classes for better determination of lake use impairment levels. The oligo-mesotrophic class is a special grouping that denotes a lake that produces little algal biomass due to light limitation. The "potential" trophic state classification would usually be much higher than that assigned by observed algal biomass for these lakes. For reporting purposes, oligo-mesotrophic lakes are included in the mesotrophic category.

In instances where macrophytic production contributes significantly to overall lake productivity, the chlorophyll-a based trophic state classification will be placed in the next highest category. For example, if a lake is assigned a "fully eutrophic" classification based on algal biomass, but has a very abundant macrophyte community, the final trophic state class will be considered "very eutrophic." Table 18 presents trophic state ratings for the lakes assessed during this reporting cycle.

Table 18. Trophic Status of Lakes Assessed During This Reporting Cycle (Percent of total in parentheses)

TROPHIC STATUS	NUMBER OF LAKES	ACREAGE OF LAKES
Oligotrophic	0	0
Mesotrophic	42 (14.4)	65,881 (37.6)
Eutrophic	130 (44.7)	104,546 (59.7)
Hypereutrophic	69 (23.7)	3,091 (1.8)
Dystrophic	0	0
Unknown	50 (17.2)	1,742 (0.9)
Total	291 (100.0)	175,260 (100.0)

The majority of lakes fall into the eutrophic and hypereutrophic categories, while the vast majority of surface acreage falls into the mesotrophic and eutrophic categories. This primarily results from the influence that lake size (area, volume, depth) exerts on lake trophic state development. Many of the larger lakes in the state are mesotrophic to eutrophic, while many of the small lakes in Kansas develop hypereutrophic conditions, based primarily on hydrologic and morphometric influences. While a significant percentage of reported lakes have not been assessed for their trophic status, they constitute less than 1% of the total reported acreage. Since the last 305(b) reporting cycle, roughly half of the lakes in the unknown category have been surveyed. At present, the majority of reported lakes with unknown trophic state conditions are within the Mined Land Lakes (MLL) Recreation Area in southeast Kansas.

Control Methods

The Kansas Department of Health and Environment provides guidelines for the construction of drinking water supply lakes. These guidelines recommend that (1) cattle shall be fenced at least 15 feet from the high water elevation, (2) there shall be no discharge of treated or untreated wastewater directly into the lake, (3) there shall be no wastewater facilities, septic tanks, or sanitary sewers allowed within 200 feet from the high water elevation, and (4) the potential for pollutant or nutrient contribution of the watershed shall be evaluated. When reviewing NPDES discharge permits, proximity of the discharge to lakes is considered in setting effluent limitations.

As of 1995, two spreadsheet eutrophication/nutrient loading models have been adopted by KDHE as management tools for predicting nutrient loading and trophic response in lakes. An early version of one of these models was used to assess the potential effects of municipal point source discharges on three federal lakes and several smaller lakes. More recently, an updated version of this model (EUTROMOD 2.50) has become available, and is now utilized by KDHE for lake trophic state and nutrient load modeling. To date, between 10 and 20 lakes and watersheds have been modeled using EUTROMOD 2.50 with very satisfactory results. The second lake trophic state model utilized by KDHE is one developed by Dr. William Walker (U.S. Army Corps of Engineers), which is distributed under the name CNET.

In addition to the lake protection items addressed above, KDHE operates a monitoring network of the lakes and wetlands within Kansas. This network is designed to provide long-term trend and baseline data for determining if point source or NPS pollution is a problem within a given watershed, or within a major river basin generally. Wetlands were first added to this monitoring network in 1988. All water quality standards adopted by the State are applicable to lakes and wetlands within Kansas, contingent on the determination of use attainability at these monitored sites (K.A.R. 28-16-28d(c)).

Technical advice and assistance, concerning lake protection, restoration, and assessment, is available to all citizens and agencies in Kansas through the Kansas Clean Lakes Program to determine the best protection and/or restoration options for a given lake. During 1993, the Kansas Clean Lakes Program completed a series of brochures concerning basic lake ecology and protection. These brochures are designed for the general public, as well as for school groups in the grade 4-9 range.

In addition, KDHE began a Taste and Odor/Algae Bloom Technical Assistance Program for water supply lakes in 1989. The main thrust of this program is to provide technical assistance in the identification of water supply taste and odor problems caused by algal blooms or other lake-related ecological processes. Samples from any water body are accepted by KDHE when toxic blooms are possible. A total of 73 investigations into taste/odor problems and algae related complaints have been completed as of October 31, 1995.

Most lake restoration efforts through KDHE are limited to the cost-sharing Clean Lakes Program administered by EPA.

Kansas Department of Wildlife and Parks provides guidance to municipalities and counties for the construction of lakes used for recreation. The KDWP considers such things as proximity to point source pollution and, depending on soil type and runoff potential, the land use within the watershed.

Restoration/Rehabilitation Efforts

Several restoration techniques have been applied in Kansas, but many of the instances are not documented in a format that is readily accessible. Therefore, only restoration actions specific to KDHE projects are listed within this report. Other restoration activities, known to have occurred at Kansas lakes, are discussed in a more general fashion. Among the more common are the control of nuisance algal and macrophyte populations through the use of grass carp or copper sulfate additions, both of which tend to be symptomatic treatments only. The practice of copper sulfate use is discouraged by KDHE unless monitoring of the lake algae community is conducted concurrently to determine need. The use of grass carp for macrophyte control is discouraged unless macrophyte abundance clearly causes an impairment and no other option is feasible. The introduction of grass carp to lakes is frequently associated with the loss of macrophytic habitat and an increase in phytoplankton production.

The KDWP is involved in lake restoration primarily for the improvement of fish habitat and fishing/hunting recreation. A common practice is the addition of brush piles or discarded trees to augment fish breeding habitat and shelter. To control excessive macrophyte growth, KDWP has recommended use of grass carp (*Ctenopharyngodon idella*) over the use of aquatic herbicides. Dredging of lakes to deepen silted-in areas has become a less common practice due to lack of funds. When dredging is conducted at a lake, the sediment is often recycled for use in fishing pier construction.

Management and improvement of fish habitat and consumptive recreation has utilized direct manipulation of the fish population through stocking and/or selective removal. Water level adjustment to improve fish and waterfowl habitat is also practiced. The KDWP annually submits water level adjustment plans for many of the federal lakes in Kansas to the KWO, which are reviewed and commented on at public meetings prior to submission to the Army Corp of Engineers. Under certain situations, these fishery habitat practices can also be used to improve water quality.

Hypolimnetic aeration/destratification has been used as a fishery management/restoration tool at both Pottawatomie and Neosho County State Fishing Lakes. This so called "helixor" device was first used at these lakes in 1976 with some success. Such efforts are only feasible in small impoundments in Kansas, usually limited to those with 100 or fewer surface acres. Many communities have used aerators in their water supply lakes to prevent summer stratification which is believed to contribute to taste and odor problems. The department recommends that such practices be limited to the prevention of stratification, rather than enacted to destratify lakes.

As stated before, dredging remains a useful (but expensive) tool for lake restoration. Dredging has been undertaken at Ford County and Lone Star Lakes under their Phase II Clean Lakes Projects, and has been suggested for several other lakes in Kansas as the only long term restoration strategy available, when coupled with preventative measures in the watershed.

Watershed management practices remain a vitally important tool for lake protection. These management practices cover a variety of options which include terracing, buffer strips, grassed waterways, improved cropping practices, feedlot waste containment, and sediment ponds. Most often, such watershed practices are initiated by the Natural Resources Conservation Service and local Conservation Districts. Other watershed management practices might include local ordinances on construction practices, pesticide use on public lands, or restrictions on zoning of land use.

Modeling will play an important role in lake restoration and protection in future years. The department has already employed such modeling efforts to select optimal nutrient reduction strategies for specific lakes.

To date, Phase I Diagnostic and Assessment projects have been undertaken at Ford County Lake, Sabetha City Lake, Lake Afton, New Olathe Lake, Santa Fe Lake at Chanute, Herington Reservoir, and Nemaha County State Fishing Lake. All have been completed. A Phase I study is in the final stages of completion for Rimrock Park and Mary's lakes, two urban lakes located in northeastern Kansas.

Phase II Restoration projects have been initiated at Ford County Lake and Lone Star Lake in Kansas. No Phase III Evaluation projects have been undertaken in this state. Table 19 presents specific information on Clean Lakes Program projects and associated protection/restoration efforts.

Kansas completed a Lake Water Quality Assessment (LWQA) project in 1989 which surveyed 121 lakes throughout the state for trophic state, use impairment, and watershed land use. This data has been used to determine need and ranking for the application of future Clean Lakes Program monies, as well as for assessing projects for other types of protection and/or restoration monies.

A second, two year, LWQA project was begun in 1991 to continue watershed assessment activity and other follow-up activities identified in the 1989 LWQA work. In addition to follow-up work, this grant was used to produce several lake ecology/protection brochures for general public distribution. It is hoped that these publications will allow for enhanced public awareness of lake water quality and the need for lake protection. Continuation of this LWQA effort, during 1994, resulted in assessments for an additional 59 lakes around the state. The data for these additional 59 lakes is included in the assessments made within this report.

The use of watershed practices to control sediment and nutrient pollution in surface runoff is the most utilized restoration/rehabilitation option for Kansas lakes (Table 19). Watershed protection strategies take on numerous forms and practices, and tend to be tailored to the specific situation. However, several practices are often included by local/state/federal participants and include, terracing of cropland, detention ponds, feedlot waste management, riparian vegetation protection, and fertilizer and pesticide management. A total of 1,272 acres (nine lakes) have had watershed protection proposed and/or enacted as part of the Clean Lakes Program to protect and restore water quality.

Dredging is the primary option for removing accumulated silt, despite the high costs. Dredging has been conducted for both Clean Lakes Program Phase II projects in Kansas. These two lakes comprise 243 surface acres.

Table 19. Clean Lakes Program Phase I and II Projects Undertaken in Kansas, Including Restoration/Rehabilitation Efforts

LAKE (ACRES)	PROJECT TYPE (PHASE)	MANAGEMENT (PRINCIPAL)	PROBLEMS IDENTIFIED	RESTORATION PROPOSED/UNDERTAKEN
Ford County Lake (48)	I	Dodge City College	Sediment	Dredging and Watershed Protection
Sabetha Lake (112)	I	City	Sediment, Eutrophication	Watershed Protection
Lake Afton (196)	I	County	Eutrophication	Watershed Protection
Olathe Lake (85)	I	City	Eutrophication	Watershed Protection
Chanute City Lake (80)	I	City/KDHE	Sediment, Eutrophication	Watershed Protection
Nemaha County SFL	I	KDWP/County	Discontinued: Dam failure resulted in the abandonment of the lake	
Herington Reservoir (546)	I	KDHE/City	Pesticides, Salinity, and Eutrophication	Watershed Protection
Rimrock Park/Mary's Lakes (10 total)	I	KDHE/City	Eutrophication	Watershed Protection, Hydrologic Modification and Dredging
Lone Star Lake (195)	II	County	Sediment	Dredging and Watershed Protection
Ford County Lake (48)	II	KDWP	Sediment	Dredging and Watershed Protection

Impaired and Threatened Lakes

Table 20 summarizes overall use support ratings for lakes assessed during this reporting cycle. Support rating for individual designated uses for lakes is presented in Table 21.

Table 20. Summary of Fully Supporting, Threatened, and Impaired Lakes

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED ACRES
	EVALUATED	MONITORED	
Fully supporting all uses	0	0	0
Supporting but threatened for at least one use	2,875	24,063	26,938
Size impaired for one or more uses	2,696	145,626	148,322
Total size assessed	5,571	169,689	175,260

The majority of lake surface acres in Kansas are considered to be monitored (Table 20). This is primarily due to the inclusion of all the federal impoundments within the KDHE Lake and Wetland Monitoring Program. These 24 lakes comprise the majority of the reported surface acreage in the state.

Beginning in 1992, bacteria samples were no longer collected in the open water of each lake but at selected swimming beaches. While the data from the open waters of lakes were used to assess the conditions pertaining to the whole waterbody, the same assessment cannot be carried out based on swimming beach samples that reflect specific, very small locales in each lake. While it is presumed that lakes in Kansas, based on whole-lake assessments, normally support the swimming use, it is possible to find temporary, high FCB counts at specific swimming beaches.

Lakes that have exhibited elevated FCB counts (greater than 200 per 100 ml) at swimming beaches include Big Hill Lake, Fort Scott City Lake, Marion Lake, Mission Lake, and Webster Lake.

All monitored lakes have data for a range of heavy metals and pesticides, including a number of those substances defined as "toxics" by the EPA. Out of the total reported acreage (175,260 acres) 169,689 acres are surveyed for total recoverable metals and pesticides (97% of the total). For the purposes of this report, due to EPA promulgated dissolved metals criteria, impairments due to heavy metals only includes those due to mercury and selenium. For these two parameters, numeric criteria were the same in both state water quality standards and the EPA promulgated criteria. Of the total acres assessed, 96,122 acres (55% of total) demonstrated impairment of the chronic aquatic life criteria due to pesticides (primarily atrazine), mercury, selenium, or other substances defined as toxics by EPA. Table 22 shows assessment data pertaining to the causes of use impairments in lakes in Kansas while Table 23 lists contaminant sources responsible for lake use impairments.

Table 21. Individual Use Summary in Acres for Lakes

GOALS	USE	SIZE ASSESSED	SIZE FULLY SUPPORTING BUT THREATENED	SIZE PARTIALLY SUPPORTING	SIZE NOT SUPPORTING	SIZE NOT ATTAINABLE
Protect & Enhance Ecosystems	Aquatic Life	175,260	26,938	35,983	112,339	0
Protect & Enhance Public Health	Fish Consumption	45,107	45,106	0	1	0
	Shellfishing	*	*	*	*	*
	Swimming	175,260	113,437	46,298	15,525	0
	Secondary Contact	175,260	161,375	10,428	3,457	0
	Domestic Water Supply	175,260	68,813	40,518	65,929	-
Social & Economic Enhancement	Agricultural (irrigation)	175,260	133,584	9,755	31,921	-
	Agricultural (livestock)	175,260	159,587	10,371	5,302	-
	Cultural	*	*	*	*	*

* = category not applicable
0 = category applicable, but size of waters in category is zero
- = category applicable, no data available

Table 22. Total Lake Acres Impacted by Various Cause Categories

CAUSE CATEGORY	ACRES BY CONTRIBUTION TO IMPAIRMENT	
	MAJOR[1]	MODERATE/MINOR[2]
Cause unknown	-	-
Unknown toxicity	-	-
Pesticides	28,459	60,276
Priority organics	-	-
Nonpriority organics	-	-
Metals	0	40,872
Ammonia	-	-
Chlorine	-	-
Other inorganics	11	275
Nutrients/eutrophication	18,358	137,800
pH	0	17,393
Siltation	-	-
Organic enrichment/low DO	7	8,292
Salinity/TDS/chlorides	10,841	20,492
Thermal modifications	-	-
Flow alterations	3,816	7,775
Other habitat alterations	-	-
Pathogen indicators	-	-
Radiation	-	-
Oil and grease	-	-
Taste and odor	-	-
Suspended solids	25,641	30,982
Noxious aquatic plants	856	1,333
Total toxics	-	-
Turbidity	25,641	30,982
Exotic species	-	-
Other (specify)	-	-

- = category applicable, no data available

[1] = indicates nonsupport for designated use

[2] = indicates partial support for designated use

Table 23. Total Lake Acres Impaired by Various Source Categories

SOURCE CATEGORY	CONTRIBUTION TO IMPAIRMENT	
	MAJOR[1]	MODERATE/MINOR[2]
Industrial Point Sources	-	-
Municipal Point Sources	30,207	110,500
Combined Sewer Overflows	-	-
Agriculture	46,740	92,857
Silviculture	-	-
Construction	-	-
Urban Runoff/Storm Sewers	283	7,348
Resource Extraction	273	647
Land Disposals	-	-
Hydromodification	3,445	5,822
Habitat Modification	-	-
Marinas	-	-
Atmospheric Deposition	-	-
Contaminated Sediments	-	-
Unknown Source	0	1,240
Natural Sources	19,312	43,482
Other (specify)	-	-

- category applicable no data available

[1] = indicates nonsupport for designated use
[2] = indicates partial support for designated use

Acid Effects on Lakes

A total of 175,146 acres of lakes in Kansas were monitored or evaluated for pH, out of the total reported during this cycle. This combines the KDHE Lake and Wetland Monitoring Program sites, LWQA survey sites, and an additional 1,150 acres within the Mined Land Lakes Area in southeast Kansas. These additional 1,150 acres were part of a special study (funded by Clean Lakes Program LWQA money) to look specifically for low pH problems. In all, about 99.9% of reported lake acres were assessed for pH. Table 24 presents data on pH assessments and impacts due to low pH.

Table 24. Acid Effects on Lakes

CATEGORY	NUMBER OF LAKES	ACREAGE OF LAKES
Assessed for low pH	287	175,146
Impacted by low pH *	7	43
Vulnerable to acidity	over 200**	1,500**

* = While Table 23 indicates that 17,393 acres were impaired by pH, this refers to pH values over 8.5 as well as below 6.5. Tables 24 & 25 present data that refer only to low pH problems.

** = The KDWP indicates that there are "over 200" lakes and "about 1500" acres within the Mined Land Lakes Area in southeast Kansas. This is the group of lakes with the most vulnerability to low pH. A total of 85 of these lakes were assessed for pH as part of a special study.

Until 1993, there were no lakes reported in which pH averaged below 6.5, despite the inclusion of five Mined Land Area Lakes within the KDHE monitoring program. However, it is generally accepted that low pH lakes exist in southeast Kansas due to the extensive coal mining activity that took place from the late 1800s to about 1970.

In order to fully investigate the extent of low pH occurrence in the public lakes of southeast Kansas, a special study was conducted as part of Clean Lakes Program LWQA activity at the MLL Area (Carney 1993). This recreational area, composed of strip pits reclaimed after coal mining, is owned by the state and is operated by the KDWP for recreational and aquatic life support uses. It was hypothesized that this area would include the public lakes with the highest potential for low pH problems within the state.

A total of 85 individual lakes (within 45 "units" operated by KDWP) were assessed for pH as part of this project, which included an estimated 1,440 surface acres. Using rough KDWP estimates for the MLL Area, about 96% of the existing acres were assessed and up to 43% of the total number of lakes were assessed. The remaining lakes within the MLL Area, therefore, constitute a very small percentage of the overall surface acres. The study results found that only about 3% of the assessed acres within the MLL Area were below a pH of 6.5. For the entire state, only 0.025% of assessed lake acres are impacted by low pH. The lowest pH measurements found during this specific survey were in the range of 4.0 to 4.5.

The extent of heavy metal mobilization due to high acidity is negligible in Kansas, despite documentation that suggests the pH of rainfall has decreased over time (van der Leeden, *et al.*1990). The surface geology of Kansas is so highly dominated by limestone strata that the buffering capacity of lakes prevents acid mobilization from being a concern. In addition, the high trophic state of many Kansas lakes acts to raise pH, thus providing another protective factor.

The causes of the low pH in the 43 impacted lake acres are entirely due to seepage from spoil piles left over from past coal mining activity. Table 25 lists the various sources of high acidity that might occur in Kansas.

Table 25. Sources of Low pH in Lakes

SOURCE	NUMBER OF LAKES IMPACTED	ACREAGE OF LAKES IMPACTED
Acid deposition and precipitation	0	0
Acid mine drainage	7	43
Natural sources	0	0
Spills	0	0

While liming of lakes in southeast Kansas has been undertaken in the past in order to mitigate the effects of low pH, its effectiveness is highly dependent on the amount of acid drainage being supplied to the systems. The best strategy would appear to be letting natural processes (non-cultural eutrophication and natural limestone geology) correct low pH problems over time. However, liming would be a remedial activity of choice if a shorter time-frame for remediation were required, or if a serious problem were identified.

Approximately 17,350 lake acres are impacted by high pH (Table 22 value minus the 43 acres discussed in this section). In all cases, high summer time pH incidents are related to periods of intense phytoplankton productivity.

Trends in Lake Water Quality

Time trends in lake water quality are difficult to determine, given that the data do not lend themselves well to statistical analysis at this time. Trophic state remains the indicator of overall lake water quality for the determination of trends within this report. If a given lake had trophic state assessments for two, or more, occasions during the last eight years, then a trend of "improving," "degrading," or "stable" was assigned. If no recent trophic state data were available, or if the most recent data were more than eight years old, then a trend classification of "unknown" was assigned. Table 26 presents the lake trophic state trends for this reporting period.

Table 26. Trophic State Trends in Lakes (% of total in parentheses)

CATEGORY	NUMBER OF LAKES	ACREAGE OF LAKES
Assessed for Trends	291 (100%)	175,260 (100%)
Improving	5 (2%)	546 (<1%)
Stable	77 (26%)	121,199 (69%)
Degrading	39 (13%)	46,620 (27%)
Trend Unknown	170 (59%)	6,895 (<4%)

According to the data in this table, the majority of lakes are of unknown trophic state trend, but they constitute less than four percent of the total reported acreage. These are the small lakes that have undergone assessment, but have not been monitored for trophic state over time. Therefore, trends cannot be determined. Of the monitored lake acreage in Kansas, almost 70% is stable over time, while slightly more than 25% appear to be degrading over time. Very few lakes in the state have shown any appreciable improvement in trophic state condition during this reporting cycle (Table 26).

Chapter Five: Wetlands Assessment

Extent of Wetland Resources

The wetland acreage reported for the current 305(b) reporting cycle amounts to 35,597 acres. This value includes all state and federal acres containing wetlands, as reported in the document titled "Classification of Wetland and Riparian Areas in Kansas" (WRAP 1992), plus Cadillac Lake (Pracht Wetland) in Sedgwick County and the recently established Marais des Cygnes National Wildlife Refuge (NWR) in Linn County. This does not, therefore, include the majority of wetlands on private lands, or the extensive area of southwest Kansas which is dotted with playa lakes. The total acreage reported is different from previous 305(b) reports due to the assessment made as part of the Wetlands and Riparian Areas Project (WRAP), and the recent opening of the federal wildlife refuge in Linn County. This assessment produced refined acreage estimates for all state and federally managed wetlands. However, this assessment did not produce estimates of the various wetland types (Cowardin *et al.* 1979) that would be useful for this report.

At present, KDHE has no data to estimate wetland losses in the state. It is assumed that the generally quoted two percent annual national loss amount applies to Kansas as well. Dahl (1990) reports that by the 1980s the conterminous United States had lost 53% of its original wetlands, while Kansas had lost 48% of its historic total. This suggests that the state's wetland loss rate is similar to the loss rate of the lower forty-eight.

While no acreage estimates are available for wetland types in the state, the majority of Kansas wetlands are palustrine freshwater marshes, palustrine saltwater marshes, riparian forested wetlands, and wet meadows. Table 27 contains existing data on the extent of wetlands statewide.

Table 27. Extent of Wetlands (in acres)

WETLAND TYPE	HISTORICAL ESTIMATES	1954 USFWS*	1980's USFWS	1987 NRI*	1987-1990 SCS*
Total	841,000	216,423	435,400	143,400	145,823

* = methodology used in inventories significantly different and are not comparable

Sources of Information

Historical Estimates: Dahl, 1990
1954 United States Fish and Wildlife Service (USFWS): WRAP, 1992
1980's USFWS: Dahl, 1990
1987 National Resources Inventory (NRI): WRAP, 1992
1987-1990 SCS "Swampbusters" Inventory: WRAP, 1992

The 1954, 1987, and 1987-1990 acreages contained within Table 27 are considered inappropriate for addressing overall wetland losses within Kansas due to the methodology and purposes of these inventories. Therefore, the 48% loss reported in Dahl (1990) remains the best estimate of wetland area changes in the state. Applying the previously mentioned two percent annual loss rate to the 1980s data from Dahl (1990) indicates that wetlands in Kansas may now total around 370,000 acres, or around 85% of the acreage reported by the USFWS in the 1980s.

Integrity of Wetland Resources

Out of the 35,597 wetland acres (36 wetlands total) assessed during this reporting cycle, 25,069 acres (9 wetlands total) are considered to be monitored sites. This represents 70% of the total acres reported, and 25% of the total number of reported wetlands. An additional wetland is reported as evaluated (3% of total wetlands). This single, evaluated, wetland comprises less than one percent of total acreage. The remaining 72% of the reported wetlands are "not assessed." These unassessed wetlands comprise roughly 30% of the reported acreage.

As indicated earlier, the vast majority of the wetlands within the state are on private lands. Using the best statewide estimate from Table 28, Kansas should contain between 370,000 and 435,000 acres of wetlands. This suggests that only about 5.7 to 6.8% of the state's wetland acres are monitored.

Wetland monitoring is conducted as part of the state's overall lake/wetland monitoring program activities. Seven of the nine monitored wetlands are surveyed at a single sampling point every three years for total nutrients, total minerals, total heavy metals, clarity and suspended solids, pesticides, bacteria, algae (biomass and taxonomy), temperature, and dissolved oxygen. The other two monitored wetlands, Kirwin and Flint Hills (NWRs), are above monitored lakes (both monitored on a three year cycle). Assessments made on these lakes are extrapolated to the water quality conditions within the wetlands. The single evaluated wetland was the site of a brief field survey, coupled with computer modeling exercises. The remaining state and federally managed wetlands listed within this report are not assessed. Geographic coverage of these 36 wetlands includes most of the state, although the largest portion (both in numbers and surface acres) are within the Lower Arkansas, Marais des Cygnes, and Kansas-Lower Republican river basins.

At a minimum wetlands are designated for noncontact recreation, food procurement, and aquatic life support uses. Wetlands are not generally designated for other uses in Kansas. Overall aquatic life support use is as follows, in terms of total reported acreage (monitored and/or evaluated sites): 10,458 acres are unknown, 2,240 acres are fully supported but threatened (36%), 1,576 acres are partially supported (4%), and 21,323 acres are not supported (60%). These numbers refer only to exceedences of chronic aquatic life support criteria. Noncontact recreational use, and food procurement use, support are as follows, in terms of reported acreage: 10,458 acres are unknown, 11,060 acres are fully supported but threatened (60%), 14,009 acres are partially supported (39%), and 70 acres are not supported (less than one percent).

The major causes of partial and/or nonsupport of designated uses in Kansas' wetlands are excessive nutrient load, salinity, high pH, and turbidity. The major sources of partial and/or non-support of designated uses are agriculture, hydromodifications in watersheds, and natural sources.

Out of the 25,069 monitored wetland acres in Kansas, 100% are monitored for toxics (heavy metals, pesticides, and ammonia). During this reporting cycle, 1,055 acres of wetlands were impacted by toxics (3% of reported acres, 4% of monitored acres).

During this reporting cycle, 21,323 wetland acres were assessed as hypereutrophic (59.9%), 2,316 acres were assessed as eutrophic (6.5%), 1,500 acres were assessed as mesotrophic (4.2%), and 10,458 acres were not assessed (29.4%). Out of the reported wetland acres, trends in trophic status were as follows: 57.8% were stable over time (20,569 acres), 12.6% were degrading over time (4,500 acres), and trends in 29.6% (10,458 acres) were unknown.

Development of Wetland Water Quality Standards

Wetlands are currently classified as "waters of the state" within the Kansas surface water quality standards, and are designated for noncontact recreation, food procurement, and aquatic life support uses. As such, most narrative and numeric criteria that apply to surface waters in Kansas will also apply to wetlands. This is felt to adequately protect the water quality of the state's wetlands. Wetlands are specifically mentioned within the antidegradation section of the water quality standards. Table 28 compiles data on the development of wetland water quality standards in Kansas. Wetlands classified as Outstanding Natural Resource Waters (ONRW's) are afforded enhanced levels of protection under state water quality standards. Kansas uses its water quality standards, and the antidegradation policies stated within, to protect wetlands through 401 water quality certification and 404 permit review.

Table 28. Development of State Wetland Water Quality Standards

ITEM	IN PLACE	PROPOSED
Use classification	X	
Narrative Biocriteria	X ("free froms")	
Numeric Biocriteria		X (by EPA)
Antidegradation	X	
Implementation Method	X	

Additional Wetland Protection Activities

Numerous small wetlands have been lost by conversion to agriculture. It is estimated that 40% of total acres have been lost since 1955. The Natural Resource Conservation Service Wetland Protection Program and the swampbuster provisions of the 1985 Food Security Act may help reverse the trend. Kansas statutes (K.S.A. 82a-325 *et seq.)* require eight state agencies, including KDHE, to review proposed water development projects for "beneficial and adverse environmental effects." An additional regulatory program for wetland protection directs conservation districts to "prepare district programs" to address resource management concerns of water quality, erosion and sediment control, and wildlife habitat.

Any person or agency desiring to alter a wetland in the state must file for a Section 404 "dredge and fill" permit with the Army Corp of Engineers. Simultaneously, the same information is sent to KDHE for a section 401 water quality certification. The department makes a determination of the projected impact on water quality resulting from the proposed action and may approve the action, approve it with modifications, or deny the action based on projected water quality impacts.

Wetland protection is addressed at every available opportunity in KDHE programs and activities. This includes standards, monitoring, Clean Lakes Program projects, groundwater, section 319 assessments, and local NPS pollution control programs. An emphasis on local and watershed-based planning in the future will affect wetland protection in the state as well.

Several state agencies are responsible for protection of wetlands. Coordination is sought amongst these agencies on any project which would deal with wetlands in Kansas. Other agencies besides KDHE, include the KDWP, the KWO, the Kansas Department of Agriculture (Water Resources), the SCC, the NRCS, and the local conservation districts.

More recent wetland activities include the WRAP coordinated by the KDWP and the KWO, and the selection of KDHE as a repository for the National Wetland Inventory Maps for Kansas produced by the United States Fish and Wildlife Service.

The most recent effort (1995) to assess and protect wetlands by KDHE is the submittal of an application for an EPA State Wetland Protection Grant. If awarded, this grant will allow the department to undertake a five year assessment effort at all of the 35 public wetland areas within the state.

Size of Waters Affected by Toxicants

Essentially all streams, lakes and wetlands monitored by the department during the 1991-1995 305(b) reporting cycle were assessed for selected pesticides, priority organics, metals, and unionized ammonia. An additional toxicant, total residual chlorine, was measured in a few streams during compliance monitoring activities and special investigations. Approximately 57% of the monitored lakes, 47% of the monitored streams, and four percent of the monitored wetlands suffered some form of use impairment owing to elevated levels of one or more of the monitored toxicants (Table 29).

TABLE 29. Total Stream Mileage and Lake/Wetland Acreage Affected by Toxicants

WATERBODY	SIZE MONITORED FOR TOXICANTS	SIZE WITH ELEVATED LEVELS OF TOXICANTS
Rivers (miles)	20,078	8,791
Lakes (acres)	169,689	96,122
Estuaries (miles)	*	*
Coastal Waters (miles)	*	*
Great Lakes (miles)	*	*
Freshwater wetlands (acres)	25,069	1,055
Tidal wetlands (acres)	*	*

* = not applicable

Toxicant Impacts on Aquatic Life Support Use

During the 1991-1995 reporting cycle, toxicants were implicated in 62 fishkills in Kansas (Table 30). Waterbodies impacted by these fishkills included two public lakes, 35 private urban ponds or farm ponds, and 25 streams. Causative agents included pesticides in 27 cases, ammonia in 12, chlorine in eight, diesel fuel or other petroleum products in seven, copper sulfate in two, and surfactants, landfill leachate, ethylene glycol (antifreeze) and propylene glycol in one each. Of the pesticide related fishkills, urban runoff was involved in 11 cases, agricultural runoff in 10, algal control in two, unknown sources in two, and urban drift and urban point sources in one each. Of the ammonia related fishkills, feedlots were implicated in six cases, municipal point sources in three, and sewer bypasses, industrial point sources and urban runoff in one each. It is believed that these reported fishkills represented only a fraction of the actual number of such incidents occurring in the state during the five-year reporting cycle.

Table 30. Waterbodies Affected by Fishkills (1991-1995)

DATE OF FISHKILL	REPORTING COUNTY	NAME OF WATERBODY	POLLUTANT(S) OF CONCERN	SOURCE OF POLLUTANT(S)	SIZE AFFECTED ACRES/MILES	NUMBER OF FISH KILLED	NUMBER OF FISH SPECIES AFFECTED
2/91	SG	Tributary to Ark River	Ammonia, Propylene glycol	Urban Runoff NPS	-	-	-
2/91	FR	Private Farm Pond	Petroleum Product	Industrial Point Source	-	-	-
4/91	SG	Spring Creek	Herbicide-Atrazine	Agriculture Runoff NPS	3.25M	678	4
5/91	SG	Private Urban Pond	Chlorine	Urban Runoff NPS	-	3,208	5
5/91	JO	Tributary to Cedar Creek	Diesel Fuel	Industrial Point Source	1.00M	-	-
5/91	HV	Private Farm Pond	Herbicide-Atrazine, Alachlor, Sencor, 2,4-D	Unknown	-	936	6
7/91	BR	South Fork Wolf River	Diesel Fuel	Other-Road Spill	0.02M	35	4
7/91	SG	Private Farm Pond	Herbicide-Atrazine	Agriculture Runoff NPS	3.00A	332	5
7/91	MN	Private Farm Pond	Herbicide	Agriculture Runoff NPS	1.00A	10,424	4
8/91	JO	Private Urban Pond	Herbicide	Urban Runoff NPS	-	179	3
8/91	JO	Tributary to Indian Cr.	Diesel Fuel	Industrial Point Source	1.20M	2,670	5
9/91	SG	Private Urban Pond	Algacide-Cutrine Plus	Urban Runoff NPS	1.00A	95	5
9/91	JO	Mill Creek	Pesticide	Urban Runoff NPS	-	288	4
1/92	JO	Indian Creek	Chlorine	Municipal Point Source	-	-	-
1/92	JO	Tributary to Indian Cr.	Chlorine	Municipal Point Source	0.10M	100	2
2/92	HV	Sand Creek	Ammonia	Municipal Point Source	8.00M	-	1
4/92	F.R.	Private Farm Pond	Ammonia	Agriculture Point Source	1.20A	1,000	3
4/92	JO	Indian Creek	Herbicide-Dursban	Urban Runoff NPS	1.50M	332	6
4/92	SG	Private Urban Pond	Petroleum Product	Urban Runoff NPS	-	500	1
4/92	SG	Private Military Pond	Herbicide-2,4-D, Silvex	Urban Runoff NPS	0.25A	31	1
5/92	MG	Verdigris River	Chlorine	Municipal Point Source	0.50M	-	6
7/92	SG	Cowskin Creek	Ammonia	Sewer Overflow failure	8.00M	34,540	12
7/92	SN	Private Farm Pond	Pesticide	Agriculture Runoff NPS	0.50A	-	3
7/92	SN	Private Urban Pond	Pesticide-Trimac	Urban Runoff NPS	0.75A	1,070	4
7/92	MP	Private Farm Pond	Herbicide-Atrazine	Agriculture Runoff NPS	-	176	2
8/92	SG	Afton Lake	Cooper Sulfate	Other-Algal Control	-	-	-
8/92	BR	Unnamed Trib. Wolf River	Ammonia	Animal Feedlot Point Source	1.10M	1,236	6
9/92	JO	Tomahawk Creek	Chlorine	Municipal Point Source	1.50M	2,288	6

Table 30. Waterbodies Affected by Fishkills (1991-1995) (-continued)

DATE OF FISHKILL	REPORTING COUNTY	NAME OF WATERBODY	POLLUTANT(S) OF CONCERN	SOURCE OF POLLUTANT(S)	SIZE AFFECTED ACRES/MILES	NUMBER OF FISH KILLED	NUMBER OF FISH SPECIES AFFECTED
11/92	MR	Level Creek	Ammonia	Agriculture Point Source	7.00M	7	2
	BT	Arkansas River	Surfactant	Industrial Point Source	2.00M	400	5
5/93	FR	Private Farm Pond	Diesel Fuel	Unknown	-	200	4
5/93	FR	Tributary to Wilson Creek	Diesel Fuel	Industrial Point Source	0.33M	1213	2
5/93	BT	Vets Memorial Park Lake	Herbicide-Simazine	Municipal Point Source	30.00A	6140	7
6/93	SG	Private Urban Pond	Herbicide-Karmex, Diuron	Urban Runoff NPS	-	35	4
6/93	WS	Private Farm Pond	Pesticide	Agriculture Runoff NPS	1.00A	176	3
7/93	SG	Riggs Park Pond	Herbicide-Simazine, Propazine, Dual	Urban Runoff NPS	-	-	1
8/93	NM	Private Farm Pond	Leachate-Landfill	Municipal Point Source	-	-	2
8/93	JO	Private Urban Pond	Pesticide-Sevin	Urban Runoff NPS	-	373	4
3/94	RO	Private Farm Pond	Petroleum Product	Industrial Point Source	-	-	-
3/94	MC	Unnamed Trib-Solomon River	Ammonia	Industial Point Source	0.50M	3	2
4/94	BU	Henry Creek	Ammonia	Agricultural Point Source	4.00M	265	3
4/94	LN	Unnamed Trib-Middle Creek	Pesticide	Unknown	0.10M	-	-
4/94	MI	Private Farm Pond	Herbicide-2,4-D, Roundup Secptor, Prowl, Command	Agricultural Runoff NPS	5.00A	30	1
5/94	SG	Chisholm Creek	Ammonia	Municipal Point Source	1.10M	262	6
6/94	SN	Private Urban Pond	Herbicide-Atrazine, Simazine	Urban Runoff NPS	-	290	2
6/94	HV	Private Farm Pond	Herbicide	Agricultural Runoff NPS	-	100	3
6/94	SG	Private Farm Pond	Herbicide	Agricultural Runoff NPS	-	-	-
6/94	BT	Private Farm Pond	Herbicide-Atrazine, Buctril, Banvil	Agricultural Runoff NPS	0.26A	290	2
6/94	SN	Private Farm Pond	Herbicide	Agricultural Runoff NPS	1.00A	200	2
8/94	MI	Private Farm Pond	Copper Sulfate	Other-Algal Control	2.50A	12	1
9/94	SG	Private Urban Pond	Chlorine	Other-Treated pond	-	3	1
1/95	BU	Private Urban Pond	Pesticide-Daconil	Urban Runoff NPS	1.50A	20	1
4/95	AT	Private Farm Pond	Ammonia	Agricultural Point Source	-	4,000	4

Table 30. Waterbodies Affected by Fishkills (1991-1995) (-continued)

DATE OF FISHKILL	REPORTING COUNTY	NAME OF WATERBODY	POLLUTANT(S) OF CONCERN	SOURCE OF POLLUTANT(S)	SIZE AFFECTED ACRES/MILES	NUMBER OF FISH KILLED	NUMBER OF FISH SPECIES AFFECTED
5/95	MG	Private Urban Pond	Pesticide	Urban Runoff NPS	0.75A	100	3
6/95	SG	Private Urban Pond	Antifreeze	Other-Spill	-	30	1
6/95	SG	Public Pond	Herbicide-Dimension, Confront	Algal Control	-	500	2
6/95	SG	Private Urban Pond	Pesticide	Other-Spraying	-	200,000	1
6/95	SD	Saline River	Ammonia	Animal Feedlot Point Source	7.00M	36,989	6
7/95	JO	Unnamed Trib-Shawnee Mission Lake	Chlorine	Municipal Point Source	1.00M	266	6
8/95	FR	Private Farm Pond	Herbicide-2,4 D	Algal Control	0.75A	15	1
9/95	SG	Cowskin Creek	Ammonia	Municipal Point Source	5.00M	2,740	12
9/95	JO	Mill Creek	Chlorine	Municipal Point Source	0.13M	200	-

Total Number Killed: 314,977
Total Acres: 50.46
Total Miles: 54.33

In 1993, several new fish consumption advisories were jointly issued by KDHE and KDWP (Table 31). All advisories were based on RAFTMP, KSFP, and FISP data collected during 1990, 1991, and 1993, and all involved elevated levels of the insecticide chlordane in the edible tissues of bottom-feeding or bottom-dwelling fish. Consumption warnings or "no consumption" advisories were issued for the Kansas River (Johnson and Wyandotte counties), Antioch Park Lake (Johnson County), and Cow Creek and its major tributaries (Crawford and Cherokee counties).

Consumption restrictions or "limited consumption" advisories were issued for the Arkansas River (Sedgwick and Sumner counties), Cowskin Creek (Sedgwick and Sumner counties), the Little Arkansas River (Sedgwick County), Cow Creek (Reno County), the Blue River (Johnson County), the Kansas River (Douglas and Leavenworth counties), Kill Creek (Johnson County) and the Cottonwood River (Lyon County). Although the registration for chlordane was suspended by EPA in 1988, long-term monitoring data suggest that concentrations of this pesticide in fish tissue may be increasing at some locations. Chlordane concentrations are expected to decline eventually as the fraction of this pesticide remaining in soils and sediment becomes degraded or transported downstream.

Contact and noncontact recreational advisories were issued by KDHE in August 1993 owing to elevated levels of bacteria and other contaminants in floodwater. Impacted waterbodies included Milford Lake, Perry Lake and Tuttle Creek Lake in northeastern Kansas, the entire length of the Kansas River, and Shunganunga Creek in Shawnee County. Physical hazards, such as flood debris, unusual currents, submerged obstacles, and high turbidity, provided an additional impetus for these advisories. All advisories were rescinded by KDHE in September 1993, following a documented return to pre-flood water quality conditions. Departmental staff also performed mosquito enumerations and taxonomic work at the request of Douglas County. This information was forwarded to the Centers for Disease Control and Prevention (CDC) and used to evaluate the potential for encephalitis outbreaks in areas of the county subjected to repeated or prolonged inundation.

In September 1991, a contact and noncontact recreational advisory was issued for Limestone Creek in Mitchell County based on elevated levels of fecal coliform and fecal streptococcus bacteria and high concentrations of ammonia and organic wastes derived from livestock confinement operations. Although heavy rainfall in 1993 effectively purged the stream and improved its general sanitary condition, the advisory remains in effect pending resolution of the factors originally contributing to this problem. The KDHE's Bureau of District Operations (BODO) currently is working with livestock producer groups and area feedlot owners/operators on the implementation of best management practices and other measures necessary to correct this problem.

Toxicant Impacts on Domestic Water Supply Use

Approximately 8,612 stream miles and 175,260 lake acres in Kansas are designated for the domestic water supply use. Criteria for the protection of this use are predicated on EPA maximum contaminant levels and applied at the point of water supply diversion (K.A.R. 28-16-28e(c)(3)(C)). Water quality monitoring stations typically do not coincide with such points of diversion, however, and this 305(b) assessment has applied the criteria to entire waterbodies. Using this approach, only 40% of the stream miles designated for domestic water supply fully support this use. Similarly, 42% of all lake acres designated for domestic water supply are considered fully supporting but threatened for the use (Tables 32 and 33).

Table 31. Waterbodies Affected by Fish Consumption Restrictions

NAME OF WATERBODY	WATERBODY TYPE	SIZE AFFECTED	TYPE OF FISHING RESTRICTION				CAUSE(S) - POLLUTANT(S) OF CONCERN
			NO CONSUMPTION		LIMITED CONSUMPTION		
			GENERAL POPULATION	SUB-POPULATION	GENERAL POPULATION	SUB-POPULATION	
Kansas River in Kansas City	Stream	19 Miles	Yes	No	No	No	Chlordane
Antioch Park Lake	Lake	1 Acre	Yes	No	No	No	Chlordane
Cow Creek in Pittsburg	Stream	40 Miles	Yes	No	No	No	Chlordane
Arkansas River in Wichita	Stream	50 Miles	No	No	Yes	No	Chlordane
Little Arkansas River in Wichita	Stream	15 Miles	No	No	Yes	No	Chlordane
Cowskin Creek in Wichita	Stream	45 Miles	No	No	Yes	No	Chlordane
Cow Creek in Hutchinson	Stream	15 Miles	No	No	Yes	No	Chlordane
Blue River in Johnson County	Stream	10 Miles	No	No	Yes	No	Chlordane
Kansas River in Lawrence	Stream	15 Miles	No	No	Yes	No	Chlordane
Kill Creek in Johnson County	Stream	8 Miles	No	No	Yes	No	Chlordane
Cottonwood River in Emporia	Stream	15 Miles	No	No	Yes	No	Chlordane

Total dissolved solids and the constituent anions, chloride and sulfate, are the parameters most often associated with impairments of the domestic water supply use in streams and lakes. However, in Kansas many instances of salt contamination are naturally occurring or result from historical acts. A number of lakes contain concentrations of atrazine or antimony at concentrations greater than the applicable domestic water supply criteria. Taste and odor problems, resulting from algal blooms and other manifestations of nutrient enrichment, are additional factors impairing the water supply use in lakes.

Assessment of Domestic Water Supply Use Support for Streams and Lakes

Approximately 41% of streams designated for domestic water supply use, fully support this use. The major causes for nonsupport of domestic water supply use in streams include TDS, sulfate, and chloride (Table 32). Domestic water supply use is supported in 40% of the lake acreages designated for this use; where impairment occurs, it is associated primarily with euthrophication and high levels of TDS (Table 33).

Table 32. Summary of Domestic Water Supply Use Impairments in Streams

Total Stream Mileage Designated for Use: 8,612 **Total Stream Mileage Assessed for Use:** 7,973			
	Miles	**Percent**	**Major Causes**
Fully Supporting Use	3,260	41	
Fully Supporting Use but Threatened	*	*	
Partially Supporting Use	163	2	
Not Supporting Use	4,550	57	TDS sulfate chloride
Total Assessed for Use	7,973	100	

* not applicable

Table 33. Summary of Domestic Water Supply Use Impairments in Lakes

Total Waterbody Area Designated for Use: 142,910 acres **Total Waterbody Area Assessed for Use:** 175,260 acres			
	Acres	**Percent**	**Major Causes**
Fully Supporting Use	0	0	
Fully Supporting Use but Threatened	73,632	42	
Partially Supporting Use	40,518	23	sulfate chloride antimony TDS atrazine eutrophication
Not Supporting Use	61,110	35	eutrophication TDS
Total Assessed for Use	175,260	100	

PART IV: GROUNDWATER ASSESSMENT

Kansas Groundwater Resources

Much of Kansas is underlain by porous geological formations containing appreciable quantities of groundwater. The largest such formations consist of unconsolidated materials(gravel, sand, and silt) deposited by streams. Some unconsolidated glacial deposits and consolidated bedrock formations also contain appreciable quantities of groundwater. The total freshwater storage in all major Kansas aquifers is estimated at 590 million acre-feet.

Groundwater resources are relatively abundant in the western two-thirds of the state where surface water is scarce. Groundwater resources are limited in the eastern one-third of Kansas where surface water is more plentiful. Ninety percent of all water use within the state is supplied from groundwater. Irrigation continues to account for the greatest consumptive use of this resource.

A total of 637 community public water supplies are dependent on groundwater, either solely or in combination with surface water sources. These supplies serve a total population of 1,717,464. In most rural areas, groundwater provides the primary source of drinking water.

Groundwater quality in most of the state is generally sufficient to maintain existing uses. The mineral content of the soil and rock formations in which groundwater is found causes the water to be quite hard (greater than 200 mg/L as calcium carbonate). Groundwater quality problems are generally site-specific. A few of these site specific problems are the result of natural source contamination, but usually the contamination is due to human activities. The Kansas Department of Health and Environment is cognizant of over 500 isolated groundwater pollution problems not including Leaking Underground Storage Tanks (LUST) sites.

Groundwater Monitoring Program

The department's groundwater quality monitoring network is the primary ambient groundwater program in Kansas. Public water supply wells are monitored by KDHE's Bureau of Water (BOW) for compliance with state and federal drinking water standards. Additional monitoring is done in intensive groundwater usage areas by five groundwater management districts (GMDs).

A statewide Wellhead Protection Program (WHPP) was recently approved by EPA. At least three Kansas counties are in the process of developing or establishing local WHPP plans and several other communities in the state have expressed interest and/or have started collecting information about forming local WHPPs. The City of Hays already has adopted a local WHPP.

Numerous other state programs have been established or are in the developmental stages to assist in groundwater protection and pollution prevention (Table 34).

Table 34. Summary of State Groundwater Protection Programs

Programs or Activities	Check (X)	Implementation Status	Responsible State Agency
Active SARA Title III program	X	fully established	KDHE*
Ambient groundwater monitoring	X	fully established	KDHE
Aquifer vulnerability assessment	X	on going	KDHE*
Aquifer mapping	X	fully established	KGS
Aquifer characterization	X	on going	KGS
Comprehensive data management	X		
EPA-endorsed Core Comprehensive State Groundwater Protection Program	X	under review	KDHE
Groundwater discharge permits	X	fully established	KDHE
Groundwater Best Management Practices	X	fully established	KDHE
Groundwater legislation	X		
Groundwater classification	X		
Groundwater quality standards	X	not established	KDHE
Interagency coordination for groundwater protection initiatives	X		
NPS controls	X	fully established	KDHE*
Pesticide State Management Plan	X	under revision	KDA
Pollution Prevention Program	X	fully established	KDHE
RCRA Primacy	X	fully established	KDHE
State Superfund	X	fully established	KDHE
State RCRA with more stringent requirements than RCRA Primacy	X	fully established	KDHE
State septic system regulations	X	fully established	KDHE
Underground Storage Tank (UST) installation requirements	X	fully established	KDHE
UST Remediation Fund	X	fully established	KDHE
UST Permit Program	X	fully established	KDHE
Underground Injection Control Program	X	fully established	KCC & KDHE
Vulnerability assessment for drinking water/wellhead protection	X	in process	KDHE
Well abandonment regulations	X	fully established	KDHE
Wellhead Protection Program (EPA-approved)	X	approved by EPA	KDHE
Well installation regulations	X	fully established	KDHE

*principal administrative agency

Groundwater Quality Monitoring Network

The Kansas groundwater quality monitoring network (Figure 9), established in 1976 as a cooperative program between USGS and KDHE, is the principal statewide groundwater quality monitoring effort. In 1990, KDHE assumed sole responsibility for the monitoring network.

The primary goal of the network is to procure long-term, statewide groundwater quality data for use in the identification of temporal and spatial trends in groundwater quality associated with the following: (1) alterations in land use, (2) application of land treatment methods and other NPS best management practices, (3) changes in groundwater availability or withdrawal rates, and (4) variations in climatological conditions within the state. In addition, the network is intended to assist in the identification of groundwater contamination problems in Kansas.

The current (1995) Kansas groundwater quality monitoring network is composed of 242 wells including public water supply (PWS)(71%), irrigation (14%), rural-domestic (10%), multiple use (3%), livestock watering (1%), and industrial wells (1%). During the period 1991-1995, 628 well samples were analyzed for common inorganic chemicals and heavy metals; 490 well samples were analyzed for pesticides; 113 well samples were analyzed for volatile organic compounds (VOCs); and 124 well samples were analyzed for radionuclides (Appendix Part I.E.). Additionally, some of the network wells were also sampled by other programs.

Most wells were sampled more than once during this reporting period. Each network well is sampled for inorganics every other year. The wells chosen to be sampled each year for pesticides, VOCs, and radionuclides are rotated systematically throughout the network; five of the wells repeatedly sampled for radiation are located in southeastern Kansas because of known problems in that region. Beginning in 1993, an allotment of 10 radiation samples per year was also analyzed for radon.

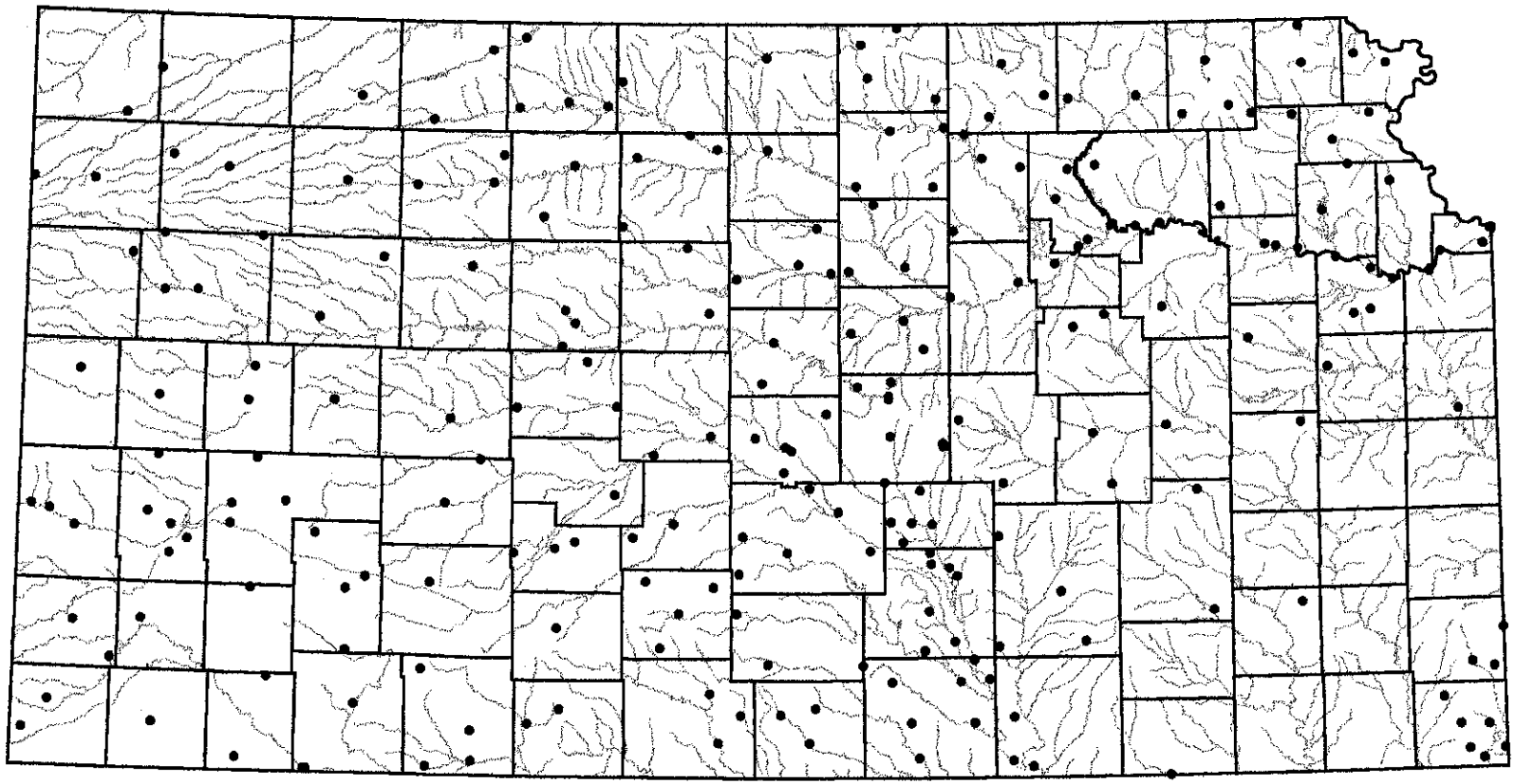
In evaluating the data from 1991-1995, 126 instances were found in which the chemical quality of the raw groundwater samples exceeded federal drinking water Maximum Contaminant Levels (MCLs). Of these, 81 were due to nitrate exceedences. The occurrence of nitrate in groundwater is generally attributed to human activities (such as agricultural fertilizer applications, malfunctioning septic systems, etc.), natural conditions, or both.

Special Studies

In response to the "flood of 1993", CDC funded a systematic study of private water wells in Kansas and eight other midwest states to determine the extent of microbiological and/or chemical contamination of groundwater resulting from flood waters or subsequent high watertables. The department's Division of Health implemented the Kansas portion of this multi-state study.

The surveyed wells were analyzed for total coliform bacteria, *Escherichia coli*, nitrate, atrazine, and lead. In addition to the collection of water samples, a questionnaire for each well was completed that covered the following topics: well construction, depth, age, location in relation to possible sources of contamination, demographic data, and health of the well users.

FIGURE 9. GROUNDWATER MONITORING NETWORK



KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

1996 305(b) Report

The results of this study indicated that certain types of wells, especially dug wells, are more susceptible to contamination. However, since the survey tested wells randomly derived from intersecting points on a map grid, samples were collected regardless of whether the well was properly constructed or sealed.

For this reason and because the samples were collected from a faucet inside the homes with minimal purging (lead samples were taken from the first flow), this study does not give a true representation of actual groundwater quality. Nevertheless, the study does provide useful insight concerning drinking water quality "at the tap" of typical rural-domestic well users in Kansas.

Major Causes and Sources of Groundwater Contamination

Based on the most recent available compilation by KDHE's Bureau of Environmental Remediation (BER), there are 645 documented contamination sites on the Identified Sites List (ISL) within the state, excluding sites under the jurisdiction of the Kansas Corporation Commission (KCC). Of these ISL sites, 120 were resolved leaving 525 active sites. The most common sources of contamination are operational problems at active facilities, spills, and leaking and/or overflowing lagoons (KDHE 1996).

Within recent years, BER has expanded the petroleum storage tank program which has uncovered several occurrences of groundwater contamination and has implicated leaking storage tanks as a significant source of groundwater contamination.

The Underground Petroleum Storage Tank Release Trust Fund was established to provide reimbursements to tank owners for corrective action costs. A total of 197 new site applications were received by the Fund in 1995.

Nonpoint sources of pollution comprise another major concern in Kansas; however, it is an extremely difficult issue to address due to the widespread nature of the problem. Nonpoint sources of groundwater contamination potentially include such things as agricultural activities, urban runoff, mining, application of residential lawn chemicals, highway deicing materials, feedlots, salvage yards, airports, golf courses, and many other factors.

Additionally, certain regions of the state have groundwater quality problems due, in part, to naturally occurring conditions. One example would be brine intrusion from underlying salt deposits in some areas. Table 35 lists a few of the most significant sources of groundwater contamination in the state based on the best professional judgement of KDHE staff.

Table 35. Major Sources of Groundwater Contamination

Twelve Highest Priority Contaminant Sources	Factors Considered in Selecting a Contaminant Source	Types of Contaminants
AGRICULTURAL ACTIVITIES:		
Agricultural chemical facilities	D,A,C	C,E
Agricultural chemical applications	A,C,D	E,B
Animal feedlots	D,A,C	J,E
STORAGE AND TREATMENT:		
Storage tanks (AST/LUST)	D,B,A,C	D
Surface impoundments	E,A	J,E
DISPOSAL ACTIVITIES:		
Landfills/illegal dumping	E,C,A	H
OTHER:		
Abandoned facilities	A,B,C	C,H
Industrial facilities	A,B,C	C,H
Oil and gas activities	D,A,B,C	D,G
Pipelines and sewer lines	E,A	D,E
Salt water intrusion	E,C,B	G
Spills	D,A	D,C

Factors Considered in Selecting a Contaminant Source:
(A) Human health and/or environmental risk (toxicity)
(B) Size of population at risk
(C) Location of sources relative to drinking water sources
(D) Number and/or size of contaminant sources
(E) Hydrogeologic sensitivity

Types of Contaminants:
(A) Inorganic pesticides
(B) Organic pesticides
(C) Halogenated solvents
(D) Petroleum compounds
(E) Nitrate
(F) Fluoride
(G) Salinity/brine
(H) Metals
(I) Radionuclides
(J) Bacteria
(K) Protozoa
(L) Viruses

Nationally, the EPA has identified 1,245 contaminated sites that are included on the 1995 National Priorities List (NPL) and are targeted for cleanup under Superfund (EPA 1995b). Presently, there are twelve NPL sites located in Kansas. All but one of these 12 NPL sites are located in the eastern half of the state.

With the possible exception of the nitrate problem, most of the groundwater contamination occurs mainly as isolated situations due to human activity involving VOCs, heavy metals, and/or petroleum products. In a few areas, naturally occurring constituents, such as fluoride, selenium, and radionuclides, may locally exceed MCLs. A summary of all known groundwater contamination sites is presented in Table 36.

Summary of Groundwater Quality

Kansas groundwater is generally very hard (usually greater than 200 mg/L) and often contains relatively high concentrations of TDS, manganese, and iron. In some areas, elevated levels of ammonia, sulfate, sodium, and chloride also exist. These constituents normally do not cause health-related problems; however, they may create aesthetic problems such as scale deposits, stains, odor, and undesirable taste.

Nitrate contamination in groundwater is a major concern due to the many, widespread sources. Nitrate accounted for most instances in which federal drinking water MCLs were exceeded. During the period 1991-1995, excessive concentrations of nitrate (greater than 10 mg/L as N) were observed in approximately 12% of 681 well samples collected from the Kansas groundwater quality monitoring network (most wells were sampled more than once), compared to 14% during the period 1976-1981.

A majority of the well samples with excessive concentrations of nitrate during this reporting period were obtained from relatively shallow wells that were 100 feet or less in total depth. Wells located in areas of the state where the soils are extremely sandy and where the water table is relatively close to the surface have a greater chance of yielding higher nitrate levels. Water quality in most Kansas aquifers may be highly variable which makes definitive source assessment of nitrates difficult.

Groundwater contamination in Kansas is typically site-specific. Isolated groundwater pollution problems are occasionally due to natural sources, but more often are due to human activity or a combination of both. Despite these various documented problems, groundwater quality in the state is generally adequate to maintain present uses, if pollution prevention and groundwater protection practices continue to be implemented.

Table 36. Groundwater Contamination Summary. Statewide Summary for the Period of 1991-1995

Source Type	Present in Kansas	# of Kansas Sites	# of Sites with Confirmed Releases	# with Confirmed Groundwater Contamination	Primary Contaminants	# of Site Investi-gations	# of Sites with Source Removed	# of Sites with CAPs	# of Sites with Active Remediation	# of Sites with Cleanup Completed
NPL	yes	15	15	13	VOCs, metals	15			8	3
CERCLIS (non-NPL)	yes	557	424	360	VOCs, metals & pesticides	557	323			
DOD/DOE	yes	47	31	26	VOCs, metals	23	1	4	4	0
LUST	yes	4,498	2,257	unavailable	petroleum	4,498	1,305		1,620	953
RCRA Corrective Action	yes	under EPA control								
Underground Injection *	yes	33	0	0		0	0	0	0	0
State Sites **	yes	481	481	299	VOCs, metals	265			138	78
NPS	yes	unknown								
Totals		5,631	3,208	698		5,358	1,629	4	1,770	1,034

CAPs - Corrective Action Plans
CERCLIS - Comprehensive Environmental Response, Compensation, and Liability Information System
DOD/DOE - Department of Defense/Department of Energy
LUST - Leaking Underground Storage Tanks
NPL - National Priority List
NPS - Non Point Source
RCRA - Resource Conservation and Recovery Act

* Represents Class I, III, and V injection wells, but does not include Class II brine injection wells.
** Numbers are for 1993 only and do not include sites under KCC jurisdiction

REFERENCES

Carlson, R.E. 1977. A Trophic State Index For Lakes. Limnology and Oceanography 22(2):361-369.

Carney, C. Edward. 1993. pH Survey of the Mined Land Lakes Area Clean Lakes Program). Kansas Department of Health and Environment (KDHE). Topeka, KS..

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitat of the United States. FWS/OBS-79/31. United States Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Dahl, T.E. 1990. Wetlands Losses in the United States, 1780's to 1980's. United States Department of the Interior, Fish and Wildlife Service, Washington, D.C.

Davenport, T.E. and M.H. Kelly. 1983. Water Resource Data and Preliminary Trend Analysis for the Highland Silver Lake Monitoring and Evaluation Project, Madison County, Illinois. Phase II. Report No. IEPA/WPC/83-013. Illinois Environmental Protection Agency. Springfield, IL.

Davies, T.T. and R.H. Waygand. 1995. Correspondence.

Huggins, D.G. and M.F. Moffet. 1988. Proposed Biotic and Habitat Indices for Use in Streams. Report No. 35. Kansas Biological Survey. Lawrence, KS.

Hutton, U.G. 1995. Correspondence.

Kansas Department of Health and Environment. 1994. Kansas Surface Water Register. KDHE. Topeka, KS.

_____. 1995. Division of Environment Quality Management Plan. KDHE. Topeka, KS.

_____. 1996. Summary of Bureau of Environmental Remediation Sites in Kansas for 1995. KDHE. Topeka, KS.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessemnt Protocols for Use in Streams and Rivers. Benthic Macroinvertebrates and Fish. USEPA Assessment and Watershed Protection Division, Washington, DC.

U.S. Environmental Protection Agency (EPA). 1995a. Guidelines for Preparation of the 1996 State Water Quality Assessments (305(b) Reports). EPA 841 B-95-001. Office of Water. Washington, DC.

_____. 1995b. Progress at Region VII National Priorities List (N.P.L.) Superfund Sites. Washington, DC.

van der Leeden, F., F.L. Troise, and D.K. Todd. 1990. The Water Encyclopedia. Second Edition. Lewis Publishers, Chelsea, MI.

Wetland and Riparian Areas Project (WRAP). Classification of Wetland and Riparian Areas in Kansas. 1992.

APPENDIX

Part I. LABORATORY CHEMICAL ANALYSES

A1. Compliance Monitoring Program

Parameters of Frequent Interest

1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
1,1-dichloroethane
1,2-dichloroethane
1,1-dichloroethylene
1,2-dichloropropane
1,1,2,2-tetrachloroethane
1,1,1-trichloroethane
Alkalinity, total
Aluminum
Ammonia
Antimony
Arsenic
Barium
Benzene
Beryllium
Biochemical Oxygen Demand (BOD)
Boron, total
Bromodichloromethane
Bromoform
Bromomethane
Cadmium
Calcium, total
CBOD
Chloride
Chlorobenzene
Chloroethane
Chloromethane
Chromium, hexavalent
Chromium
Cis 1,3-dichloropropene
Cobalt
Chemical Oxygen Demand (COD)
Cyanide
Dibromochloromethane
Dichloromethane
Dissolved oxygen (DO)
Ethylbenzene
Fecal coliform bacteria (FCB)
Fecal streptococcus bacteria
Fluoride
Hardness, total
Iron
Lead
Magnesium, total
Manganese
MBAS
Mercury
Meta-xylene
Molybdenum
Nickel
Nitrate + nitrite
Nitrogen, total
Oil and grease
Ortho &/or para-xylene
Phenols
Phosphorus, total
Potassium, total
Selenium
Silica, total
Silver
Sodium, total
Sulfate
Tetrachloroethylene
Tetrachloromethane
Thallium
Toluene
Total dissolved solids (TDS)
Total suspended solids (TSS)
Trans &/or cis 1,2-dichloroethylene
Trans 1,3-dichloropropene
Trichloroethylene
Trichloromethane
Vanadium
Vinyl chloride
Zinc

A1. Compliance Monitoring Program - continued

Parameters of Occassional Interest (but beyond lab's current analytical capability)

Guanidine nitrate
Nitroguanidine
RDX
TN

A2. Effluent Toxicity Program

Routine Parameters

Ammonia
Arsenic
Barium
BOD
Cadmium
Chromium
COD
Copper
Iron
Lead
Manganese
Mercury
Nitrate + nitrite
Phosphorus, total
Selenium
Silver
Specific conductance
TDS
TSS
Zinc

B. Stream Program

Routine "Inorganic" Parameters

Alkalinity, total
Aluminum
Ammonia
Antimony
Arsenic
Barium
Beryllium
BOD
Boron, total
Cadmium
Calcium, total
Chloride
Chromium
Cobalt
DO
Hardness, total
Iron
Lead
Magnesium, total
Manganese
Mercury
Molybdenum
Nickel
Nitrate + nitrite
Phosphorus, total
Potassium, total
Selenium
Silica, total
Silver
Sodium, total
Specific conductance
Sulfate
Thallium
TDS
TSS
Turbidity
Vanadium
Zinc

Routine Organic Parameters

2,4-D
2,4,5-T
Alachlor
Aldrin
Atrazine
Chlordane
Cyanazine
DCPA
Dieldrin
Endrin
Gamma BHC
Heptachlor
Heptachlor epoxide
Methoxychlor
Metolachlor
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Picloram
Propachlor
Propazine
Silvex
Toxaphene

Routine Microbiological Parameters

Fecal coliform bacteria
Fecal streptococcus bacteria

C. Fish Tissue Program

Routine Inorganic Parameters

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury

Routine Organic Parameters

Alachlor (Lasso)
Aldrin
p,p'-DDD
p,p'-DDE
p,p'-DDT
Dieldrin
alpha-Endosulfan
Endrin
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
alpha-Hexachlorocyclohexane
beta-Hexachlorocyclohexane
gamma-Hexachlorocyclohexane
Metolachlor (Dual)
PCB-1016
PCB-1221
PCB-1232
PCB-1248
PCB-1254
PCB-1260
Pentachloroanisole
Technical Chlordane
    Oxychlordane
    cis-Chlordane
    trans-Chlordane
    cis-Nonachlor
    trans-Nonachlor
    Chlordene
    alpha-Chlordene
    beta-Chlordene
    gamma-Chlordene
Toxaphene
Trifluralin (Treflan)

D. Lake Program

Routine "Inorganic" Parameters

Alkalinity, total
Aluminum
Ammonia
Antimony
Arsenic
Barium
Beryllium
Boron, total
Bromide
Cadmium
Calcium, total
Chloride
Chromium
Cobalt
Copper
Fluoride
Hardness, total
Iron
Kjeldahl nitrogen
Lead
Magnesium, total
Manganese
Mercury
Molybdenum
Nickel
Nitrate + nitrite
Nitrite
Ortho-phosphate
Phosphorus, total
Potassium, total
Selenium
Silica, total
Silver
Sodium, total
Specific conductance
Sulfate
Thallium
TDS
TSS
Turbidity
Vanadium
Zinc

Routine Microbiological Parameters

Fecal coliform bacteria
Fecal streptococcus bacteria

Routine Organic Parameters

2,4-D
2,4,5-T
Alachlor
Aldrin
Atrazine
Chlordane
Cyanazine
DCPA
Dieldrin
Endrin
Gamma BHC
Heptachlor
Heptachlor epoxide
Methoxychlor
Metolachlor
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Picloram
Propachlor
Propazine
Silvex
Toxaphene

Miscellaneous:

Algal taxonomy*
Chlorophyll-a
DO
Macrophyte abundance*
Secchi depth*

* not chemical analyses

E. Groundwater Program

Routine Physical Properties

Temperature

Routine "Inorganic" Parameters

Alkalinity (as $CaCO_3$)
Aluminum
Ammonia (as N)
Antimony
Arsenic
Barium
Beryllium
Boron, total
Bromide
Cadmium
Calcium, total
Chloride
Chromium
Cobalt
Copper
Fluoride
Hardness, total
Iron
Lead
Magnesium, total
Manganese
Mercury
Molybdenum
Nickel
Nitrate (as N)
Nitrite (as N)
Ortho Phosphate (as P)
pH
Phosphorus, total (as P)
Potassium, total
Selenium
Silica, total
Silver
Sodium, total
Specific conductance
Sulfate
Thallium
TDS
Vanadium
Zinc

Routine Organic Parameters

2,4-D
2,4,5-T
Alachlor
Aldrin
Atrazine
Bladex (Cyanazine)
Butachlor
Chlordane
DCPA (Dacthal)
Dieldrin
Endrin
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Lindane (Gamma BHC)
Methoxychlor
Metolachlor
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Propazine
Ramrod (Propachlor)
Sencor (Metribuzin)
Silvex
Simazine
Tordon (Picloram)
Toxaphene

Groundwater Program -
continued

Routine Purgable Organic Parameters

1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
1,1-dichloroethane
1,2-dichloroethane
1,1-dichloroethylene
1,2-dichloropropane
1,1,2,2-tetrachloroethane
1,1,1-trichloroethane
1,1,2-trichloroethane
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Chlorobenzene
Chloroethane
Chloromethane
Cis 1,3-dichloropropene
Dibromochloromethane
Dichloromethane
Ethylbenzene
Tetrachloroethylene
Tetrachloromethane
Toluene
Trans 1,3-dichloropropene
Trans &/or cis 1,2-dichloroethylene
Trichloroethylene
Trichloromethane
Vinyl chloride
Xylene

Routine Radiological Parameters

Gross alpha
Gross Uranium
Radium-226
Radium-228
Radon-222
Total dissoved solids

Part II. DATA SOURCES FOR FIGURES AND MAPS

Figures 1-7 and Figure 19:

Hydrology: RF2, EPA (modified)
Political Boundaries: Kansas Geological Survey (KGS)
KDHE Monitoring Networks: KDHE

Figures 8-18

Hydrology: RF2, EPA (modified)
Political Boundaries: KGS
305(b) Designated Use Support: KDHE
305(b) Causes & Sources for Nonsupport of Designated Uses: KDHE