1996 State of Kentucky's Environment

Safe Drinking Water

There is no doubt that the quality of the nation's and Kentucky's public drinking water has improved since the passage of the federal Safe Drinking Water Act in 1974. For the most part, water treated by the state's 767 public systems and piped to homes and businesses is considered safe. But the vulnerability of public drinking water supplies to contamination cannot allow us to take its quality for granted.

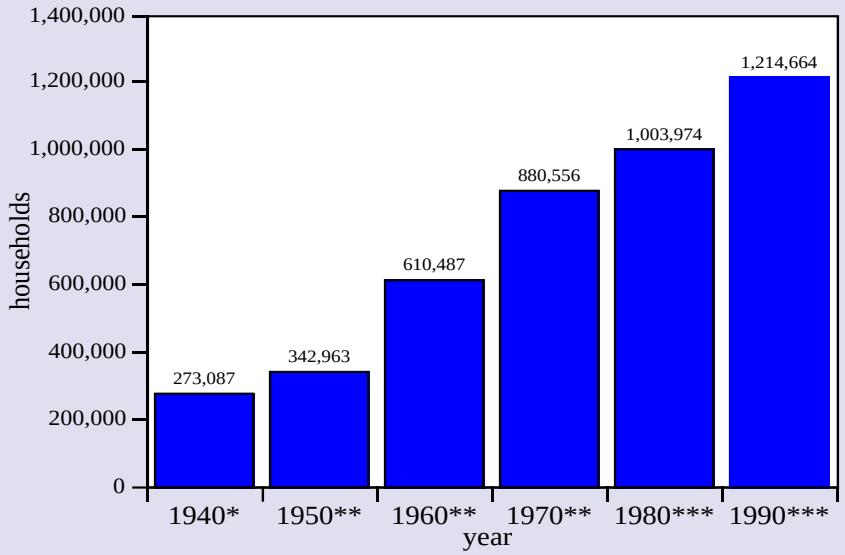
The national Centers for Disease Control and Prevention (CDC) estimate 940,000 people become ill each year from consuming contaminated water, and 900 people die as a result.[1] Major waterborne disease outbreaks in Wisconsin, Georgia, and Texas in the past three years have caused many health and environmental professionals to question the safety of the country's public drinking water. In addition, an estimated 15% of the U.S. population depend on private wells for drinking water, which are not normally tested for contaminants.[2]

So how safe is Kentucky's drinking water? This *State of Kentucky's Environment Report* will present data and trends to determine the quality of drinking water. The intent is to provide state policy makers and the public with a better understanding of drinking water problems and help target resources to achieve safe drinking water for all Kentuckians.

Access to Public Drinking Water Varies by County

An estimated 81% of the state's households now have access to drinking water treated by 767 public water systems (**Figure 1**).[3] Nationwide, about 84% of the population has treated drinking water piped to their homes.[4] Half of the 767 public systems in Kentucky are supplied by surface water sources such as rivers, lakes, and reservoirs. These systems serve 92% of households with drinking water. The

Figure 1 Kentucky Households Served by Public Drinking Water



**Households with running water in dwelling unit. Supply source not identified. **Households with hot and cold running water. Supply source not identified. ***Households served by public drinking water systems. Source: U.S. Census of Population and Housing*

EQC
Environmental Quality Commission
Environmental Indicators Program
Reporting on Environmental Trends and Conditions in Kentucky.

1996 Report Series
- Safe Drinking Water
- Air Quality
- Waste Management
- Water Quality
- Toxics
- Natural Resources
- Resource Extraction

EQC is a seven-member citizen commission created under state law with a mission to monitor environmental trends and conditions, promote partnerships to improve and protect the environment, provide a public forum for the discussion of environmental issues, and advise state officials on environmental matters.

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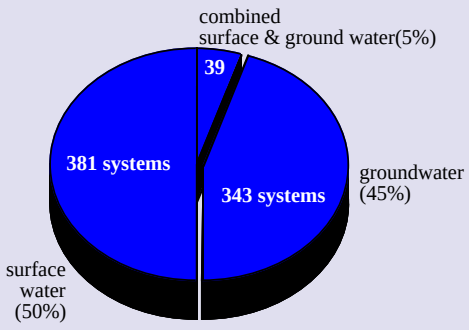
Counties with Groundwater-Supplied Public Drinking Water Systems (1996)

Ballard	Larue
Barren	Lawrence
Bell	Lee
Boone	Leslie
Bourbon	Letcher
Bracken	Lewis
Breathitt	Lincoln
Breckinridge	Livingston
Calloway	Lyon
Campbell	McCracken
Carlisle	McLean
Carroll	Madison
Carter	Magoffin
Christian	Marshall
Clay	Martin
Daviess	Mason
Edmonson	Meade
Elliott	Menifee
Floyd	Mercer
Franklin	Morgan
Fulton	Nelson
Gallatin	Ohio
Garrard	Oldham
Grant	Owen
Graves	Owsley
Greenup	Perry
Hancock	Pike
Hardin	Russell
Harlan	Scott
Henderson	Todd
Henry	Trigg
Hickman	Trimble
Hopkins	Washington
Jefferson	Wayne
Johnson	Webster
Kenton	Whitley
Knott	Wolfe
Knox	Woodford

Source: KY Div. of Water

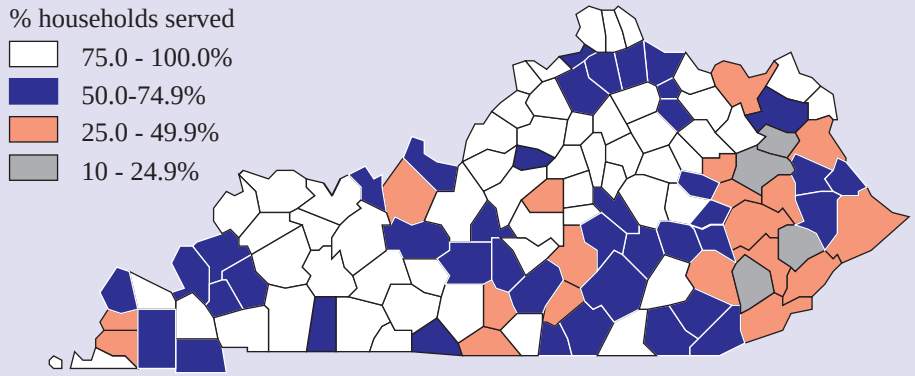
Figure 2 Sources of Public Drinking Water in KY (1996)



Note: Surface includes rivers, lakes, springs, reservoirs. Source: KY Division of Water

remaining systems depend on underground supplies of water or a combination of ground and surface water to meet drinking water needs **(Figure 2)**. A closer look at households served by public drinking water systems shows that access to public drinking water varies greatly by county **(Figure 3)**. For example, only 10% of Knott County's households are served by public water systems compared to 100% in Fayette County. And an estimated 700,000 Kentuckians still rely on private wells and other sources for drinking water supplies.

Figure 3 Kentucky Households Served by Public Drinking Water



Source: U.S. Census of Population and Housing, 1990

Drinking Water Contamination Threats Numerous

While drinking water treated and supplied by public water systems is generally considered safe for consumption, improved methods of testing reveal new threats to the resource. Substances such as bacteria, nutrients, minerals, salts, trace metals, and organic matter are normally found in drinking water. At elevated levels some of these substances can make drinking water unsightly and unpalatable; while others can impair human health.

Contaminants can enter water a number of ways and come from a range of sources. In Kentucky, polluted runoff washed into streams, rivers, and lakes from farmlands and coal mines is the leading cause of water pollution.[5] Other sources include sewage, waste sites, runoff from urban areas, and toxic releases and spills.

The federal Safe Drinking Water Act of 1974 (amended in 1986) requires public water systems to treat water to meet health-based standards. The U.S. Environmental Protection Agency (U.S. EPA) — the federal agency responsible for implementing and enforcing environmental laws — has established drinking water standards for 73 contaminants. The standards are known as "Maximum Contaminant Levels" or MCLs — the maximum allowable amount of a contaminant that can be safely consumed without causing harmful health affects. In some cases, such as lead and copper, a treatment technique or action level has been established if measuring a contaminant level is not technically or economically feasible. Secondary standards have also been set for 14 other contaminants that affect the aesthetic quality of

drinking water, such as taste and color.

Systems are also required to comply with monitoring and reporting (M/R) requirements to ensure they are properly testing water for contamination and reporting results to state or federal authorities. M/R requirements are taken very seriously since without monitoring there is no assurance the water is safe to consume.

Kentucky assumed authority from the U.S. EPA in 1977 to implement the Safe Drinking Water Act. This allows the Division of Water to regulate public drinking water systems to ensure compliance with federal and state laws.

In 1995, 51% of the 767 public drinking water systems in the state had one or more violations of drinking water regulations. A majority of the violations were monitoring and reporting infractions.

Public Drinking Water Violations Decline But Problems Remain

Most Kentuckians take the safety of their drinking water for granted. While drinking water is generally considered safe, a review of violations at public drinking water systems reveals concerns. In 1995, 391 systems, 51% of the 767 public drinking water systems in the state, had one or more violations of drinking water regulations **(Figure 4)**.

Figure 4 Public Drinking Water Systems in KY and Violation Trends

Facility Size (Population Served)	Number of Systems*			Number of Systems w/Violations**			Number of Drinking Water Violations**(percent total)		
	1993	1994	1995	1993	1994	1995	1993	1994	1995
<101	198	308	299	123	115	208	660(49%)	506(36%)	746(62%)
101-500	179	77	68	83	119	43	923(22%)	345(25%)	198(16%)
501-1,000	60	54	50	19	42	22	77(6%)	101 (7%)	52(4%)
1,001-2,500	122	128	127	51	83	48	78(6%)	166(12%)	106(9%)
2,501-3,300	55	48	50	35	35	17	91(7%)	92 (7%)	25(2%)
3,301-5,000	53	47	46	21	27	17	39(3%)	37 (3%)	27(2%)
5,001-10,000	82	71	73	37	44	17	76(6%)	90 (6%)	31(3%)
10,001-50,000	61	48	50	22	38	17	31(2%)	64 (5%)	20(2%)
50,001-100,000	2	2	2	0	0	0	0	0	0
>100,000	3	2	2	2	1	2	2(<1%)	1 (<1%)	2(<1%)
Total	**815**	**785**	**767**	**393**	**504**	**391**	**1,346**	**1,402**	**1,207**

**Includes public community, noncommunity, and non-transient systems.*

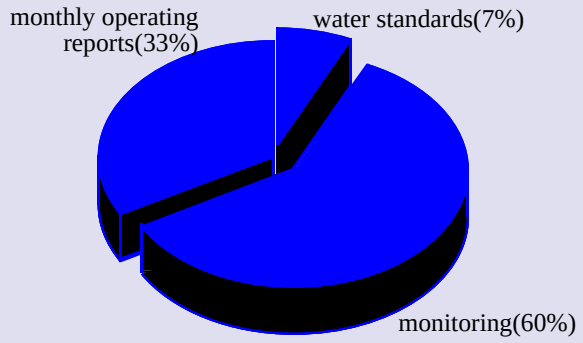
***Includes violations of drinking water standards (MCLs), monitoring, and reporting violations. Does not include Phase II and IV chemical testing results (see Figure 14).*

Source: KY Division of Water

A breakdown of the 1,207 violations cited by the Division of Water in 1995 reveals that 93% were monitoring and reporting infractions **(Figure 5)**. While these infractions may seem like trivial paperwork violations, the failure of a system to test or report contamination can place consumers at risk.

Violations of MCL drinking water standards for various contaminants represent about 7% of the total violations cited by the Division of

Figure 5 Public Drinking Water System Violations in Kentucky (1995)



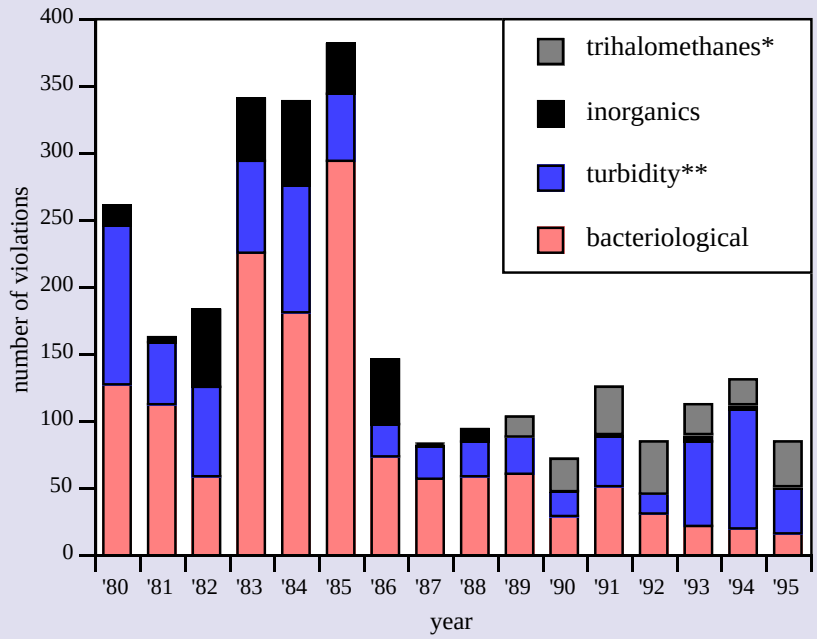
Note: Based on 1,207 violations. Does not include Phase II and IV chemical testing results. Source: KY Division of Water

Water for 1995 and are listed statewide in **Figure 6** and by county in **Figure 7**. Violations of MCL standards were cited at 41 systems in 1994 and 39 in 1995. The most common MCL violations in Kentucky are:

* coliform bacteria (an indication water is possibly contaminated with fecal matter),
* turbidity (cloudiness - another indicator of possible microbiological contamination),

Violations of MCL drinking water standards represent 7% of the total 1,207 violations cited at public water systems in Kentucky during 1995.

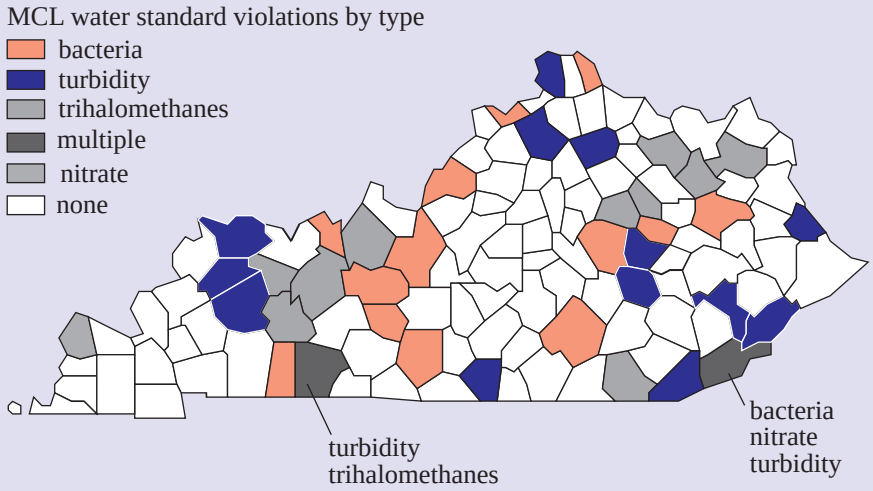
Figure 6 MCL Drinking Water Standard Violations in Kentucky



*Note: Based on violations of MCL drinking water standards. *Trihalomethane monitoring not required prior to 1989. **More stringent turbidity standard took effect in 1993. Does not include Phase II and IV chemical testing results. Source: KY Division of Water*

Violations of MCL drinking water standards were cited at 39 systems in 1995. Contamination from bacteria, turbidity, and trihalomethanes are the most common MCL drinking water standards violated in Kentucky.

Figure 7 MCL Drinking Water Standard Violations in KY (1995)



Note: Chart denotes county location of public water systems with MCL violations in 1995. Population served by systems with MCL violations varies and does not necessarily include the entire county population. Does not include Phase II and IV chemical testing results. Source: KY Division of Water

* trihalomethanes (organic chemical by-products created from the disinfection of water with chlorine), and
* nitrates (a synthetic chemical found in fertilizers).

While a majority of the violations are resolved, some result in fines. In 1995, 24 systems were fined a total of $44,375. There are also several systems that are significant non-compliers, having 12 or more drinking water violations in a running calendar year. As of April 15, 1996, ten systems, serving a population of 1,183, were in significant noncompliance with drinking water regulations **(Figure 8)**.

Drinking Water Penalties Assessed in Kentucky

Year	# Systems	$Fine*
1990	11	41,585
1991	18	59,950
1992	28	69,825
1993	22	71,125
1994	31	62,300
1995	24	44,375

**Includes total civil and performance penalties assessed per calendar year. Source: KY Div. of Water*

Ten public drinking water systems in Kentucky are currently classified as significant non-compliers, having 12 or more drinking water violations in a running calendar year.

Figure 8 Kentucky Public Water Systems in Significant Noncompliance with Drinking Water Regulations*

Water System	County	Population Served
Kettle Island Water System	Bell	396
Martin Lynch Water Co.	Bourbon	40
Weeksbury Water Supply	Floyd	90
Howard's Water Supply	Harlan	92
Bluediamond Camp	Harlan	59
Jackhorn Water Supply	Letcher	200
Millstone Water Co.	Letcher	90
New Tribes Mission	Perry	60
Ponderosa Mobile Home	Pike	56
Lee City Livestock Auction Res	Wolfe	100
Total 10	**8**	**1,183**

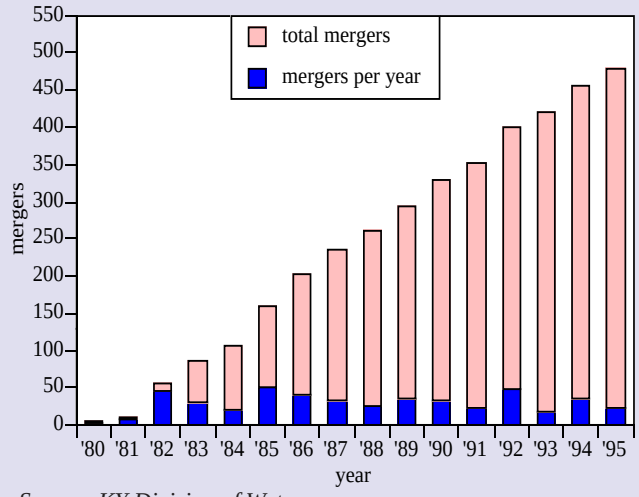
*Note: As of April 15, 1996. *Defined as systems with 12 or more violations in a running calendar year. Source: KY Division of Water*

Smaller Water Systems Greatest Violators of Drinking Water Rules

The greatest violators of drinking water regulations are those small systems serving 3,300 people or less. These 594 small, often rural, systems constitute 77% of the public water systems in the state, although they serve only 14% of the population. Small drinking water systems comprise the bulk of monitoring, reporting, and MCL standard violations. In 1995, 338 of these small systems accounted for 93% of the violations cited. Many small systems do not have the expertise, equipment, or resources to meet drinking water rules. Efforts to merge small systems with large ones to improve drinking water quality have progressed (**Figure 9**). While it would be impossible (both financially and physically) to eliminate all small public water systems, it is important to merge facilities where possible.

In 1995, 338 small drinking water systems, serving 3,300 people or less, accounted for 93% of the violations cited by the Division of Water.

Figure 9 Drinking Water System Mergers



Source: KY Division of Water

Many small water systems do not have the expertise, equipment, or resources to meet drinking water rules. Efforts to merge small systems with large ones to improve drinking water quality have progressed.

Half of Private Wells Tested Reveal Bacterial Contamination

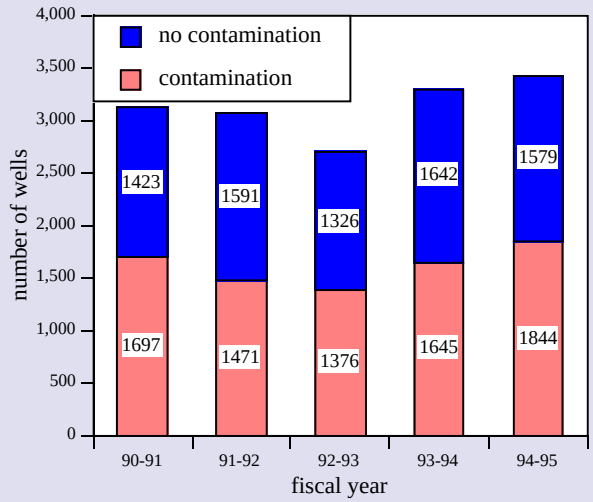
An estimated half-million Kentuckians depend on private water wells and another 209,034 rely on other private sources such as cisterns and springs for their drinking water, according to 1990 census data. In Kentucky, as in many other states, private sources of drinking water are not required to be tested for contamination so it is difficult to determine the overall quality of this resource.

An estimated half-million Kentuckians depend on private wells and another 209,034 rely on other private sources such as cisterns and springs for drinking water.

Local health departments will test private water wells for bacteria by request, which provides some insight into the quality of drinking water wells. In 1995, 54% of the 3,423 water wells sampled in Kentucky tested positive for total coliform bacteria and required further testing and treatment **(Figure 10 & Figure 11)**. According to state health officials, many private wells are not routinely tested or properly maintained.

The Division of Water established a statewide ambient groundwater monitoring network in 1995 to assess groundwater quality at 70 well and spring locations across the state. Public water supply wells and springs comprise 55% of the sampling sites, 6% are private wells and springs, and the remaining 39% are either unused roadside springs or those used as a drinking water supply. Sites are being tested for 15 pesticides, 30 metals, nutrients, and other parameters such as pH and nitrates. A report will be prepared by the division in 1996 summarizing and interpreting the test results. The report will be available to the public upon request.

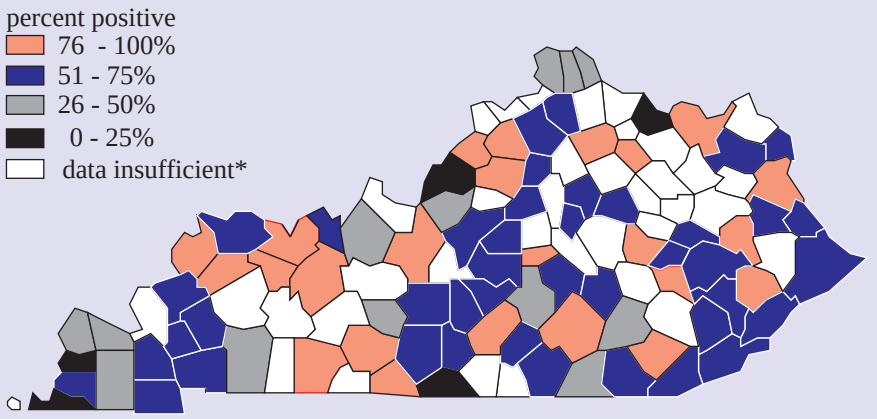
Figure 10 Voluntary Testing of Drinking Water Wells for Bacteria



Note: Tests of private wells for total coliform bacteria.
Source: KY Cabinet for Health Services

In 1995, 54% of the 3,423 private water wells sampled in Kentucky tested positive for coliform bacteria and required further testing and treatment. According to state health officials, many private drinking water wells are not routinely tested or properly maintained.

Figure 11 Voluntary Testing of Drinking Water Wells for Bacteria (FY 94-95)



*Note: Tests of private wells for total coliform bacteria. *Three or less private drinking water wells sampled. Source: KY Cabinet for Health Services*

Figure 12 Environmental Risks to Human Health

Source: U.S. EPA, Region IV, 1995

Water Standards Set To Protect Public Health

Public drinking water standards are set to protect human health from a variety of risks. A U.S. EPA project to scientifically assess and rank environmental risks revealed that drinking water ranked high among human health risks in the Southeastern U.S. **(Figure 12)**.

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Drinking water risks associated with cancer received increased attention in the 1980s. For those chemicals suspected or known to cause cancer, MCL drinking water standards were calculated on a lifetime of 70 years with a daily intake of two liters of water per day where the risk of getting cancer is one in 10,000 to one in a million. Some argue that no level of contamination is acceptable and are calling for zero-risk. Others claim that cancer risks below one in a million are too costly to regulate.

While public drinking water in the U.S. is among the safest in the world, recent waterborne disease outbreaks from microbial contamination indicate that water treatment is far from perfect. This has led to a shift in focus by the U.S. EPA and water systems to balance both cancer and microbial drinking water risks. Between 1991 and 1994, there were 64 disease outbreaks in the U.S. associated with drinking water causing an estimated 422,830 persons to become ill.[6] Public health officials believe that the number of illnesses caused by contaminated drinking water may be much higher than documented. But tracking waterborne illnesses is difficult. Many gastrointestinal illnesses caused by bacteria, protozoa, or viruses in drinking water can be easily misdiagnosed since symptoms such as nausea and abdominal discomfort can also be associated with colds, flu, and other problems unrelated to drinking water.

While public drinking water is the safest in the world, 64 waterborne disease outbreaks in the U.S. between 1991 and 1994 indicate that water treatment is far from perfect.

Bacteriological and turbidity contamination are among the most common violations of drinking water MCL standards in the state. While violations of the bacteria standards have declined significantly since the 1980s, the risk of contamination still remains great. In Kentucky, the last known reported waterborne disease outbreak — Hepatitis A —occurred in Meade County in 1982 reportedly from fecal contamination of well water. A waterborne disease outbreak is defined as having at least two persons experiencing a similar illness after the ingestion of drinking water or after exposure to water for recreational purposes. Hepatitis A, a liver infection that causes

In Kentucky, the last known waterborne disease outbreak occurred in 1982 reportedly from contaminated well water.

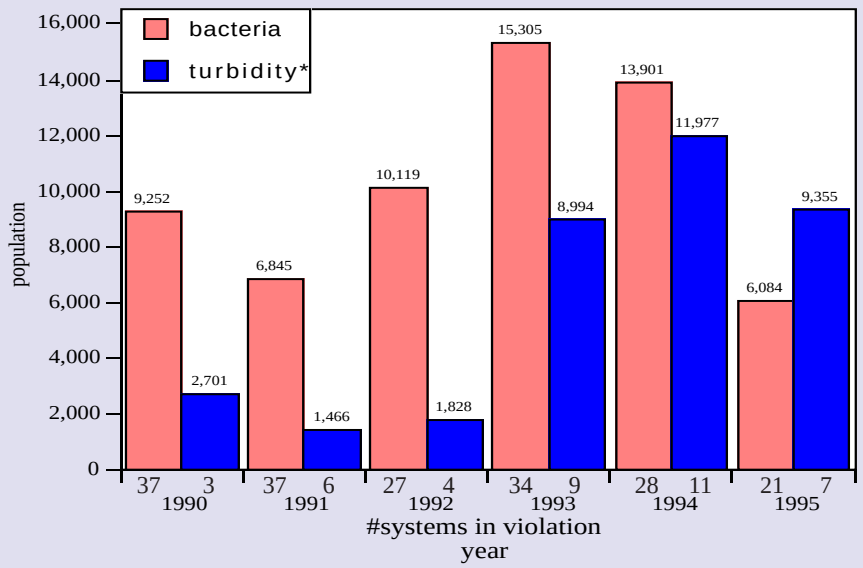
nausea, fever, and abdominal discomfort, is one of the several diseases that can be spread by contaminated drinking water. Between 1990 and 1994, there were 197 cases of Hepatitis A reported in 35 Kentucky counties, according to the Cabinet for Health Services. The agency does not track the sources of isolated Hepatitis A cases (food, water, other), except in the case of outbreaks (more than two people infected). Health officials report that Hepatitis A outbreaks during the past five years in Kentucky were contracted through food or person-to-person contact and not drinking water.

Waterborne Disease Outbreaks Lead to More Testing

Waterborne disease outbreaks in 17 states during 1993 and 1994 have led many states to strengthen efforts to bring problem drinking water plants into compliance. Measures have focused primarily on drinking water plants with bacteria and turbidity violations. During 1995, an estimated 15,439 people in Kentucky were at risk from public drinking water systems with persistent violations of bacteria and turbidity standards **(Figure 13)**.

During 1995, an estimated 15,439 people in Kentucky were at risk from public drinking water systems with persistent violations of bacteria and turbidity standards.

Figure 13 Population Served by Public Water Systems With Persistent Violations of Water Standards in KY



*Note: Persistent violators are systems with 4 or more monitoring or MCL violations in a running calendar year. *More stringent turbidity standard took effect in 1993. Source: KY Division of*

Turbidity, caused by small particles of silt, clay, or other matter, can interfere with the disinfection process and allow pathogenic organisms such as Cryptosporidium or Giardia to survive in treated drinking water.

Turbidity, caused by small particles of silt, clay, or other matter, can interfere with the disinfection process and allow pathogenic organisms such as Cryptosporidium or Giardia to survive in treated drinking water. Problems with the water treatment process to remove turbidity were associated with the deadly waterborne disease outbreak that occurred in Milwaukee on April 1, 1993 — the largest outbreak since reporting began in 1920. Inadequate treatment allowed the parasite Cryptosporidium, referred to as crypto, to remain in the water. Contaminated water from the system hospitalized 4,000 people, 100 of which died, most of whom were HIV positive. As a result, Milwaukee adopted a turbidity standard five times more stringent than the U.S. EPA's and a zero standard for Cryptosporidium. The outbreak prompted the U.S. EPA to cut the national turbidity MCL standard by one-half and strengthen sampling procedures.

It is not known how extensive the crypto or Giardia problem is in Kentucky since monitoring for these parasites is not required. However, surface water tests conducted during 1995 in eight counties by Commonwealth Technology Inc., a consulting firm, found crypto oocysts in 60% and Giardia cysts in 20% of the raw water samples analyzed.[7] It was concluded from the tests that these parasites are widespread in surface water and could pose a significant health risk for Kentuckians. However, no parasites were detected in the treated drinking water from seven public water systems in six counties tested by the company.

Several systems in the state have or are currently doing voluntary monitoring for the parasites. These systems include Louisville, Lexington, Kenton County, Paducah, Nicholasville, Middlesboro, Bardstown, Danville, Hopkinsville, and Leitchfield (*see sidebar- Cryptosporidium: Is it a Problem in Kentucky?*). The Division of Water is working with water plants to optimize water treatment processes to improve particulate removal through turbidity monitoring and heterotrophic plate counts (a bacteriological test) of individual filters and/or particle counting.

The national Centers for Disease Control have recommended that those afflicted with immune deficiency disorders boil tap water prior to consumption to avoid potential health effects associated with the parasite. The U.S. EPA also recently announced that it will require large systems serving 100,000 people or more to monitor for crypto and other microbial contaminants beginning in 1997 for an 18-

Surface water tests conducted during 1995 in eight Kentucky counties by Commonwealth Technology Inc., a consulting firm, found the pathogenic organisms Crytospordium or Giardia present in 20% to 60% of the raw water samples analyzed.[7] It was concluded from the tests that these parasites are widespread in surface water and could pose a significant health risk for Kentuckians.

Cryptosporidium: Is it a Problem in Kentucky?

Cryptosporidium (Crypto) is an important emerging pathogen in the U.S and a cause of a severe, life-threatening disease in patients with AIDS. The parasitic cyst is transmitted through the feces of infected animals and can survive up to a year in water. Consumption of viable cysts causes cryptosporidiosis, a gastrointestinal disease. Most people recover within a few weeks, however, children, the elderly, cancer patients, and people with AIDs are at risk for prolonged illness and possible death.[8]

Public water systems are not yet required to monitor for Cryptosporidium. However, crypto has been detected in 65% to 97% of the untreated surface water supplies recently tested throughout the U.S.[9] Recent investigations have also found small numbers of the parasites in treated drinking water from 27% to 54% of municipal treatment plants studied across the country.[10]

Some Kentucky systems have begun to voluntarily test for these parasites.

- The Louisville Water Co. began testing for crypto and Giardia in 1993. In 1995, two of the eight raw and settled water samples revealed crypto oocysts.[11]
- The Kenton County Water Department began testing for crypto and Giardia in 1993. During 1995, monthly tests of raw Ohio River water at the Ft. Thomas and Taylor Mill water treatment plants confirmed a crypto oocyst in one sample.[12]
- The Kentucky-American Water Co. which serves six Bluegrass counties, conducted tests for crypto and Giardia in 1989 through 1992 and again in 1994 and 1995. The 17 samples revealed 5 Giardia cysts and 54 crypto cysts, in raw water sources. However, the viability of the cysts could not determined. The company plans to begin testing again in May 1996.[13]
- A 1994 study conducted by Morehead State University at four water plants in Eastern Kentucky revealed the presence of crypto and Giardia in the raw water at three of the four plants tested and in the treated water at two plants.[14]

Many water system operators believe that testing is no substitute for a well-run water system. The American Water Works Association, a trade group of water resource professionals, reports that proper coagulation and filtration can achieve better than 97% removal of the parasites.

month period. The data collected, in conjunction with scientific research now underway, will be used to evaluate the need for future regulations to address the threat of these parasites to the nation's drinking water.

Chemical Testing of Drinking Water Reveals Problems

Chemicals can also contaminate drinking water supplies. These chemicals can come from a number of sources including transportation spills, hazardous waste sites, and improper disposal of untreated industrial and household chemical wastes. Pesticides used on farmlands and lawns can permeate soil and enter groundwater or run off into surface waters. In addition, small amounts of organic chemicals can be formed as by-products during the drinking water disinfection treatment process.

Advances have been made in the ability to detect and measure chemicals at very low concentrations in drinking water.

During the past two decades, advances have been made in the ability to detect and measure chemicals at very low concentrations in drinking water. This, together with a better understanding of chemical toxicology, has led to greater knowledge of the health consequences from human exposure to chemicals.

The first round of testing for chemicals in public drinking water supplies in Kentucky (conducted between 1987 and 1993) revealed 60 systems with measurable levels of the eight regulated chemicals. The nine systems that exceeded chemical standards were required to treat the water to remove the contaminant or change water sources.

Tests Detect Nitrate Contamination in Three Counties' Drinking Water

A new round of testing for various chemicals in 1993 through 1995 detected the presence of chemicals in the treated water of many public drinking water systems, although most levels were well below those set to protect public health.

Results from water tests conducted in 1994 and 1995 found violations of the nitrate MCL standard at small rural drinking water systems in Ballard, Harlan, and Morgan counties.

One exception was nitrate. Results from water tests conducted in 1994 and 1995 found violations of the nitrate MCL standard at small rural drinking water systems in Ballard and Harlan counties for both years and Morgan County in 1994. These three systems served a total of 622 people in 1994 and 814 in 1995. Ingestion of nitrates at elevated levels are a particular danger to infants and have also been linked to stomach cancer in humans. While sources of nitrate contamination vary, a suspected source at two of the drinking water plants is nitrogen fertilizer used on farmlands. In 1995, there were 923,504 tons of fertilizer sold in the state.[15] Fertilizer can run off fields and lawns and contaminate water supplies.

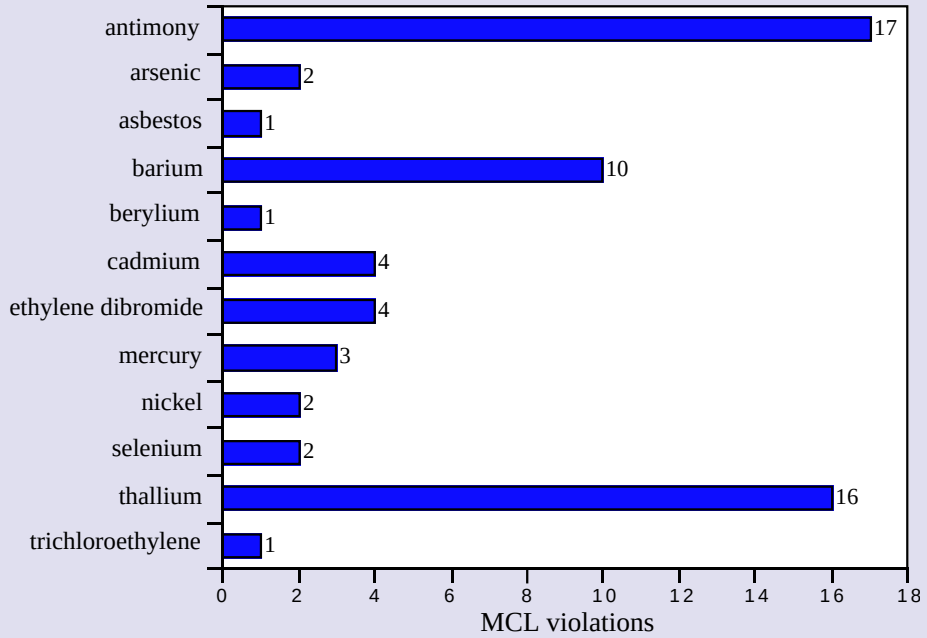
Chemicals Found in the Treated Drinking Water of 47 Systems

Preliminary findings from tests for 68 chemicals conducted by the Division of Water at public drinking water plants between 1993 and 1995, known as Phase II and V, found 47 systems with MCL water standard violations for various chemicals **(Figure 14)**. These systems served an estimated 187,342 people. The chemical levels detected, in most cases, were slightly above the MCL standards.

Many of the chemicals detected are naturally occurring elements. These elements become contaminants at elevated levels. Some of the chemicals found in drinking water at unsafe levels are also generated by industries **(Figure 15)**. However, sources of contamination at many of the water plants have not been identified.

Elevated levels of antimony, a silvery white metal, were detected in the treated water at 12 public water systems. Small amounts of antimony are found in the earth's crust and enters the environment during the production of antimony metal, alloys, antimony oxide. This chemical is used in the manufacture of textiles and plastics. During 1993, manufacturing plants in Kentucky reported generating 33,419 pounds of antimony.[16] Small amounts of antimony can also be released to the environment by incinerators and coal-burning power plants. Ingestion of elevated levels of this

Figure 14 Chemical MCL Drinking Water Standard Violations in Kentucky (1993-1995)



Note: Based on preliminary results of a total of 116,687 tests for 68 chemicals conducted by the Division of Water during Phase II and Phase V chemical testing at public drinking water systems in Kentucky for 1993-1995. Source: KY Division of Water

Preliminary results from tests conducted for 68 chemicals in public drinking water revealed 47 systems had MCL water standard violations for various chemicals. These systems serve an estimated 187,342 people. The chemical levels detected, in most cases, were slightly above the MCL standards.

chemical can cause vomiting and diarrhea.[17] It should be noted that several factors will determine whether harmful health effects will occur should exposure to antimony or any other chemical occur. These factors include dose, duration, other chemicals exposed to, age, sex, life style, and state of health.

Another chemical found above the MCL standard at nine drinking water systems was barium. Barium is a silvery-white metal that occurs in nature and is used by the oil and gas industry to make drilling muds. It is also used to make paints, glass and rubber. Ingestion of barium at high levels can cause cardiovascular and gastrointestinal effects.[18] Industries reported generating 601,300 pounds of barium compounds during 1993.

Figure 15 Generation of Selected Toxic Chemicals in Kentucky (1993)

Chemical	Pounds
antimony	33,419
arsenic	1,711
asbestos	197,185
barium*	601,300
beryllium	0
cadmium	3,363
mercury	10,455
nickel*	5,268,894
selenium*	6,068
trichloroethylene	925,118

*Note: Selected chemicals reported released to the environment or transferred for further treatment by manufacturing companies in Kentucky. *Includes compounds.*
Source: 1993 KY Toxic Chemical Release Inventory Report

Many of the chemicals found above drinking water standards at 47 systems tested during 1993-95 are naturally occurring elements. These elements become contaminants at elevated levels. Some of the chemicals found in drinking water at unsafe levels are also generated by industries in Kentucky.

Twelve water systems exceeded the drinking water standard set for thallium. This chemical is used in the manufacture of electronic devises and switches and is produced or used in power plants, cement factories, and smelters. Hazardous waste sites are also a source of thallium. Up until 1972, thallium was also used as a rat poison but was banned because of its potential harm to human health. If large amounts of thallium are consumed in a short period of time it can affect the nervous system,

lung, heart, liver, and kidneys.[19]

Another chemical found in treated drinking water above the MCL standard at two systems was selenium, which can seep from coal mining areas into groundwater. While selenium is an essential nutrient, consumption of high levels of this chemical can be harmful to the liver and kidneys.[20] Elevated levels of mercury were also found in the drinking water of two systems. Mercury occurs naturally in the environment and also as a result of human activity. Sources of mercury include incinerators, waste sites, and coal-fired power plants. Exposure to high levels of mercury can damage the brain, kidneys, and developing fetus.[21]

As a result of the testing, advisories notifying consumers not to drink the water due to chemical contamination were issued at six plants in 1994 and 14 in 1995.

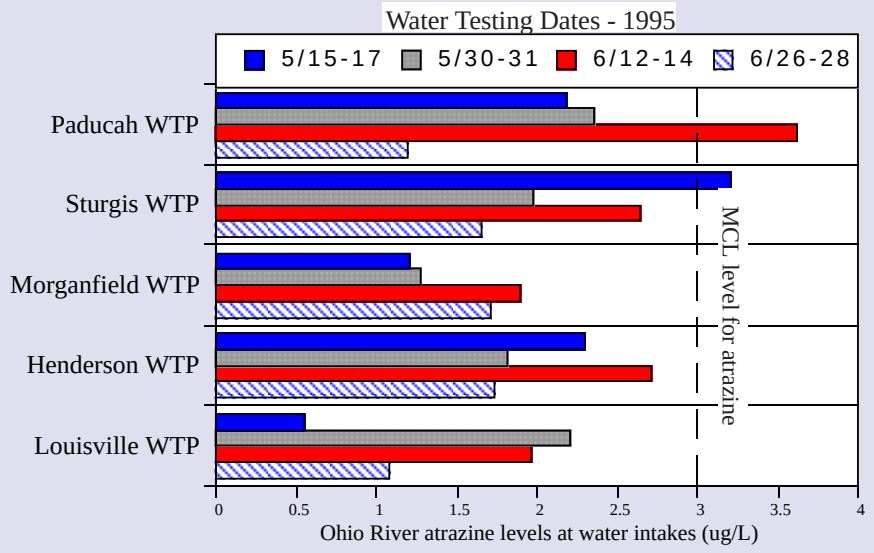
As a result of the testing, advisories notifying consumers not to drink the water due to chemical contamination were issued at 6 plants in 1994 and 14 in 1995 as shown in **Figure 19** on page 15. These systems were required to treat the water or switch water sources. Division of Water officials are verifying test results at the other plants and will work with systems to address contamination problems.

Testing of Ohio River Water Reveals Varying Levels of Atrazine

Pesticides and herbicides used on farms and lawns also can run off land and contaminate drinking water supplies. Testing of raw water withdrawn by drinking water plants along the Ohio River revealed varying levels of atrazine — a common herbicide used in cornfields to control weeds **(Figure 16)**. During 1995, 1.7 million pounds of atrazine were sold in Kentucky.[22] Tests of treated drinking water for atrazine, based on an average of quarterly samples, during 1993 through 1995, revealed no violations of the MCL health-based atrazine standard in Kentucky.

Tests of raw water withdrawn from the Ohio River by drinking water plants revealed varying levels of atrazine — a common herbicide used in cornfields. Tests for atrazine in treated drinking water, however, revealed no violations of the MCL health-based standard.

Figure 16 Atrazine Testing of Ohio River Raw Water Withdrawn by Drinking Water Plants in Kentucky



Note: Based on mean atrazine concentrations from raw water samples taken in May and June 1995 at Ohio River drinking water intakes at public drinking water treatment plants. Data reflects median concentrations of 3 analysis using immunoassay test methods.
Source: Ohio River Valley Water Sanitation Commission

Few Violations of Lead Standard Detected to Date

Copper and lead are two inorganic chemicals that have received increased attention in recent years. Lead is a cumulative poison and in relatively small amounts can cause brain, kidney, and nerve damage, anemia, or death. It is a particular threat to children, causing behavioral problems and mental retardation.

The Safe Drinking Water Act Amendments of 1986 banned the future use of lead pipes and solder in all public drinking water systems due to the possibility of lead leaching into the water. In 1991, the U.S. EPA revised the lead standard to adopt a complex "treatment technique" that established an "action level" of 15 parts per billion at the consumer's tap, which triggers additional requirements if 10% or more of the tap water samples exceed this level. If a public drinking water system exceeds the action level, it is given up to eight years to implement corrosion control measures to address the problem depending on the system size. If the corrosion treatment to reduce lead to acceptable levels fails, lead service line pipes would be required to be removed over a 15 year period.

A few violations of the lead action level have been cited in Kentucky during the past five years. EQC also found that 155 water systems had lead and copper monitoring violations in 1994 and 137 in 1995. This was due to a delay in sampling at the request of the Division of Water, according to state officials. They report that all systems are now in the process of testing for lead. The U.S. EPA also plans to modify monitoring rules to provide for greater flexibility in lead testing.[23]

A few violations of the lead drinking water standard have been cited in Kentucky. EQC also found that 155 water systems had lead and copper monitoring violations in 1994 and 137 in 1995.

Because lead levels are likely to be the highest in a home with lead pipes, state officials also contend that a concerted effort to educate the public to let water from an unused faucet run before drinking it to flush potentially contaminated water from the system would greatly reduce the public's exposure to lead in drinking water.

Disinfection By-Products in Drinking Water Remain a Concern

Another chemical detected in public drinking water at some plants is disinfection by-products known as trihalomethanes. This organic chemical is produced as a result of chlorination during the drinking water disinfection treatment process.

Since 1989, 186 violations of the trihalomethane MCL standard has been cited at public drinking water systems in Kentucky **(Figure 6)**. Efforts by the Division of Water to assist public systems in complying with the trihalomethane standard are ongoing. But problems still remain. During 1995, 15 drinking water systems in Kentucky were responsible for 32 violations of the trihalomethane MCL standard. The U.S. EPA has proposed a stricter standard for trihalomethanes due to the cancer risks posed. They propose to reduce the standard from 100 to 80 micrograms per liter of water. However, more pressing concerns to address microbial contamination including Cyrptosporidium in drinking water have delayed action on this rule.

During 1995, 15 drinking water systems violated the MCL standard set for trihalomethanes — a chemical produced as a result of the water disinfection process.

Drinking Water System Needs Assessment Underway

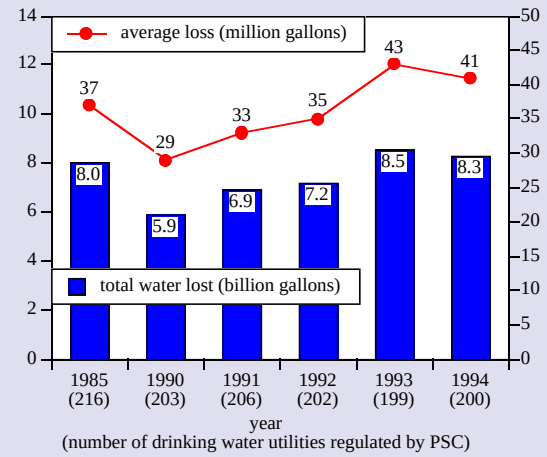
The treatment of drinking water varies widely from private water wells with no treatment to large public drinking water systems with multistep treatment processes. The installation of more advanced public drinking water technologies to improve treatment appears limited in the state. An exception is the capability of many surface water systems to feed powder-activated carbon to remove organic chemicals when detected above safe levels in raw water supplies. In Louisville, powdered-activated carbon was used to remove herbicides from the water. Georgetown, Carrollton, and Paducah have used granular-activated carbon filters to remove organic chemicals after testing revealed violations of the standards in treated water.

Recognizing the need to improve the nation's drinking water infrastructure, a $4.25 to $9.6 billion revolving loan fund to help water systems pay for equipment and upgrades necessary to meet regulatory requirements is under review by Congress as part of the reauthorization of the Safe Drinking Water Act. A study to assess drinking water infrastructure needs in Kentucky and other states has been commissioned by the U.S. EPA and should be complete in the fall of 1996.

A study to assess drinking water infrastructure needs in Kentucky and other states has been commissioned by the U.S. EPA and should be complete in the fall of 1996.

The distribution of drinking water through pipes also has an important influence on water quality. In many areas, distribution systems have not been maintained, resulting in deterioration, leakage, and failure.

Figure 17 Drinking Water Distribution Line Losses in Kentucky



Note: Based on utilities regulated by the KY Public Service Commission. Source: Public Service Commission

Water Line Breaks Lead to Increased Number of Boil Water Advisories

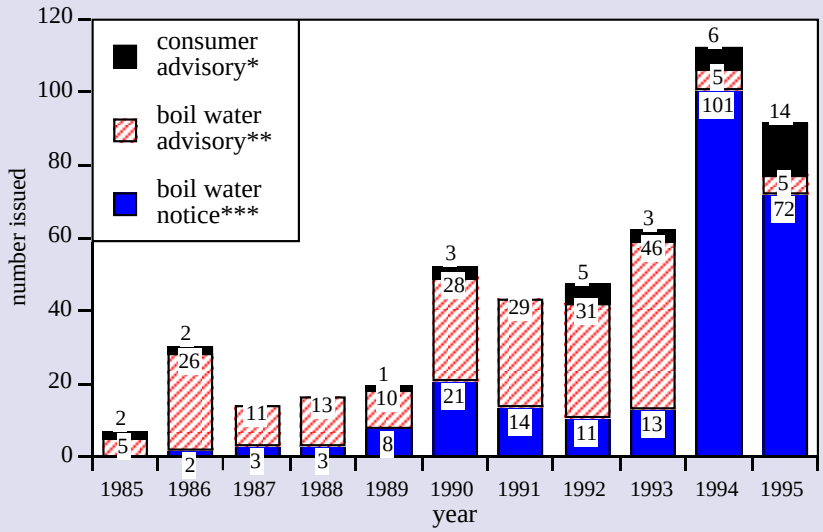
The distribution of drinking water through pipes has an important influence on water quality. In many areas, distribution systems have not been maintained, resulting in deterioration, leakage, and failure. Some water systems lose as much as 50% of their treated water due to leaks and water line breaks **(Figure 17)**. Deteriorating pipes not only can cause water loss, but can be dangerous because of infiltration of contaminants during pressure losses. A CDC study of 291 waterborne disease outbreaks in the U.S. during the last decade found that 24% were attributed to contamination of drinking water in the distribution system.

Most utilities do not replace pipes until they are broken. Large utilities have, on average, more than 200 breaks a year.

Most utilities do not replace pipes until they are broken. Large utilities have, on average, more than 200 breaks a year. In Kentucky, the number of boil water advisories and notices have increased significantly due to greater efforts by water systems to report line breaks and educate the public about possible contamination problems **(Figures 18 & Figure 19)**. In 1995, five boil water advisories —issued when there is potential for bacterial contamination — and 72 boil water notices — issued when evidence shows bacterial contamination — were issued in 28 counties. Boil water advisories and notices generally last just a few days. However, some communities have experienced long-term advisories due to various problems. Numerous boil water advisories have been issued for the community of Evarts in Harlan County since June 1994 due to continuing problems at the water treatment plant.

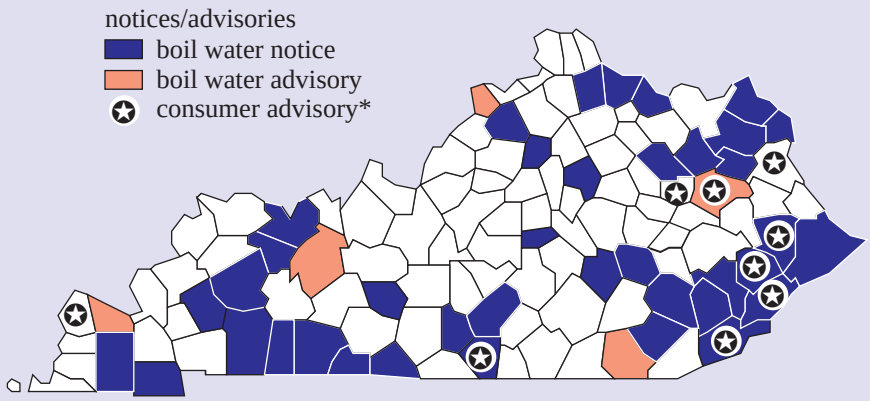
In Kentucky, the number of boil water advisories and notices have increased significantly due to greater efforts by water systems to report line breaks and educate the public about possible contamination problems.

Figure 18 Drinking Water Advisories and Notices in Kentucky



**Issued when chemical contamination is detected above MCL standards. **Issued when there is potential for bacteriological contamination. ***Issued when evidence shows bacteriological contamination. Source: KY Division of Water*

Figure 19 Drinking Water Advisories and Notices Issued in Kentucky (1994 and 1995)



Note: Harlan, McCracken, and Ohio counties also had boil water advisories issued during 1994 or 1995. Source: KY Division of Water

***Drinking Water Consumer Advisories Issued in 1994 and 1995 Due to Chemical Contamination**

*nitrate (Morgan, Ballard, Harlan counties)
*oil (Cumberland Co,)
*antimony (Letcher Co.)
*hydrogen sulfide/iron (Harlan Co.)
*petroleum (Menifee Co.)
*excessive chlorine residual (Knott Co.)
*human waste (Floyd Co.)
*thallium (Letcher Co.)
*gasoline (Harlan Co.)
*barium (Lawrence Co.)

Drinking Water Infrastructure Needs Are Great

Kentucky has made great progress during the past 50 years in building the infrastructure necessary to provide 81% of the state's households with access to public drinking water. Most of these systems are now more than 30 years old and many require improvements. Efforts to upgrade the state's drinking water infrastructure have progressed. Between 1991 and 1995, there were 5,694 system upgrades, expansions, construction, and repairs approved by the Division of Water.

Most of the state's drinking water systems are more than 30 years old and many require improvements. Efforts to upgrade plants have progressed.

But the costs to improve water systems to meet drinking water standards and provide efficient distribution of water can be significant. For example, the Louisville Water Company (LWC) spends $10 million a year on water pipeline renovation. The company, which draws its water directly from the Ohio River, has also considered switching to riverside wells. The well water would be cleaner and require less treatment. The company is also concerned that zebra mussels, an exotic species of freshwater mussels, could clog surface water intake pipes from the river and cost consumers hundreds of thousands dollars to remove. LWC estimates the cost to switch to well water could run as high as $65 million.

Costs to improve drinking water systems can be significant and are passed on to the customer. In 1980, the average monthly household water bill was $10.50 compared to $19.51 in 1994. However, when adjusted for inflation, this increase is nominal.

Costs to improve drinking water systems can be significant and are passed on to the customer. The Public Service Commission (PSC) currently regulates the rates of 192 public water systems in Kentucky. In 1980, the average monthly household water bill for those systems whose rates are regulated by the PSC was $10.50 compared to $19.51 in 1994. However, when adjusted for inflation, this increase is nominal. This is likely due to the fact that more households are served by public drinking water, allowing the utilities to spread costs among a greater number of customers. Yet many drinking water systems, especially small ones, have raised concerns about the increasing costs to meet drinking water rules. In response, Congress is considering a proposal that will require the U.S. EPA to more fully consider costs and benefits of complying with new drinking water rules as it debates the reauthorization of the federal Safe Drinking Water Act.

Water Supply Planning Underway in 115 Counties

While water treatment is essential to ensuring Kentuckians with clean supplies of drinking water, planning and conservation are equally important in protecting water supplies. Kentucky is fortunate to have abundant water supplies. However,

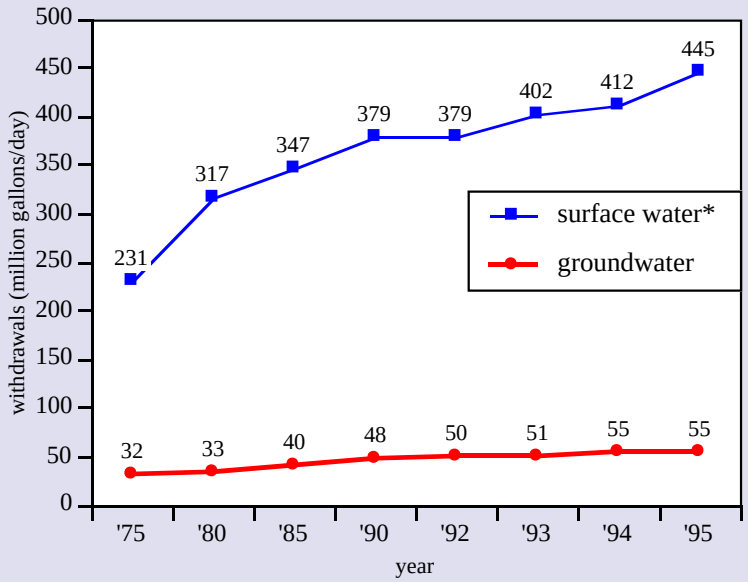
Droughts, contamination problems, and inadequate treatment capacity have affected the drinking water supplies of many communities throughout Kentucky.

the availability of clean drinking water varies widely across the state. Droughts, contamination problems, and inadequate treatment capacity have affected the drinking water supplies of many communities throughout Kentucky.

In 1990, the U.S. Geological Survey estimated that more than four billion gallons of water are withdrawn everyday in the state.[24] About 10% is used to supply public drinking water. The remainder supplies industrial, agricultural, commercial, and private needs. Since 1975, surface water and groundwater withdrawn for public drinking water supplies have almost doubled **(Figure 20)**. Presently, 286 suppliers are permitted to withdraw 10,000 gallons a day or more for drinking water purposes. These include 90 permits to withdraw groundwater, 11 for spring, and 185 for surface water to meet public drinking water needs.

About 10% of the water withdrawn in Kentucky is used for drinking. Since 1975, surface and groundwater withdrawn for public drinking water supplies have almost doubled.

Figure 20 Public Drinking Water Withdrawals in Kentucky



*Note: State permitted drinking water suppliers that withdraw 10,000 gallons per day or more. Based on actual or estimated use. *Includes springs.*
Source: KY Division of Water

Many Kentucky communities have become increasingly aware of the potential for water shortages. The Division of Water classifies 28 community systems as vulnerable to water shortages.[25] A state grant program was established in 1990 to support long-range planning for drinking water supply needs. All counties except Jefferson, Fayette, Kenton, Campbell, and Gallatin are participating in the state program. To date, only Boone County has a state approved water supply plan.

A state grant program was established in 1990 to support long-range planning for drinking water supply needs. All counties except Jefferson, Fayette, Kenton, Campbell, and Gallatin are participating in the program.

Droughts have also affected several community water supplies. Droughts led the Kentucky-American Water Co. (KAWC) to consider supplementing its treated water supplies from the Kentucky River with water purchased from the Louisville Water Co. KAWC, which serves 85,000 metered residences, businesses, and industries in Fayette, Scott, Bourbon, Jessamine, Woodford, and Harrison counties, wants to build a $50 million 55-mile pipeline to connect to Louisville's water system at the Jefferson County line. The Public Service Commission is awaiting the KY River Authority's study of water supply options, including KAWC's treated water pipeline, before a decision is made on the pipeline. The Authority, a state agency established in 1986 to manage the Kentucky River locks and dams and address other needs in the basin, believes that a system of dam crest gates and release valves in existing dams should allow the region to meet it's water supply needs.

The Authority has established a water user fee of 2.2 cents per 1,000 gallons for permitted water users in the basin plus an additional 1.6 cents per 1,000 gallons on those systems drawing water from the river's main stem. Water withdrawals for agricultural purposes are exempt from the fees. There are more than 90 permitted water users paying fees to the Authority. Some communities filed a lawsuit claiming the user fees provided no specific benefit to them and the fees were unconstitutional. The Kentucky Court of Appeals recently ruled, however, that watershed management provides benefits throughout the region, and the fees established by the state legislature were appropriate. The fees collected by the Authority, approximately $3 million a year, combined with $13 million in federal funds will be used to conduct watershed studies, place valves and crest gates in some dams, repair locks and dams, and promote tourism in the Kentucky River Basin.

Conservation May Play Greater Role as Water Demands Increase

Water use in the U.S. has generally been extravagant, consuming more and paying less than any other industrialized country. In Kentucky, the average household pays about 64 cents a day for public drinking water.[26]

Water conservation has not been a priority in Kentucky due to the low cost of water and abundant supplies. The average household in the state pays about 64 cents a day for public drinking water.

Water conservation has not been a priority in Kentucky due to the low cost of water and abundant supplies. Conservation usually only takes place when water supplies have reached low levels and a shortage is imminent. Water pricing can be an effective tool in water conservation programs. The Public Service Commission has stepped up its efforts to promote conservation and discourage excessive use instead of expanding public water systems. The PSC has devised rate schedules in several recent cases to discourage excessive residential use of water.

As economic and residential growth occurs and more systems face water supply problems or treatment capacity limitations, conservation may play an increasing role in the state. As of May 16, 1996, there were 29 systems in 13 counties under tap-on bans, prohibiting the connection of new metered customers to water lines, or water line extension bans by the Division of Water due to inadequate water treatment capacity or compliance problems.

Protecting Drinking Water Sources Receiving Increased Attention

Watershed and groundwater protection are the first lines of defense in reducing threats of drinking water contamination. Sensitive supplies, such as reservoirs, lakes, and sole-source aquifers can be protected through a number of means including land acquisition, buffer zones, sustainable agricultural practices to prevent polluted runoff, reduction of urban runoff through improved design of new developments and installation of flood control ponds, and land use planning and zoning.

Clearly protecting water sources will improve the overall quality of drinking water.

Clearly protecting water sources will improve the overall quality of drinking water. There has been some progress in the state toward protecting groundwater drinking water sources. The 1986 amendments to the Safe Drinking Water Act require each state to develop a program to protect public water supply wells and springs from contamination. The U.S. EPA approved the Kentucky Wellhead Protection Program in 1993. The state Wellhead Protection Program is designed to assist communities in preventing groundwater pollution by addressing potential sources of contamination within a designated land area around a well or spring. In Kentucky, 272 community groundwater-supplied public drinking water systems are required to adopt a wellhead protection plan by 1998.[27] As of May 1, 1996, 79 of these systems were in the process of developing plans to protect the groundwater resource. Currently, only Boone County has a state-approved wellhead plan.

In Kentucky, 272 community groundwater-supplied public drinking water systems are required to adopt a wellhead protection plan by 1998. As of May 1, 1996, 79 of these systems were in the process of developing plans to protect the groundwater resource.

Most Kentucky communities do not have plans or programs to protect surface drinking water sources such as rivers, lakes, and reservoirs and rely on the provisions of the federal Clean Water Act to protect supplies.

Most Kentucky communities do not have plans or programs to protect surface drinking water sources such as rivers, lakes, and reservoirs and rely on the provisions of the federal Clean Water Act — the principal law to control water pollution — to protect supplies. While the act has been effective in reducing water pollution, problems still remain. For example in 1993, 28% of the waterways monitored in the state were impacted by pollution. A federal provision to encourage state and local plans and programs to protect drinking water sources is under review by Congress as part of the reauthorization of the Safe Drinking Water Act. The act is expected to be reauthorized this year. The U.S. EPA is also considering a new drinking water source protection initiative that will focus on partnerships with state and community organizations to foster voluntary protection efforts.

Improving Drinking Water Quality Will Require Resources and Partnerships

There are many challenges confronting the state, communities, and water systems to improve drinking water quality in Kentucky. They range from funding system improvements to educating private well owners about the importance of routine testing and proper well maintenance.

There are many challenges confronting the state, communities, and water systems to improve drinking water quality in Kentucky. They range from funding system improvements to educating private well owners about the importance of routine testing and proper well maintenance. At an Environmental Quality Commission Public Forum held last year, government and water utility officials reviewed drinking water issues and needs. Among their recommendations were:

Local and State Government

- Increase emphasis at both the state and local level on training for water treatment plant operators and technicians, particularly for smaller system operators.
- Conduct a closer examination "up front" of each drinking water plant to ensure viability of the system to adequately treat water.
- Conduct a thorough examination of a system's physical facilities and source of water to ensure implementation of design criteria consistent with providing safe drinking water supplies.
- Focus more attention on protecting and addressing drinking water contamination problems at the source.
- Promote the formation of additional multi-county water districts to consolidate small, nonviable drinking water systems.
- Develop an aggressive statewide public education program for private water well users to promote awareness of the importance of routine testing of private well water and proper well maintenance.
- Develop a cost-share or grant program to target straight pipe discharges of sewage from homes and businesses as well as failing septic systems.
- Provide state grants and low-interest loans to help finance public water lines and improve systems.
- Commit additional resources to the statewide groundwater monitoring network to better assess groundwater quality and threats.

Federal Government

- Provide federal funding, particularly grants, for small rural systems that cannot afford to upgrade plants or conduct adequate testing due to fiscal constraints.
- Develop a national and regional consensus to help streamline water plant testing compliance requirements and provide for a more holistic approach to addressing drinking water quality problems.

Public Water Systems

- Strengthen partnerships for safe water among water systems, the service community, and public health community to better educate consumers about drinking water threats and needs.
- Optimize the treatment process and focus additional attention on the protection

of the water source to prevent contamination of drinking water.

■ Conduct more research on emerging threats including Cryptosporidium and Giardia in Kentucky and keep customers informed.

■ Create a technical assistance program among drinking water systems to provide guidance to small and problem systems.

In 1995, the U.S. EPA announced a new Partnership for Safe Water. Under the program, drinking water suppliers will carry out a comprehensive assessment of their operations, maintenance, and management and undertake corrective actions to ensure the most protective systems possible, particularly against microbial contamination. The agenda includes five specific actions:

■ Provide consumers with information about drinking water.

■ Target safety standards and resources first at contaminates that pose the greatest threat to human health, including Cryptosporidium.

■ Provide technical assistance to more small systems, communities, and states to improve facility operations and prevent problems.

■ Give states more flexibility to address individual problems and set priorities.

■ Increase investment in community drinking water facilities through mechanisms such as a federal loan program.

It is also important that Kentuckians become more informed and aware of drinking water issues in their communities. For more information about the quality of your community's public drinking water contact the KY Division of Water, Drinking Water Branch, 14 Reilly Rd., Frankfort, KY 40601 or call 502-564-3410. You can also contact individual public drinking water systems and request monitoring data and test results.

In 1995, the U.S. EPA announced a new Partnership for Safe Water. Under the program, drinking water suppliers will carry out a comprehensive assessment of their operations, maintenance, and management and undertake corrective actions to ensure the most protective systems possible, particularly against microbial contamination.

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26. Based on the average residential monthly bill per customer of the 200 water utilities regulated by the Kentucky Public Service Commission for calendar year 1994.
27. Only those systems designated as community and non-transient/noncommunity are required to comply with wellhead protection plan requirements. There are a total of 382 systems in Kentucky that use groundwater, 272 of those systems are required to develop wellhead protection plans.

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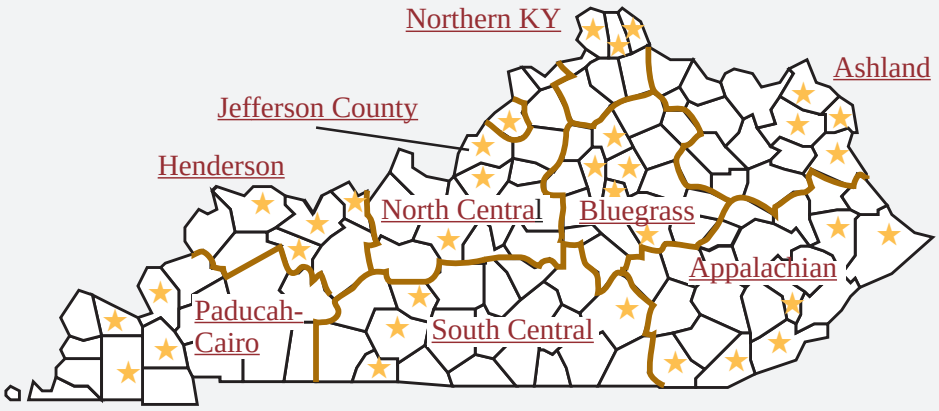
1996 State of Kentucky's Environment

Air Quality

Efforts to clean up Kentucky's and the nation's air have been ongoing since the passage of the federal Clean Air Act of 1970. And the results have been dramatic. During the past two decades, concentrations of many air pollutants in Kentucky have declined, in one case by 97%.[1] But the job is far from over. Air pollution generated by industries — along with tailpipe emissions from an ever-growing number of automobiles and other sources — continue to contribute to environmental degradation and pose public health risks.

This *State of Kentucky's Environment* report will assess the state's progress in providing Kentuckians with clean, healthy air to breathe. This includes an analysis of data collected from 113 air quality monitors in 34 counties across the state. This monitoring network provides the best measure of statewide and regional concentrations of various air pollutants in Kentucky **(Figure 1)**. This report will also review air toxics emission trends, greenhouse gas and ozone-depleting chemical releases, as well as indoor air quality, which is ranked a high health risk in Kentucky.

Figure 1 Air Quality Control Regions and Monitored Sites★



★ Monitored sites measuring one or more air pollutant operated by the KY Div. for Air Quality and the Jefferson County Air Pollution Control District. Source: KY Division for Air Quality

Air Quality Improvements Continue Into the 1990s

There are multiple sources that contribute to air pollution including industries, automobiles, and small businesses. The principal law enacted to control air pollution is the federal Clean Air Act of 1970, which was later amended in 1990. Most of the Clean Air Act provisions have focused on controlling six pollutants:

- ozone (ground-level)
- carbon monoxide (CO)
- sulfur dioxide (SO_2)
- nitrogen dioxide (NO_2)
- particulates (PM-10)
- lead[2]

Industrial emissions of some air pollutants have declined since 1980 **(Figure 2)**. For example, in 1995, sulfur dioxide emissions in Kentucky dropped 36% from 1980 levels largely due to the installation of scrubbers, pollution control devices used to remove sulfur dioxide, at 12 coal-fired power plants. Measures to curtail automobile tailpipe emissions have also contributed to improving air quality. Air quality trends show steady reductions in the concentrations of various air pollutants in Kentucky **(Figure 3)**. These improvements have been accomplished while our economy has grown, representing important progress in achieving economic growth while maintaining a safe environment.

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Reporting on Environmental Trends and Conditions in Kentucky.

1996 Trends Reports
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- Toxics
- Water Quality
- Natural Resources
- Resource Extraction

EQC is a seven-member citizen commission created under state law with a mission to monitor environmental trends and conditions, promote partnerships to improve and protect the environment, provide a public forum for the discussion of environmental issues, and advise state officials on environmental matters.

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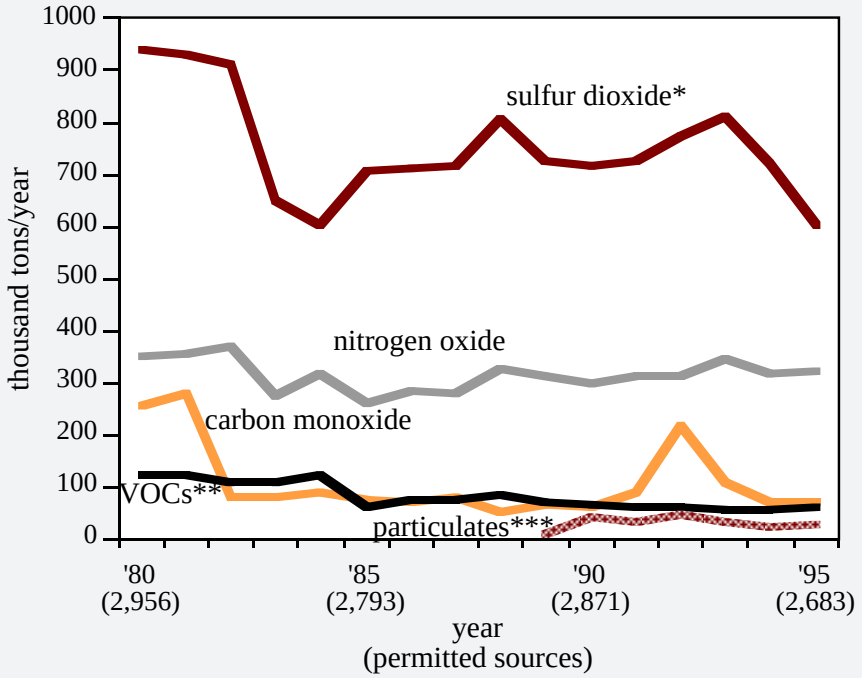
Figure 2 Air Pollutant Emissions from Permitted Sources in KY



*Note: Excludes Jefferson Co. data because the Jefferson Co. Air Pollution Control District was unable to provide data for all years displayed (see Figure 7). 1995 data preliminary. *Decline in SO_2 emissions during 1983-84 may be due to the shut down of TVA power plants for repairs and subsequent installation of scrubbers. **1980-88 VOC data represent total hydrocarbons. ***PM-10 particulate emission data collection began in 1989. Source: KY Division for Air Quality*

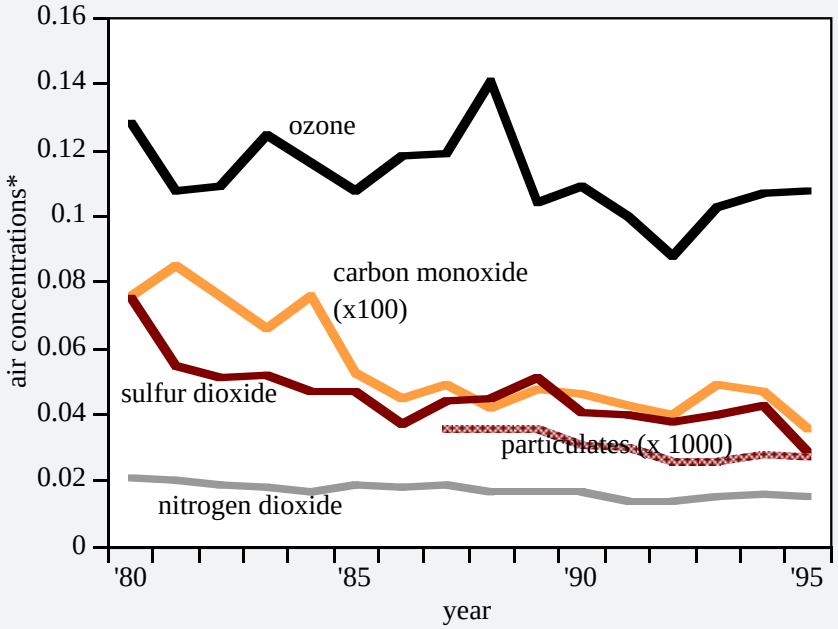
Air quality trends show steady reductions in the concentrations of various air pollutants in Kentucky. These improvements have been accomplished while our economy has grown, representing important progress in achieving economic growth while maintaining a safe environment.

Percent Change in Air Pollutant Concentrations

Ozone*	-5%
NO_2*	-27%
CO*	-42%
SO_2*	-29%
PM-10**	-18%

**Based on 10-year average air concentrations comparing 1976-85 and 1986-95. **Based on 4-year average air concentrations comparing 1988-91 and 1992-95.*

Figure 3 Air Concentrations of Pollutants in Kentucky



**Yearly air concentrations from state monitored sites based on the following: Ozone-second maximum one-hour average. CO-second maximum eight-hour average. NO_x and particulates (PM-10)-annual statewide averages. SO_2-second maximum, 24-hour average. Concentrations in parts per million for all pollutants except particulates, which are measured in micrograms per cubic meter. Source: KY Division for Air Quality*

Ozone Pollution Remains a Problem in Louisville & Northern KY

Of the six principal air pollutants, ground-level ozone has been the most difficult to control. Kentucky was among 35 states that experienced exceedances of the ozone pollution standard during 1995.[3] Ozone is produced when emissions of volatile organic compounds (VOCs), such as solvents and automobile exhaust, and nitrogen oxides (a by-product of combustion) react with sunlight. There are numerous sources that produce these "precursor" gases including manufacturing plants, coal-fired power plants, large industrial boilers, gas stations, and automobiles.

Of the six principal air pollutants, ground-level ozone pollution has been the most difficult pollutant to control. Kentucky was among 35 states that experienced exceedances of the ozone standard during 1995.[3]

The health effects from exposure to ozone can be serious, causing reduced lung function and exacerbation of asthma and other respiratory diseases. According to the American Lung Association, an estimated 432,516 people in Kentucky, or 11% of the state's population, suffer from lung cancer or chronic respiratory diseases such as asthma and emphysema that can be aggravated by exposure to ozone.[4] Ground-level ozone not only affects people with impaired respiratory systems, but healthy adults and children as well. Exposure to ozone for six to seven hours, even at low concentrations, can reduce lung function in healthy people during periods of moderate exercise. Ozone pollution can also damage crops and forest ecosystems.

Ozone formation is greatly influenced by weather conditions. The greatest number of ozone standard exceedances occurred during the hot summers of 1980, 1983, and 1988 **(Figure 4)**. Despite these fluctuations, there appears to be a general decline in statewide ozone levels as seen in **Figure 3**. Technologies to control VOC emissions such as catalytic converters on automobiles and the use of carbon absorption and thermal oxidation at industrial plants have led to a decrease in the number and severity of ozone standard exceedances in Kentucky. As a result, the U.S. Environmental Protection Agency (U.S. EPA) redesignated the Bluegrass and Ashland regions from nonattainment for ozone to attainment in 1995.

According to the American Lung Association, an estimated 432,516 people in Kentucky, or 11% of the state's population, suffer from lung cancer or chronic respiratory diseases that can be aggravated by exposure to ozone.[4]

Most regions of the state currently meet the national ozone standard **(Figure 5)**. However, ozone is still a problem in the urban airsheds of the Northern KY/Cincinnati region (which includes Boone, Campbell, and Kenton counties) and Jefferson County/Southern Indiana region which includes Jefferson and portions of Bullitt and Oldham counties **(Figure 6)**. Approximately 28% of Kentucky's population live in counties currently experiencing problems meeting the ozone standard.

Figure 4 Number of Days Ozone Standard Exceeded by Air Quality Control Region

	Bluegrass	N. KY	Henderson	Ashland	Jefferson	Paducah	N. Central	S. Central	Appalachian
1980	0	10	1	4	23	1	1	0	NM
1981	1	0	2	0	5	1	0	0	0
1982	0	1	0	3	4	0	0	0	0
1983	2	7	4	8	19	2	3	0	0
1984	0	1	0	7	11	0	0	0	NM
1985	0	1	1	3	1	0	0	0	NM
1986	3	1	2	3	2	2	3	0	NM
1987	2	3	2	8	6	0	2	1	NM
1988	5	15	12	12	7	5	12	5	NM
1989	0	1	0	1	4	0	0	0	NM
1990	1	0	3	4	1	0	2	0	NM
1991	0	0	0	3	0	0	2	0	NM
1992	0	0	0	0	0	0	0	0	0
1993	0	1	0	1	2	1	1	0	0
1994	0	0	2	2	1	0	0	0	0
1995	0	1	0	1	2	0	1	0	2

Note: Based on actual number of days in Kentucky that exceeded ozone standards as recorded at state air quality monitors. NM-not monitored. Source: KY Division for Air Quality

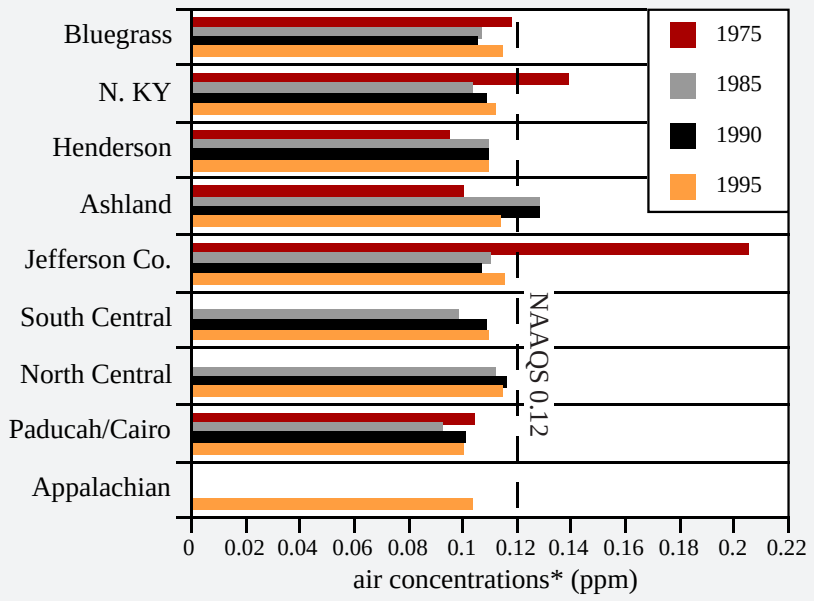
Most regions of the state currently meet the national ozone standard. However, ozone is still a problem in the urban airsheds of Northern Kentucky and Jefferson County.

Percent Change in Ozone Air Concentrations

Bluegrass	-7%
N. KY	-7%
Henderson	-6%
Ashland	-9%
Jefferson	-17%
Paducah	+2%
N. Central	+4%

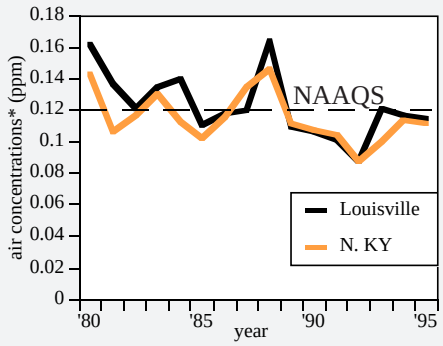
Based on 10-year average air concentrations comparing 1976-85 and 1986-95.

Figure 5 Regional Air Concentrations of Ozone



*Note: Selected years. *Yearly ozone air concentrations based on second maximum, one-hour average recorded at state monitored sites. Concentrations compared to the National Ambient Air Quality Standard (NAAQS). ppm-parts per million. Source: KY Division for Air Quality*

Figure 6 Louisville and N. KY Ozone Air Concentration Trends



**Yearly concentrations based on second maximum, one-hour average of ozone at state monitored sites. ppm-parts per million Source: KY Division for Air*

Plan to Reduce Ozone Pollution Implemented in Jefferson County

The Clean Air Act Amendments of 1990 requires that Kentucky develop plans to reduce VOC emissions ik8the Northern Kentucky and Jefferson County ozone nonattainment regions 15% by 1996 using 1990 emission levels as the baseline. These regions must also meet the ozone attainment standard of not more than one ozone standard exceedance each year over a three-year period at any one air quality monitor. Not meeting these requirements could mean a loss of federal highway construction funds and other sanctions. However, the U.S. EPA can grant extensions to provide regions additional time to meet the ozone standard.

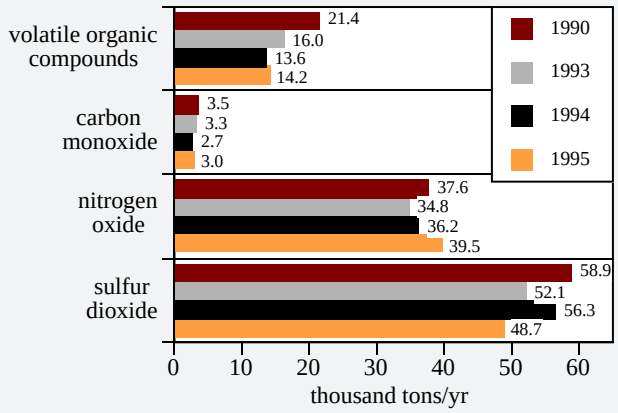
During 1995, 435,832 vehicles were tested in Jefferson County of which 32,030 required repairs and retesting to meet tailpipe emission requirements to help address the ozone pollution problem in the region. A total of 699 vehicles failed to pass the emissions test that year.

The Jefferson County Air Pollution Control District — the regulatory agency responsible for enforcing the Clean Air Act provisions in Jefferson County — has been working for the past 26 years to reduce VOC and other emissions to address ozone problems in the airshed. In 1984, the district initiated an automobile inspection program to control tailpipe emissions, which contribute to the ozone problem. During 1995, 435,832 vehicles were tested in Jefferson County of which 32,030 required repairs and retesting to meet tailpipe emission requirements to help address ozone pollution. A total of 699 vehicles failed to pass the emissions test that year. The district also required the installation of vapor controls at gasoline stations to reduce VOC emissions. In addition, the state required gas stations in Jefferson County to switch from selling conventional gasoline to reformulated gasoline (RFG),

a gasoline blend that, on average, reduces VOCs and air toxic emissions. In 1995, the first year RFG went on sale in Jefferson County, an estimated 350 million gallons of RFG were sold.

Industrial VOC emissions in Jefferson County have declined 34% between 1990 and 1994 **(Figure 7)**. The VOC reductions are attributed to plant closings as well as the County's Ozone Reduction Plan, which went into effect in 1992. The most recent plan calls for VOC reductions of 40.8 tons per day to achieve the 15% reduction by 1996. About 38% of the reductions will come from tightened vehicle inspections, 40% from a cap on large industrial sources that emit 50 tons or more a year, and 22% from a cap on smaller area sources such as gas stations and dry cleaners **(Figure 8)**. However, because of continued ozone standard exceedances during 1994 and 1995, the district proposed to go beyond the 15% VOC reduction goal. Additional VOC and nitrogen oxide reductions were implemented in 1995 and include emission limits at printing plants, further reductions at large sources, and strengthening the auto inspection program **(Figure 8)**.

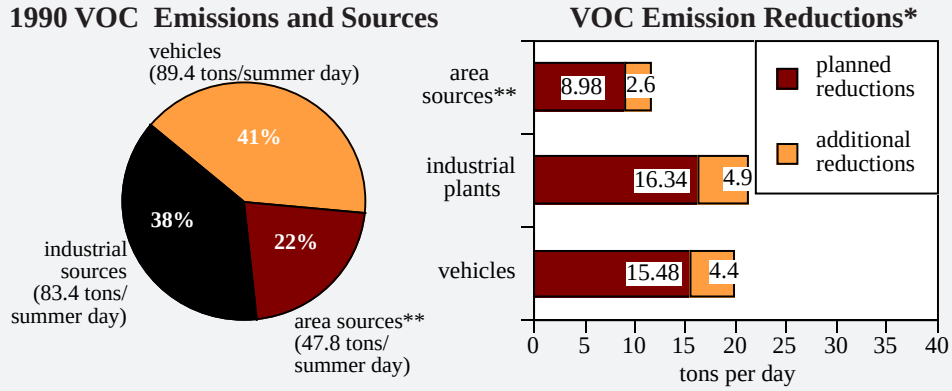
Figure 7 Industrial Emissions of Air Pollutants in Jefferson County



Note: Based on emissions reported by permitted sources. 1995 data preliminary. Data prior to 1990 and for 1992 not available.
Source: Jefferson County Air Pollution Control District

Industrial VOC emissions in Jefferson County have declined 34% between 1990 and 1995, according to data provided by the Jefferson County Air Pollution Control District. The reductions are attributed to plant closings as well as the County's Ozone Reduction Plan, which went into effect in 1992.

Figure 8 Jefferson Co. VOC Sources and Emission Reductions



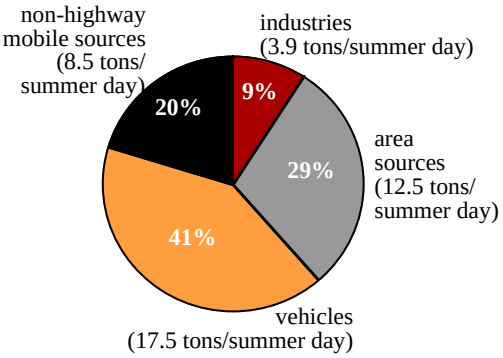
**Reductions of 30.61 tons/day of nitrogen oxide emissions are also planned over the next four years. **Area sources include gas stations, dry cleaners, and other nontraditional sources.*
Source: Jefferson County Air Pollution Control District

The most recent Jefferson County Ozone Reduction Plan calls for VOC reductions of 40.8 tons per day. About 38% of the reductions will come from tightened vehicle inspections, 40% from a cap on large industrial sources that emit 50 tons or more a year, and 22% from a cap on smaller area sources such as gas stations and dry cleaners.

U.S. EPA Issues Preliminary Denial to State's Request that Northern Kentucky be Reclassified to Attainment for Ozone

In 1993, the state submitted a 15% VOC reduction plan for Northern Kentucky ozone nonattainment area to the U.S. EPA. Because 41% of the VOC emissions in the region are from vehicles, the plan included an automobile inspection and maintenance program and the use of reformulated gasoline to address ozone pollution problems in the region.

N. KY VOC Sources[5]



Ozone violations in the Northern Kentucky region during 1995 have led the U.S. EPA to propose to deny the state's 1994 request to redesignate the region to attainment for ozone. If the request is officially denied, which is expected to occur in the near future, VOC reductions would be required Kenton, Campbell, and Boone counties.

However, in 1994 the region achieved compliance with the ozone standard, and the state requested that it be redesignated to attainment for ozone. The state later requested the U.S. EPA also allow the Northern KY region to opt-out of the RFG gas program, which was implemented in January 1995. But ozone violations in the region during 1995 have led the EPA to propose to deny the redesignation request. If the request is officially denied, which is expected to occur in the near future, VOC reductions would be required in Kenton, Campbell, and Boone counties.

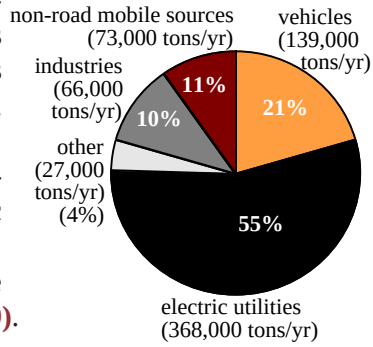
The U.S. EPA is currently reviewing the national ozone standard to determine if it is stringent enough to protect human health and the environment. Under consideration is the replacement of the 0.12 parts per million (ppm), one-hour average exposure standard with a 0.07-0.09 ppm, eight-hour standard. In addition to the new standard, the EPA is also considering a change in the number of ozone exceedances allowed under the new standard before triggering nonattainment status for a region. The U.S. EPA is expected to propose a new ozone standard sometime in 1996.[6]

State Ranks Eleventh in Nitrogen Dioxide Emissions

Nitrogen dioxide (NO_2) belongs to a family of highly reactive gases called nitrogen oxides (NO_x) — a brownish gas produced by fossil fuel combustion from sources such as cars and power plants. During 1994, 673,000 tons of nitrogen oxides were emitted to the air in Kentucky, ranking the state eleventh in the nation in NO_x emissions. This pollutant can irritate the lungs and lead to respiratory infections. NO_2 is also associated with atmospheric reactions that produce ozone and acid rain.

Air concentrations in all regions of Kentucky continue to remain below the national standard for NO_2 **(Figure 9)**.

NO_x Emissions in KY[7]



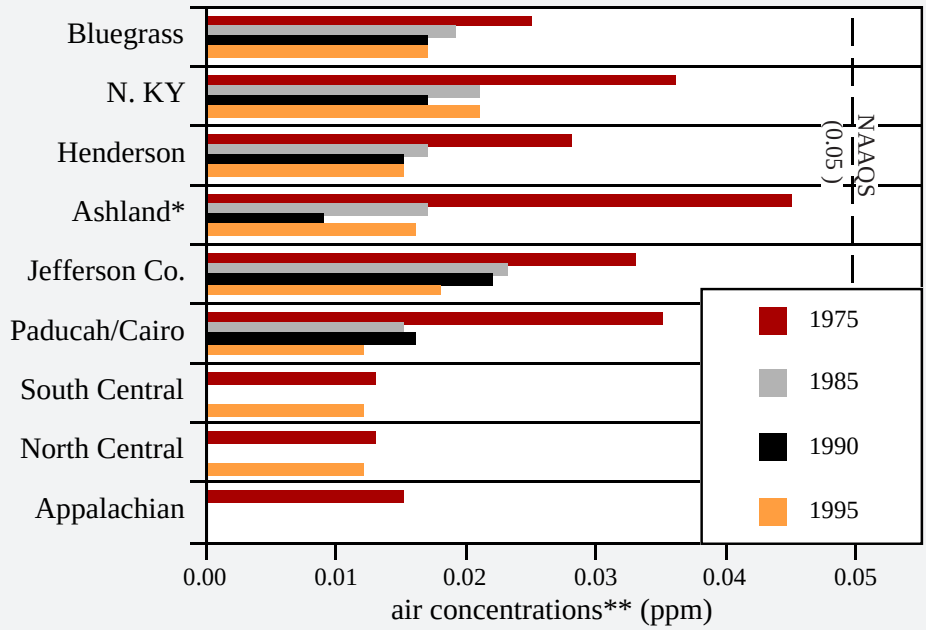
Air concentrations in all regions of Kentucky continue to remain below the national standard for nitrogen dioxide.

Percent Change in Nitrogen Dioxide Air Concentrations

Bluegrass	-5%
N. KY	-24%
Henderson	-20%
Ashland	-35%
Jefferson	-38%
Paducah	-29%

Based on 10-year average air concentrations comparing 1976-85 and 1986-95.

Figure 9 Regional Air Concentrations of Nitrogen Dioxide



*Note: Selected years. *There is no explanation for the 1990 air concentration average in the Ashland Region. This may be due to monitoring changes in the region that year. **Yearly average NO_x concentrations at state monitored sites. Concentrations compared to the National Ambient Air Quality Standard (NAAQS). ppm - parts per million. Source: KY Division for Air Quality*

Large Nitrogen Oxide Sources Must Begin to Reduce Emissions

A primary source of NO_x is fossil fuel combustion. In 1994, coal-fired power plants accounted for 55% of the NO_x emissions in Kentucky. The Clean Air Act Amendments of 1990 require large NO_x sources such as power plants to modify combustion to reduce emissions 30-40% below 1980 levels by the year 2000. Sources have the option to choose the method of compliance that best suits their needs. Some power plants in Kentucky have installed low NO_x burners, a more efficient combustion technology that can reduce NO_x emissions by 40-60% **(Figure 10).**

In Kentucky, total nitrogen oxide emissions from power plants increased 16% between the years 1980 and 1995 **(Figure 10)**. The Tennessee Valley Authority's (TVA) Paradise power plant in Muhlenberg County is one of the nation's largest power plant emitters of NO_x. According to EPA officials, the lack of NO_x reductions may be attributed to the delay in issuing final federal regulations governing NO_x emissions, the absence of an allowance market for NO_x reductions, and the hesitancy of industry to invest in controls until regulatory uncertainties are resolved.[8]

Figure 10 Nitrogen Oxide Emissions from Power Plants in KY

County	Facility	1980 tons	1990 tons	1995 tons	1980-95 % change
McCracken	TVA-Shawnee**	32,065	25,349	36,367	+13%
Muhlenberg	KY Utilities-Green	2,873	4,162	4,008	+39%
Muhlenberg	TVA-Paradise	127,451	97,787	105,119	-17%
Ohio	Big Rivers-Wilson**	N/A	6,355	7,832	+23%*
Daviess	OMU**	14,855	10,871	11,056	-25%
Hancock	Big Rivers-Coleman**	23,790	14,696	9,631	-59%
Henderson	Henderson Mun. Power	292	160	241	-17%
Webster	Big Rivers-Reid**	10,736	9,839	8,382	-22%
Webster	Big Rivers-Green**	5,940	8,292	6,708	+13%
Boone	Cincinnati Gas**	N/A	11,442	7,369	-35%*
Carroll	KY Utilities-Ghent**	20,226	22,980	25,895	+28%
Bell	KY Utilities-Pineville	216	204	489	+126%
Clark	E. KY Rural Elec-Dale	1,692	2,481	4,243	+151%
Fayette	KY Utilities-Haefling	28	26	1	-96%
Mercer	KY Utilities-Brown**	12,046	11,319	5,310	-56%
Woodford	KY Utilities-Tyrone	449	518	678	+51%
Lawrence	Am. Elec. Power-Big Sandy	N/A	25,249	24,000***	-5%*
Mason	E. KY Power-Spurlock**	N/A	12,090	16,237	+16%
Pulaski	E. KY Power-Cooper**	3,177	6,594	7,507	+136%
Jefferson	LG&E-Mill Creek**	16,391	19,475	22,899	+39%
Jefferson	LG&E-Cane Run**	14,333	8,674	8,911	-38%
Trimble	LG&E-Trimble**	N/A	2,166	11,450	+428%*
Total	**22**	**286,560**	**300,729**	**324,333**	**+16%**

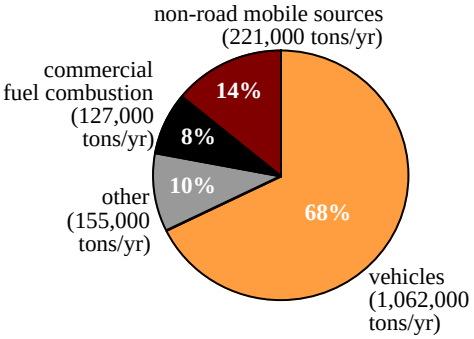
*1995 data preliminary. *1985-95 comparison. **Low NO_x burners used. TVA Shawnee installed fluidized bed combustion on 1 unit which also reduces NO_x emissions. ***Data revised by Am. Elec. Power. Source: Div. Air Quality, Jeff. Co. Air Poll. Control Dist., Utility Information Exchange*

In Kentucky, nitrogen oxide emissions from power plants increased 16% between the years 1980 and 1995. According to U.S. EPA officials, the lack of NO_x reductions may be attributed to the delay in issuing final federal regulations governing NO_x emissions.

Carbon Monoxide Air Levels Decline Significantly

Carbon monoxide (CO) is formed when the carbon in fuels is not burned completely. In the bloodstream it reduces oxygen delivered to tissues and organs producing visual impairment, dizziness, headaches, and impaired coordination. Vehicle exhaust contributed 68% of the carbon monoxide emissions in Kentucky during 1994. Other sources include industrial processes and fuel combustion in boilers and incinerators. In 1994, these sources emitted

CO Emissions in KY[9]

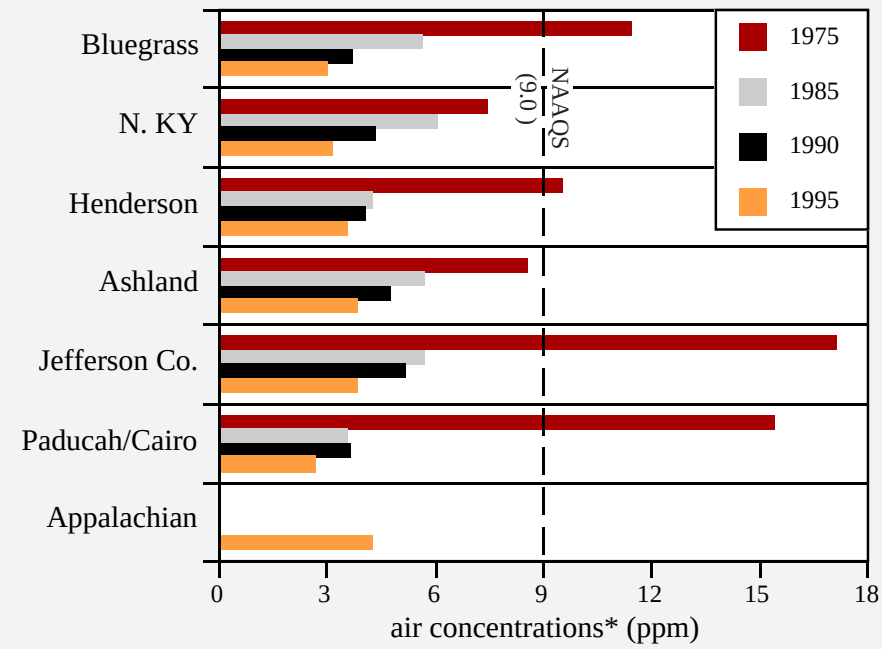


1.56 million tons of CO, ranking Kentucky 26th in the nation for CO emissions.

Statewide and regional carbon monoxide levels in the air show declining trends, primarily due to pollution controls on automobiles **(Figure 3 & 11)**. Despite an overall downward trend in national and statewide carbon monoxide air concentrations and emissions, metropolitan areas still, on occasion, have high episodes of CO. In Kentucky, Louisville experienced a few exceedances of the carbon monoxide standard in 1990 and again in 1993.

Statewide and regional carbon monoxide levels in the air show declining trends, primarily due to pollution controls on automobiles.

Figure 11 Regional Air Concentrations of Carbon Monoxide



*Note: Selected years. *Yearly concentrations based on second maximum eight-hour averages of CO at state monitored sites. Concentrations compared to the National Ambient Air Quality Standard (NAAQS). ppm-parts per million Source: KY Division for Air Quality*

Percent Change in Carbon Monoxide Air Concentrations

Bluegrass	-40%
N. KY	-33%
Henderson	-26%
Ashland	-42%
Jefferson	-56%
Paducah	-54%

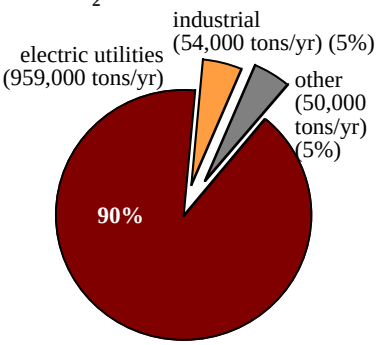
Based on 10-year average air concentrations comparing 1976-85 and 1986-95.

Sulfur Dioxide Air Concentrations Decline 29% During Past 20 Years

Sulfur dioxide (SO_2) is formed when fuel containing sulfur is burned. In 1994, Kentucky ranked among states as the seventh-largest generator of SO_2 emissions.[10] Coal-fired power plants produced 90% of the sulfur dioxide emissions during 1994.

Health concerns related to SO_2 include respiratory illness and aggravation of existing cardiovascular disease. Certain populations are particularly sensitive to SO_2 including children, the elderly, asthmatics, and individuals with chronic lung disease. SO_2 can also damage the foliage of trees and agricultural crops and is a major precursor to acid rain.

SO_2 Emissions in KY[11]

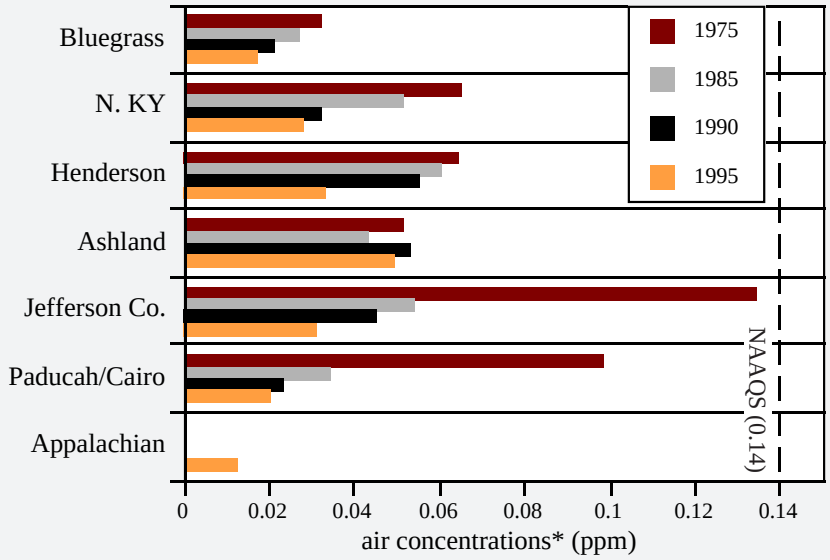


Kentucky ranked among states as the seventh-largest generator of SO_2 emissions.[10] Coal-fired power plants produced 90% of the sulfur dioxide emissions during 1994.

Statewide air concentrations of sulfur dioxide have declined 29% during the past two decades **(Figure 3)**. Regional air concentrations vary, with the Ashland region having the highest levels in 1995 **(Figure 12)**. Sulfur dioxide emissions in the Ashland region increased 10%, from 104,128 tons in 1985 to 115,075 tons in 1995, possibly contributing to the higher air levels. This region has several large sources of SO_2 including Ashland Oil, AK Steel, E.I. DuPont, American Electric Power, and East Kentucky Power. But air concentrations in the Ashland region and other regions of the state continue to remain below the national SO_2 standard.

Ongoing efforts by power plants to curb SO_2 emissions have likely contributed

Figure 12 Regional Air Concentrations of Sulfur Dioxide



*Note: Selected years. *Yearly concentrations based on second maximum 24-hour averages of SO_2 at state monitored sites. Concentrations compared to the National Ambient Air Quality Standard (NAAQS). ppm-parts per million. Source: KY Division for Air Quality*

Ongoing efforts by power plants to curb sulfur dioxide emissions have likely contributed to declining SO_2 air concentrations in most regions of the state.

Percent Change in Sulfur Dioxide Air Concentrations

Bluegrass	-6%
N. KY	-39%
Henderson	-24%
Ashland	+12%
Jefferson	-50%
Paducah	-38%

Based on 10-year average air concentrations comparing 1976-85 and 1986-95.

to declining air concentrations in most regions **(Figure 13)**. Total SO_2 emissions from power plants in Kentucky fell 41% between 1980 and 1995 while the amount of coal burned at these plants increased 11%, from 32.2 million tons in 1980 to 35.7 million tons in 1995. Nationwide, SO_2 emissions from power plants declined from 25.9 million tons in 1980 to 18 million tons in 1995, according to the U.S. EPA.

Figure 13 Sulfur Dioxide Emissions from Power Plants in KY

County	Facility	1976 tons	1980 tons	1995 tons	1980-95 % change
McCracken	TVA-Shawnee*	288,000	86,961	57,189	-34%
Muhlenberg	KY Utilities-Green River*	27,000	13,529	18,039	+33%
Muhlenberg	TVA-Paradise*	456,000	372,654	172,109	-54%
Ohio	Big Rivers-Wilson	NA	NA	8,131	-
Daviess	OMU*	74,000	45,159	2,390	-94%
Hancock	Big Rivers-Coleman*	100,000	78,650	51,302	-35%
Henderson	Henderson Mun. Power*	9,000	1,526	1,802	+18%
Webster	Big Rivers-Reid	81,000	53,443	16,240	-70%
Webster	Big Rivers-Green	NA	7,618	3,231	-58%
Boone	Cincinnati Gas	NA	NA	10,969	-
Carroll	KY Utilities-Ghent*	76,000	84,553	53,637	-36%
Bell	KY Utilities-Pineville	1,000	467	882	+88%
Clark	E. KY Rural Elec-Dale	8,000	3,929	6,702	+70%
Fayette	KY Utilities-Haefling	5	5	1	-80%
Mercer	KY Utilities-Brown*	57,000	53,153	26,336	-50%
Woodford	KY Utilities-Tyrone	2,000	1,081	1,184	+9%
Lawrence	Am. Elec. Power Big Sandy	60,000	61,617	70,251	+14%
Mason	E. KY Power-Spurlock*	NA	19,322	32,256	+67%
Pulaski	E. KY Power-Cooper*	35,000	12,743	18,125	+42%
Jefferson	LG&E-Mill Creek	112,039	107,491	36,889	-66%
Jefferson	LG&E-Cane Run	109,578	32,904	6,996	-79%
Trimble	LG&E-Trimble	NA	NA	13,489	-
Total	**22**	**1,495,622**	**1,036,805**	**608,150**	**-41%**

*1995 data preliminary. *Utilities affected under Phase I of the National Acid Rain Reduction Program. NA-not operating. Source: KY Division for Air Quality, Jefferson County Air Pollution Control District, U.S. EPA, LG&E*

Total sulfur dioxide emissions from power plants in Kentucky fell 41% between 1980 and 1995 while the amount of coal burned at these plants increased 11%, from 32.2 million tons in 1980 to 35.7 million tons in 1995. Nationwide, SO_2 emissions from power plants declined from 25.9 million tons in 1980 to 18 million tons in 1995, according to the U.S. EPA.

Seventeen units at 10 power plants in Kentucky are affected by the first phase of sulfur dioxide reductions required under the Clean Air Act Amendments of 1990. One power plant, Owensboro Municipal Utilities, recently installed scrubbers reducing SO_2 emissions 94% below 1980 levels.

Measures to reduce sulfur dioxide emissions have likely led to improvements in the pH of Kentucky's rainfall. Figure 14 shows that since 1985, rainfall has become generally less acidic.

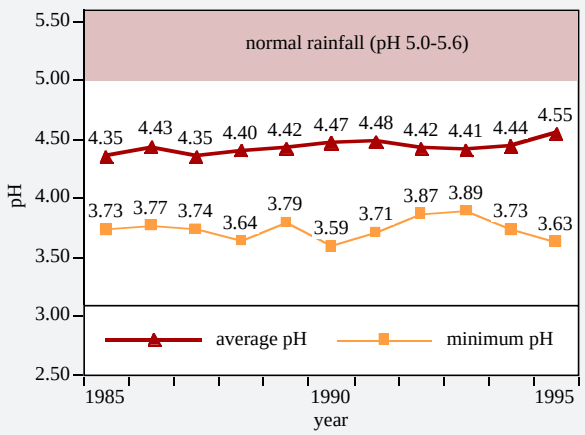
Despite the costs of bringing power plants into compliance with environmental requirements, utility rates in Kentucky have remained below the national average. A state law passed in 1992 now allows utilities to assess an environmental surcharge to recover costs of compliance with the Clean Air Act Amendments of 1990. Three companies in Kentucky currently impose surcharges as part of the utility bill.

Clean Air Act Calls for Additional SO_2 Emission Reductions

The Clean Air Act Amendments of 1990 focused additional attention on reducing the threat of acid rain. Sulfur dioxide and nitrogen oxides are the two primary pollutants linked to the formation of acid rain. Acid rain has caused acidification of waterways and can impact trees, crops, and buildings. The Clean Air Act Amendments of 1990 set a cap on SO_2 emissions that can be emitted by large sources such as power plants — about 40% of the amount released in 1980. Power plants have options for reducing emissions by burning cleaner low-sulfur fuel, installing pollution control equipment, or buying unursed SO_2 allowances from other facilities. The first phase of reductions was required by 1995, with a second round in 2000.

Seventeen units at 10 power plants in Kentucky were affected by the first phase of SO_2 reductions **(Figure 13)**. These utilities are using various methods to achieve compliance with the act. Six plants have reduced emissions through technological controls such as scrubbers or clean coal technology with the remainder switching to lower sulfur coal and obtaining additional SO_2 allowances.[12] One power plant, Owensboro Municipal Utilities, recently installed scrubbers, reducing SO_2 emissions 94% below 1980 levels. About 47% of the 35.7 million tons of coal burned by power plants in the state during 1995 was scrubbed to remove SO_2. Measures to reduce SO_2 emissions have likely led to improvements in the pH of Kentucky's rainfall. **Figure 14** shows that since 1985, rainfall has become generally less acidic.

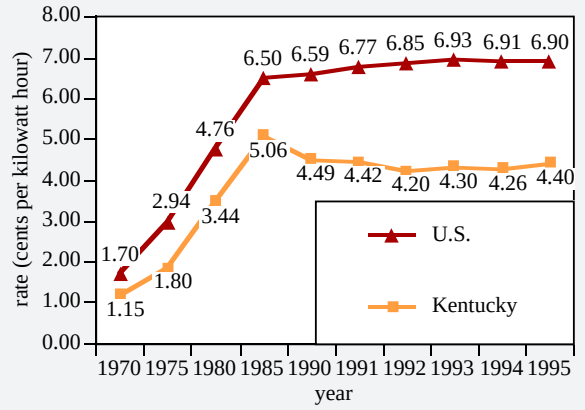
Figure 14 Average pH of Rainfall at Monitored Sites in KY



Note: Volume-weighted averages from monitored sites in Washington, Letcher, Rowan, and Trigg counties. pH is a measure of acidity or alkalinity of a solution. Source: National Precipitation Program, Illinois Water Survey

Despite the costs of complying with environmental rules, utility rates in Kentucky have remained below the national average **(Figure 15)**. A state law passed in 1992 now allows utilities to assess an environmental surcharge to recover costs of compliance with the Clean Air Act Amendments of 1990. Three companies in Kentucky currently impose surcharges as part of the utility bill. Kentucky Utilities collected $17.9 million in surcharges during 1995 to cover costs of 15 projects. Louisville Gas and Electric collected $2.7 million in 1995 from its environmental surcharges to fund five

Figure 15 Average Electric Rates in KY and United States



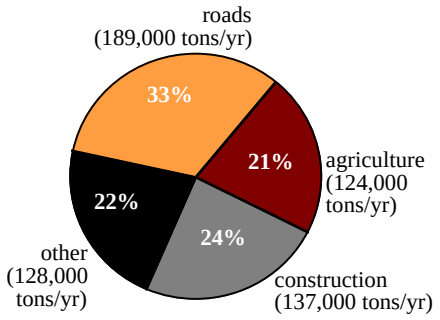
Note: Rates estimated based on monthly data. Data not adjusted for inflation. Source: U.S. DOE, State Energy Price and Expenditure Reports, 1970-95

projects. Big Rivers Electric Corp. collected $1.6 million in surcharges during 1995 to recover environmental compliance investments.[13] The surcharges were challenged by the KY Attorney General and others in January 1994 based on constitutional issues and how compliance costs were determined. The Franklin Circuit Court ruled in July 1995 that the surcharges are legal. The state is appealing the decision.

Levels of Airborne Particulates Decline 18% During Past Eight Years

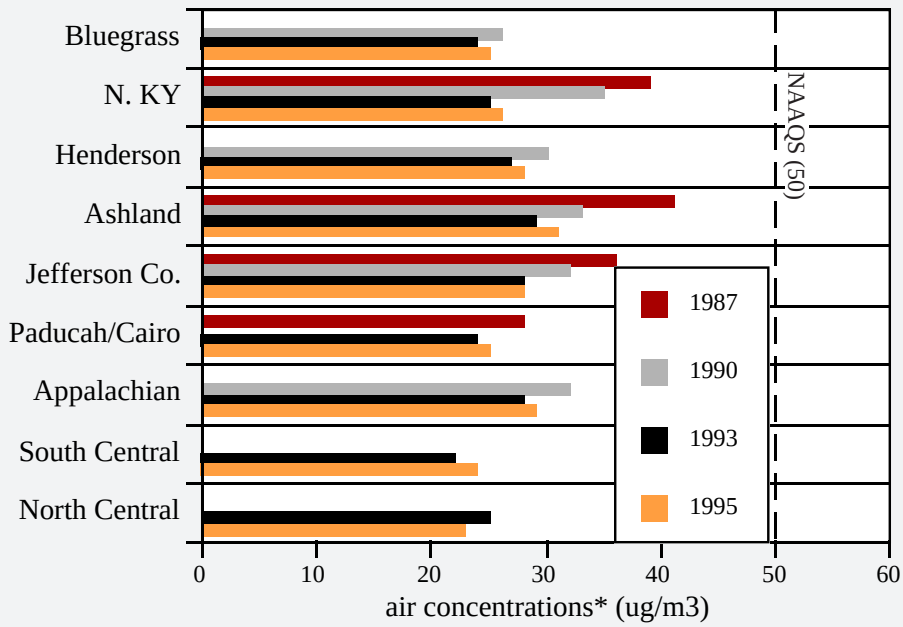
Particulates are small particles of dust, dirt, and soot emitted by sources such as cars, construction projects, agricultural operations, and roads. In 1994, 579,000 tons of particulate emissions were released from these and other sources. Kentucky ranks 33rd in the nation in particulate emissions. Health concerns from exposure to particles in the air (those 10 micrometers or less, known as PM-10) include effects on breathing and respiratory systems, cancer, and premature death. The elderly, children, and people with chronic lung disease are especially sensitive to particulate matter.

Particulate (PM-10) Sources in KY[14]



Air monitors began measuring particulates based on the PM-10 standard in 1987. Between 1987 and 1995, the average statewide PM-10 air concentrations declined 18%, as seen in **Figure 3**. All regions of the state remain well below the national PM-10 standard **(Figure 16)**.

Figure 16 Regional Air Concentrations of Particulates (PM-10)



*Note: Selected years. *Yearly concentrations based on PM-10 averages at state monitored sites. Concentrations are compared to the National Ambient Air Quality Standard (NAAQS). *ug/m3-micrograms per cubic meter. Source: KY Division for Air Quality*

Particulates are small particles of dust, dirt, and soot emitted by sources such as cars, construction projects, agricultural operations, and roads. All regions of the state currently meet the national PM-10 standard.

Percent Change in Particulate Air Concentrations

Bluegrass	-7%
N. KY	-30%
Henderson	-10%
Ashland	-12%
Jefferson	-15%
Paducah	-14%
Appalachian	-17%

Based on four-year average air concentrations comparing 1988-91 and 1992-95.

Health Concerns May Lead to More Stringent Particulate Standard

Recent studies indicate that small particles in the air may pose a more serious threat to health at levels well below the current PM-10 standard. A 1996 study by the Natural Resources Defense Council (NRDC) estimates 64,000 people die prematurely in the U.S. from cardiopulmonary causes linked to particulate air pollution.[15] However, the National Mining Association and others have questioned the findings of the NRDC report citing they were based on poor science.[16] The U.S.

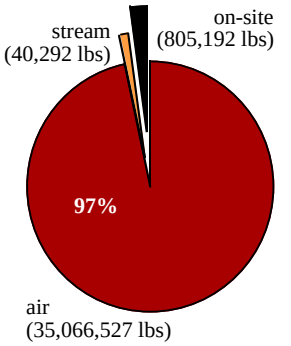
EPA is evaluating health studies to determine the need for a more stringent particulate standard. The new standard under consideration would limit emissions of fine particles of 2.5 micrometers or less and be more protective of public health.[17]

Reported Air Releases of Toxic Chemicals Decline 25% in Five Years

Toxic air pollutants are those chemicals known to cause or suspected of causing cancer or other health effects such as birth defects or reproductive problems.

The major source of data on toxic emissions is the Toxic Chemical Release Inventory (TRI). TRI is a mechanism created under federal law that requires certain manufacturing plants to report releases and transfers of toxic chemicals. Although the TRI presents the best available data on the generation of toxic chemicals, it has its limitations. TRI does not include small industrial and nonindustrial sources of toxic emissions. The TRI data is also based on calculated estimates, is not independently verifiable, and many toxic chemicals are not included in the TRI inventory. TRI reduction trends are also difficult to measure due to the addition of new reportable chemicals each year. For example, in 1995, TRI will have an additional 241 chemicals added to the list of reportable chemicals.

Toxic Releases in KY[18]



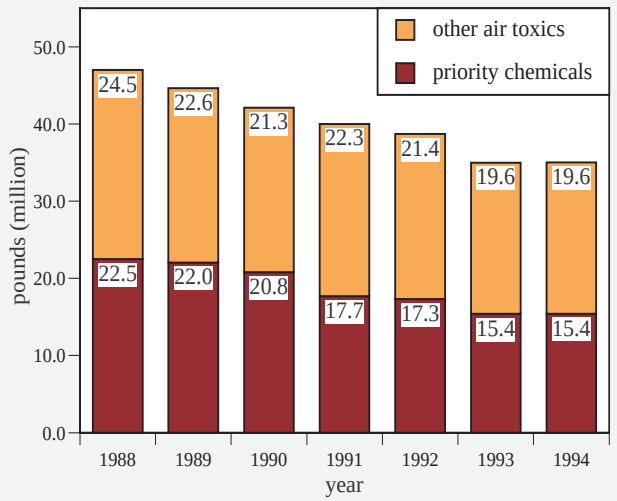
During 1994, the most recent year for which data is available, 424 industries reported releasing 36.2 million pounds of toxic chemicals to the environment, 97% of which was to the air.

During 1994, the most recent year for which TRI data is available, 424 industries in Kentucky reported releasing 36.2 million pounds of toxic chemicals to the environment, 97% of which was to the air. But data also reveal that statewide releases of air toxics have declined 25% between 1988 and 1994 **(Figure 17)**. Air releases of 17 toxic chemicals in Kentucky prioritized by the U.S. EPA for reduction because they are considered highly toxic, carcinogenic, or released in large volumes have declined 31% since 1988. A majority of the toxic air emissions occur in ten counties. These counties accounted for 75% of the toxic air emissions reported released to the air in 1994 **(Figure 18)**.

The top ten industries releasing toxic air emissions in 1994 emitted 18.9 million pounds, 54% of the state release total **(Figure 19)**. DuPont, the top emitter, reported that toxic air releases tripled between 1993 and 1994 due to the reporting of Freon 22, a new chemical added to the TRI list in 1994. This was also the case for the increase at Elf Atochem with the reporting of two new ozone-depleting chemicals added to the TRI list in 1994. A number of companies have made progress in voluntarily reducing toxic emissions. The Clean Air Act Amendments of 1990 focus additional attention on reducing toxic air

Air releases of 17 toxic chemicals in Kentucky prioritized by the U.S. EPA for reduction because they are considered highly toxic, carcinogenic, or released in large volumes have declined 31% since 1988.

Figure 17 Toxic Air Releases From Manufacturing Plants in KY



Note: Includes new chemicals added to the reportable list in recent years. Priority chemicals are 17 toxic chemicals prioritized for reduction by the U.S. EPA.
Source: Toxic Release Inventory Reports, 1988-94

emissions and will require technology-based standards on major emitters of 189 hazardous air pollutants by the year 2000.

Kentucky promulgated its own air toxic regulations in 1986. The effectiveness as well as the efficiency of the state air toxics regulations, however, have been questioned by both the environmental and regulated community. The Division for Air Quality is currently reviewing options to improve the air toxics regulations and will develop a proposal in the next several months, according to agency officials.

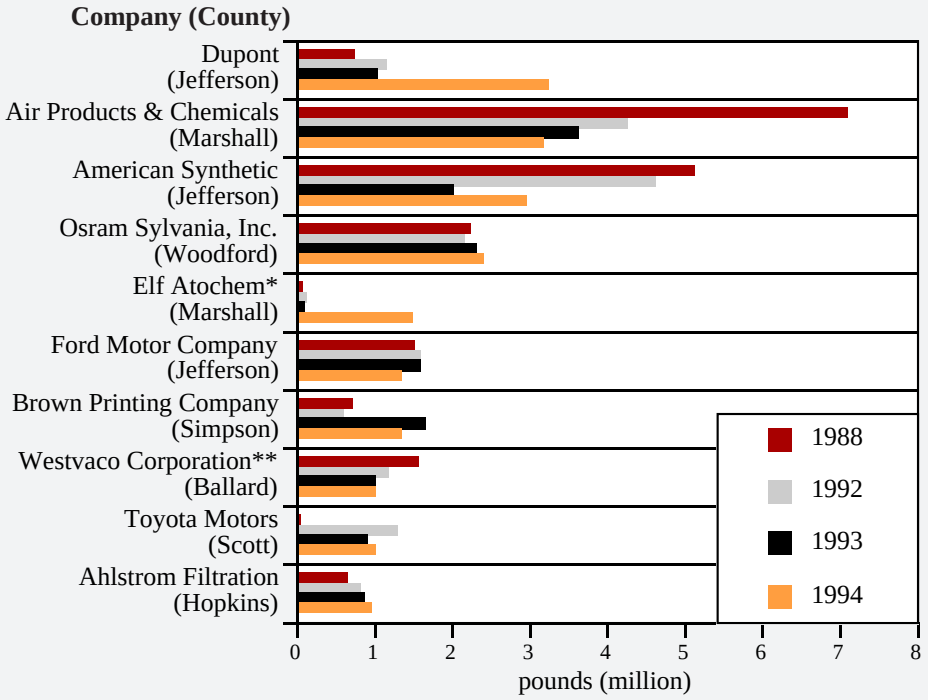
Figure 18 Top Ten Counties with Toxic Air Releases (1994)

County	1988 pounds	1993 pounds	1994 pounds	1988-94 % change	1993-94 % change
Jefferson	11,924,548	8,684,842	10,446,219	-12%	+20%
Marshall	9,921,245	4,125,941	5,099,701	-49%	+23%
Woodford	2,350,511	2,336,791	2,426,768	+3%	+4%
Hancock	3,750,587	2,075,836	1,535,112	-59%	-26%
Simpson	904,170	1,809,724	1,531,000	+69%	-15%
Logan	1,829,826	1,343,909	1,346,436	-26%	+<1%
Ballard	806,350	1,039,980	1,062,155	+32%	+2%
Scott	37,016	1,065,822	1,042,713	+2716%*	-2%
Hopkins	1,029,069	903,525	985,242	-4%	+9%
Madison	821,367	1,178,185	975,244	+19%	-17%
Total	**33,374,689**	**24,564,555**	**26,450,590**	**-21%**	**+8%**
State Total	47,023,709	35,016,322	35,066,527	-25%	+.14%

*Note: Includes new chemicals added to the reportable list in recent years. *Attributed to the location of Toyota Motor Manufacturing U.S.A. in Scott County.*
Source: Toxic Release Inventory Reports, 1988-94.

A majority of the toxic air emissions occur in ten counties. These counties accounted for 75% of the toxic air emissions reported released to the air in 1994.

Figure 19 Top 10 Facilities with Toxic Air Releases in KY (1994)



*Note: Includes new chemicals added to the reportable list in recent years. *Company name in 1988 was Pennwalt. **Data includes revisions to TRI data.*
Source: Toxic Release Inventory Reports, 1988-94.

The top ten industries releasing toxic air emissions in 1994 emitted 18.9 million pounds, 54% of the statewide release total. The Clean Air Act Amendments of 1990 focus additional attention on reducing toxic air emissions and will require technology-based standards on major emitters of 189 hazardous air pollutants by the year 2000.

Although scientific uncertainties remain concerning the potential effects of greenhouse gases on global climates, policy makers at the international level agreed to control these gases and enacted a global climate treaty to stabilize greenhouse gas emissions at 1990 levels by the year 2000.

A 1996 study, conducted by the University of Louisville Institute for the Environment and Sustainable Development, found that power plants and the production and use of refrigerants are the greatest sources of greenhouse gases in Kentucky. It was estimated that in 1990, 205 million tons of greenhouse gas emissions were released to the atmosphere from Kentucky sources.

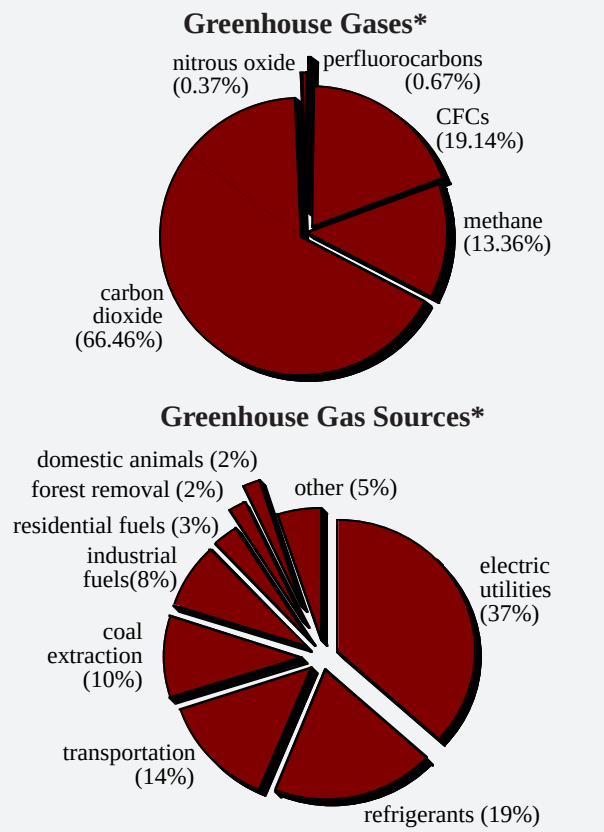
Twenty-six companies in the state reported releasing 5.6 million pounds of CFCs to the air in 1994, ranking Kentucky second in the nation in emissions of ozone-depleting chemicals.

Greenhouse Gases Inventoried in Kentucky

Many scientists believe that global temperatures are rising due to increased amounts of greenhouse gases in the atmosphere. However, others believe that it is impossible to distinguish any global temperature changes because of short-term variations in temperature and long-term weather patterns.

The primary greenhouse gases linked to global warming are carbon dioxide, chlorofluorocarbons (CFCs that include Freon and related compounds used as refrigerants), methane, perfluorocarbons, and nitrous oxides. These gases warm the Earth by trapping the sun's heat in the lower atmosphere. All of these gases are naturally occurring, except for CFCs. However, since the industrial revolution, human activities have increased atmospheric concentrations of nitrous oxides by 13%, carbon dioxide by 29%, methane by 300%, CFC-11 by 268%, and CFC-12 by 503%.[19]

Figure 20 Greenhouse Gases in KY



*Note: Based on 205 million tons of greenhouse gas emissions calculated released in 1990. *Based on carbon dioxide equivalent tons. Source: KY Greenhouse Gas Inventory, 1996*

Although scientific uncertainties remain concerning the potential effects of greenhouse gases on global climates, policy makers at the international level agreed to control these gases and enacted a global climate treaty to stabilize greenhouse gas emissions at 1990 levels by the year 2000. To help formulate a plan to meet this goal, the EPA commissioned studies to inventory greenhouse gases in the U.S.

A 1996 study, conducted by the University of Louisville Institute for the Environment and Sustainable Development, found that power plants and the production and use of refrigerants are the greatest sources of greenhouse gases in Kentucky. It was estimated that in 1990, 205 million tons of greenhouse gas emissions were released to the atmosphere from Kentucky sources **(Figure 20)**.

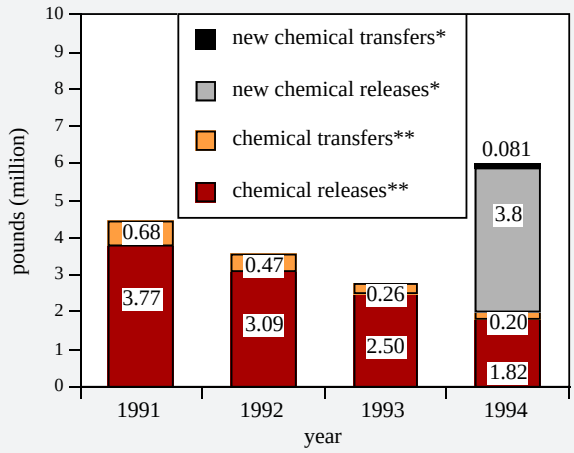
State Ranked Second in Emissions of Ozone Depleting Chemicals

The loss of the protective ozone layer is also believed to be contributing to global warming by allowing more of the sun's rays to pass through the Earth's atmosphere and warm the planet. The ozone layer surrounds the Earth and shields out ultraviolet radiation. Depletion of the stratospheric ozone has been linked to increased levels of ultraviolet-B radiation (UV-B). Excessive exposure to UV-B can lead to a greater incidence of sunburn and skin cancer and may also reduce crop yields and disrupt natural food chains.

The thinning of the ozone layer is related to both natural and human factors. The manufacture and release of ozone-depleting chemicals, namely chlorofluorocarbons, hydrochlorofluorocarbons, carbon tetrachloride, methyl bromide, methyl chloroform, and halons, have been linked to the thinning of the ozone layer. In 1988, 140 countries created a treaty, known as the Montreal Protocol. The treaty, which was amended in 1990 and 1992, stipulates sharp reductions in ozone-depleting chemicals by 1996. The U.S. EPA, under the authority of the Clean Air Act Amendments of 1990, issued regulations to phase out the production and importation of ozone-depleting chemicals controlled under the Protocol.

Data from TRI reports reveal that 26 companies in the state reported releasing 5.6 million pounds of CFCs to the air in 1994, ranking Kentucky second in the nation in emissions of ozone-depleting chemicals. Ten of these companies accounted for 93% of the total releases. Trends reveal, however, that releases of some CFC chemicals have declined. For example, emissions of Freon 113 declined 98% in the state from 2.6 million pounds in 1988 to 38,668 pounds in 1994. Releases of 11 ozone-depleting chemicals fell 52% between 1991 and 1994 in Kentucky **(Figure 21)**.

Figure 21 Generation of Ozone-Depleting Chemicals from Industries in KY



*Note: Chemical transfers are those chemicals transferred for treatment or recycling. *Chemical releases and transfers of four new chemicals required to be reported in 1994. **Based on 11 ozone-depleting chemicals reported generated in KY. Source: Toxic Release Inventory Reports, 1988-94*

Top 10 Companies Releasing Ozone-Depleting Chemicals to the Air in Kentucky (1994)

Company (County)	Pounds
DuPont (Jefferson)	2,298,386
Elf Atochem (Marshall)	1,440,945
GE Appliances (Jefferson)	533,812
U.S. Enrichment (McCracken)	361,000
Olin Corp. (Meade)	204,130
Okonite Co. (Madison)	135,700
Carpenter Co. (Logan)	84,977
Firestone Bldg (Kenton)	82,320
Prem. All. Tool (Daviess)	72,187
Topy Corp. (Franklin)	55,000
Total Top 10	**5,268,457**
Total State	**5,661,749**

Includes four new chemicals reported in 1994. Source: Toxic Release Inventory Report, 1994

Improvements in Air Quality Due to Programs to Control Pollutants

The improvement in air quality is due to various federal, state, and local regulatory measures as well as investments by both large and small sources to control air pollution. The KY Division for Air Quality is the principal agency responsible for monitoring and implementing clean air regulations in Kentucky. In addition, Jefferson County created its own Air Pollution Control District in 1952 and was approved by the U.S. EPA in 1970 to implement the provisions of the Clean Air Act for the county and metropolitan Louisville.

A major tool to address air pollution from industrial sources are permits. The Division for Air Quality currently regulates 2,082 industrial and commercial sources of air pollution through permits. The Jefferson County Air Pollution Control District regulates 1,587 sources; about half, 776, are gas stations. Air quality permits specify construction and operating requirements and set limits on air pollutant emissions. During 1995, more than 5,000 inspections were conducted in Kentucky at permitted facilities to ensure compliance with air quality permits and regulations.

A major tool to address air pollution from industrial sources are permits. The Division for Air Quality currently regulates 2,082 industrial and commercial sources of air pollution through permits. The Jefferson County Air Pollution Control District regulates 1,587 sources.

In 1995, 918 violations of air quality rules were cited by the KY Division for Air Quality (297 at permitted facilities, 43 at area sources, 158 for asbestos violations, 368 for open burning, 43 for dust, 1 for odor, and 8 at tank sources.) Of the 2,082 permitted sources regulated by the Division for Air Quality, 10% (217) were in violation of air quality rules in 1995. The Jefferson County Air Pollution Control District issued 71 notice of violations in 1995 (32 at permitted facilities and 39 for

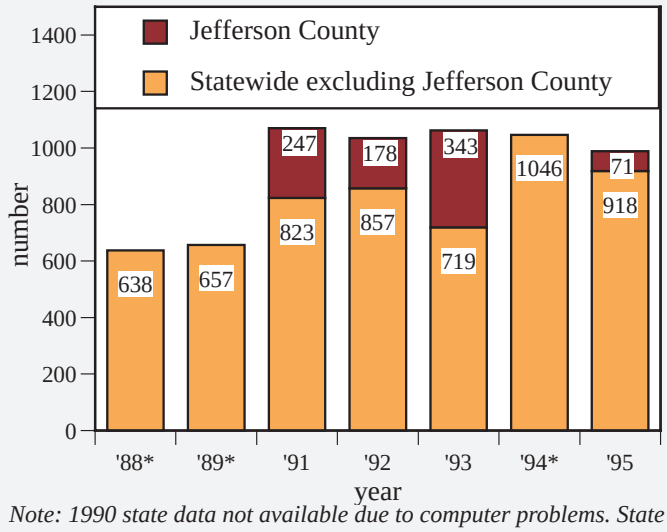
In 1995, 918 violations of air quality rules were cited by the KY Division for Air Quality, 40% of which were for open burning. The Jefferson County Air Pollution Control District issued 71 notice of violations in 1995. While most violations are resolved through demand letters or agreed orders, some result in penalties.

Air Quality Penalties

Year	$State	$Jeff. Co.*
1990	126,500	N/A
1991	1,698,375	N/A
1992	N/A	282,000
1993	847,425	377,000
1994	366,650	N/A
1995	876,450	80,000

*N/A-Data not available. *Federal fiscal year. Source: KY Division for Air Quality, KY Division of Administrative Hearings, Jefferson County Air Pollution Control District*

Figure 22 Air Quality Violations Cited in KY



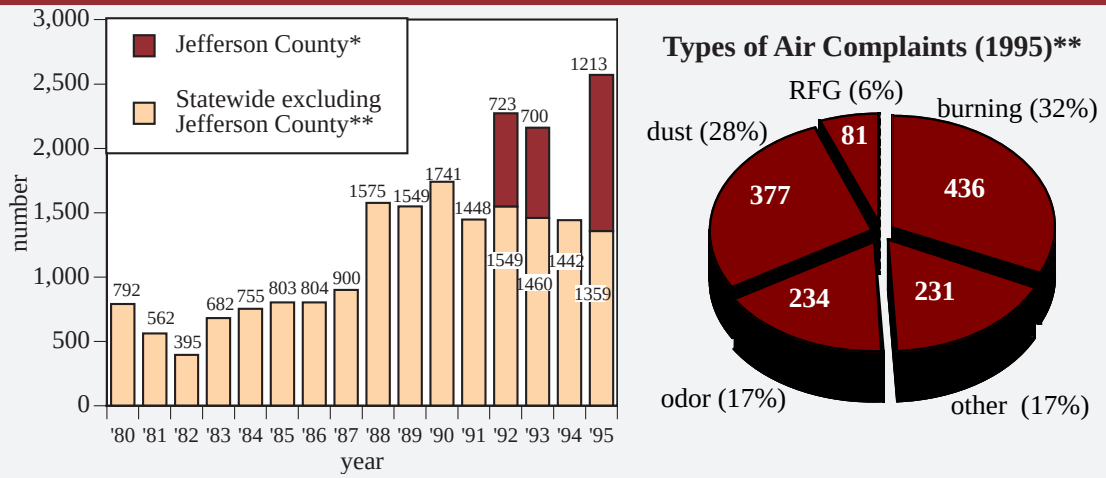
*Note: 1990 state data not available due to computer problems. State data refined from 1992 & 1994 State of Environment Reports. *Data not available for Jefferson County. Source: KY Division for Air Quality, Jefferson County Air Pollution Control District*

opening burning, asbestos, and other) **(Figure 22)**. While many violations are resolved through demand letters or agreed orders, some result in penalties. In 1995, $876,450 in penalties were assessed by the Division for Air Quality to 116 permitted facilities, 18 individuals, 8 public facilities, 2 federal facilities, and 1 state government agency. In Jefferson County, $80,000 in fines were assessed by the district against 217 parties in fiscal year 1995. The district reports that most penalties were small but a few were significant.

The Division for Air Quality has also worked to resolve violations through mechanisms known as supplemental enforcement projects (SEPs). During 1995, 10 SEPs were used to mitigate $885,000 in penalties. These projects ranged from television announcements to advise the public about open burning laws to an agreement by one company to study and potentially install a hydrogen fluoride mitigation system.

Many violations are the result of complaints received by regulatory agencies. In 1995, more than 2,500 complaints were received by air quality officials **(Figure 23)**. Many complaints concern open burning, dust, and odor. However, in 1995, state officials received 81 complaints regarding the use of RFG gasoline, which went on sale in 1995 in Jefferson County and Northern Kentucky to help control ozone pollution. The fuel has been criticized for poor vehicle performance and health concerns. While these problems are largely unsubstantiated, RFG does cost slightly more than conventional gasoline, which has also been among the complaints.

Figure 23 Air Quality Citizen Complaints in KY - Number and Type



*Jefferson County data not available for all years. **Complaints received by the KY Division for Air Quality. Source: KY Division for Air Quality, Jefferson County Air Pollution Control District*

Large Air Pollution Sources Must Apply for New Permits in 1996

The Clean Air Act Amendments of 1990 also created a new air quality permitting program. The requirements are mandated in Title V of the amendments. Approximately 955 sources in Kentucky will be affected by the Title V program.

All major air pollution sources are required to submit applications for new Title V permits by December 14, 1996. Approximately 955 sources in Kentucky will be affected by the Title V program.

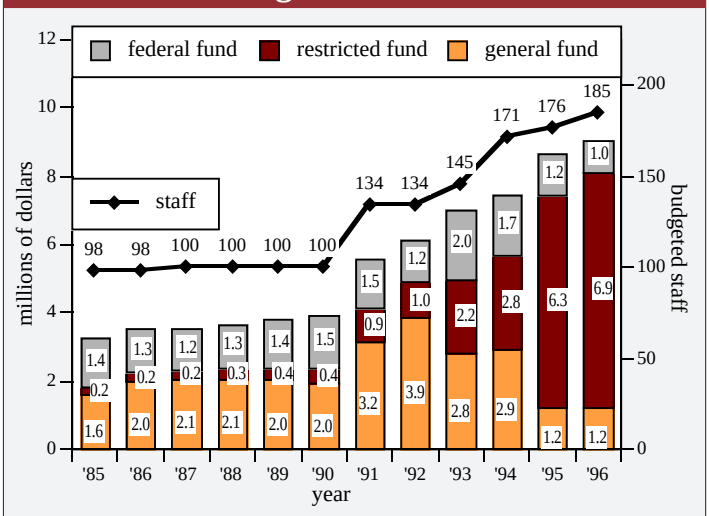
The Title V program is designed to improve the permitting process by providing national conformity in the permitting process, guaranteeing that permits address all applicable Clean Air Act requirements, and requiring sources to demonstrate how they will comply with those requirements. Title V provides additional opportunities for public review and comment on air quality permits as well.

The Division for Air Quality was granted interim approval by the U.S. EPA to implement the Title V program, effective December 14, 1995. All major air pollution sources are required to submit Title V permit applications by December 14, 1996. Major sources are defined as those that have the potential to emit 10 tons per year of a hazardous pollutant, 25 tons per year or more of a combination of hazardous pollutants, or 100 tons per year or more of any other regulated air pollutant. The Division is required to issue Title V permits to 60% of the major sources by December 14, 1998, with the remainder issued by the year 2000.

The Title V permit program will be funded by fees charged to air pollution sources based on actual air emissions. In fiscal year 1995, $5.5 million in emission fees were collected by the Division for Air Quality from 963 sources to fund the new Title V permit program. This amounted to an emission fee of $34.35 per ton. The fees, which were phased in beginning in 1992, will cover the costs of issuing the Title V permits. The fees accounted for 63% of the division's $8.7 million budget in 1995 **(Figure 24)**. Jefferson County collected $1.2 million in emission fees from 48 sources during 1995.

In fiscal year 1995, $5.5 million in emission fees were collected by the Division for Air Quality from 963 sources to fund the new Title V permit program. These fees accounted for 63% of the division's $8.7 million budget in 1995.

Figure 24 KY Division for Air Quality Budget and Staff Trends



Note: Based on fiscal year. Not adjusted for inflation. General funds are state appropriated money. Federal funds are federal program grants. Restricted funds are funds collected through permit fees and other sources. Source: Budget Office, KY Natural Resources and Environmental Protection Cabinet

Minor air pollution sources must also obtain Title V permits but the U.S. EPA has deferred this until the year 2000. In the meantime, Kentucky has established a program to assist small businesses comply with air quality rules. The KY Business Environmental Assistance Program (KBEAP) began operations in 1994. Its staff of three has provided assistance to 80 businesses to date. KBEAP, located at the University of KY, has an annual operating budget of $250,000, which is provided through emission fees collected by the state. KBEAP has also conducted 35 workshops on permitting and other topics. The KY Natural Resource and Environmental Protection Cabinet also created an Ombuds Office to assist small businesses comply with air quality rules and an Advisory Panel to help assess the small business assistance program. Jefferson County has also established similar small business programs.

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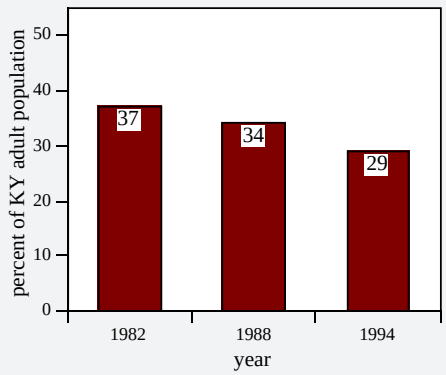
Indoor Air Pollution Ranked a High Health Risk in Kentucky

Many Americans spend up to 90 percent of their time indoors, often at home. Therefore, indoor air quality can have an important impact on health. A recent assessment by the U.S. EPA ranked indoor air pollution as a leading public health threat in the Southeastern U.S. Most homes have more than one source of indoor air pollution. For example, air pollutants can come from tobacco smoke, building materials, home furnishings, and activities such as cooking, heating, and cleaning.

Exposure to environmental tobacco smoke was ranked as a high health risk, according to a 1995 draft state environmental risk study.[20] National studies indicate that secondhand smoke causes lung cancer in adult nonsmokers and impairs the respiratory health of children.[21] While Kentucky ranks the highest among states for the percentage of adults that smoke, those levels are declining **(Figure 25)**.[22] The Cabinet for Health Services has targeted a reduction of smoking to a level of no more than 23% of the adult population by the year 2000.

In Kentucky, exposure to environmental tobacco smoke was ranked as a high health risk. While Kentucky ranks the highest among states for the percentage of adults that smoke, those levels are declining.[22]

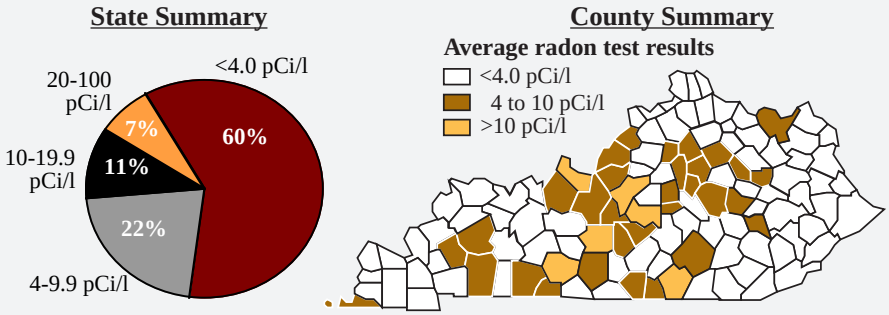
Figure 25 Percent of KY Adult Population Who Smoke Cigarettes



Source: KY Cabinet for Health Services

Another indoor air pollutant that was ranked a high risk in Kentucky is radon. Radon is a colorless, odorless gas that occurs naturally but can enter homes through cracks in foundations. It is estimated that 207 lung cancer cases occur annually in the state due to exposure to radon gas, according to the state risk study. Forty percent of the 24,547 homes tested in Kentucky for radon in the past 10 years by one company exceeded the U.S. EPA health advisory limit of 4.0 pico Curies per liter (pCi/l) **(Figure 26)**.[23] Recent studies have questioned the link between cancer and radon, however, the U.S. EPA has indicated that it does not plan to revise the radon limits at this time.

Figure 26 Indoor Air Radon Levels in Kentucky



Note: Based on 24,547 radon tests conducted from 1986-July 1996. Source: Air Chek Inc.

Forty percent of the 24,547 homes tested in Kentucky for radon in the past 10 years by one company exceeded the U.S. EPA health advisory limit of 4.0 pico Curies per liter (pCi/l).[23]

While sources of indoor air pollution are not regulated, homeowners can take steps to minimize threats. The U.S. EPA recommends limiting exposure, especially for young children, to secondhand tobacco smoke. The Cabinet for Health Services also recommends that homeowners test for radon. Most local health departments provide information about radon testing and steps to take to reduce exposure. Risks of carbon monoxide exposure can be reduced by keeping gas appliances adjusted, using exhaust fans, maintaining heating systems, and installing carbon monoxide detectors. Steps to reduce formaldehyde include increasing ventilation when bringing new sources of formaldehyde, such as drapes, textiles, and glues into the home.

State efforts to minimize public exposure to airborne asbestos fibers, which are known to cause cancer, have been ongoing since 1987. Since the program began, the Jefferson County Air Pollution Control District has issued 4,954 asbestos removal permits, and the Division for Air Quality has overseen 7,901 asbestos removal projects in commercial, institutional, and industrial buildings.

1995 Emissions From Permitted Sources by Air Quality Control Region (emissions reported in tons)

	County	SO_2	NO_x	CO	VOC	PM-10
Paducah-Cairo	Ballard	518	738	7,757	966	203
	Caldwell	8.9	54	15	57	48
	Calloway	4	26	20	194	73
	Carlisle	0	0	0	.3	13
	Christian	685	125	31	1,263	233
	Crittenden	11	1	4	17	16
	Fulton	5	8	1	65	117
	Graves	32	141	27	482	329
	Hickman	0	.4	.1	0	29
	Hopkins	77	54	23	413	492
	Livingston	.6	4	43	4	667
	Lyon	15	29	4	40	74
	McCracken	57,630	36,706	1,790	618	1,036
	Marshall	2,301	2,630	682	10,139	682
	Muhlenberg	190,219	109,169	1,830	278	703
	Todd	22	40	9	14	69
	Trigg	.01	2	.4	82	39
Henderson	Daviess	2,943	11,558	739	3,641	531
	Hancock	57,473	10,388	13,009	1,107	2,647
	Henderson	5,062	463	25,487	710	1,254
	McLean	.2	1	.5	.05	8
	Ohio	8,133	7,846	432	318	149
	Union	.1	10	1	263	246
	Webster	19,476	14,983	671	114	604
Northern KY	Boone	11,044	7,481	609	1,333	310
	Campbell	15	100	76	311	42
	Carroll	53,672	26,217	1,557	682	590
	Gallatin	8	28	17	3	21
	Grant	17	9	2	98	1
	Kenton	3.2	32	8	571	13
	Owen	0	.08	.01	31	.4
	Pendleton	195	1,260	617	36	230
Appalachian	Bell	9,008	504	34	52	223
	Breathitt	.2	12	8	31	125
	Clay	0	.8	.2	11	21
	Floyd	5	47	22	28	67
	Harlan	12	3	310	87	334
	Jackson	5	.5	3	7	7
	Johnson	8	9	5	37	70
	Knott	.06	66	66	99	208
	Knox	.7	6	20	62	66
	Laurel	16	18	121	4,895	155
	Lee	3	.2	.9	61	4
	Leslie	0	0	0	0	159
	Letcher	4	.5	1	20	208
	Magoffin	0	0	0	0	4
	Martin	531	485	28	155	308
	Owsley	0	0	0	0	.06
	Perry	14	23	21	54	282
	Pike	6	6	51	29	2,059
	Rockcastle	3	2	1	6	8
	Whitley	.08	12	9	13	38
	Wolfe	0	0	0	6	.3
Bluegrass	Anderson	71	78	31	1,986	121
	Bourbon	21	11	47	137	73
	Boyle	183	300	81	347	69
	Clark	6,710	4,282	152	100	217
	Estill	4	.3	1	49	163
	Fayette	104	774	170	721	155
	Franklin	152	82	33	15,522	105

	County	SO_2	NO_x	CO	VOC	PM-10
Bluegrass continued	Garrard	17	7	13	24	5
	Harrison	1	33	20	607	79
	Jessamine	.3	14	9	705	24
	Lincoln	.3	7	11	92	38
	Madison	102	301	88	624	211
	Mercer	26,357	5,336	330	150	226
	Nicholas	.03	5	1	.2	1
	Powell	3	17	7	1	1,066
	Scott	2	149	69	3,031	219
	Woodford	1,460	1,660	39	2,203	118
Ashland	Bath	0	0	0	0	0
	Boyd	10,483	6,343	6,144	3,834	2,469
	Bracken	0	0	0	0	12
	Carter	7	13	18	30	103
	Fleming	4	.3	1	22	4
	Elliott	0	0	0	0	0
	Greenup	1,936	65	13	140	23
	Lawrence	70,255	31,006	903	116	1,846
	Lewis	0	0	0	0	0
	Mason	32,338	17,595	1,748	118	598
	Menifee	.1	.7	8	.9	28
	Montgomery	.07	9	3	113	48
	Morgan	30	19	319	28	88
	Robertson	0	0	0	0	0
	Rowan	22	53	39	8	28
North Central	Breckinridge	9	458	91	18	39
	Bullitt	345	159	54	2,768	233
	Grayson	13	31	16	133	95
	Hardin	7	191	55	392	718
	Henry	10	9	40	104	30
	Larue	0	0	0	11	2
	Marion	37	250	71	301	258
	Meade	158	833	88	492	86
	Nelson	264	212	64	4,945	39
	Oldham	11	8	5	47	52
	Shelby	.4	57	21	465	88
	Spencer	.7	0	0	0	.06
	Trimble	13,493	11,463	427	67	217
	Washington	3	5	2	22	18
South Central	Adair	13	3	5	22	62
	Allen	.05	10	21	28	23
	Barren	81	141	150	330	272
	Butler	.2	26	5	1	18
	Casey	7	1,065	142	136	12
	Clinton	8	10	6	2	9
	Cumberland	0	0	0	0	4
	Edmonson	0	0	0	0	.02
	Green	14	25	27	58	25
	Hart	5	25	19	185	35
	Logan	54	243	55	212	149
	McCreary	2	1	6	.2	19
	Metcalfe	0	24	2	14	19
	Monroe	3	9	87	10	50
	Pulaski	18,170	7,628	314	1,791	750
	Russell	62	78	27	1	5
	Simpson	1	35	8	1015	92
	Taylor	100	128	195	234	30
	Warren	74	105	40	906	282
	Wayne	5	14	12	14	60
Jefferson County	Jefferson	56,353	36,223	2,700	13,616	4,150

Note: Based on 1995 preliminary data. Source: KY Division for Air Quality, Jefferson County Air Pollution Control District

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Acknowledgments

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1996 State of KY's Environment

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1996 State of Kentucky's Environment

Waste Management

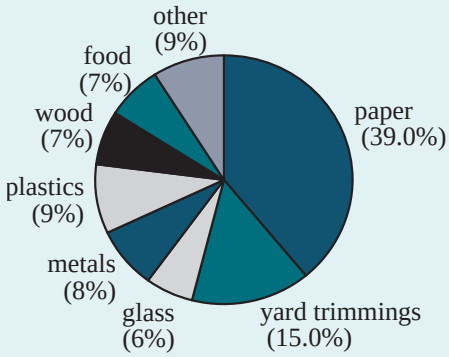
Managing Kentucky's waste has long been a challenge. But during the past decade, the state has met this challenge head on and passed numerous laws and regulations to further promote the proper disposal of waste. Today, Kentucky has 24 state-of-the-art municipal solid waste landfills. More Kentuckians are participating in garbage collection and recycling programs. The number of hazardous waste sites cleaned up now number more than 500. And renewed efforts to target illegal dumping attest to the state's continued commitment to tackling the tough waste issues confronting Kentucky.

Yet with all these efforts, improper disposal of solid and hazardous wastes still threatens our environment. This *State of Kentucky's Environment* trends report will measure the state's progress in properly managing its waste. Included in this indicator report is a review of solid waste generation, disposal, and recycling trends; hazardous waste generation and reduction activities; and the clean up of contaminated waste sites and leaking underground storage tanks.

Solid Waste

Kentuckians continue to produce more garbage than ever before. The average person now generates 4.4 pounds of garbage a day.[1] In Kentucky, this amounts to an estimated 17 million pounds of garbage daily. Most of the solid waste produced is paper, comprising 39% of the waste stream, followed by yard waste at 15% **(Figure 1)**. The typical person discards about 3.4 pounds of waste each day (after recycling and composting), according to the U.S. Environmental Protection Agency (U.S. EPA).[2]

Figure 1 Composition of the Municipal Solid Waste Stream



Note: By weight, 1994 nationwide average.
Source: U.S. EPA

Solid Waste Landfills in KY Decline 68% Since 1992, 24 State-of-the-Art Landfills Permitted

About 61% of the nation's solid waste is disposed of in landfills.[3] But now there are fewer, but larger landfills in which to dispose of waste with the closing of many due to stringent construction and operating standards which took effect in 1993, pursuant to Subtitle D of the federal Resource Conservation and Recovery Act. Nationwide, the number of solid waste landfills fell from 5,345 in 1992 to 3,581 in 1995.[4]

In Kentucky, solid waste laws and regulations passed in 1990 and 1991 resulted in the closure of more than half of the 75 municipal solid waste landfills by 1992 **(Figure 2)**. Since then, six more facilities have closed, leaving 24 state-of-the-art municipal solid waste (MSW) landfills **(Figure 3)**. These landfills must meet stringent standards including plastic and clay composite liners (20 landfills) or double composite liners (4 landfills), leachate recovery, and the use of comprehensive systems to monitor groundwater for up to 75 different parameters.

EQC

Environmental Quality Commission
Environmental Indicators Program
Reporting on Environmental Trends and Conditions in Kentucky.

1996 Trends Reports
- Safe Drinking Water
- Air Quality
- Waste Management
- Toxics
- Water Quality
- Natural Resources
- Resource Extraction

EQC is a seven member citizen commission created under state law with a mission to monitor environmental trends and conditions, promote partnerships to improve and protect the environment, provide a public forum for the discussion of environmental issues, and advise state officials on environmental matters.

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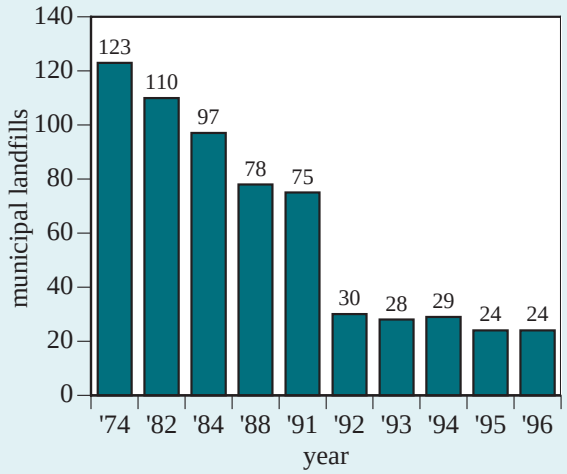
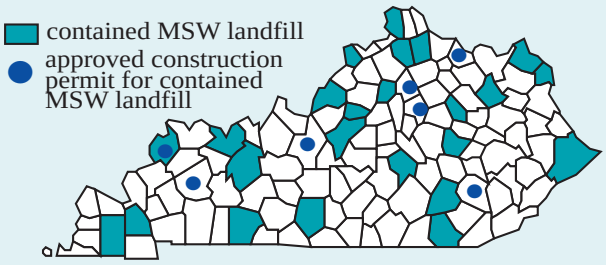
Figure 2 Number of Municipal Solid Waste Landfills in Kentucky



Note: Contained permitted MSW landfills.
Source: KY Division of Waste Management

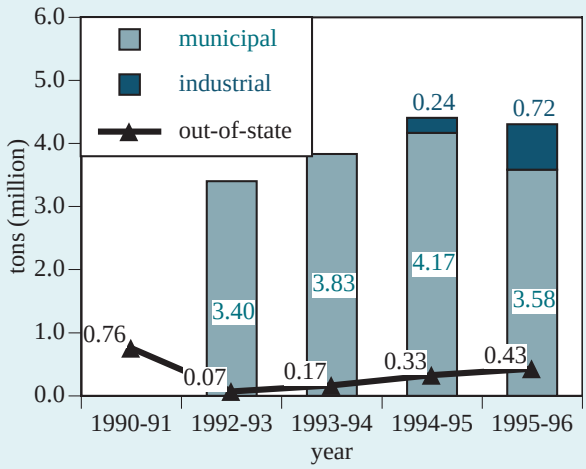
Figure 3 Location of Contained Municipal Solid Waste Landfills in KY



Note: Contained MSW landfills as of September 15, 1996.
Source: KY Division of Waste Management

Municipal solid waste disposed at landfills fell 14% during the past year, due likely to the diversion of waste to other facilities such as construction and demolition landfills and the recovery of materials for recycling. During fiscal year 1995-96, out-of-state garbage accounted for 10% of the total waste disposed at MSW landfills. About 97% of the out-of-state garbage came from neighboring states.

Figure 4 Disposal of Solid Waste at Municipal Solid Waste Landfills in KY



Note: Fiscal year (July-June). Totals rounded. 1990-91 data not available for total waste disposed.
Source: KY Division of Waste Management

4.3 Million Tons of Waste Disposed at Landfills in 1995-96

The amount of garbage disposed at MSW landfills has increased in the past few years as more Kentuckians participate in garbage collection programs **(Figure 4)**. However, Figure 4 also shows that waste disposed at the 24 contained MSW landfills fell 14% during the past year, due likely to the diversion of waste to other facilities such as construction/demolition landfills and the recovery of materials for recycling.

Out-of-state garbage disposed at MSW landfills has steadily increased from 2% of the total in 1992-93 (70,000 tons) to 10% of the total in 1995-96 (429,938 tons) **(Figure 4)**. About 97% of the out-of-state garbage came from neighboring states with the remainder shipped from NJ, NY, PA, SC, LA, MD, MI, MS, OK, AL, and AR in FY 95-96. Landfills in Kentucky accepting waste from noncontiguous states in FY 95-96 were Bavarian, Boone Co.; Waste Management, Jefferson Co.; LWD, Marshall Co.; and the Ohio Co. Balefill. Kentucky exported 228,968 tons of solid waste to other states for disposal in 1995, according to county solid waste reports.

The export of garbage to other states for disposal has led Congress to consider legislation to restrict garbage shipments. The proposed Interstate Waste Act would give local governments authority to control waste coming into their jurisdiction. The mea-

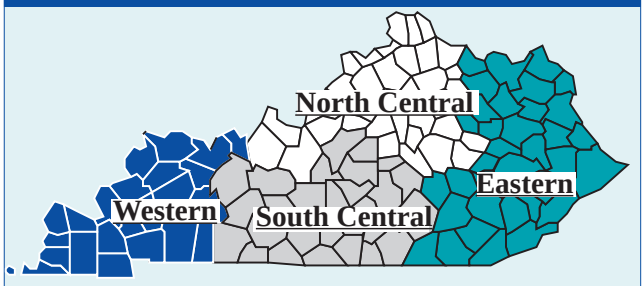
sure is currently being debated by Congress with heavy opposition from waste exporting states.

25.3 Years of Statewide Landfill Capacity Permitted

Kentucky has 25.3 years of statewide permitted landfill capacity, compared to less than five years of capacity just four years ago. State statutes, as revised by Senate Bill 2 in 1991, gave local governments the ability to determine whether they want to site a landfill and its ultimate size (capacity). As such, landfill capacity varies by region **(Figure 5)**. Construction permits have been approved for another 7 landfills in the state which will provide even additional capacity.

In Aug. 1994, Eastern KY Resources (EKR), a Florida-based partnership, challenged the constitutionality of Senate Bill 2. EKR had submitted an application to the state in Jan. 1991 to site a 10,000 ton-per-day landfill in Magoffin County. The application was not processed because of a lawsuit involving a contract between EKR and the Magoffin County Fiscal Court and a local decision not to host the landfill. EKR, in its case, claimed that the authority granted to counties to host a landfill interferes with the Interstate Commerce Clause of the U.S. Constitution. The U.S. District Court upheld the constitutionality of Senate Bill 2 in Sept. 1995. EKR has appealed this decision to the Sixth Court of Appeals. A ruling is anticipated in 1997.

Figure 5 Permitted Municipal Solid Waste Landfill Capacity By Region (1996)



County	Landfill	Remaining Capacity (cubic yards)
North Central		
Boone	Bavarian	2,883,935
Estill	Waste Management	7,154,242
Franklin	BFI	3,566,653
Grant	Epperson	11,193,697
Pendleton	Rumpke	4,633,365
Trimble	Laidlaw	7,292,015
Jefferson	Waste Management	28,450,000
Spencer	Williams Sanitation	2,055,031
Total remaining capacity		**67,228,938 or 14.6 years***
Eastern		
Montgomery	Rumpke	3,401,559
Laurel	Laurel Ridge	9,570,865
Whitley	Tri-County	3,175,287
Pike	Pike Co. Fiscal Court	612,287
Boyd	Cooksey Brothers	1,303,243
Greenup	Green Valley	2,655,630
Rowan	Local Sanitation	12,723,089
Total remaining capacity		**33,441,960 or 33.8 years***
Western		
Daviess	Daviess Co. Fiscal Ct.	5,348,653
Graves	Jones Sanitation	869,384
Marshall	LWD	2,630,000
Union	Dozit	6,272,775
Total remaining capacity		**15,120,812 or 23 years***
South Central		
Barren	City of Glasgow	664,995
Lincoln	Tri-K Landfill	6,653,459
Logan	Southern Sanitation	7,444,065
Nelson	Nelson County Landfill	2,474,561
Ohio	Ohio County Balefill	20,711,997
Total remaining capacity		**37,949,077 or 56.7 years***

*Note: As of 4/30/96. *Regional capacity needs based on waste reported disposed by county as reported in 1995 County Solid Waste reports. Source: KY Div. of Waste Management*

Kentucky has 25.3 years of permitted landfill capacity, compared to less than five years of capacity just four years ago. State statutes, as revised by Senate Bill 2 in 1991, gave local governments the ability to determine whether they want to site a landfill and its ultimate size (capacity). As such, landfill capacity varies by region.

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Closure permits were issued to 56 landfills in the spring of 1996, and 14 have already detected groundwater contamination. Contaminants detected at some of the old landfills include benzene, vinyl chloride, lead, and various heavy metals and toxic chemicals.

Monitoring at Old Landfills Detect Groundwater Contamination

The 24 MSW landfills now operating must meet strict closure requirements which include monitoring for a 30-year period. Rather than meet the new monitoring and closure requirements, 56 MSW landfills closed by 1992. Under the 1990 state rules, these landfills are required to monitor groundwater for a two-year period and install a leachate system if an outbreak occurs to collect and treat water discharged from the site. The Division of Waste Management has recommended that closed landfills have a groundwater monitoring system in place and also construct a 36-inch soil cap over the disposal area by Nov. 15, 1996 **(Figure 6)**.

The 56 landfills that closed under the 1990 state rules are now in the process of meeting the closure requirements. Closure permits were issued to the 56 landfills in the spring of 1996, and 14 have already detected groundwater contamination. Contaminants detected at some of the old landfills include benzene, vinyl chloride, lead, and various heavy metals and toxic chemicals.

Sites where groundwater contamination is detected are required to conduct an assessment to determine if contamination has advanced beyond the borders of the site. As of August 1, 1996, 14 closed landfills with confirmed groundwater contamination were conducting assessments **(Figure 6)**. Once a groundwater assessment is complete, a report is prepared to further detail contamination problems. A corrective action plan is then prepared to address the contamination. Two of the 56 landfills — McCracken County Fiscal Court and Pulaski Grading — have submitted corrective action plans and are conducting remediation activities. Groundwater contamination has also been detected at old disposal cells at existing MSW landfills and several sites are in assessment including Bavarian (Boone Co.), Local Sanitation (Rowan Co.), Waste Management (Jefferson Co.), Rumpke (Pendleton & Montgomery Co.), Southern Sanitation (Logan Co.), and Cooksey (Boyd Co.).

Financial assurance bonds for the 24 contained MSW landfills operating in Kentucky have been increased to better cover closure costs. It costs on average $90,000 to $100,000 per acre to close a landfill. Current MSW landfill bonds now range from $3.3 million (Pike County Landfill) to $37 million (Outer Loop Landfill in Jefferson County).

Financial Assurance Bonds Increased to Cover Closure Costs

Many old landfills are today's contaminated waste sites. One of the recently closed landfills, Roe Creek in Lawrence County, was declared a state superfund site in 1995, after the owners declared bankruptcy and bags of asbestos illegally disposed at the site were found washing into a creek. State officials have spent $117,000 to contain the Roe Creek nine-acre landfill during 1996 using state funds and the forfeiture of the landfill's $35,000 bond. The state has since assessed a fine against the landfill for $4.6 million. Landfill owners are required to secure bonds in the event the owner or operator fails to close a site properly. Financial assurance bonds for the 24 contained MSW landfills have been increased to better cover closure costs and are based on size and other factors. It costs, on average, $90,000 to $100,000 per acre to close a landfill. Current MSW landfill bonds now range from $3.3 million (Pike Co. Landfill) to $37 million (Waste Management in Jefferson Co.).

Landfill Construction and Operating Costs Lead to Higher Tipping Fees

Complying with the federal solid waste requirements has led to higher landfill tipping fees throughout the nation. National average solid waste landfill tipping fees have increased almost 400% since 1985. **Figure 7** shows that the average tipping fees in Southern states, including Kentucky, are slightly below the national average.[5] The Northeast has the highest tipping fees in the nation.

Average landfill tipping fees in Kentucky increased 27% between 1993 and 1995 **(Figure 8)**. According to the National Solid Waste Management Association, tipping fees can be expected to rise, on average, about seven percent a year. A June 1996 survey of tipping fees at the 24 MSW landfills found rates ranged from $19.52 a ton at the Local Sanitation Landfill in Rowan County to $35 a ton at Williams Sanitation Landfill in Spencer County.[6]

Figure 6 Status of Closed Residential Landfills in Kentucky (as of 8/1/96)

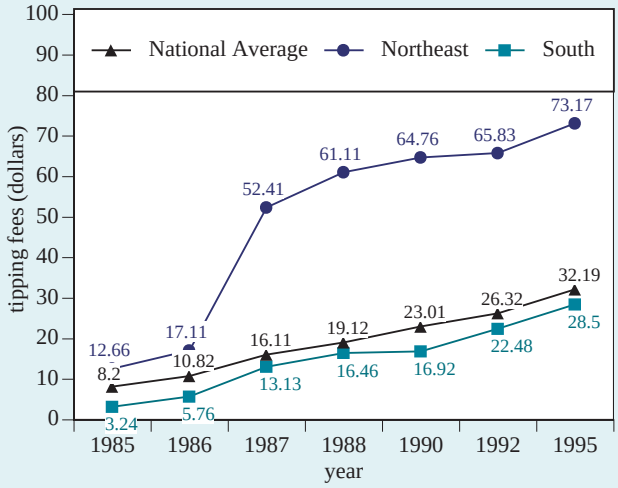
Landfill	County	GW Monitoring	Cap	Leachate System
Scottsville/Allen County	Allen	yes	no	no
Bullitt County Landfill	Bullitt	yes*	no	no
City of Bowling Green	Butler	yes	no	no
Crider and Rogers	Caldwell	yes	yes	no
City of Murray	Calloway	yes*	no	no
City of Hopkinsville	Christian	yes*	no	no
Winchester Mun. Utilities	Clark	yes	no	yes
Ferrill and Stockton	Cumberland	yes**	partial	no
Daviess County Fiscal Court East	Daviess	yes	no	no
City of Owensboro	Daviess	yes	no	no
Lexington/Fayette Co.	Fayette	yes*	yes	yes
Raymond Carpenter	Fleming	yes	no	yes
Floyd County Fiscal Court	Floyd	yes	partial	yes
B & J Sanitation	Fulton	yes	no	no
City of Leitchfield	Grayson	yes	no	no
Hilltop Landfill	Greenup	no	no	no
Hancock County Fiscal Court	Hancock	yes	yes	yes
Hardin County Fiscal Court	Hardin	yes*	no	no
Fort Knox/U.S. Army	Hardin	yes*	yes	no
City of Cynthiana	Harrison	yes	yes	no
Orville Nunn	Hart	no	no	no
City of Henderson	Henderson	yes	no	no
City of Dawson Springs	Hopkins	yes	no	no
Hopkins County Fiscal Court	Hopkins	yes	no	no
Jackson County Fiscal Court	Jackson	yes**	partial	yes
Valley Sanitation Landfill	Jefferson	no	no	no
Kramers Lane Landfill	Jefferson	yes*	yes	no
City of Barbourville	Knox	no	no	partial
E.R. Hooper Landfill	Laurel	yes	partial	yes
Roe Creek Development	Lawrence	yes***	no	yes
Letcher County Fiscal Court	Letcher	no	no	no
McCracken Fiscal Court	McCracken	yes****	no	yes
Paducah Gaseous Diffusion	McCracken	yes*	yes	no
McLean County Fiscal Court	McLean	no	no	no
Berea Sanitation Department	Madison	no	partial	yes
City of Richmond	Madison	no	no	no
Magoffin County Fiscal Court	Magoffin	yes	no	no
City of Lebanon	Marion	yes*	no	no
Marshall County Fiscal Court	Marshall	yes*	no	no
Mason County Fiscal Court	Mason	yes*	partial	yes
Otter Creek Park	Meade	no	yes	no
Mercer County Fiscal Court	Mercer	yes	partial	partial
Foothills Development	Montgomery	yes	partial	yes
Muhlenberg County Landfill	Muhlenberg	no	no	no
Ohio Co. Fiscal Court	Ohio	yes*	yes	no
Perry County Fiscal Court	Perry	no	no	no
Pulaski Grading Landfill	Pulaski	yes****	no	yes
City of Georgetown	Scott	yes*	yes	yes
Solid Waste Comm. (Waddy)	Shelby	yes	no	no
Solid Waste Comm. (Shelbyville)	Shelby	yes	no	no
City of Campbellsville	Taylor	no	no	yes
Trigg County Fiscal Court	Trigg	no	no	no
Earle C. Clements Job Corps	Union	yes	no	no
City of Springfield*	Washington	yes*	yes	no
Donald R. Carrender	Wayne	yes	yes	no
Webster County Landfill	Webster	no	no	no

The 56 MSW landfills that closed prior to 1992, under the 1990 rules, are required to monitor groundwater for a two-year period and install a leachate system if an outbreak occurs to collect and treat water discharged from the site. The closed landfills are required to have a groundwater monitoring system in place and also construct a 36-inch soil cap over the disposal area by Nov. 15, 1996.

**Groundwater contamination confirmed; in assessment. Contaminants detected at some of the old landfills include benzene, vinyl chloride, lead, and various heavy metals and toxic chemicals. **Wells installed, not monitoring. ***State superfund site. ****Groundwater contamination confirmed; in corrective action. Source: KY Division of Waste Management*

National average tipping fees at solid waste landfills have increased almost 400% since 1985. The average tipping fees in Southern states, including Kentucky, are slightly below the national average.[5]

Figure 7 Average MSW Landfill Tipping Fees



Source: National Solid Waste Management Association

Average landfill tipping fees in Kentucky have increased 27% between 1993 and 1995.

Figure 8 Average MSW Landfill Tipping Fees in KY

Year	Tipping Fee
1993	$21.69
1994	$23.49
1995	$24.43
1996	$27.49

Source: National Solid Waste Management Assn.

Construction/ Demolition Landfills Double Since 1994

There are other facilities that process or dispose of waste in Kentucky **(Figure 9 & 10)**. These include:

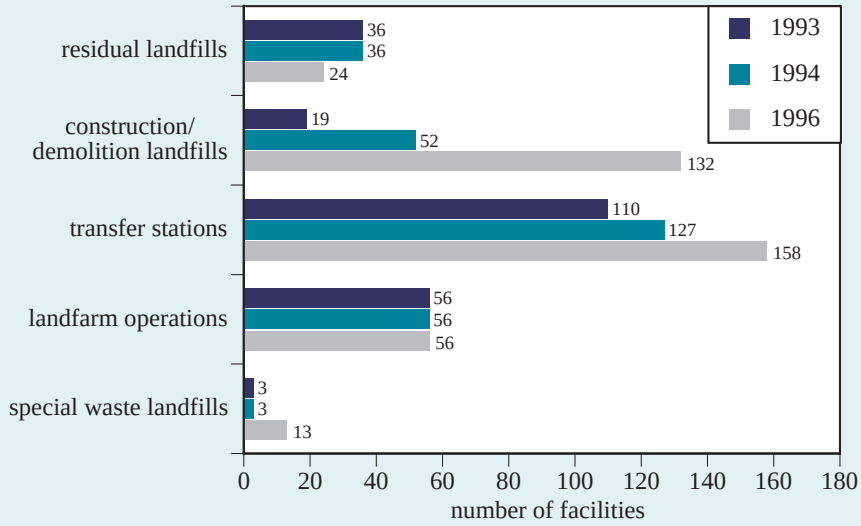
- Residual landfills - which are typically operated by an industry to dispose waste by-products from the manufacturing process.
- CDD landfills - construction/demolition debris landfills which receive inert waste.
- Transfer stations - facilities where shipments of waste are held or transferred.
- Landfarms - operations that land apply solid waste, biosolids (wastewater treatment sludge that has met minimum treatment standards) or special waste.
- Special waste landfills - high-volume, low hazard waste that includes mining waste, electric-generating utility ash, sludge, cement kiln ash, oil and gas drilling muds, and oil production brines.

The construction, operation, and closure requirements for these facilities vary according to the risks posed to the environment. For example, construction/demolition debris (CDDs) landfills are exempt from groundwater monitoring requirements if they are less than one acre in size. Of the 132 CDD landfills currently with permits to operate in Kentucky, 111 are less than one acre.

The number of CDDs in Kentucky has more than doubled since 1994. CDDs offer municipalities a low-cost disposal alternative for certain types of inert waste. The average cost to dispose waste at a CDD landfill is $7 to $10 a ton compared to $27 at a MSW landfill. Many small CDDs are operated by developers for disposal

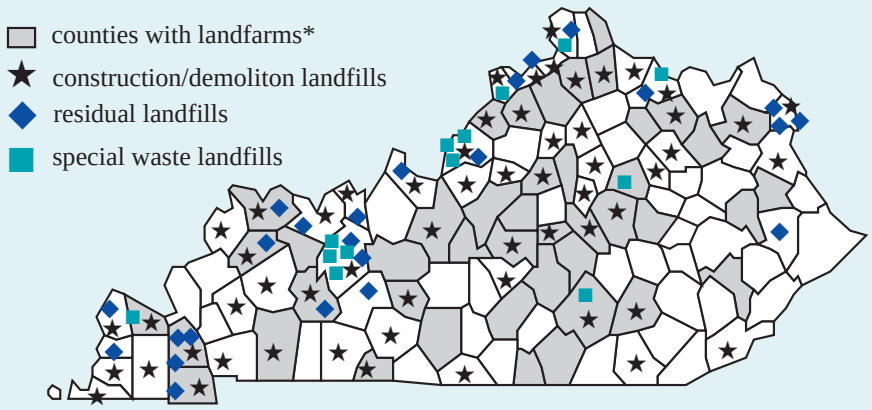
The number of construction/demolition debris landfills (CDDs) in Kentucky has more than doubled since 1994. CDDs offer municipalities a low-cost disposal alternative for certain types of inert waste. The average cost to dispose waste at a CDD landfill is $7 to $10 a ton compared to $27 at a MSW landfill.

Figure 9 Other Solid Waste Management Facilities in KY



Source: KY Division of Waste Management

Figure 10 Other Solid Waste Management Facilities in Kentucky



**Petroleum contaminated soil remediation landfarms in Webster, Simpson, and Campbell counties. Compost special waste landfarms in McCracken, Simpson, Morgan counties. Landfarms that spread food or other types of waste in Henderson, Adair, Garrard, Oldham and Carter counties. Remaining facilities landfarm biosolids. Source: KY Div. of Waste Management*

of waste during construction. All CDDs less than one acre must post a $10,000 bond. Bonds for CDDs greater than one acre are based on the size of the site and average $10,000 to $15,000 an acre. During fiscal year 1995-96, 592,048 tons of waste were disposed at the 21 CDDs greater than one acre, diverting about 12% of the waste stream from contained MSW landfills.[7] Data on how much waste is disposed at CDDs less than one acre is not required to be reported.

The number of solid waste transfer stations has increased due to the closure of many landfills and the permitting of larger, regional MSW landfills. In 1995, 725,134 tons of waste were reported processed at 158 transfer stations.

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Special Waste Landfills Increase to 13 While Residual Landfills Decline

During 1995, 24 residual landfills reported disposing 739,242 tons of waste. The construction and operating requirements for residual landfills and the amount of financial assurance bonds are determined on a case-by-case basis. However, all sites must monitor groundwater. Of the 24 residual landfills with permits, five have confirmed groundwater contamination and are in the process of conducting assessments to verify the extent of contamination **(Figure 11)**.

The number of residual solid waste landfills is declining as several transition to special waste landfills **(Figure 9)**. The special waste landfill was created as a separate regulatory category in 1992 to dispose of high-volume low hazard wastes, such as fly ash generated by power plants. Special waste landfills require less stringent construction and operating requirements than residual landfills, although they are required to monitor groundwater. There are 13 special waste landfills with permits to dispose fly ash generated by power plants. These landfills are typically 50 to 100 acres. Special waste landfills received transition permits in Feb. 1996. Data is not available from the Division of Waste Management on the amount of special waste disposed at these sites or groundwater monitoring results.

There are 13 special waste landfills with permits to dispose fly ash generated by power plants. These landfills are required to monitor groundwater and are typically 50 to 100 acres. Special waste landfills received transition permits in Feb. 1996.

Most Wastewater Sludge Disposed of in Landfills

The spreading or landfarming of certain wastes on the land is considered a beneficial reuse of wastes since it adds nutrients back to the soil. The number of landfarm operations has remained unchanged since 1993 **(Figure 9)**. Landfarm operations must test materials for various metals including copper, lead, selenium, arsenic, cadmium, zinc, chromium, nickel, and mercury. If these metals exceed certain lev-

During 1995, the 24 residual landfills operating in the state reported disposing 739,242 tons of waste. All must monitor for groundwater contamination. Five of the residual landfills have confirmed groundwater contamination and are conducting assessments to verify the extent of contamination.

Figure 11 Status of Residual Landfills in Kentucky

Landfill	County	GW Monitoring	Contaminants Detected
Westvaco	Ballard	yes	
Bavarian Trucking	Boone	yes	
A.K. Steel	Boyd	yes	
Ashland Petroleum	Boyd	yes*	barium, chromium
Pittsburgh Activated Carbon	Boyd	yes	
IMCO	Butler	yes	
City of Murray	Calloway	yes*	chloroethane, TCE, vinyl chloride, etc.
Westvaco	Carlisle	yes*	chromium, arsenic, barium (gross alpha & gross beta naturally occurring)
DOW Corning	Carroll	yes	
Dayton Walther Corp.	Carroll	yes	
Addwest Mining Inc.	Daviess	yes	
Costain Coal Inc.	Floyd	yes	
Willamette Industries	Hancock	yes	
Alcan Ingot & Recycling	Henderson	yes*	chlorides
E.I. DuPont	Jefferson	yes	
Air Products & Chemicals	Marshall	yes**	
ISP Chemicals	Marshall	no	
SKW Alloys	Marshall	yes	
Mason Co. Fiscal Court	Mason	yes*	barium
Olin Chemicals	Meade	yes	
Reed Minerals	Muhlenberg	yes	
Pyramid Mining Inc.	Ohio	yes	
Zielinski Construction	Ohio	yes	
J. Smith Coal/Costain Coal	Webster	yes	

**Groundwater contamination confirmed; in assessment. **Additional groundwater wells to be installed.*
Source: KY Division of Waste Management

Forty-eight of the 56 landfarm operations in Kentucky have permits to spread sludge generated by wastewater treatment plants. During 1995, 5,644 tons of sludge, or about 12% of the total generated in Kentucky, was landfarmed.

els, the landfarm must monitor groundwater. The four landfarm operations required to monitor groundwater have not detected contamination caused by the operations.

Forty-eight of the 56 landfarm operations have permits to spread biosolids generated by wastewater treatment plants. However, most of the sludge generated by the 2,289 wastewater treatment plants operating in Kentucky is disposed of in landfills. A 1993 University of Kentucky state study found that wastewater plants generate an average of 47,351 tons of sludge annually.[8] During 1995, 5,644 tons of sludge, or about 12% of the total generated in Kentucky, was landfarmed.

Three operations have permits to landfarm petroleum contaminated soil, three landfarms compost special waste, and five are permitted to landfarm food, rendering waste, or other types of waste. Thirty-seven of the landfarm permits have been issued to municipalities with the remainder to private companies.

The low number of landfarms in Kentucky may be due to several factors including competition from MSW landfills, whose tipping fees have been comparable to the costs for landfarming waste. Landfarm permit fees for private operations, which can be as high as $6,000, may have also discouraged operations, according to some consultants. As MSW landfill rates continue to rise, additional interest in landfarming may increase. The average cost to landfarm waste in Kentucky is $15 per ton.

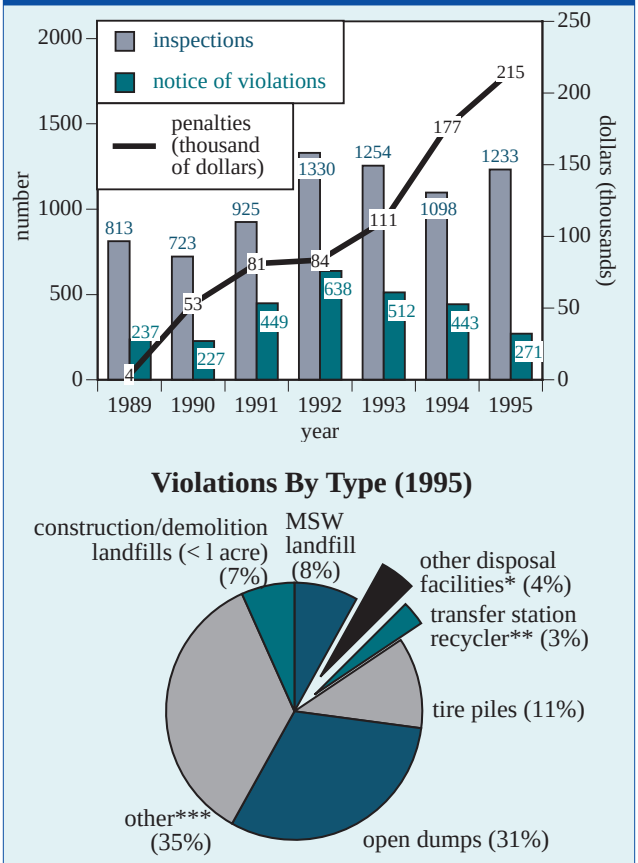
Requirements to prevent contamination of land and water from landfarming also may have limited operations in the state, according to Division of Waste Management officials. Landfarm operations must meet strict siting requirements to prevent potential surface and groundwater contamination. These requirements include buffer zones near streams and sinkholes, and slope requirements to prevent runoff. Siting

restrictions have particularly limited landfarms in Eastern Kentucky, where little flat land exists. While opportunities to landfarm waste on coal mines exists, there have been few operations to date.

Solid Waste Violations Decline 58% Since 1992

A review of solid waste enforcement and compliance trends reveals that the number of violations cited by state officials fell 58% between 1992 and 1995. The decline is attributed to the closure of many landfills and the upgrading of others to meet new solid waste rules. A closer look at the 271 solid waste violations cited by state officials in 1995 found that tire piles and open dumps received 42% of the citations **(Figure 12)**. But trends also show that penalties have increased in the past four years. During 1995, 27 facilities were assessed fines. The penalties, collected against landfills, transfer stations, and private waste facilities ranged from $100 to $30,000.

Figure 12 Solid Waste Enforcement and Compliance Trends



**Permitted CDDs (>1 acre), residual, special waste, landfarms, compost facilities. **Commercial recyclers. ***Includes junkyards, sawdust piles, oil and brine pits, septic tanks, convenience centers, road oiling, sludge give away.*
Source: KY Division of Waste Management

A review of solid waste enforcement and compliance trends reveals that the number of violations cited by state officials fell 58% between 1992 and 1995. A closer look at the 271 violations cited in 1995 found that tire piles and open dumps received 42% of the citations. But trends also show that penalties have increased in the past four years. During 1995, 27 facilities were assessed fines.

More Kentuckians Participating in Garbage Collection

State law now requires counties to provide residents with garbage collection services. All counties have adopted ordinances to provide for garbage collection, although most are voluntary in nature. To date, 19 counties have passed ordinances requiring mandatory participation in garbage collection **(Figure 13)**.

In 1995, an estimated 1.17 million Kentucky households, about 80% of the state total, participated in a garbage collection program. This is 161,000 more households than was the case in 1993 **(Figure 14 & 15)**. Door-to-door garbage collection programs are increasing as well. A number of communities in 118 counties have access to door-to-door collection of waste. However, data is not available to determine the number of communities or population served by these programs.

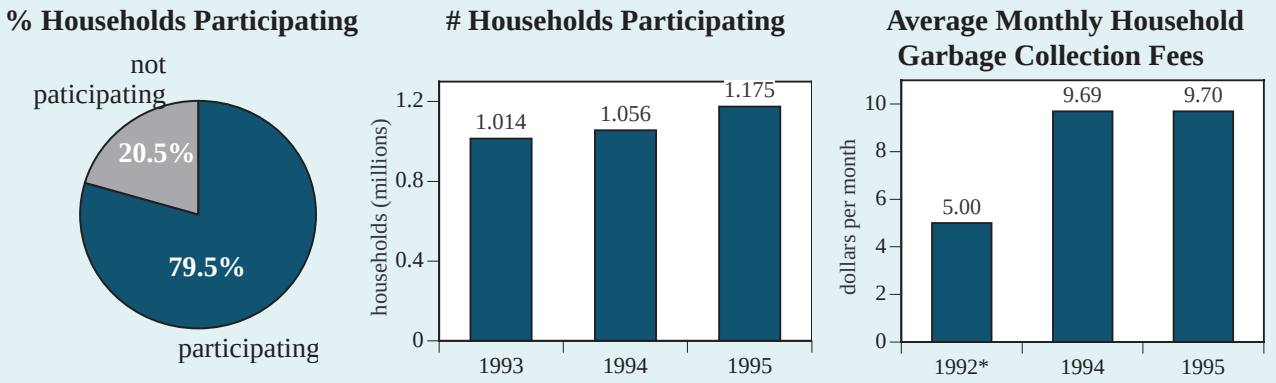
Household garbage collection rates continue to rise as a result of increasing landfill tipping fees and transportation costs. Household garbage collection rates have nearly doubled since 1992 and now average $9.70 per month **(Figure 14)**. However, rates vary greatly across the state, from $3 a month in Garrard County to a high of $15 per month in Logan County.

All counties have adopted ordinances to provide for garbage collection, although most are voluntary in nature. To date, 19 counties have passed ordinances requiring mandatory participation in garbage collection.

Figure 13
Mandatory County Garbage Collection Ordinances

Bell	Letcher
Breathitt	McCreary
Elliott	Magoffin
Floyd	Marion
Franklin	Meade
Greenup	Nelson
Harlan	Perry
Johnson	Pike
Knott	Washington
Lee	

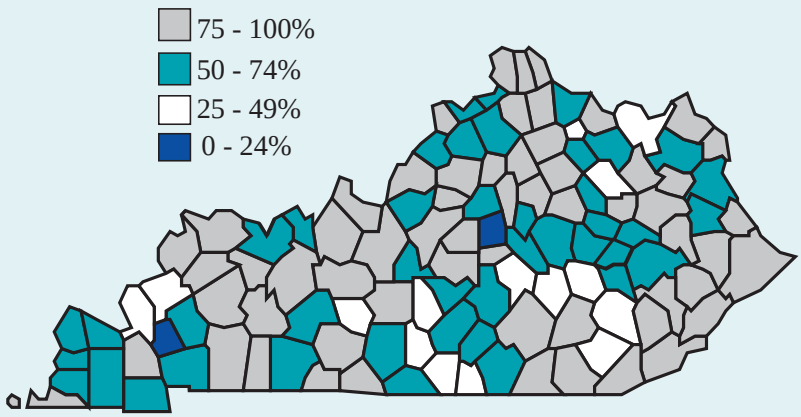
Figure 14 Households Participating in Garbage Collection and Garbage Fees in KY



**Estimate. Source: KY Division of Waste Management*

In 1995, an estimated 1.17 million households, about 80% of the state total, participated in a garbage collection program. This is 161,000 more households than was the case in 1993.

Figure 15 Households Participating in Garbage Collection(1995)



Source: 1995 County Solid Waste Reports

Household garbage collection rates have nearly doubled since 1992 and now average $9.70 per month. Garbage rates vary greatly across the state, from $3 a month in Garrard County to $15 per month in Logan County.

Open Dump Cleanups Increasing, 4,379 Citations Issued in 1995

Kentucky faces a significant challenge when it comes to curtailing open dumping. With 20% of Kentucky's households still disposing of their garbage illegally, the number of open dumps increases each year. State and local efforts to identify and clean up open dumps have progressed **(Figure 16)**. In 1995 alone, 1,761 dumps were cleaned up at an average cost of $2,135 per dump.

In 1996, the Natural Resources and Environmental Protection Cabinet initiated a campaign to stop illegal dumping. The Cabinet has joined with other agencies to promote greater public awareness of the threats posed by illegal dumping and to step up enforcement of open-dump laws. A statewide hotline (1-888-no-dump) was established in April 1996 to provide Kentuckians an opportunity to report open dumps to state and local officials. During a five-month period, April 22 through Sept. 19, 345 calls had been made by citizens to the open-dump hotline.

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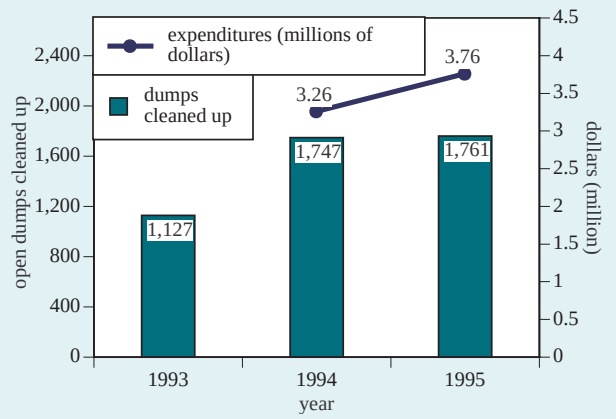
Many counties have appointed local solid waste coordinators to promote proper solid waste management. The number of counties with solid waste coordinators has increased from 40 in 1992 to 88 in 1995 **(Figure 17)**.

Eighty-five counties have enacted open dump ordinances to give the county authority to cite and prosecute violators. Local solid waste coordinators have taken the lead in enforcing open-dump ordinances **(Figure 18)**. In Leslie County for example, the solid waste coordinator cited 404 violations of the local open-dump ordinance in 1995. Jefferson County officials issued 682 open-dump violations during 1995. Most of the 4,379 open-dump violations cited by local officials during

1995, were resolved out of court. Only 1,257, or 29%, resulted in court action.

Some solid waste coordinators have developed innovative approaches to deal with the open dump problem. In Jackson County, two officers were hired to issue citations for illegal dumping. The county has already seen results with an increase in the amount of waste being processed at the local transfer station. Scott and Boone County have programs to help property owners fund the clean up of dumps and sinkholes. And the LaRue County Solid Waste Coordinator requires violators to issue public apologies in newspapers and watch videos about the hazards of dumping.

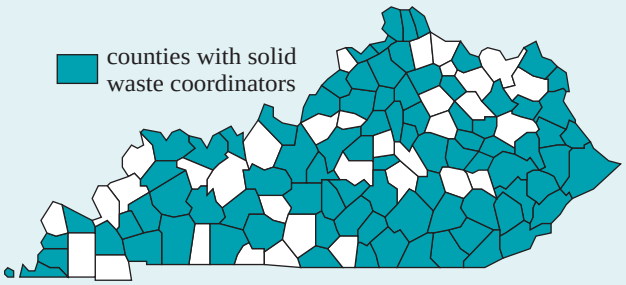
Figure 16 Open-Dump Cleanups and Expenditures in Kentucky



Note: Earlier data not available.

With 20% of Kentucky's households still disposing of their garbage illegally, the number of open dumps increases each year. State and local efforts to identify and clean up open dumps have progressed. In 1995 alone, 1,761 dumps were cleaned up at an average cost of $2,135 per dump.

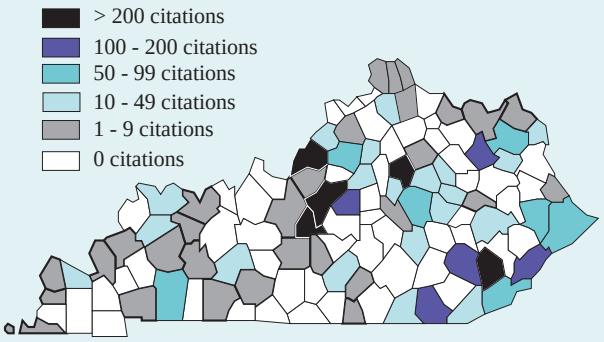
Figure 17 Counties With Solid Waste Coordinators (1995)



Source: KY Division of Waste Management

Many counties have established local coordinators to promote proper solid waste management and curb open dumping. Since 1992, the number of counties with solid waste coordinators has increased from 40 to 88.

Figure 18 Open-Dump Violations (1995)



Source: 1995 County Solid Waste Reports

Most of the 4,379 open-dump violations cited by local officials during 1995 were resolved out of court. Only 1,257, or 29%, resulted in court action. Some county solid waste coordinators have developed innovative approaches to deal with the open-dump problem.

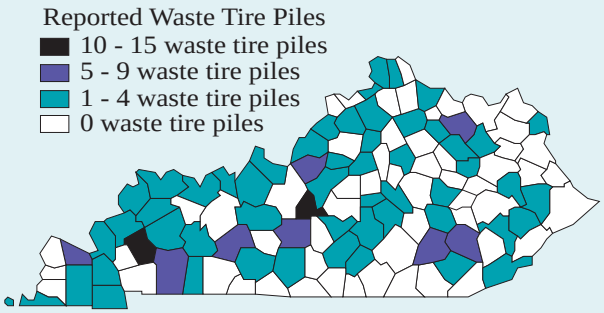
Tire Piles Growing, State Cleans Up Six Largest in 1996

There are 193 known waste-tire dumps in 87 counties **(Figure 19)**. An estimated 7 to 10 million waste tires at these sites pose health and environmental threats. For example, tire piles are breeding grounds for mosquitoes, including the Asian Tiger Mosquito, a carrier of two types of encephalitis. And each year tire fires emit toxic chemicals into the air and water. In 1994 and 1995, 10 waste tire fires were reported in Kentucky.

Waste-tire disposal remains a major problem in the Commonwealth. In addition to the 10 million estimated tires stockpiled across the state, Kentuckians produce another 3.8 million waste tires each year. While state regulations allow for the disposal of shredded tires at solid waste landfills, few accept them due to space restrictions. So, many tires wind up in piles or are trucked to Ohio and Illinois for use as a tire-derived fuel.

There are 193 known waste-tire dumps in 87 counties. An estimated 7 to 10 million waste tires at these sites pose health and environmental threats. The Natural Resources and Environmental Protection Cabinet recently awarded six contracts in 1996 to clean up six tire piles containing 1.8 million tires at a cost of $1.6 million.

Figure 19 Waste Tire Dumps in KY (1995)



Source: KY Division of Waste Management

Figure 20 Cleanup of Waste Tire Piles in Kentucky (1996)

Site (County)	# tires
Windy Ridge (Campbell)	350,000
H. Lindsey (Barren)	657,000
G. Ridge* (Campbell)	150,000
Tire Power (Franklin)	51,000
Enconne (Logan)	225,000
Law-Mac (Franklin/Simpson)	390,000
Total	**1,823,000**
Cost to Clean up Sites	**$1,600,000**

**awaiting cleanup*

The Natural Resources and Environmental Protection Cabinet awarded six contracts in 1996 to clean up six tire piles containing 1.8 million tires at a cost of $1.6 million **(Figure 20)**. Most of the tires were shipped to the Illinois Power Company for use as a tire-derived fuel or to Indiana for landfill construction. There are no facilities in Kentucky permitted to use waste tires for fuel at this time, although a final determination was made Aug. 1996 to grant Cox Interior Inc. an air permit to modify its heat exchangers to burn multiple fuels including waste tires at its wood-products plant in Campbellsville.

State funds used to clean up tire sites are generated by a $1 fee on new tires sold in the state. The KY Waste Tire Fund, established in 1990, generates about $600,000 a year. As of June 30, 1996, the fund had collected $3.4 million (plus $345,524 in interest) for tire dump cleanups and grants to county governments to purchase tire shredders and recycling equipment. It was hoped that the fee would generated $3.6 million annually, however, a fee exemption for retailers who recycle waste tires has limited the funds needed to clean up sites. The Cabinet is developing regulations for financial assurance, tracking and reporting requirements, and management standards to better enforce the tire fee exemptions for retailers.

The Cabinet is also exploring other tire disposal options including use as artificial reefs in lakes, landfilling, and as a fuel source in power plants. While recycling is also an option, current markets for waste tires at this time appear limited.

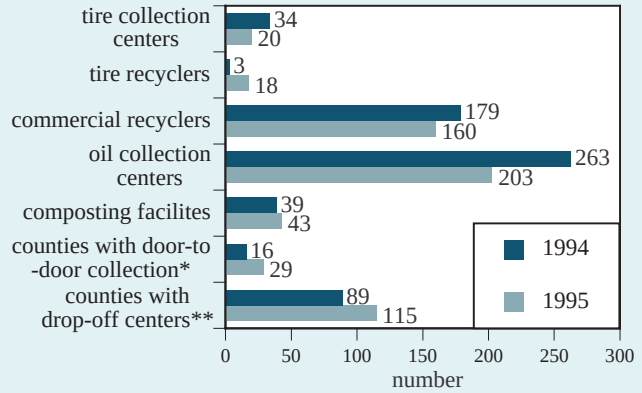
Recycling Programs and Collection Increasing

Kentucky established a statewide goal to reduce the amount of solid waste disposed at landfills 25% by 1997. Data reported by counties reveal that in 1995, 971,713 tons of materials were collected for recycling along with 190,687 tons of yard waste, diverting about 24% of the municipal waste stream from landfills.

Prior to the 1993 state law mandating local solid waste management plans, few counties operated recycling programs. There was little infrastructure in existence to process these commodities and few markets in which to sell the recovered materials. According to 1995 county solid waste reports, all but five counties (Edmonson, Knott, Monroe, Washington, and Wolfe) now have established drop-off centers for recyclables, compared to 89 counties in 1994 **(Figure 21)**.

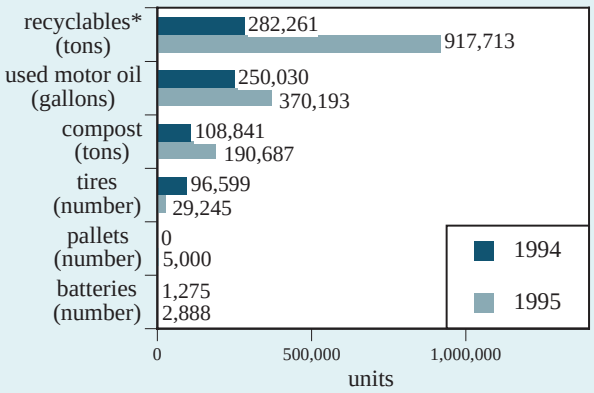
Nationwide, the U.S. EPA estimates that recycling and composting recovered 24% of the municipal solid waste in 1994, up from 21% in 1993 and 17% in 1990. Kentucky established a statewide goal to reduce the solid waste disposed at landfills 25% by 1997. Data reported by counties reveal that in 1995, 971,713 tons of materials were collected for recycling along with 190,687 tons of yard waste, diverting about 24% of the municipal waste stream from landfills **(Figure 22)**. There are 43 compost facilities permitted in Kentucky. State officials estimate that these facilities processed 207,000 tons of compostable materials during 1995, close to what was reported in the county solid waste reports.

Figure 21 Recycling Facilities/Programs in KY



**Counties where one or more communities have door-to-door recycling collection. **Counties with one or more recycling drop-off centers. Source: KY Div. of Waste Management*

Figure 22 Collection of Recyclables in KY



**Aluminum, newspapers, cardboard, paper, glass, plastic. Source: 1994-1995 County Solid Waste Reports which include data on public and private sector collection, where available.*

In communities with curb-side recycling programs, collection rates vary. Louisville reports that 76% of the city's households participate in curb-side recycling, diverting about 14% of the waste stream from landfills. City officials expect to collect 13,000 tons of recyclables in 1996 compared to 9,500 tons in 1993. The U.S. EPA estimates that commercial sources also generate 35% to 45% of the municipal solid waste stream. Nationwide recycling levels for commercial sources are estimated at 27%.

Some communities are trying innovative projects to encourage more waste reduction. The Northern Kentucky Solid Waste District reports that 30 families were involved in a pilot program called "Don't Bag It" in Florence, Ft. Thomas, and Edgewood this summer. Volunteer families were given the use of a new mulching mower with the option to purchase the mower at a reduced price. The families diverted 30 tons of yard waste from landfills.

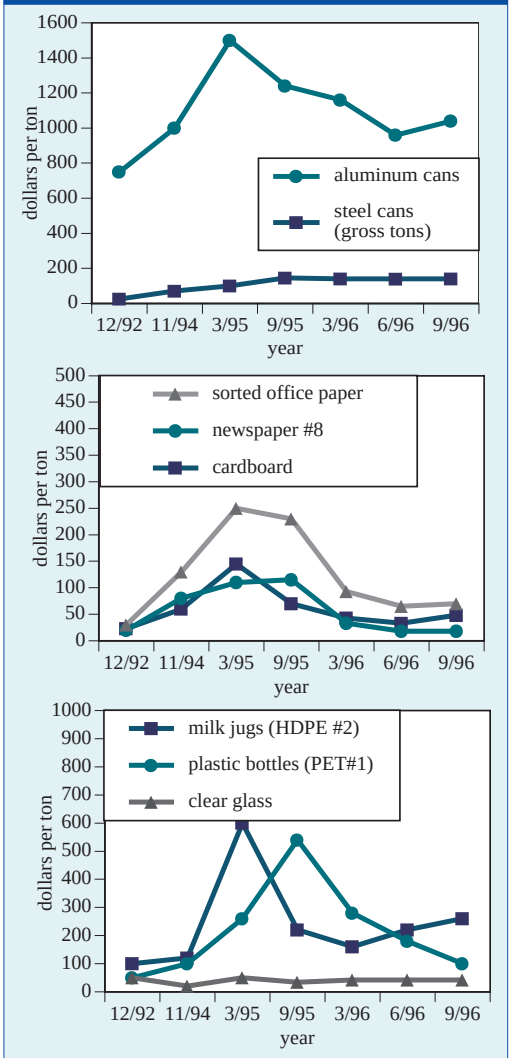
Prices for Recyclables Plunge in 1996

Markets, as well as market fluctuations, remain the greatest barriers to recycling. Fueled, in part, by government and business buy-recycled programs, prices for recyclables reached all-time highs in 1994 and 1995. Then demand and prices fell due to oversupply, economics, and changes in federal procurement rules **(Figure 23)**.

Some counties have joined together to create five regional recycling partnerships to better market recyclables in Kentucky. The Tri-County recycling partnership (Henderson, Union, and Webster counties) established a recycling center in 1993. The center collected 1,162 tons of recyclables in 1995 and generated almost $30,000 in revenues. The Bluegrass Regional Recycling Corp. (consisting of 22 counties and 29 cities) collected 36,000 tons of recyclables since 1990 while also creating 30 new jobs.

While recycling is an important part of the hierarchy of waste management, attention is now shifting to waste reduction. The U.S. EPA has begun to encourage municipalities to adopt so-called "pay as you throw" (PAYT) programs, which charge citizens individually for waste services based on

Figure 23 Prices for Recyclables



Source: KY Recycling and Marketing Assistance

the amount of garbage they produce. Nationwide, more than 2,000 communities have adopted PAYT programs, although none are located in Kentucky. Initial research reveals that waste reduction in those communities with PAYT programs ranged from 25% to 45%.[9] But there are issues associated with PAYT programs such as affects on low-income residents and concern about increased illegal dumping.

Hazardous Waste

The management and disposal of hazardous waste is regulated under the provisions of the Resource Conservation and Recovery Act of 1976, known as RCRA, and its amendments. Kentucky's hazardous waste laws and regulations have been in place since 1982. The regulation of hazardous waste is considered one of the most comprehensive sets of rules governing the protection of the environment, seeking to manage every aspect of hazardous waste, from cradle to grave.

Generation of Hazardous Waste Remains Constant at 6.5 Million Tons

Federal and state hazardous waste laws have primarily focused on managing waste produced by large generators. Large quantity generators produce:

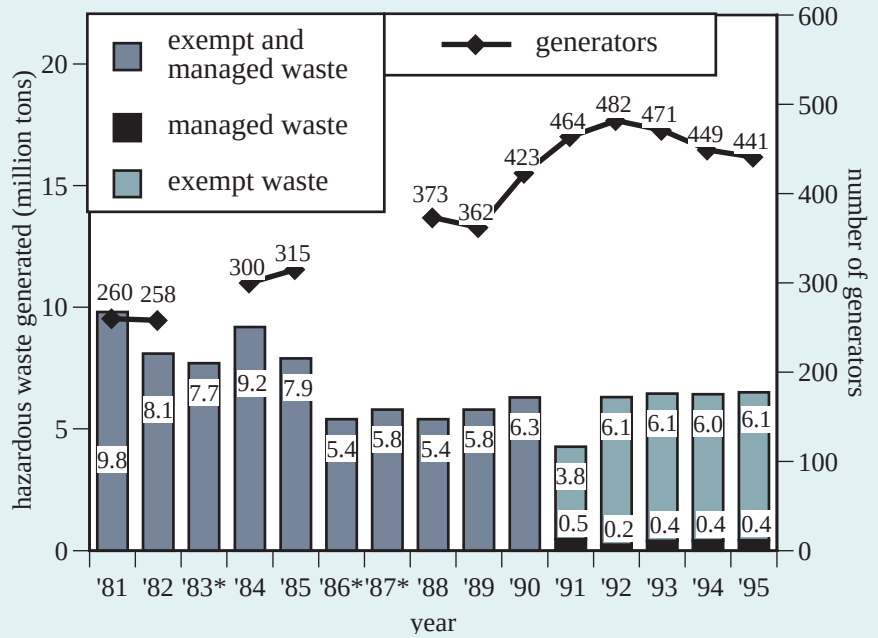
- 2,205 pounds of hazardous waste a month, or
- 2.2 pounds or more of acutely hazardous waste a month, or
- 220 pounds of spill cleanup materials a month.

In 1995, 441 large-quantity generators reported producing 6.5 million tons of hazardous waste **(Figure 24)**. The amount of hazardous waste generated in the state has remained fairly constant for the past several years except for 1991 which saw a drop due to the redesignation of calcium sulfate to a by-product.

The treatment and disposal of hazardous waste depends on the type of waste produced **(Figure 25)**. There is managed hazardous waste which includes toxic wastes and waste of greater hazard subject to permitting requirements. In 1995,

In 1995, 441 large-quantity generators reported producing 6.5 million tons of hazardous waste. While some companies have made the reduction and recycling of hazardous waste a priority, it would appear that little statewide progress has been made in the past decade in reducing the total amount of hazardous waste produced in Kentucky.

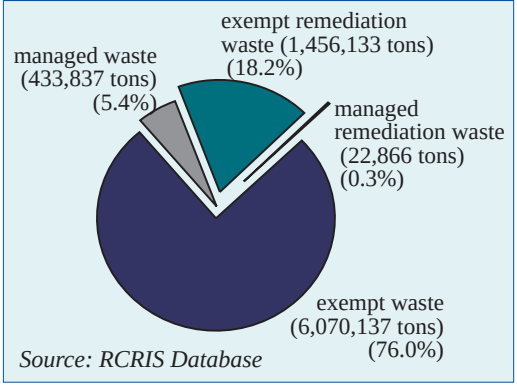
Figure 24 Hazardous Waste Generation in Kentucky



*Note: Does not include remediation waste. Totals rounded. *Generator data not available.*
Source: RCRIS Database

433,837 tons of managed hazardous waste were generated. Most of the waste produced, 6.1 million tons, was corrosive wastewater. This waste is considered a low risk and its treatment and disposal is exempt from most hazardous waste permitting requirements. In 1995, 1.47 million tons of remediation waste was also generated from the clean up of spills and waste sites.

Figure 25 Types of Hazardous Waste Generated in KY (1995)



Source: RCRIS Database

Trends show that the amount of managed hazardous waste subject to permitting requirements has remained the same since 1993 **(Figure 24)**. In 1995, ten companies generated or handled 80% of the managed hazardous waste in the state **(Figure 26)**. The amount of exempt hazardous waste has remained about the same since 1992. Ten generators accounted for 90% of the exempt hazardous waste produced in 1995 **(Figure 27)**.

The treatment and disposal of hazardous waste depends on the type of waste produced. There is managed hazardous waste which includes toxic wastes and waste of greater hazard subject to permitting requirements. In 1995, 433,837 tons of managed hazardous waste were generated. Ten companies generated or handled 80% of the managed hazardous waste in the state.

Because of hazardous waste reclassifications and other regulatory changes made from year to year, it is difficult to determine whether Kentucky is moving toward its statewide waste-reduction goal of 25% by 1997, based on 1988 levels. While some companies have made reduction and recycling of hazardous waste a priority, it would appear that little overall statewide progress has been made by large quantity generators in reducing the total amount of hazardous waste produced in Kentucky.

Most Hazardous Waste Treated On-Site

Much of the hazardous waste produced in Kentucky is chemically neutralized on-site to render it nonhazardous **(Figure 28)**. During 1995, 99% of the hazardous waste was treated at the site of generation. Most is treated and discharged to waterways under conditions specified in state water permits.

There are three hazardous waste incinerators operating in Kentucky; Elf Atochem at Calvert City and Carrollton and LWD in Calvert City. LWD operates the only commercial hazardous waste incinerator **(Figure 29)**. The state denied the LWD incinerator permit in 1990, but a court order allowed the facility to continue to operate. Other state and federal litigation has caused further delays in the review of the permit application. A decision on the LWD permit is expected soon. Two facilities are also permitted to burn hazardous waste as a blended fuel in their industrial boilers. In 1995, KY Solite (Bullitt Co.) burned 4,634 tons and Rohm and Haas (Jefferson Co.) burned 12,996 tons of blended fuel.

Figure 26 Top 10 Generators/ Handlers of Managed Hazardous Waste

Company (County)	Tons 1990	Tons 1995
Ken Dec (Hart)	712	192,724
Safety Kleen*. (Henry)	43,744	83,576
Rohm & Haas (Jefferson)	20,006	13,196
LWD Inc.* (Marshall)	8,003	11,599
Universal Fast. (Anderson)	100,748	11,246
Envmtl. Conservation (Henderson)	19,449	9,331
Gallatin Steel (Gallatin)	**	7,632
ISP Chemical (Marshall)	9,350	6,585
NSA (Hancock)	761	5,901
James Graham Brown Foundation (Jefferson)	**	5,365
Total Top Ten	**202,773**	**347,155**
Total State	**471,136**	**433,837**

**Treatment, storage, disposal facility. ** Not operating. Source: RCRIS Database*

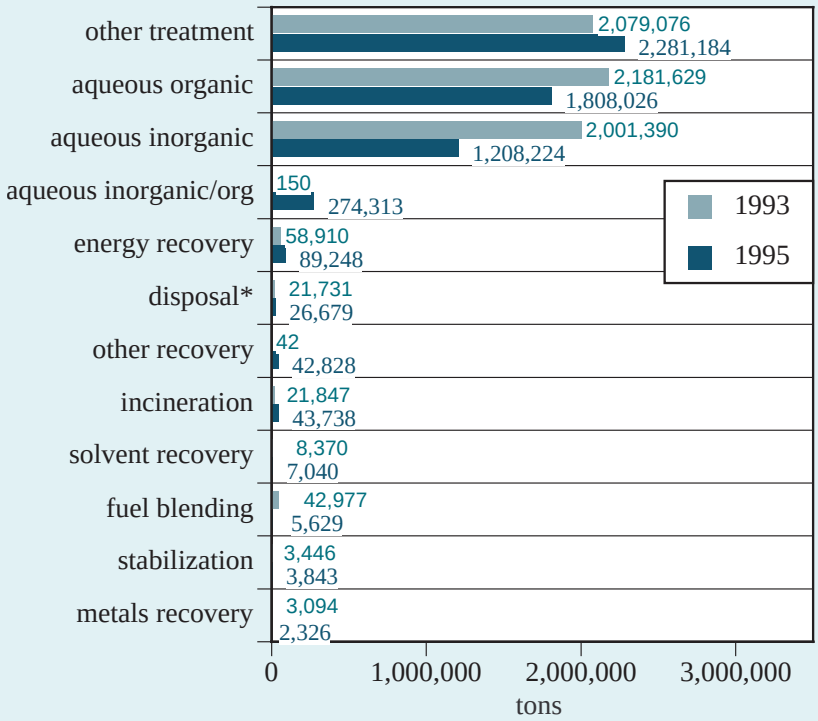
Figure 27 Top 10 Generators Exempt Hazardous Waste

Company (County)	Tons 1995
B.F. Goodrich (Marshall)	2,505,340
Elf Atochem (Marshall)	721,938
Westlake Monomers (Marshall)	716,044
Olin Corp. (Meade)	486,300
DOW Corning (Carroll)	283,495
B.F. Goodrich (Jefferson)	223,009
Coltech Ind. (Warren)	140,802
Gamco Products (Henderson)	137,610
Willamette (Hancock)	125,466
Englehard (Jefferson)	106,488
Total Top Ten	**5,446,492**
Total State	**6,070,137**

Source: RCRIS Database

Much of the hazardous waste produced in Kentucky is chemically neutralized on-site to render it nonhazardous. During 1995, 99% of the hazardous waste was treated at the site of generation.

Figure 28 Hazardous Waste Treatment and Disposal Methods in Kentucky



*Note: Large quantity generator waste. Does not include waste imported into KY for disposal or treatment because data is not available. Earlier data not available. *Landfills, waste piles, impoundments. Source: RCRIS Database*

LWD operates the only commercial hazardous waste incinerator. The state denied the LWD incinerator permit in 1990, but a court order allowed the facility to continue to operate. Other state and federal litigation has caused further delays in the review of the permit application. A decision on the LWD permit is expected soon.

Figure 29 LWD Hazardous Waste Incineration

Year	Tons
1992	30,912
1993	34,811
1994	45,750
1995	35,320

Source: LWD Inc.

Alternatives to Nerve Gas Weapon Incineration to be Studied

The U.S. Army's proposal to build an incinerator to burn chemical munitions such as nerve and mustard agents stored at the Bluegrass Army Depot in Richmond, Kentucky, continues to receive state and national attention. Approximately 70,000 obsolete rockets are stored at the depot. The U.S. Army has proposed to construct an on-site incinerator to destroy the weapons stored in Kentucky. The depot stockpile represents 1.6% of the nation's nerve gas weapons. Opposition to the army's plan has been voiced by city and county government officials, concerned citizens and others. The Army filed a permit application for the chemical munitions incinerator with the state in Dec. 1995.

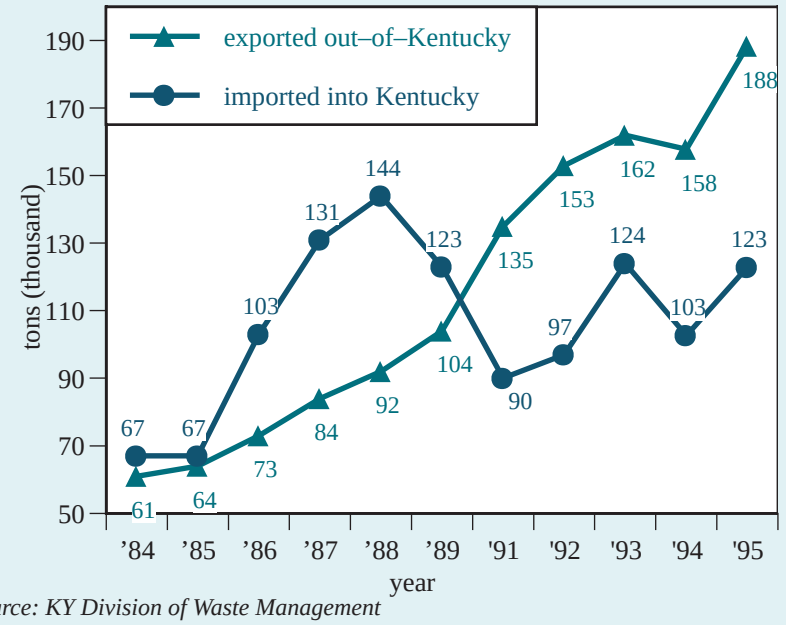
President Clinton recently indicated that he will order a study of alternative technologies for destroying the chemical weapon munitions and allocate $25 million to test these technologies in response to public concern about the safety of incineration. A $40 million research provision to have the Pentagon identify at least two alternatives to incineration was also included by Congress in the 1996-97 federal defense appropriations bill.

Kentucky Net Exporter of Hazardous Waste

Kentucky remains a net exporter of hazardous waste **(Figure 30)**. In 1995, 188,000 tons of hazardous waste generated in the state was shipped to 28 states for treatment or disposal.

During 1995, 85% of the 123,000 tons of hazardous waste imported into Kentucky was received by three facilities for treatment or disposal — Safety Kleen in Henry County and LWD Inc. and LWD Sanitary Landfill in Marshall County.

Figure 30 Hazardous Waste Imports and Exports in KY



Source: KY Division of Waste Management

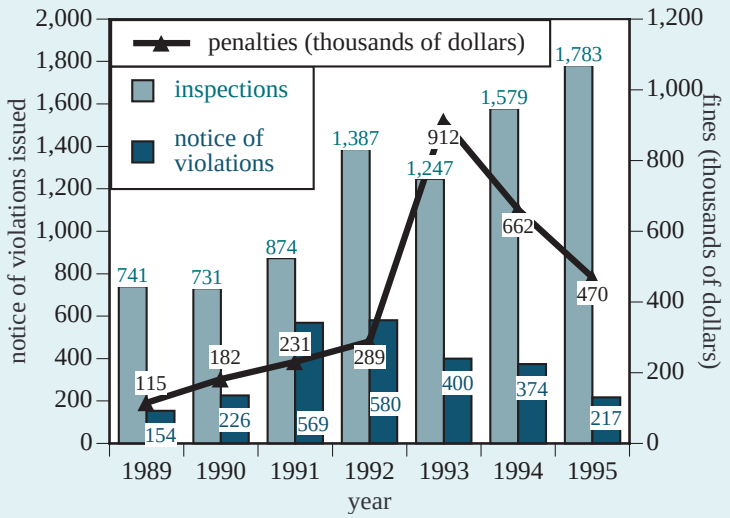
Kentucky remains a net exporter of hazardous waste. In 1995, hazardous waste generated in Kentucky was shipped to 28 states for treatment or disposal. During 1995, 85% of the hazardous waste imported into Kentucky was received by three facilities — Safety Kleen in Henry County and LWD Inc. and LWD Sanitary Landfill in Marshall County.

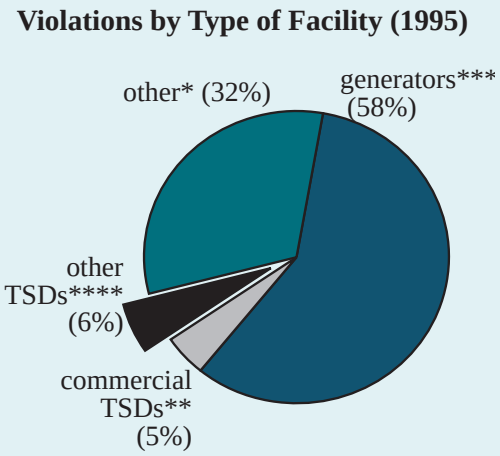
More Inspections, Fewer Hazardous Waste Violations Cited in 1995

Each year, the Division of Waste Management conducts inspections of generators and the 91 facilities that have permits to treat, store, or dispose of hazardous waste. Hazardous waste inspections have steadily increased since 1990, reaching a record high of 1,783 in 1995 **(Figure 31)**.

Although there were more inspections, the number of violations has decreased. Most hazardous waste violations were paperwork in nature, according to state officials. During 1995, 28 facilities were assessed fines, ranging from $500 to $100,000.

Figure 31 Hazardous Waste Enforcement and Compliance Trends in Kentucky





**Used oil marketers, transporters, non-notifiers, limited quantity generators, illegal disposal. **Permitted treatment, storage, disposal facilities that receive waste from off-site. ***Large and small quantity generators. ****Permitted treatment, storage, disposal facilities that process waste on-site. Source: KY Division of Waste Management*

Contaminated waste sites in Kentucky continue to pose threats to human and environmental health. In the past two years, more than 500 sites have been identified.

563 New Potential Contaminated Waste Sites Identified in Past Two Years

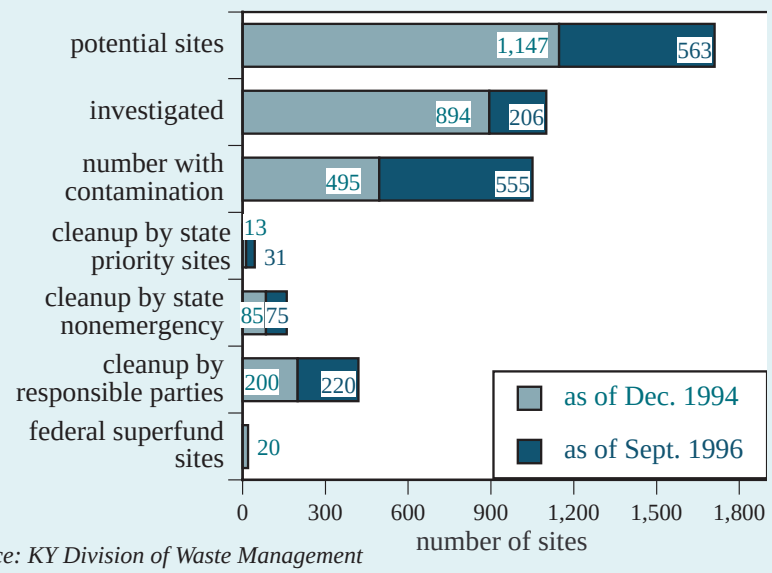
Contaminated waste sites continue to pose threats to human and environmental health. In the past two years, more than 500 sites have been identified. Reported waste sites in Kentucky now number 1,710. Investigations at 1,100 of these sites have confirmed contamination at all but 50 **(Figure 32)**. Waste sites are located throughout the state with the largest number in Jefferson County **(Figure 33)**.

Progress toward the clean up of contaminated waste sites continues. Since Dec. 1994, 220 sites have been addressed by responsible parties **(Figure 32)**. Another 160 sites had removal actions and 44 had more extensive cleanup activities conducted by the state in the past two years where the responsible party could not be identified or was financially unable to remediate the site.

State monies to address abandoned waste sites are provided through the KY Hazardous Waste Management Fund **(Figure 34)**. The fund, established by the General Assembly in 1981 and later amended in 1990, is financed through a fee on hazardous waste produced. Each year, about $2.2 million is collected from hazardous waste generators to finance the fund. But many sites remain in need of cleanup and hundreds of new sites are discovered each year. Resources and personnel to address these sites are limited. The state is only able to address about 22 sites a year. Currently, 25 high-priority sites are now in some stage of remediation **(Figure 35)**.

Reported waste sites in Kentucky now number 1,710. Investigations at 1,100 of these sites confirmed contamination at all but 50. Progress toward the clean up of contaminated waste sites continues. Since Dec. 1994, 220 sites have been remediated by responsible parties.

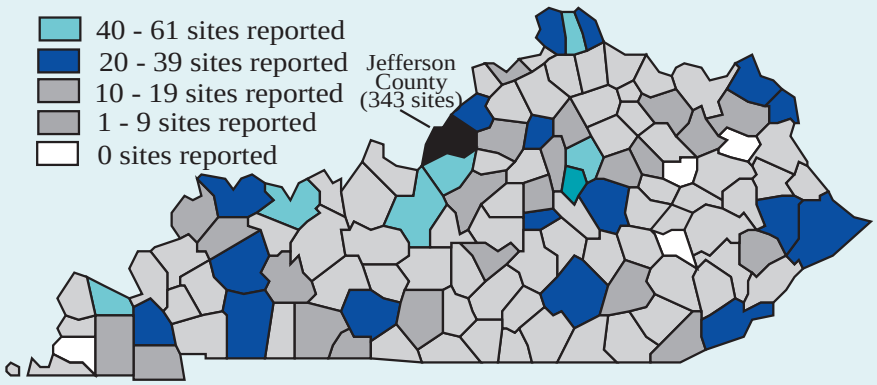
Figure 32 Status of Contaminated Waste Sites in Kentucky



Source: KY Division of Waste Management

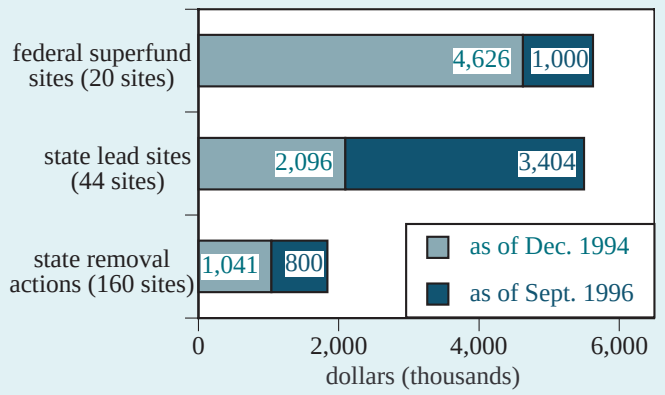
Waste sites are located throughout the state. The largest number of reported sites, 343 is in Jefferson County.

Figure 33 Reported Contaminated Waste Sites in KY (1995)



Note: Contaminated or potentially contaminated sites. Source: KY Div. of Waste Management

Figure 34 Expenditures from Kentucky Hazardous Waste Management Fund



Source: KY Division of Waste Management

State monies to address abandoned waste sites are provided through the Kentucky Hazardous Waste Management Fund. The fund is financed from a fee on hazardous waste generated and collects $2.2 million a year.

Figure 35 Priority Contaminated Waste Sites in KY

County	Site
Boyd	Johnson Fork Dump
Bullitt	Mudd Property
Carlisle	Deena Products
Crittenden	Hunts Hardwoods
Fayette	Tobacco States
Fleming	Maxey Flats*
Franklin	Environment Salvage & Recycling
Grayson	Sawdust Fire
Greenup	Jeff Meade Landfill**
Hardin	Kent Records
	Industrial Haulers***
Hopkins	Jesse Gibson
Jefferson	Exmet
	Shively Battery Dump
Kenton	Bank Lick Creek
	Donaldson Art Sign
Lawrence	Roe Creek Landfill**
Marion	Allen Chemical***
McCracken	Rottgering Well
Meade	Derby Tank & Car
Muhlenberg	Primary Recovery***
Nelson	BC Battery
Warren	Rad Chemical
Woodford	Caldwell Burn Site

**Federal Superfund site*
***Old landfill*
****Responsible party to conduct cleanup.*
Source: KY Division of Waste Management

290,155 Kentuckians Live Within 4 Miles of a Federal Superfund Site

Twenty of the 1,227 federal NPL (national priority list) federal Superfund sites are located in Kentucky. Federal NPL Superfund sites are considered the country's worst contaminated sites. An assessment conducted by EQC of the 20 federal NPL Superfund sites located in the state using Landview II, a mapping software program, found that 290,155 Kentuckians, or 8% of the state's population, live within a four-mile radius of a contaminated site, of which 42,389 are children nine years of age and younger **(Figure 36)**. Eight of the 20 sites are located in areas where the median household income is below the state average.

The U.S. EPA has primary authority for ensuring the clean up and management of federal Superfund sites. Progress, while often times slow, has been made toward the containment or remediation of Kentucky's 20 federal Superfund sites. Cleanup activities at six sites — A.L. Taylor (Valley of the Drums), Lee's Lane Landfill, Newport Dump, Howe Valley, Distler's Farm, and Distler's Brickyard — have been completed and the sites are now in long-term maintenance.

For many federal Superfund sites, monitoring and maintenance will last for many years. For example, Maxey Flats, a federal Superfund site in Fleming County, will likely be monitored for hundreds of years. Four hundred responsible parties recently agreed to pay $60 million to contain the 4.75 million cubic feet of mostly low-level radioactive waste disposed at Maxey Flats during 1963 to 1977. It could take as long as 35 to 100 years for the disposal cells to settle before a permanent cap is constructed at the site. In the meantime, workers will remove 3 million gallons of contaminated water and install temporary plastic covers at the site.

The federal Superfund law has been the subject of intense national debate. The program has been criticized for the length of time, costs, and remedies used to clean up sites, mismanagement of sites, responsible party liability, and other legal issues. Fourteen years after the law was enacted, only 304 of the 1,227 NPL Superfund sites (23%) had cleanups completed.[10] The average cost to clean up a Superfund site is $30 million. Last year, the U.S. EPA announced 20 reforms to make the program more efficient. Congressional efforts to reform the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, otherwise known as Superfund), has been ongoing since 1994. Several bills have been introduced to reform the Superfund law by reducing litigation, requiring greater consideration of the future uses of the site in assessing risk and selecting cleanup remedies, and reducing costs while speeding cleanups.

The U.S. EPA has primary authority for ensuring the cleanup and management of federal Superfund sites. Progress, while often times slow, has been made toward the containment and remediation of Kentucky's 20 federal Superfund sites. Cleanup activities at six sites — A.L. Taylor (Valley of the Drums), Lee's Lane Landfill, Newport Dump, Howe Valley, Distler's Farm and Distler's Brickyard — have been completed and the sites are now in long-term operation and maintenance.

For many federal Superfund sites, monitoring will last for years. Maxey Flats, a Superfund waste site in Fleming County, will likely be monitored for hundreds of years.

Figure 36 Status of Federal Superfund Sites in Kentucky

Site	Listed	Population 4 miles*	Median Income**	Cleanup Phase	Cleanup Cost dollars***
A.L. Taylor-Valley of Drums Brooks–Bullitt Co.	1981	42,178	$27,838	O&M	$800,000
B.F. Goodrich/Airco (2 sites) Calvert City–Marshall Co.	1982	4,430	$24,585	remedy designed	$1.3 million
Distler Brickyard West Point–Hardin Co.	1982	2,558	$17,997	O&M	$7.4 million
Distler Farm Louisville–Jefferson Co.	1982	4,048	$19,528	O&M	$1.2 million
Lee's Lane Landfill Louisville–Jefferson Co.	1982	49,028	$26,687	O&M	$2.2 million
Newport Dump Wilder–Campbell Co.	1982	94,183	$24,730	O&M	$516,000
Smith's Farm Brooks–Bullitt Co.	1984	20,595	$29,504	cleanup underway	$26.4 million
Maxey Flats Hillsboro–Fleming Co.	1986	1,948	$21,808	remedy selected	$60 million
Howe Valley Howe Valley–Hardin Co.	1987	1,675	$15,542	O&M	$345,525
Red–Penn Sanitation Co. Peewee Valley–Oldham Co.	1989	17,038	$36,712	no action deferred to state****	----
Tri–City Indstrl. Disp. Site Brooks–Bullitt Co.	1989	8,221	$24,923	cleanup underway	$3 million
Brantley Landfill Island–McLean Co.	1990	1,884	$17,871	remedy designed	$1.5 to $4.2 million
Caldwell Lace & Leather Auburn–Logan Co.	1990	1,361	$20,703	no action deferred to state	----
Fort Hartford Coal Olaton–Ohio Co.	1990	767	$16,750	remedy selected	$8.9-10.3 million
General Tire & Rubber Mayfield–Graves Co.	1990	8,078	$18,510	no action deferred to state****	----
Green River Disposal Site Maceo–Daviess Co.	1990	2,381	$22,623	cleanup underway	$11 million
Paducah Gaseous Diff. Plant Paducah-McCracken Co.	1992	7,960	$28,721	site study	not determined
National Southwire Alum. Hawesville-Hancock Co.	1992	12,572	$23,926	site study	not determined
National Elec. Coil Dayhoit-Harlan Co.	1992	9,250	$23,926	remedy selected	$2.3 million

**1990 census. ** 1990 median income of households within 4-mile radius of site. State median household income in 1990 was $22,534. ***Includes only actual cleanup costs. Remedial investigations and studies for a site, which are not included in this total, can range from $100,000 to millions of dollars per site. ****State does not concur with the U.S. EPA, no action finding.*
Source: KY Division of Waste Management, Landview II, U.S. EPA

Louisville Selected as Pilot for U.S. EPA Brownfield Initiative

Contaminated commercial and industrial sites in urban areas, known as brownfields, have received increased attention in recent years. A U.S. Government Accounting Office report estimates there are 130,000 to 450,000 brownfields across the country. The cleanup of these sites is estimated to cost $650 billion.[11]

Financial lenders and purchasers are reluctant to invest in brownfields due to liability concerns and instead have turned to developing more pristine "greenfields" in the suburbs and rural areas. The impacts of brownfields are great, posing health

risks, reduced property values, and loss of tax revenues. Many of these sites are disproportionately located in communities of color and in poor neighborhoods.

The 1996 Kentucky General Assembly passed Senate Bill 219 which added several new provisions to address brownfields. The law sets up a mechanism to relieve a public entity from further responsibility for environmental assessment and cleanup of the site upon issuance of a letter from the state relieving the entity from further responsibility. The intent is to provide private interests incentive to acquire and develop brownfields by releasing them from any future site liability.

The U.S. EPA has also proposed a new effort to clean up and redevelop brownfields. The U.S. EPA Brownfield Initiative, launched in Jan. 1996, is an effort to attract investment by streamlining regulations. Brownfields legislation has also been introduced in Congress to address liability issues and provide financial support to states to help clean up these sites.

The City of Louisville was selected in 1995 as one of U.S. EPA's 50 Brownfield projects to assess, safely clean up, and sustainably reuse brownfields. Brownfields in Louisville cost the city about $8.7 million annually in lost property tax revenues and have significantly affected the revitalization of inner-city neighborhoods.[12] Louisville chose the Ni-Chro Plating site as its brownfield pilot project. The site was a former metal plating plant located in the city's heavy industrialized corridor. The corridor encompasses 5,401 acres including the city's most distressed neighborhoods. The brownfields program in Louisville has statewide implications, as these sites are know to exist even in the smallest of towns throughout Kentucky.

The City of Louisville has been selected as one of U.S. EPA's 50 Brownfield projects to assess, safely clean up, and sustainably reuse brownfields. Brownfields in Louisville cost the city about $8.7 million annually in lost property tax revenues and have significantly affected the revitalization of inner-city neighborhoods.[12]

Underground Storage Tanks

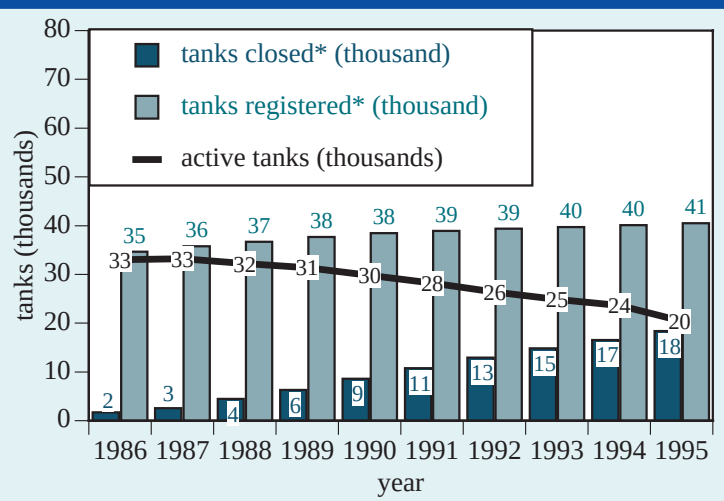
Underground petroleum and hazardous chemical storage tanks began to be regulated in Kentucky in 1986. These tanks can pose pollution threats to drinking water supplies and the environment. State and federal laws now require underground tanks that store petroleum or hazardous chemicals to be registered and be closed, removed, or upgraded to meet various protective measures by 1998.

Underground storage tanks (USTs) were required to meet release detection requirements by Dec. 22, 1993. As of 1995, 55% of the active tanks in Kentucky met release detection rules.

Half of the 20,368 Active Tanks Will Require Closure, Removal, or Upgrading to Meet 1998 Federal Requirements

Underground storage tanks (USTs) were required to meet release detection requirements by Dec. 22, 1993. As of 1995, 55% of the active tanks in Kentucky met release detection rules. By 1998, tanks must meet spill, overfill, and corrosion protection requirements. As of 1995, 30% of the active tanks in Kentucky met spill prevention, 28% met overfill, and 50% met corrosion protection requirements. It is estimated that half of the 20,368 active tanks will require closure, removal, or upgrading to meet the 1998 federal requirements **(Figure 37 & 38)**.

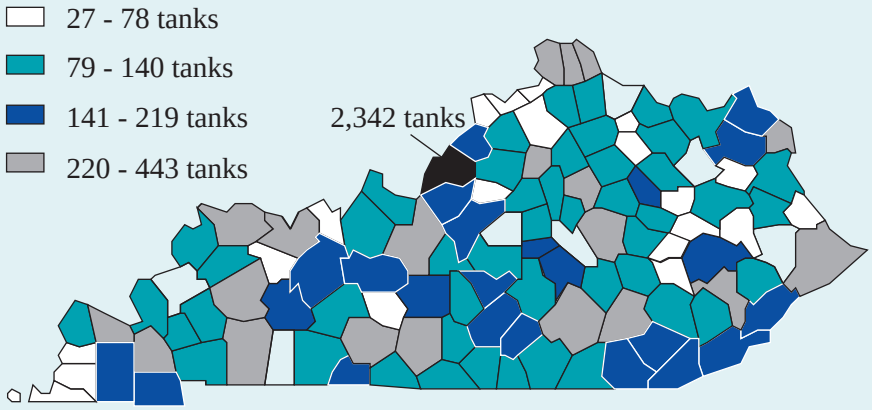
Figure 37 Underground Storage Tanks in KY



**Cumulative yearly total. Source: KY Division of Waste Management*

By 1998, tanks must meet spill, overfill, and corrosion protection requirements. It is estimated that half of the 20,368 active tanks will require closure, removal, or upgrading to meet the 1998 federal requirements.

Figure 38 Registered Active Underground Storage Tanks (1996)



Note: Includes registered petroleum and hazardous chemical underground storage tanks regulated by the state. Source: KY Division of Waste Management

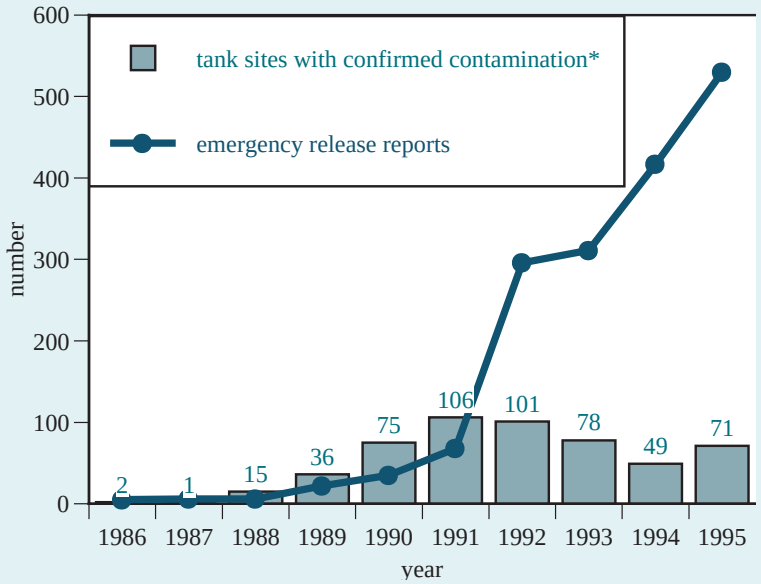
Investigations at 6,000 UST facilities in Kentucky detected soil or water contamination at 9%, or 534 tank sites which required long-term cleanup **(Figure 39)**. There has also been a 93% increase in emergency releases reported by USTs between 1990 and 1995, from 35 to 530. This increase is attributed to programmatic changes that have allowed for better tracking of releases, new regulations requiring release detection, and the aging of many tanks.

UST Inspections Increase, More Violations Discovered

Efforts to bring USTs into compliance with federal and state rules are ongoing. In 1995, there were four times as many inspections of tanks as were conducted in 1994 **(Figure 40)**. Consequently, more violations were cited and penalties assessed than in previous years. The increase was largely due to an effort to make the state UST program more efficient and clear out the backlog of cases. Many violations were administrative in nature. During 1995, 53 UST facilities were assessed fines

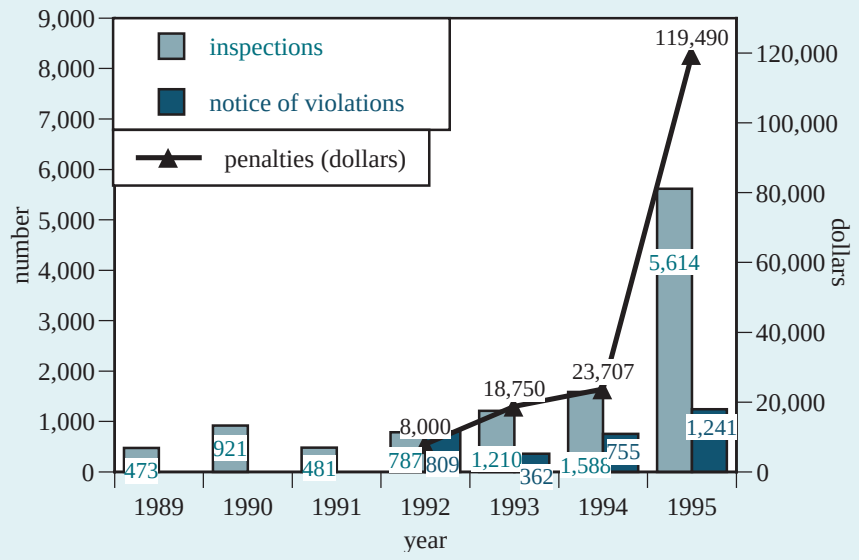
Investigations at 6,000 UST facilities in Kentucky detected soil or water contamination at 9%, or 534 tank sites which required long-term cleanup. There has also been a 93% increase in emergency releases reported by USTs between 1990 and 1995, from 35 to 530.

Figure 39 Underground Storage Tank Contamination in KY



**Groundwater and/or soil. Source: KY Division of Waste Management*

Figure 40 Underground Storage Tank Enforcement and Compliance Trends in Kentucky



Source: KY Division of Waste Management

In 1995, there were four times as many inspections of tanks as were conducted in 1994 . Consequently, more violations were cited and penalties assessed than in previous years. During 1995, 53 UST facilities were assessed fines ranging from $100 to $5,000.

ranging from $100 to $5,000.

The state program to register tanks and review corrective action plans led to a significant backlog of cases due to a lack of resources and personnel. In Dec. 1995, a two-year backlog of more than 3,000 applications was awaiting review. The Cabinet for Natural Resources and Environmental Protection initiated a project to tackle the backlog of cases. Between Jan. 1996 and March 1996, the Cabinet assembled a workgroup of 42 employees to process the 3,266 UST cases using risk-based standards. The state risk-based UST standards went into effect April 18, 1994. These standards consider type of soils, depth to groundwater, environmentally sensitive features, drinking water impacts, and fumes in structures to determine cleanup levels. The Cabinet does have the option of reopening a UST case to take further action if contamination problems are suspected. To date, 10 UST cases have been reopened.

The state risk-based UST standards went into effect April 18, 1994. These standards consider type of soils, depth to groundwater, environmentally sensitive features, drinking water impacts, and fumes in structures to determine cleanup levels.

Fund Finances 896 UST Projects at $106.1 Million

The Petroleum Storage Tank Assurance Fund was established in 1990. The purpose of the fund is to provide insurance to tank owners and help pay for tank site cleanups. The state law was later amended in 1994 to help raise additional money to pay for tank site cleanups. The law now provides for a fee of 1.4 cents per gallon of motor fuel sold in the state to finance the fund. The Fund is administered by the Office of Petroleum Tank Environmental Assurance Fund.

As of Oct. 1996, $106.1 million has been obligated from the fund to 896 applicants and approximately $25.2 million remained unobligated. The fund has about $24.2 million in potential obligations awaiting processing. To date, 296 of the funded projects have been completely remediated at an average cost of $47,809 per site. There are 600 UST site cleanups underway with a projected average cost of $147,809 per site. Cleanup costs at tank sites are expected to decline due to the use of state's new risk-based UST cleanup standards. It has taken, on average, one year to obligate monies to reimburse tank owners for corrective action costs. It is anticipated that a recent restructuring of the agency responsible for administering the funds will speed the time it takes to process a claim.

There are 600 UST site cleanups underway with a projected average cost of $147,809 per site. Cleanup costs at tank sites are expected to decline due to the use of new state risk-based UST standards.

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1996 State of Kentucky's Environment

Toxics

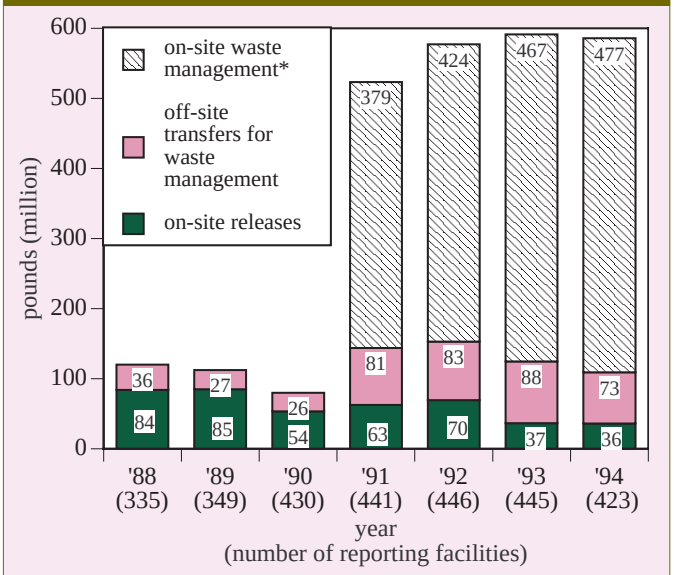
Every day, the typical person comes in contact with some of the 70,000 chemicals registered for commercial use — from household cleansers used in our homes to the gasoline we put in our cars.[1] Nearly six trillion pounds of these chemicals are produced each year.[2] The potential public health and environmental risks posed by industrial and other chemicals used in society are just beginning to be understood. However, most have not been tested to determine their short- and long-term effects or combined effects on people, wildlife, and ecosystems.[3] And new chemical threats are discovered each year. For example, in 1996 after testing imported vinyl mini-blinds, the U.S. Consumer Product Safety Commission alerted the public that these blinds present a lead poisoning hazard for young children.

This *State of Kentucky's Environment Report* reviews the risks posed by toxic chemicals. The report includes information on the generation and release of industrial toxic chemicals to the environment, pollution prevention trends, agricultural and lawn-care chemical-use trends, and toxics in the home.

Industrial Toxic Chemicals

Industrial toxic chemical wastes are produced as by-products of the manufacturing process. One source of data to measure industrial toxic generation and emissions is the Toxic Release Inventory (TRI). The inventory was established in 1988 as part of the federal Emergency Planning and Community Right-to-Know Act of 1986. The act requires certain large manufacturers to self-report to the public the amount of more than 300 toxic chemicals generated, disposed in landfills, released to the air or water, or otherwise managed on- or off-site.[4] (The TRI list was recently increased to more than 600 chemicals for reporting year 1995.)

Figure 1 Generation of Toxic Chemicals in KY



*Note: Previous yearly totals are not adjusted for newly added or deleted chemicals. Data not required to be reported on recycling and energy recovery for 1988-1990. *On-site category was added in 1991 and includes chemicals generated, treated, and recovered at the site of generation.*
Source: Toxic Release Inventory Reports

585 Million Pounds of Toxics Generated During 1994 in KY

In 1994, the most recent year which data is available, 22,744 facilities in the U.S. reported generating 6.13 billion pounds of toxic chemicals. In Kentucky, 423 industrial facilities reported generating 585.8 million pounds of TRI chemicals that year **(Figure 1)**. This amounts to 154 pounds of toxic

EQC

Environmental Quality Commission
Environmental Indicators Program
Reporting on Environmental Trends and Conditions in Kentucky.

1996 Trends Reports
- Safe Drinking Water
- Air Quality
- Waste Management
- Toxics
- Water Quality
- Natural Resources
- Resource Extraction

EQC is a seven-member citizen commission created under state law with a mission to monitor environmental trends and conditions, promote partnerships to improve and protect the environment, provide a public forum for the discussion of environmental issues, and advise state officials on environmental matters.

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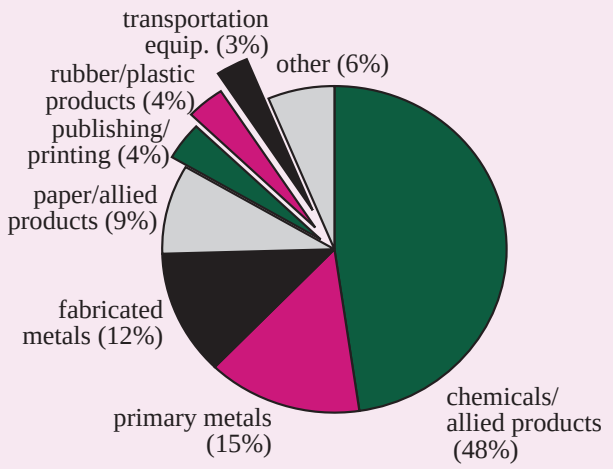
Leslie Cole, Ex. Director
Scott Richards, Asst. Dir.
Erik Siegel, Research Asst.
Frances Kirchhoff, Adm. Asst.

Figure 2 Major Generators of TRI Toxic Chemicals in Kentucky (1994)



Note: Based on the generation of 585.8 million pounds of toxic chemicals by those KY manufacturers required to report under the federal TRI. Source: Toxic Release Inventory Report

In 1994, the most recent year which data is available, 423 industrial facilities in Kentucky reported generating 585.8 million pounds of TRI chemicals. This amounts to 154 pounds of toxic chemicals for every Kentuckian. The major generators of TRI chemicals in the state are the chemical, primary and fabricated metals, and paper/allied products industry.

Some areas of the state have a larger concentration of industry and thus a greater burden and potential environmental or health risks from toxics. Eight counties accounted for 68% of the toxic chemical releases in 1994 (Ballard, Hancock, Jefferson, Logan, Marshall, Scott, Simpson and Woodford).

chemicals for every Kentuckian. The major generators of TRI chemicals in the state are the chemical, primary and fabricated metals, and paper/allied products industry **(Figure 2)**.

It should be noted that the TRI inventory has serious limitations when it comes to detailing toxic releases and measuring reduction trends. Chemicals are continually added to or deleted from the TRI list, making yearly comparisons difficult, and the TRI does not include many chemicals. While the number of chemicals required to be reported was recently increased from 343 to 629 for the 1995 reporting year, the U.S. Environmental Protection Agency (U.S.EPA) estimates that the TRI only accounts for 5% of the total releases of toxic chemicals to the environment.[5] Many generators of toxic chemicals such as incinerators, utilities, mineral extraction processes, and waste management facilities are not required to report. And the annual threshold for those companies reporting is 25,000 pounds if the chemical is processed or manufactured and 10,000 if the chemical is otherwise used. Also, facilities with less than 10 employees are not required to report to TRI.

The U.S. EPA's recent efforts to expand TRI toxics reporting to 6,400 new facilities including petroleum bulk terminals, coal mines, and chemical wholesalers have come under fire by industry groups claiming these facilities are already heavily regulated.[6] Despite these limitations, the TRI is still an important source of data on the generation and release of industrial toxic chemicals.

Toxic Releases to KY's Environment Decline 57% Since 1988

Most industrial toxic chemicals in the state are managed on the site of generation, primarily through recycling and treatment **(Figure 1)**. However, in 1994, 36.2 million pounds of industrial toxic chemicals were reported released to Kentucky's environment. That year, nationwide releases totaled 2.26 billion pounds. Kentucky ranked 21st in the nation for total 1994 TRI toxic chemical releases.[7]

Some areas of the state have a larger concentration of industry and thus a greater burden and potential environmental or health risks from toxics **(Figure 3 & Table on page 15)**. Eight counties accounted for 68% of the toxic chemical releases in 1994 (Ballard, Hancock, Jefferson, Logan, Marshall, Scott, Simpson, and Woodford). The top ten chemicals released to the air, water, and land are listed in **Figure 4**.

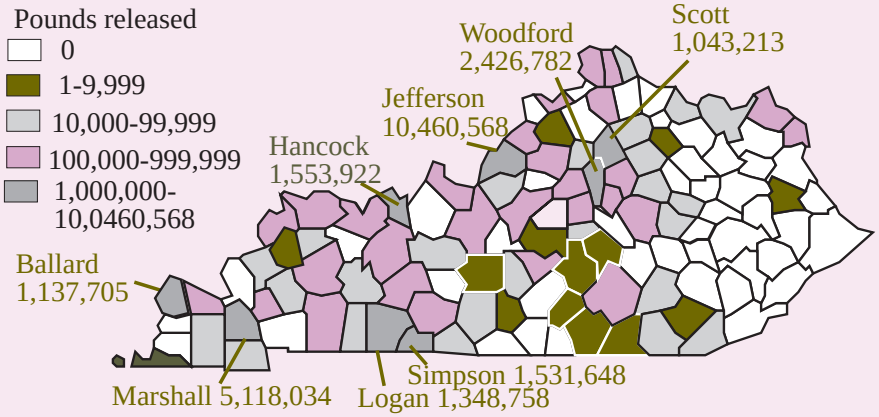
Documenting industrial toxic chemical release trends is difficult because reporting requirements have changed nearly every year. But based on the data reported by industrial sources, the total releases of TRI toxic chemicals to Kentucky's environment have declined 57% between 1988 and 1994 **(Figure 1)**.

Toxics Releases Decline to Air 25%, to Water 71% Since 1988

Most of toxic releases reported in Kentucky are to the air. In 1994, air releases accounted for 97% of the toxic emissions. Reported toxic air releases have declined 25% between 1988 and 1994 **(Figure 5)**. A more detailed discussion of air toxic emissions appears in the 1996 State of Kentucky's Environment Report on Air Quality which can be obtained from EQC.

An estimated 3.2 million pounds of TRI chemicals were also reported released to state waterways from 1988 through 1994. But trends reveal that the yearly amount of toxics discharged to waterways is declining. In 1994, 403,292 pounds of toxic

Figure 3 Toxic Chemical Releases in KY and Leading Counties (1994)



Source: Toxic Release Inventory Report

chemicals were reported released to waterways, an 18% decrease from 1993 and a 71% reduction since 1988 **(Figure 5)**. Of the 13 river basins in Kentucky, the Tennessee River received the greatest burden of toxic chemical discharges from Kentucky industries since 1990, followed by the Big Sandy and Ohio rivers **(Figure 6)**.[8]

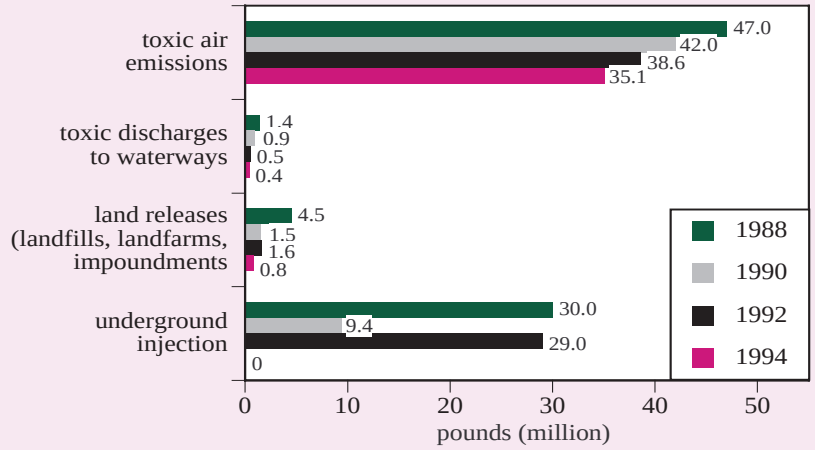
During 1994, there was no underground injection of toxic chemicals reported in Kentucky **(Figure 5). The** only facility in the state with permitted injection wells, E.I. DuPont in Jefferson County, found a market for the hydrochloric acid it had been injecting and closed its two injection wells in 1992.

Releases to the land, which include impoundments and landfills, show declining trends **(Figure 5)**. Land releases have fallen 82% since 1988. The decline is primarily attributed to one facility, Newport Steel, reducing its land releases from 3.4 million pounds in 1988 to zero releases in 1994. The company is no longer disposing of its hazardous waste in its on-site landfill in Campbell County and is now recycling much of this waste.

Most Chemicals Transferred Off-Site are Recycled

Toxic chemicals generated in Kentucky and transferred off-site for disposal or treatment have varied from year to year **(Figure 1)**. In the past few years, the amount of toxics transferred off-site by Kentucky facilities for waste management has shown declining trends, from 88 million pounds in 1993 to 73 million in 1994.

Figure 5 Toxic Releases to Kentucky's Environment



Note: Releases on-site of generation. Source: Toxic Release Inventory Reports

Figure 4 Top Ten Toxic Chemicals Released to KY's Air, Water, Land (1994)

Air Releases (lbs.)

Toluene (6,200,555)
Methanol (5,045,316)
Xylene (4,231,861)
Chlorodifluoromethane (2,329,742)
Dichloromethane (1,177,328)
Glycol Ethers (1,075,992)
Methyl Ethyl Ketone (1,019,709)
Trichloroethylene (1,009,103)
Hydrochloric Acid (874,150)
1,1-Dichloro-1-fluoroethane (766,752)

Water Releases (lbs.)

Ammonia (159,119)
Methanol (74,600)
Chlorine (37,103)
Zinc Compounds (20,849)
Formaldehyde (14,748)
Methyl Ethyl Ketone (13,365)
Hydrogen Fluoride (13,150)
Tert-butyl Alcohol (10,824)
Hydrochloric Acid (9,535)
Manganese Compounds (5,943)

Land Releases (lbs.)

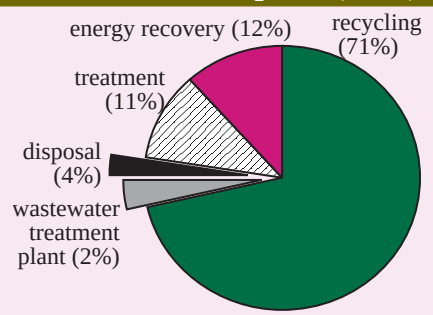
Aluminum (570,005)
Copper (72,575)
Manganese (56,255)
Copper Compounds (18,265)
Manganese Compounds (16,014)
Chromium Compounds (15,838)
Zinc Compounds (13,005)
Chromium (11,284)
Nickel (10,758)
Ethylene Glycol (8,862)

Figure 6 Reported Toxic Chemical Discharges to KY Waterways

River Basin	lbs. Released (1990-94)
TN River	1,459,177
Big Sandy	346,373
Ohio	316,538
MS River	299,450
Ohio Tribs.*	92,250
Barren	79,548

**White Oak watershed.*
Source: Environmental Working Group

Figure 7 Toxic Transfers Off-Site for Treatment/Disposal (1994)



Note: Based on 73 million pounds of toxics transferred off-site by KY companies.
Source: Toxic Release Inventory Report

Most of the chemicals transferred off-site were recycled or burned in industrial boilers for energy **(Figure 7)**. Copper, lead compounds, and manganese comprised 47% of the toxic chemicals recycled. Organic solvents are also commonly recycled.

About 12% of the toxics transferred off-site were treated to render them nonhazardous. Kentucky facilities sent 7.3 million pounds off-site for treatment in 1994, compared to 9.57 million pounds in 1993 and 15.9 million pounds in 1988. Treatment can take several forms, including physical neutralization and incineration.

Kentucky industries also reported discharging 1.8 million pounds of toxic chemicals to publicly owned wastewater treatment plants during 1994, compared to 2.1 million pounds in 1993 and 2.8 million pounds in 1988. Although the U.S. EPA does not consider industrial toxic chemical discharges to publicly owned wastewater treatment plants as direct releases, they estimate that about 10% of these transfers pass untreated through wastewater systems and are discharged to waterways.[9]

Most of the 73 million pounds of toxic chemicals transferred off-site in 1994 by Kentucky industries were recycled or used for energy recovery.

Kentucky Net Exporter of Toxic Chemical Waste

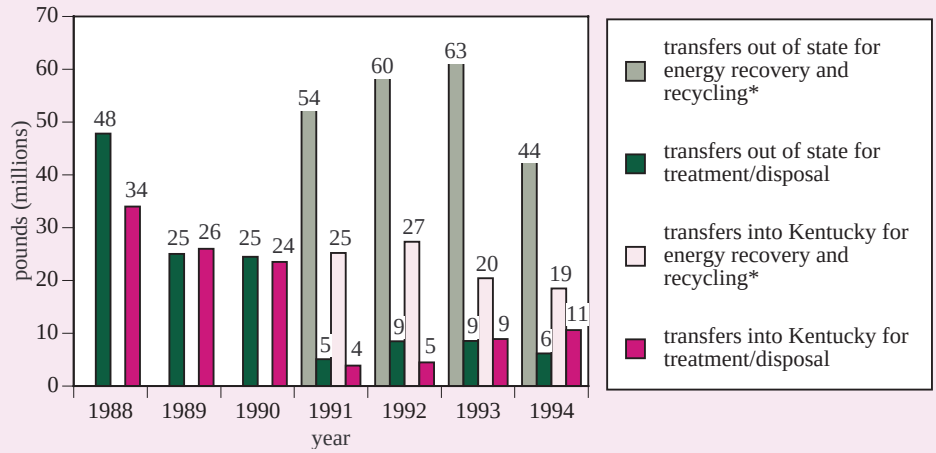
Kentucky is a net exporter of toxic chemical waste **(Figure 8)**. In 1994, 50 million pounds of chemicals were shipped to other states. About 88% of the waste transferred out of state was recycled or used as fuel for energy. Kentucky received 30 million pounds of toxic chemicals from other states for treatment and disposal. About 63% of this waste was recycled or used as an energy source. Unfortunately, the TRI database in not programmed to easily summarize data to determine what companies in Kentucky are major shippers of toxics out of state or are receivers of toxic chemicals imported into the state for treatment or disposal .

Kentucky is a net exporter of toxic chemical waste. In 1994, 50 million pounds of chemicals were shipped to other states. About 88% of the waste transferred out of Kentucky was recycled or used as fuel for energy.

Ten Facilities Release 54% of Toxic Emissions in 1994

Ten facilities accounted for 54% of the total on-site releases of toxic chemicals in 1994. Five of these facilities have reduced toxic emissions since 1988 **(Figure 9)**. For example, Air Products in Marshall County cut releases by 55% and American Synthetic Rubber reduced emissions by 42%. A listing of the top ten industries releasing toxic chemicals to the air, water, and land in Kentucky during 1994 appears in **Figure 10**.

Figure 8 Toxic Chemical Exports/Imports in Kentucky

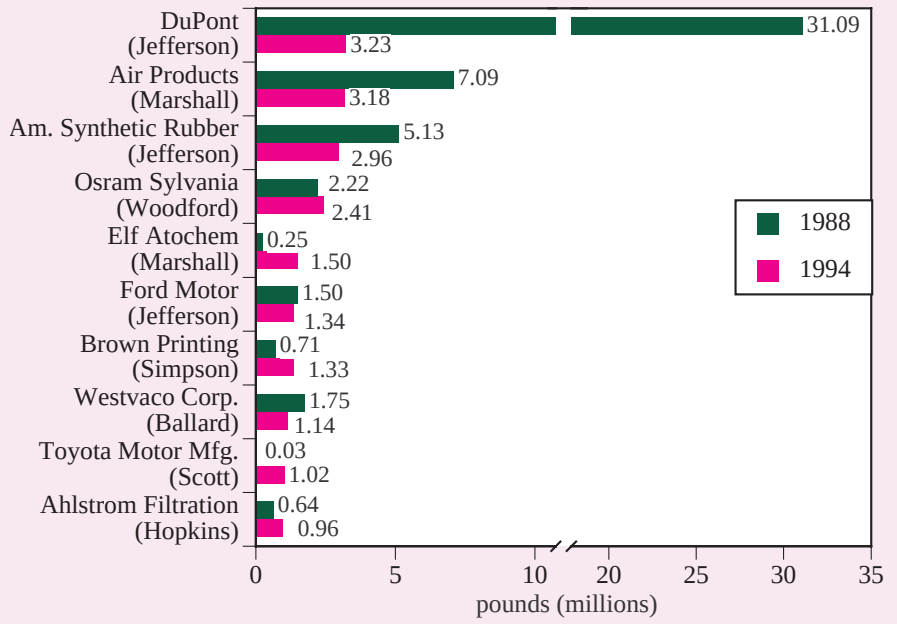


**Facilities not required to report or delineate chemicals transferred for recycling and energy recovery prior to 1991. Source: Toxic Release Inventory Reports*

Priority Toxic Releases and Transfers Fall 39%

In Kentucky, industries have reduced the total releases and transfers of 17 high-priority chemicals by 39%, from 31.8 million pounds in 1988 to 19.4 million pounds in 1994 **(Figure 11)**. Priority toxics are TRI chemicals that have been targeted for reduction by the U.S. EPA because they are highly toxic, used in large volumes, or pose a significant risk to public health and the environment. The U.S. EPA estab-

Figure 9 Top 10 Facilities Releasing Toxic Chemicals in KY



Note: Reported releases on-site. Source: Toxic Release Inventory Reports

Figure 10 Top Ten Releasers of Toxic Chemicals in KY (1994)

To Air-Company, County (lbs.)
DuPont, Jefferson (3,233,381)
Air Products, Marshall (3,172,655)
Am. Synthetic, Jefferson (2,963,602)
Osram Sylv., Jefferson (2,413,755)
Elf Atochem, Marshall (1,475,615)
Ford Motor, Jefferson (1,343,275)
Brown Print, Simpson (1,334,275)
Westvaco, Ballard (1,062,155)
Toyota, Scott (1,022,055)
Ahlstrom Filt., Hopkins (959,860)
54% of state total air releases

To Water-Company, County (lbs.)
ISP Chemicals, Marshall (141,077)
Westvaco, Ballard (71,500)
Ashland Petroleum, Boyd (69,692)
Elf Atochem, Marshall (24,485).
TVA, McCracken (21,000)
Willamette, Hancock (17,100)
U.S. Bureau Prison, Fayette (13,000)
Air Products, Marshall (10,755)
AK Steel, Boyd (7,395)
Elf Atochem, Carroll (3,966)
98% of state total water releases

To Land-Company, County (lbs.)
Imco Recycling, Butler (670,790)
Dravo Lime, Mason (23,482)
Alcan Ingot, Henderson (21,120)
Dow Corning, Carroll (18,348)
ISP Chemicals, Marshall (15,586)
AK Steel, Boyd (15,015)
Rohm and Haas, Jefferson (13,000)
KY Leather Co., Bell (6,174)
Westvaco, Ballard (4,050)
Dayton Walther, Carroll (3,205)
98% of state total land releases

lished a voluntary pollution prevention program, entitled 33/50, in 1991 to promote the voluntary reduction of these 17 priority chemicals 33% by 1992 and 50% by 1995, using 1988 as the base year. Nationwide, 1,300 companies are participating in the 33/50 program. Seventy-six of those companies have facilities in Kentucky.[10]

The total on-site releases and transfers off-site for further waste management of the 17 priority toxics generated in the state have declined, with the exception of two chemicals. Benzene increased 56% between 1988 and 1994 due to rise in demand **(Figure 12)**. Benzene, which is an important component of unleaded gasoline because of its antiknock characteristics, is a human carcinogen that can also effect the nervous system and is toxic to the environment. Trichloroethylene also increased 33%. This chemical is a potential human carcinogen that can also effect the nervous system and cause developmental problems. While **Figure 12** also shows that releases/transfers of heavy metals, such as mercury and lead have declined, heavy metals warrant particular concern because they can reside in the environment for hundreds of years.

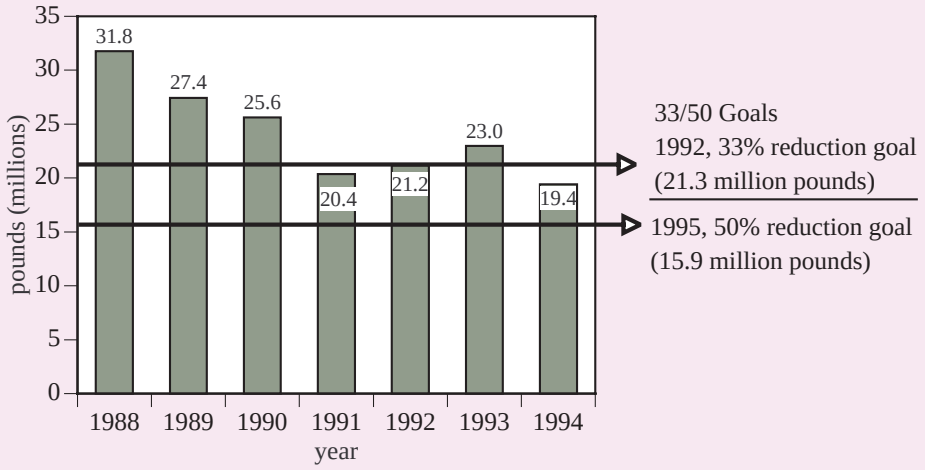
More Incentives Needed to Prevent Toxics Generation

The best way to minimize the threats posed by toxic chemicals is to eliminate waste at every step of industrial process. There are many notable examples in Kentucky where companies have worked to prevent the generation of toxics. For example, MPD, a midsize manufacturer of electronic equipment in Owensboro, reduced the generation of trichloroethylene from 13,200 pounds in 1994 to 5,940 pounds in 1995, while saving $7,000 in disposal costs. Dow Corning in Carrollton reduced all toxic emissions by 92% between 1988 and 1995 and releases of 17 priority toxics by 100%, while more than doubling production. The U.S. EPA reports that the 1,300 companies participating in the 33/50 program at the national level had met the 1995 goal to reduce 17 priority toxics by 50% for reporting year 1994. A review of those 76 companies with operations in Kentucky participating in the 33/50 program reveals that 31 facilities have met the 1995 50% reduction goal for the 17 priority chemicals **(Figure 13)**.

The best way to minimize the threats posed by toxic chemicals is to eliminate waste at every step of industrial process.

In Kentucky, industries have reduced the total releases and transfers of 17 high priority chemicals by 39%, from 31.8 million pounds in 1988 to 19.4 million pounds in 1994. Priority toxics are TRI chemicals that have been targeted for reduction by the U.S. EPA because they are highly toxic, used in large volumes, or pose a significant risk to public health and the environment.

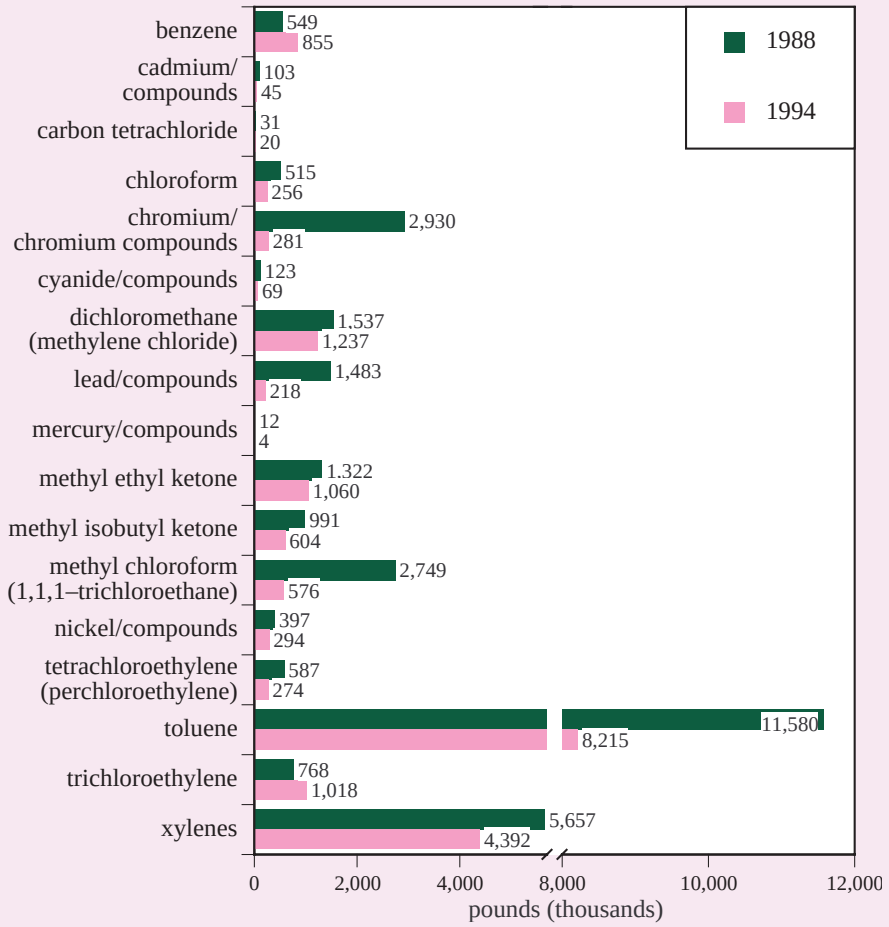
Figure 11 Top 10 Facilities Releasing Toxic Chemicals in KY



Note: Based on releases on-site and transfers off-site for waste management. Does not include transfers for recycling and energy recovery which were not reported until 1991. The yearly totals are based on the reduction of priority chemicals by all KY facilities and not just those participating in the national 33/50 program. Source: Toxic Release Inventory Reports

While the releases and transfers of 17 priority toxics generated in Kentucky have declined, two of these chemicals are increasing. Benzene increased 56% since 1988. Benzene is a human carcinogen that can also effect the nervous systems and is toxic to the environment. Trichloroethylene also increased 33% since 1988. This chemical is a potential human carcinogen that can also cause developmental problems.

Figure 12 Releases and Transfers of 17 Priority Toxics in KY



Note: 33/50 or priority toxics are 17 chemicals prioritized for reduction by the U.S. EPA due to their high toxicity, carcinogenicity, or high volume of release with potential environmental impacts. This chart includes releases on-site and transfers off-site. Excludes transfers for recycling and energy recovery which were not required to be reported until 1991.
Source: Toxic Release Inventory Reports

Many companies are getting assistance from the Kentucky Pollution Prevention Center, which was created under state law in 1994, to help businesses voluntarily reduce wastes. The goals of this initiative are to reduce the generation of TRI toxic chemicals and hazardous waste 25% by 1997 and 50% by the year 2002, using 1987 as a baseline. Since 1990, the center, located at the University of Louisville, has performed 266 on-site inspections. During 1995, the center also conducted 80 workshops which were attended by 5,000 people.

Much more remains to be done to meet the state's goal to reduce the generation of toxic chemicals. At a recent pollution prevention forum hosted by EQC, several participants expressed the need to implement the state Environmental Leadership Program passed in 1994 (KRS 224.46-335). The law includes incentives for pollution prevention including green product labeling, compliance credits, consolidation of requirements into one permit, offsetting voluntary actions against future regulatory requirements, and accelerated review of permits. The state has yet to promulgate regulations to implement the program.

Other recommendations suggested at the EQC forum include

- Utilize alternative enforcement actions aimed at reducing toxics.
- Establish community-based goals for pollution prevention.
- Create a pollution prevention policy to guide the state's permitting, compliance, and enforcement programs.
- Provide state regulatory and/or economic incentives for pollution prevention.
- Conduct a pollution prevention campaign to educate corporate leaders in KY.
- Mandate a fee for those companies generating certain toxic chemicals.

Figure 13 KY 33/50 Companies Meeting 50% National Priority Toxic Reduction Goal

Company (county)	% reduction
Airtech Chemical (Boone)	100%
ATR Wire (Boyle)	100%
Dow Corning (Carroll)	100%
General Tire (Graves)	100%
Interlake (Bullitt)	100%
National Southwire (Hancock)	100%
United Tech. (Union)	100%
Dept. Energy (McCracken)	100%
Florida Tile (Anderson)	100%
Inland Container (Jefferson)	100%
SKW Alloys (Marshall)	100%
Am. Standard (Jefferson)	100%
Tecumseh (Pulaski)	99%
Speed Queen (Hopkins)	94%
Gates Rubber (Hardin)	90%
North Star Steel (Marshall)	87%
Am. Olean Tile (Hancock)	86%
Phillips Lighting (Boyle, Madison)	86%
Emerson Elec. (Logan)	83%
Lord Corp. (Warren)	80%
Armco Steel (Boyd)	73%
Vista Performance (Jefferson)	71%
Elf Atochem (Carroll, Marshall)	70%
General Motors (Warren)	70%
Englehard Corp. (Jefferson)	61%
Green River Steel (Daviess)	61%
B.F. Goodrich (Marshall, Jefferson, Knox)	59%
Gamco Products (Henderson)	59%
Westvaco Corp. (Ballard)	56%
Air Products (Marshall)	54%
Thomas Ind. (Christian, Ohio)	51%

Note: Based on 1988-1994 reductions of 17 priority toxic chemicals released on-site or transferred off-site. Source: Toxic Release Inventory Reports

Toxics Impacts on Health and Ecosystems Are Hard to Assess

Assessing the impacts of toxic chemicals is difficult since little is known about the toxicity of most chemicals or their cumulative effects on health and the environment. Of the 70,000 chemicals in the marketplace, only a small fraction have been adequately assessed for toxic effects on humans and other life forms. EQC has compiled a chart on the known risks posed by the top 15 TRI chemicals released to Kentucky's environment. **Figure 14** shows that exposure to 10 of these chemicals at certain levels can effect the nervous system and two are potential carcinogens. It is important to note that several factors will determine whether harmful health effects will occur upon exposure to a toxic chemical. These include dose, duration, exposure to other chemicals, age, sex, lifestyle, and state of health.

In addition, five of the top 15 TRI chemicals released in Kentucky are reproductive toxins and nine have been linked to fetus developmental defects. The U.S. EPA recently announced it plans to "flag" chemicals on the TRI list that have reproductive or fetus developmental effects to better incorporate gender considerations into risk assessment and standard-setting.[11] A state Birth Surveillance Registry, located in the Cabinet for Health Services, will begin collecting information on the incidence of birth defects, still births, disabling conditions and their possible causes. The registry should serve as an important tool to help identify possible linkages between birth defects and environmental conditions.

Exposure to 10 of the top 15 chemicals released to Kentucky's environment at certain levels can effect the nervous system, five are reproductive toxins, two are potential carcinogens, and nine have been linked to fetus developmental defects. A number of factors such as dose and duration will determine if harmful effects will occur upon exposure to a chemical.

Toxic Hot Spots in State Studied

The TRI is a useful tool to identify those areas of the state where further investigation should be conducted into possible environmental and health effects posed by toxic chemicals. One such study has been initiated in the KY-WV-OH 2,300 mile tri-state area that contains 42 industries near Catlettsburg, KY, and Kenova, WV. The Tri-State Geographic Initiative is a multimedia environmental study being

Figure 14 Potential Health and Environmental Effects of Top 15 Chemicals Released to Kentucky's Environment

	Pounds (1994)	acute	cancer	chronic	developmental	reproductive	neurotoxic	ecotoxic	smog	ozone depleter
Toluene	6,201,726	x		x	x	x	x	x	x	
Methanol	4,233,314	x		x	x	x	x	x		
Xylene (mixed isomers)	4,233,314	x					x			
Chlorodifluoromethane	2,329,742	x			x	x	x			x
Dichloromethane	1,177,648	x	x	x			x	x		
Glycol Ethers	1,076,296	x		x		x				
Methyl Ethyl Ketone	1,033,074	x			x		x			
Trichloroethylene	1,009,102	x	x	x	x		x			
Hydrochloric Acid	896,102	x						x		
Aluminum (fume/dust)	864,698	x		x	x		x	x		
1,1-Dichloro-1-fluoroethane	864,688	x					x			x
1-Chloro-1,1-difluoroethane	766,772	x			x					x
Hydrogen Fluoride	743,970	x			x					
Ammonia	717,515	x						x		
N-Butyl Alcohol	689,311	x			x	x	x	x		

Note: Acute toxicity-toxicity that results from a single exposure. Cancer-potential human carcinogenic effects based on current classification by U.S. EPA. Chronic toxicity-toxicity that results from repeated exposure over a long period. Developmental-causing fetal developmental defects. Reproductive-causing reduced fertility or infertility, miscarriages. Neurotoxic-effects to the nervous system. Ecotoxic-chemicals that are toxic to aquatic and terrestrial organisms, both natural and agricultural. Smog-ground-level ozone precursor. Ozone depleter-release linked to the thinning of the ozone layer. Source: KY DEP Risk Assessment Branch, Toxic Release Inventory Report, U.S. Agency for Toxic and Disease Registry, Federal Hazardous Substances Database

The TRI is a useful tool to identify those areas of the state where further investigation should be conducted into possible environmental and health effects posed by toxic chemicals.

conducted by state, local, and federal environmental agencies. The area has been divided into six industrial clusters. In April 1996, six air toxics monitors became fully operational in the Catlettsburg, KY, and Kenova, WV, cluster area which includes four major industries. The monitors will measure air toxics concentrations to determine if levels pose a threat to public health and the environment. Monitoring is expected to continue for one year then be moved to other industrial cluster areas.

The Calvert City Multimedia Project was initiated by the state in 1987 to assess the impacts of industrial pollutants on public health and environmental quality. Calvert City, in Marshall County, is home to several chemical and industrial plants. During 1994, industries in Marshall County reported releasing 5.1 million pounds of toxics to the environment, the second highest levels in the state **(see Figure 3 & table on page 15)**. Some of the findings from the project studies include elevated air levels of VOCs and carbon disulfide, and degradation of the Cypress Creek watershed. Reevaluation of the watershed in the early 1990s found the creek to be recovering after industrial discharges were moved from the creek to the Tennessee River. In addition, a greater incidence of non-Hodgkin's lymphoma and brain tumors in males were discovered in the Calvert City area, although the cause is unknown. While Kentucky has had a cancer registry since 1991, lack of funding and resources have limited its capability to assess the relationship between cancer clusters and toxic hot spots in the state. A federal health study was conducted in response to public concerns that pollution from industrial facilities and a commercial hazardous waste incinerator was causing cancer and other health concerns. The results of the federal health study, issued in 1995, found that Calvert City residents' health was similar to the health of people living 36 miles away in Cadiz. Environmental interests in Calvert City have questioned the findings of the study, indicat-

In April 1996, six air toxics monitors became fully operational in Catlettsburg, KY, and Kenova, WV, area. The monitors will measure air toxics concentrations to determine if levels pose a threat to public health and the environment.

ing that industrial emissions could also be affecting the residents of Cadiz.

There are other areas in Kentucky where toxic chemicals are alleged to be impacting public health. In Owenton, KY, two lawsuits were filed by residents in 1996 claiming an auto parts manufacturing plant built near their town last year exposed them to a highly toxic chemical, nickel carbonyl, during a test run. The owners chose not to open the plant due to public opposition. An assessment conducted by the state in 1996 found no evidence that a significant amount of the toxin was released by the plant, although 10 pounds of the chemical could not be accounted for. In Dayhoit, a lawsuit was recently settled between National Electric Coil and 550 Harlan County residents who alleged exposure to vinyl chloride in well water. The company used the solvent at its plant, which operated from 1951 to 1985.

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Residents living in western Louisville near an industrial corridor known as Rubbertown have expressed concern about possible health effects from exposure to toxic chemicals. The neighborhoods around Rubbertown, a World War II industrial chemical complex, are largely composed of low-income and minority people. This area of Jefferson County has an above average state cancer rate (262 per 100,000 population compared to the statewide rate of 192 per 100,000). A study recently conducted by the Jefferson County Health Department suggests that many cancers in the area are not due to emissions from chemical plants and may be related more to health care quality, accessibility, and affordability, although it was noted that pollution may be a factor in some cancer cases.

In the spring of 1996, the Jefferson County Health Department received a grant from the National Association of City-County Health Organizations to assemble the West County Community Task Force to identify public concerns in Rubbertown area. In September 1996, the task force formalized its list of concerns, including odor problems, particulate air pollution, toxic discharges to waterways, public access to toxic emissions and other data, the need for health screening and assessments, and access to affordable, quality health care. The task force made several recommendations including identification and remediation of dump and spill sites, installation of continuous monitors for major facilities emitting air toxics, development of a community pollution prevention strategy, and conduct a study to identify health and environmental risks in the Rubbertown area.

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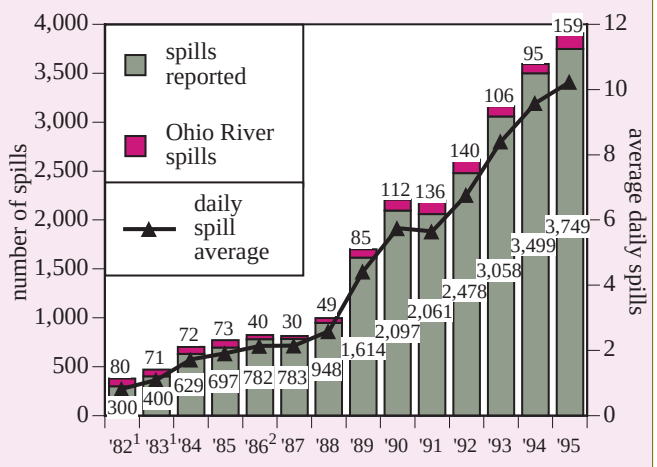
In December 1996, the University of Louisville was awarded a $312,000 Environmental Justice grant from the U.S. EPA to build upon the recommendations of the West County Community Task Force and examine ways to reduce emissions from industrial sources in the Rubbertown area. The U.S. EPA also awarded a $20,000 grant to the Justice Resource Center in Shelbyville, KY to help document and monitor environmental problems in low-income neighborhoods. The center plans to use the funds to monitor smokestack emissions in Louisville and will work to educate low-income neighborhoods about pollution and health.

Toxic and Hazardous Spills

Toxic spills are considered a high ecological threat in Kentucky.[12] Most spills reported to state and local officials are transportation related or occur at industrial sites. Reported chemical spills continue to increase in Kentucky. This is attributed to an increase in transportation activity, tightening of reporting requirements in 1993, and better education and awareness of reporting requirements. In 1994, 3,898 spills and incidents were reported, 159 of them occurred along the Ohio River **(Figure 15)**. The state now averages about 10 spills per day.

The number of spills reported to state and local officials continues to increase. In 1994, 3,898 spills were reported, 159 of them occurred along the Ohio River. The state now averages about 10 spills per day.

Figure 15 Toxic and Hazardous Spills in KY



[1]Estimates. [2]Federal Emergency Planning and Community Right-to-Know Act signed into law which required more extensive spill reporting. Source: KY Dept. for Environmental Protection; Ohio River Valley Sanitation Commission

There have been several major spills/incidents in the state in the past few years including

■ August 12, 1995 - A nitric acid cloud released at the Square D Company in Lexington forced the evacuation of several businesses and a nearby golf course within a half-mile radius of the plant.

■ August 21, 1995 - A sulfuric acid leak from a DuPont plant in Greenup County caused 1,000 residents to be evacuated from their homes and hospitalized 21 people.

■ January 8, 1996 - A 5,000-gallon storage tank at Ashland Inc.'s Catlettsburg refinery ruptured, spilling about 200 gallons of fuel into the Big Sandy River.

■ March 2, 1996 - A railroad car explosion spewed ammonium bisulfate one block wide and several blocks long, covering houses, cars, lawns, and trees in the Clifton neighborhood in Louisville.

■ May 22, 1996 - A sulfuric acid leak from a tractor-trailer near Cynthiana off U.S. Highway 27 was neutralized with lime. Several firefighters were treated for blistered legs from exposure to the acid.

■ June 8, 1996 - A chemical spill from a tanker truck kept KY 40 closed most of the day and caused the evacuation of 20 residents near Warfield.

■ June 19, 1996 - Officials in Northern KY discovered a mile-long oil slick on the Licking River of unknown origin and closed the river to traffic for several hours.

Agriculture, Lawn-Care Chemicals

There are about 21,000 pesticide products and 860 active ingredients registered for use in the U.S.[13]

There are about 21,000 pesticide products and 860 active ingredients registered for use in the U.S.[13] An active ingredient is defined as a chemical that can kill, repel, attract, mitigate, or control a pest or that acts as a plant growth regulator. The U.S. EPA pesticide registration process is intended to address the toxicity of individual active pesticide ingredients to health and the environment. But toxicity testing for many pesticides is incomplete. Moreover, by focusing on individual chemicals, the registration process fails to account for multiple, additive, or synergistic exposures.[14] Most pesticide formulations also contain inert ingredients with their own toxicity and health risks which are relatively unknown. It should be noted that the term "pesticides," as defined under federal law and used in this report, is a broad nonspecific term which includes insecticides, herbicides, fungicides, and other agents.

Agriculture accounts for three-fourths of the total amount of pesticides used in the U.S.[14] In Kentucky, sales of agricultural pesticides increased slightly in recent years. However, five-year trends reveal that sales overall have declined by 6% between 1990 and 1995.

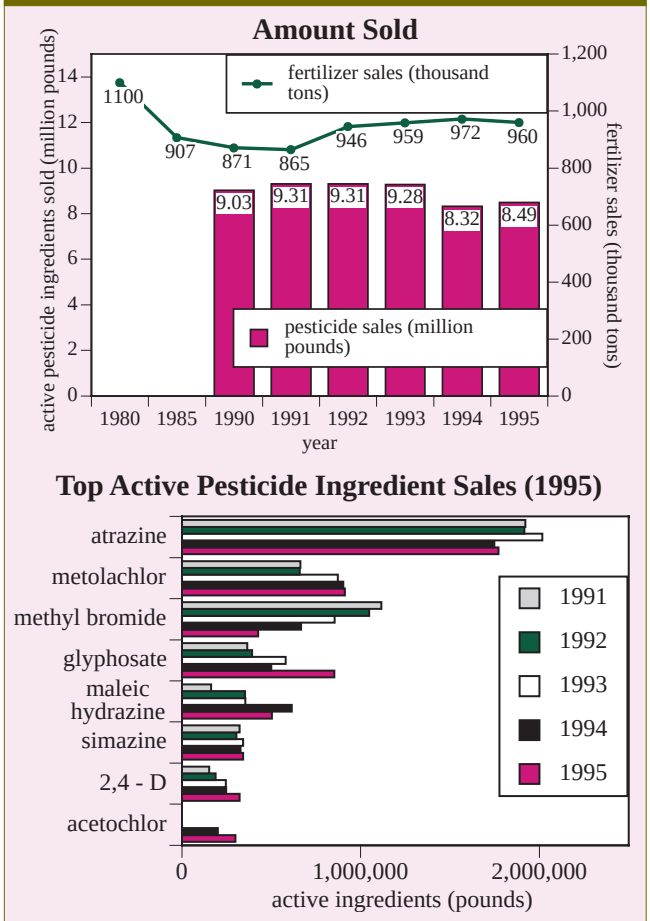
Pesticides are used in large quantities throughout the world. Nationwide, pesticide use increased steadily through the 1960s and 70s; however, this trend has slowed during the 1980s and 90s due to the development of more potent pesticides, more efficient usage, and lower farm commodity prices.[15] But, according to U.S. EPA data, nationwide pesticide use may have hit an all-time high in 1995 at 1.25 billion pounds compared to 1.23 billion pounds in 1994, reversing its downward trend.[16]

Farm Chemical Use in KY Declines 6% Since 1990

Pesticides are a key factor in the production of food and fiber in the U.S. Agriculture accounts for three-fourths of the total amount of pesticides used in the U.S.[17] In Kentucky, sales of agricultural pesticides increased slightly in recent years, totaling 8.49 million pounds in 1995. However, five-year trends reveal that overall pesticide sales have declined by 6% between 1990 and 1995 **(Figure 16)**.

The decline in sales is likely the result of several factors, including a decrease in corn production in the state. The 1995 corn crop was the lowest in four years in Kentucky.[18] The reduction may also be partly due to a shift from the use of tobacco beds to greenhouses and float systems. In 1995, about one-half of Kentucky's tobacco plants were produced with greenhouse/float systems, reducing the need for some pesticides.[19] And harvested acres of tobacco have dropped 20,000 acres per year in 1994 and 1995. Farmer education programs that encourage reduced use of pesticides, like the Integrated Pest Management Program, may also be contributing to the decline in sales. Finally, some pesticide formulations have been changed to make them more concentrated resulting in a smaller amount being applied to achieve the same results of previous formulations. It should be noted that sales data are compiled from annual surveys of agricultural pesticide suppliers in Kentucky and may not be complete. However, the data is important since it is the only information available to document the type and amount of agricultural pesticides used in the state.

Figure 16 Agricultural Chemical Sales in KY



Note: Pesticide sales based on annual surveys. Source: KY Department of Agriculture, KY Agriculture Statistics Service

U.S. EPA Plans to Restrict Use of Several Common Pesticides Used in KY

Eight agricultural pesticides accounted for 64% of the sales in Kentucky in 1995 **(Figure 15)**. As has been the case for the past six years, atrazine remains the top agricultural pesticide sold. Atrazine is a herbicide used to control weeds in field corn. The second leading pesticide sold in the state is metolachlor, another broad spectrum herbicide. Data also reveal that the sale of methyl bromide in 1996, the third leading pesticide sold in the state, has decreased 62% since 1991. Methyl bromide is a soil fumigant used primarily in tobacco beds. However, about half of the tobacco plants grown in Kentucky are now produced in greenhouses reducing the need for this chemical. Methyl bromide is considered an ozone-depleting chemical and will be phased out of use by the year 2001. Another widely used herbicide, cyanazine (ranked 16th in state sales), will be phased out over the next four years because of suspected cancer risks. In 1995, 132,391 pounds of cyanazine were sold compared to 149,112 pounds in 1991.

Data reveal that the sale of methyl bromide, the third leading pesticide sold in the state, has decreased 62% since 1991. Methyl bromide is considered an ozone-depleting chemical and will be phased out of use by the year 2001.

Some pesticides are increasing in sales, including glyphosate (Roundup™) an all-purpose herbicide used in corn and soybean production. Roundup™ is widely used by farmers who practice conservation tillage, a group of plowing techniques that disturb less soil and reduce erosion, to kill weeds prior to planting. The sale of acetochlor, a recently approved pesticide, has also increased in Kentucky.

Several pesticides used in Kentucky will be affected by a rule proposed by the U.S. EPA in June 1996. The rule will restrict the use of five pesticides that have been identified as either probable or possible human carcinogens — alachlor, atrazine, cyanazine, metolachlor, and simazine.[20] These pesticides have been detected in groundwater at short durations in Kentucky during the growing season.[21] Atrazine has also been detected at elevated levels at drinking water intakes in Kentucky along the Ohio River. The proposed federal rule will require the develop-

ment of state comprehensive groundwater protection programs including pesticide state management plans to prevent groundwater contamination.

Programs Collect Old Pesticides, Recycle Containers

A state program to collect unused agricultural pesticides began in 1996. The KY Department of Agriculture expects to collect 50,000 pounds of unused pesticides during 1996.

A state program to collect unused agricultural pesticides began in 1996. The KY Department of Agriculture expects to collect 50,000 pounds of unused pesticides during 1996. The program is funded through pesticide registration fees. In addition, 1996 marked the sixth year of a rinse-and-return plastic pesticide container recycling project. The 1996 program, sponsored by the KY Fertilizer and Agriculture Chemical Association, along with various cosponsors, was funded by a $6,900 donation from DuPont. During 1996, 72 counties participated in the program, and 93,468 pounds of plastic were collected, a 16% increase since 1995. About 27% of the plastic pesticide jugs sold in the state were recycled. A new state law to regulate the storage of fertilizer and pesticides was also passed in 1996 to reduce the potential for surface and ground water contamination.

Random Testing Finds Pesticide Residues in 4% of KY Produce

The safety of food has long been a public concern. There is a common perception that food supplies may not be as wholesome as desired because of pesticide and other chemical residues.[22] But according to former U.S. Surgeon General Dr. C. Everett Koop, "Our food supply is not only the safest, but is the most abundant in the world and pesticides are one of the important tools that have made that abundance possible."[23] Still, many Americans remain worried about chemical residues in food, especially as they affect infants and children. A 1994 U.S. Government Accounting Office public opinion poll found that chemical residues in food were rated as the preeminent health hazard by 72% of those surveyed.[24]

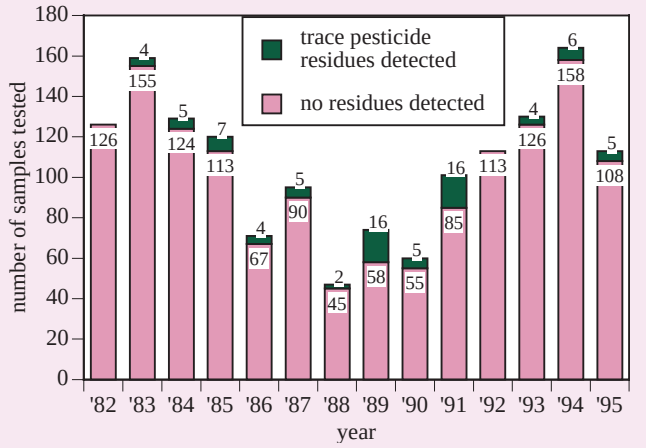
Random state testing of agricultural produce grown in Kentucky found that 4% of the samples had trace pesticide residues. Levels detected were below the tolerance standards set by the federal government.

Public concerns have led to an increase in demand for chemical-free produce in Kentucky. In 1996, 102 farms were registered as organic farms, compared to 27 in 1990. The KY Department of Agriculture expects the number of organic farms to increase with additional interest in organic field crops and produce. The state is also looking at developing an animal product organic-certification program.

Random state testing in 1995 of produce grown in Kentucky found that 4% of the 113 samples had trace pesticide residues **(Figure 17)**. Levels detected were below the tolerance standards which represent the maximum residue allowed on food. But most of the food we consume comes from other states and countries. The federal Food and Drug Administration (FDA) routinely tests food for pesticide residues. The agency has reported that pesticide residues on infant and adult foods are almost always well below tolerances set by the federal government.[25] In 1994, of the 11,346 domestic and imported food samples tested by the FDA, 195 samples or 1.7% had pesticide residues above the tolerance standards. However, the FDA testing program has been criticized because less than 1% of the nation's food is monitored and the penalties for unacceptable residue levels do little to stop contaminated foods from entering the market.[26]

Congress recently passed legislation to further address pesticide food safety concerns. The federal Food Quality Protection Act was signed into law in August 1996. The act amends the Federal Insecticide,

Figure 17 Pesticide Residues in KY Produce



Note: Food samples screened for parts per billion of chlorinated pesticides and .05 parts per billion of organophosphates. If other contaminants are suspected, additional analysis is conducted. Residue levels detected have been below tolerance standards since 1990. Source: KY Cabinet for Health Services

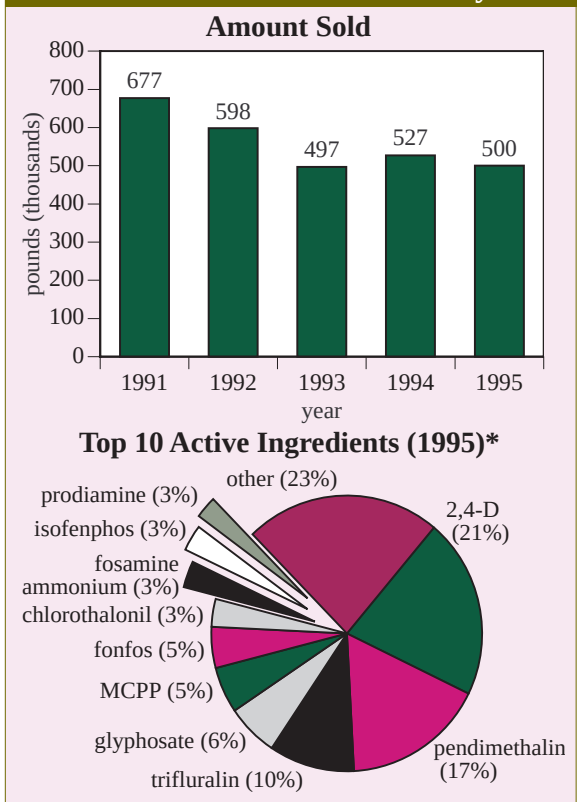
Fungicide, and Rodenticide Act (FIFRA) and the federal Food, Drug, and Cosmetic Act. The act mandates a single, health-based standard for pesticides in food, provides special protections for infants and children, expedites approval of safer pesticides, creates incentives for farmers for effective crop protection tools, and requires reevaluation of pesticide registrations and tolerances to ensure they are up to date.[27] The law also requires grocery stores to provide information on the health effects of pesticides and how to avoid risks.

Commercial Lawn-Care Pesticide Sales Show Decline of 6% Since 1991

The sale of lawn-care pesticides in Kentucky to commercial applicators averages about 560,000 pounds per year, However, the five-year trend shows a decline in sales by about 6% **(Figure 18)**. It should be noted that sales data are based on annual surveys and information is likely incomplete. In addition, this data does not include home owner pesticide sales.

Water contamination from various lawn-care chemicals has been detected in some parts of the state due to improper pesticide application and disposal. Wastewater treatment plants in Harrodsburg, Lexington, and Lawrenceburg have had problems meeting toxicity limits due to the presence of diazinon, a common insecticide sold in Kentucky, in the plants' effluent.[28] The U.S. EPA recently designated diazinon as a restricted-use product, which limits its use to licensed pesticide applicators to minimize environmental impacts. In 1995, 5,224 pounds of diazinon were sold for commercial lawn-care use in Kentucky compared to 7,615 pounds in 1991.

Figure 18 Commercial Lawn-Care Chemicals Sold in Kentucky



**Based on 500,118 pounds of active ingredients sold in KY to licenced commercial applicators om 1995 as reported in surveys. Source: KY Dept. of Agriculture*

The sale of lawn-care pesticides in Kentucky to commercial applicators averages about 500,000 pounds per year. However, the five-year trend shows a decline in sales by about 6%.

Toxics in the Home

Toxics in the home, such as lead and household hazardous products, are considered a high public health risk in Kentucky.[29] Poisoning from toxics in the home remains a significant concern. In 1995, the Kentucky Regional Poison Center received 49,764 calls, 65% of which involved small children. That year, 9% of the calls received at the poison center (4,880) involved exposure to toxic household cleansers, of which 422 were considered very serious, with one fatality. Exposure to gasoline and other hydrocarbons resulted in 1,841 calls, of which 123 were serious, with one fatality. And 1,541 calls were due to exposure to pesticides, of which 54 were serious.

New toxic threats in our homes are continually discovered. The U.S. Consumer Product Safety Commission issued an alert in June 1996 warning consumers about lead exposure from imported vinyl mini-blinds.[30] Lead was added to the mini-blinds to stabilize the plastic, but exposure to sunlight and heat causes deterioration of the blind and the release of lead dust. The agency has recommended that these blinds be removed from homes with children under six years old.

Several Kentucky counties have initiated programs to collect household toxic wastes. During 1995, Calloway, Carroll, Hardin, Jefferson, Powell, and Scott counties hosted household hazardous waste collection days. However, many counties

Poisoning from toxic chemicals in the home remains a significant concern. In 1995, the Kentucky Regional Poison Center received 49,764 calls, 65% of which involved small children.

In 1995, local health departments conducted 41,325 blood lead screenings in children under six years of age. Tests reveal that 226 children, nearly 1% of those tested, had lead levels in the blood high enough to cause severe and adverse health impacts such as kidney and liver damage. Another 5,382 tests (13%) found blood lead levels in children from 10 to 19 µg/dl, which can cause decreased intelligence, reduced growth, and learning disabilities.

are limited in their ability to host household collection programs due to a lack of resources and liability concerns.

14% of 41,325 Tests Reveal Unsafe Levels of Lead in Children

While exposure to lead in the ambient air is no longer a concern since the phase out of lead-based gasoline in the 1970s and 80s, it is still a problem in some homes. Studies estimate that from 1.7 million to 3 million preschool-age children in the U.S. have unsafe levels of lead in their systems.[31]

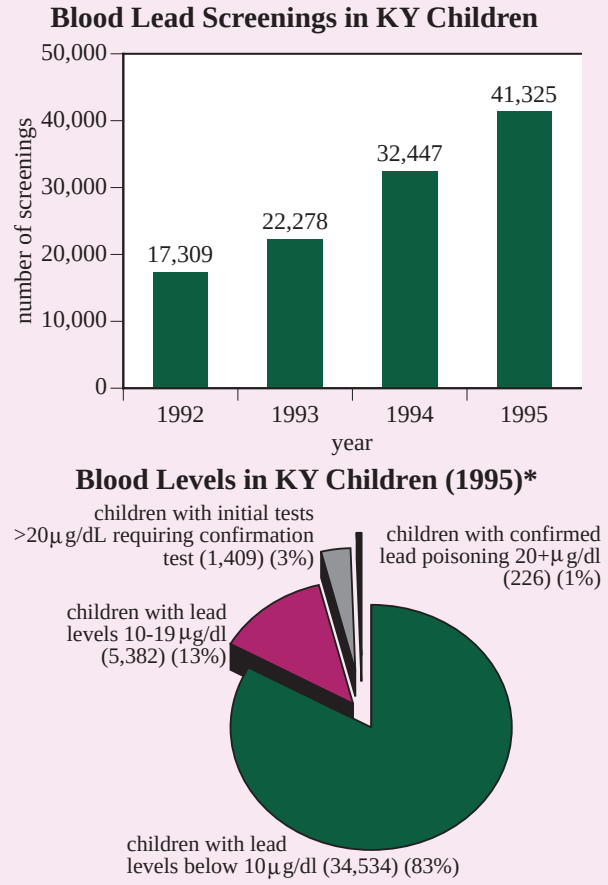
Most lead exposure in the home is now linked to lead-based paint, which was banned for domestic use in 1978. But many homes still contain lead paint. The U.S. Department of Housing and Urban Development estimates that 64 million dwellings, 75% of houses built prior to 1978, have lead-based paint. This translates to 875,000 homes in Kentucky that could contain lead-based paint, 148,750 of which are estimated to have young children considered at risk from lead exposure. The U.S Public Health Service has called lead "the most serious environmental hazard to young children" and recommends that children under six be tested for lead.[32]

The KY Cabinet for Health Services conducts programs for lead poisoning prevention, child blood-lead level testing, and public education about the hazards of lead through local health departments. In 1995, health departments conducted 41,325 blood lead screenings on children under the age of six **(Figure 19)**. Initial tests revealed that 1,409 children had lead blood levels above 20µg/dl which required further testing. Of those retested, 226 children, nearly 1% of those tested, had confirmed lead levels in the blood greater than 20µg/dl — high enough to cause severe and adverse health impacts, such as kidney and liver damage. Another 5,382 tests (13%) found lead blood levels in children ranging from 10 to 19 µg/dl, which can cause decreased intelligence, reduced growth, and learning disabilities. Children with elevated lead levels (above 10µg/dl) receive more frequent testing and an assessment of exposure routes.

The state passed Senate Bill 182 in 1996 to require certification of persons testing and abating lead hazards in homes by July 1, 1997. Beginning January 1, 1997, state regulations will also require all lead-hazard training providers to be accredited.

Federal right-to-know rules, which took effect Dec. 1996, will require home-sellers and landlords to disclose any known lead-based hazards in homes. The rule covers most public and private housing that was built before 1978. To learn more about the federal Lead Hazard Abatement rule you can call 1-800-424-LEAD toll free.

Figure 19 Blood Lead Testing in KY Children



**Percentages rounded. µg/dl-micrograms per deciliter of blood. Source: Kentucky Cabinet for Health Services*

References

1. Inform (1995). Toxics Water 1995: Toxic Chemicals in the Environment: A Far-Ranging Problem. Executive Summary, p. 1.
2. Ibid.
3. Cheryl Simon Silver & Dale S. Rothman (1995). Toxicity and Health, The Potential Long-Term Effects of Industrial Activity, p. 8.
4. Facilities required to report to TRI include those that conduct manufacturing operations within Standard Industrial Classification (SIC) codes 20-39, have 10 or more full-time employees, and process more than 25,000 pounds or use more than 10,000 pounds of TRI listed chemicals.
5. U.S. EPA (1996). 1994 Toxic Release Inventory Report, p. 214.
6. Environmental Policy Alert (1996). OMB Forces EPA to Revise Proposed Expansion of Toxics Reporting, p. 22 (Sept. 11, 1996).
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continued page 16.

1994 Toxic Releases and Transfers Off-Site for Further Waste Management (Pounds)

County	Water*	Land*	POTW**	Air*	Transfers***
Allen	0	0	41	45,656	1,075,921
Anderson	200	0	429	100,912	3,021,507
Ballard	71,500	4,050	0	1,062,155	0
Barren	0	15	668	14,209	1,292,935
Bath	0	0	0	0	1,500
Bell	0	6,174	16,762	35,562	37,755
Boone	755	0	39	397,170	601,042
Bourbon	0	0	107	38,279	2,268,737
Boyd	80,052	16,765	75,765	613,986	7,294,610
Boyle	47	0	88,390	77,571	491,869
Bullitt	0	2,417	0	88,526	129,159
Butler	0	670,790	0	12,110	0
Caldwell	0	0	20	85,882	2,330
Calloway	824	0	918	81,806	126,882
Campbell	1,467	0	0	66,108	2,574,722
Carroll	6,305	22,308	0	243,109	5,116,466
Carter	0	0	0	0	0
Casey	0	0	0	1,250	0
Christian	5	2,380	561	832,126	385,174
Clark	10	0	4,720	29,767	151,520
Crittenden	0	0	0	12,750	700
Daviess	2,577	0	905	441,451	1,391,594
Estill	0	0	0	30,155	0
Fayette	13,000	0	82,557	418,486	525,070
Franklin	0	0	19	98,565	174,689
Fulton	0	0	0	510	18,265
Grant	0	0	81,473	308,476	102,694
Graves	10	410	1,455	11,510	170,572
Grayson	15	0	250	33,050	1,000
Green	0	0	0	35,500	0
Greenup	507	0	53,300	338,765	181,450
Hancock	18,810	262	0	1,535,112	538,335
Hardin	21	190	32,665	278,284	5,054,091
Harrison	10	0	19	75,567	225,452
Hart	0	0	0	1,755	14,092
Henderson	505	21,120	835	274,783	373,906
Henry	0	0	48,003	2,210	49,968
Hopkins	250	250	5,280	985,242	165,521
Jefferson	1,099	13,250	1,307,638	10,446,219	16,511,033
Jessamine	0	0	985	174,248	135,895
Johnson	0	0	0	500	0
Kenton	0	0	11,850	95,013	46,925
Knox	0	0	0	8,155	130,596
Laurel	0	0	278	37,327	42,090
Lewis	0	0	0	11,304	250
Lincoln	5	0	5	10	10
Logan	72	2,250	5	1,346,436	2,358,987
Lyon	0	0	0	112,144	14,172
Madison	233	0	1,037	975,244	5,535,953
Marion	0	0	260	15	67,818
Marshall	177,725	18,156	0	5,099,701	4,861,876
Mason	3,090	23,482	0	6,036	287,106
McCraken	21,260	0	0	539,282	284,361
McCreary	0	0	0	10	0
Meade	0	668	0	261,444	83,121
Mercer	250	0	11	160,509	544,333
Metcalfe	0	0	0	4,960	6,990
Monroe	0	0	3	0	34,103
Muhlenberg	0	0	0	90,380	1
Nelson	0	0	15	314,741	55,530
Nicholas	250	0	0	0	0
Ohio	0	0	0	112,000	69,397
Oldham	5	0	0	119,426	3,064,685
Owen	0	0	0	0	8,298
Pendleton	0	0	0	0	0
Powell	15	0	0	11,400	22,250
Pulaski	1,005	0	750	99,861	22,025
Russell	1	0	0	86	317,463
Scott	500	0	1,775	1,042,713	3,145,151
Shelby	255	0	83	302,168	502,750
Simpson	393	255	653	1,531,000	470,733
Taylor	250	0	6,820	179,697	140,292
Todd	0	0	5	26,700	21,005
Union	0	0	0	228,690	81,503
Warren	0	0	14,733	546,395	229,118
Wayne	0	0	1	7,701	17,930
Webster	0	0	0	15,964	750
Whitley	0	0	100	23,925	2,100
Woodford	14	0	309	2,426,768	313,579
Total	**403,292**	**805,192**	**1,842,497**	**35,066,527**	**71,194,175**

**Reported releases on-site of generation. **Transfers off-site to publicly owned treatment works (POTWs). ***Transfers off-site for further waste management excluding transfers to publicly owned treatment works (POTWs) which are listed separately in this chart.*

Source: Toxic Release Inventory Report

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1996 State of KY's Environment

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1996-97 State of Kentucky's Environment

Water Quality

Kentuckians are greatly concerned about the quality of their waterways. Year after year, public opinion polls rank water pollution among the top environmental problems facing the Commonwealth. While many waterways are degraded by pollution, there are continuing signs of improvement. This *State of Kentucky's Environment Report* documents whether federal, state, local, and private efforts to clean up our waterways are achieving results. The report includes information on water quality trends and conditions of rivers, lakes, and groundwater. The report also looks at how well sewage treatment plants, industries, and other water pollution sources are meeting state and federal clean water rules.

Water Quality of Streams, Lakes, Groundwater

Thirteen major river basins lie within Kentucky **(Figure 1)**. These basins contain 89,431 miles of waterways.[1] In addition, there are an estimated 2,721 lakes and reservoirs in Kentucky, of which 953 are greater than 10 acres in size.[2] The quality of these waterways varies from severely degraded by pollution to clean enough for fishing, swimming, or for use as a drinking water supply.

To measure the water quality of streams and rivers, data from the Division of Water's 44 stream monitoring stations and other monitoring data were reviewed. Waterways are monitored for 32 different parameters including pH, mercury, lead, and fecal coliform bacteria. Unfortunately, the monitoring stations can only assess a small portion, about 7%, of the total stream and river miles in the state. While this data may not represent a statistically valid sample of water quality statewide, it does provide a general indicator of water quality trends and pollution sources in Kentucky. Data on lake and groundwater quality were also reviewed to assess conditions.

Improving Water Quality Trends Continue at Monitored Waterways

Data collected from stream monitoring stations show continuing overall im-

Figure 1 River Basins in Kentucky

Source: Natural Resources and Environmental Protection Cabinet

EQC

Environmental Quality Commission
Environmental Indicators Program
Reporting on Environmental Trends and Conditions in Kentucky.

1996-97 Reports
- Safe Drinking Water
- Air Quality
- Waste Management
- Toxics
- Water Quality
- Natural Resources
- Resource Extraction

EQC is a seven-member citizen commission created under state law with a mission to monitor environmental trends and conditions, promote partnerships to improve and protect the environment, provide a public forum for the discussion of environmental issues, and advise state officials on environmental matters.

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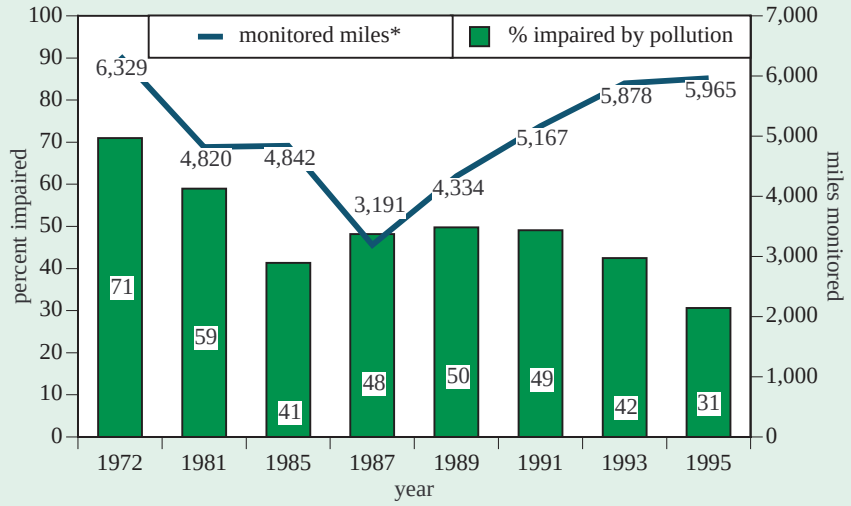
Erik Siegel, Research Asst.
Frances Kirchhoff, Adm. Asst.

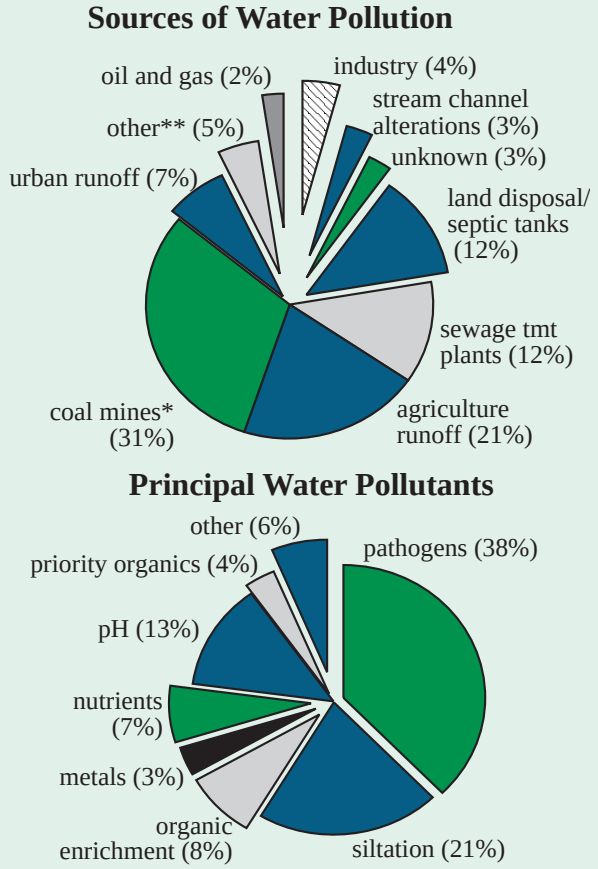
Data collected from stream monitoring stations show continuing improvements in water quality. For example in 1993, 42% or 2,495 of the 5,878 miles of waterways monitored were impaired by pollution, compared to 31% or 1,865 of the 5,965 miles monitored in 1995.

Figure 2 Percent of Monitored Waterways Impacted by Pollution



**1972 and 1981 data include waterways monitored and evaluated. 1985 through 1995 data include just monitored waterways. Source: KY Reports to*

Figure 3 River and Stream Pollution in Kentucky (1995)



*Note: Based on miles of streams and rivers assessed with major pollution impacts. Many waterways have multiple sources of pollution which are reflected in this chart. *Water pollution from abandoned and active mine sites combined (not distinctly separated in 1996 KY Report to Congress on Water Quality). **Logging, construction, development, combined sewer overflows.*
Source: 1996 KY Report to Congress on Water Quality

provements in water quality **(Figure 2)**. For example, in 1993, 42% or 2,495 of the 5,878 miles of the waterways monitored were impaired by pollution, compared to 31% or 1,865 of the 5,965 miles monitored in 1995.

Water quality improvements at monitored waterways in the past few years are attributed to a number of factors. These include a decline in oil production, additional requirements at industrial and municipal wastewater plants to control toxic discharges, and targeted enforcement at problem wastewater treatment plants and other pollution sources combined with improving compliance by the regulated community.

Coal Mining, Agriculture, Sewage Plants Remain Leading Sources of Water Pollution

Figure 3 reveals the various sources of water pollution. Coal mining is the leading source of pollution in monitored and assessed waterways followed by agriculture, sewage plants, and land disposal/septic tanks.

Thirty-one percent of the major pollution problems found in assessed waterways are attributed to coal mining. Siltation from coal mines can impair water quality and destroy aquatic habitat. Contaminated runoff from mines is also contributing to high acidity and elevated levels of toxic metals found in some monitored streams. Information is not available to determine how much of this pollution is caused by active mines as opposed to abandoned mines. However, the data does reveal that acid mine drainage is responsible for about 46% of the 963 miles of streams and rivers impaired by coal mining in Kentucky. Acid mine drainage is primarily associated with abandoned coal mines. The KY Division of Abandoned Mines estimates that there are 80,000 to 150,000 acres of abandoned mine lands

in the state. It is not known how much of this acreage is contributing to water quality problems since no detailed inventory or assessment of these lands has been done. A discussion of coal mining water impacts will be presented in the *Resource Extraction* Report to be published as part of the *1996-97 EQC State of Kentucky's Environment* series.

Agricultural activities are responsible for 21% of the major pollution problems found in assessed waterways **(Figure 3)**. Sediment from eroding farmlands along with nutrients and chemicals from fertilizers, manure, and pesticides can impair water quality. Efforts to address agriculture nonpoint pollution have primarily relied on voluntary controls. These include the use of conservation tillage to control erosion and cost-share monies for livestock waste management systems and other practices to prevent water pollution **(see inserted box below - Agriculture and Water Quality: State Measures Focus on Education and Prevention)**.

Poorly operated wastewater treatment plants are contributing 12% of the pollution to impaired waterways while on-site sewage disposal systems including septic tanks, illegal straight pipe sewage discharges, and improper disposal of waste impact another 12% of the streams monitored in the state. Other sources contributing to water pollution include urban runoff (7%), industry (4%), stream channel alterations (3%), and oil and gas production (2%). Pathogens are the greatest cause of water pollution, responsible for 38% of the problems found in monitored rivers and

Thirty-one percent of the major pollution problems found in assessed waterways are attributed to coal mining. Acid mine drainage is responsible for about 46% of the 963 miles of monitored streams and rivers impaired by coal mining in Kentucky. Acid mine drainage is primarily associated with abandoned coal mines.

Agricultural activities are responsible for 21% of the major pollution problems found in assessed waterways. Sediment from eroding farmlands along with nutrients and chemicals from fertilizers, manure, and pesticides can impair water quality.

Agriculture and Water Quality: State Measures Focus on Education and Prevention

Agriculture is the second leading source of water pollution in Kentucky. Some 88,000 farms cover 56% of the state's 25.4 million acres of land.[3] Farmlands can contribute to water pollution in a number of ways, including:

- sediment - soil eroding from farmlands can cloud water, smother small aquatic organisms, and coat aquatic plants depriving them of sunlight and making it more difficult for fish to feed. Sediment can also reduce the life of lakes and lead to an increase in flooding.
- nutrients - application of fertilizers, manure, and other organic materials increases the chance that nutrients will run off into surface waters and leach into groundwater. Excessive amounts of nutrients in water can lead to a proliferation of algae and a depletion of oxygen resulting in fish kills and impairment of drinking water quality.
- pesticides - pesticides can run off farmlands, degrading surface and groundwater quality and posing drinking water health risks.
- farm animal waste - animal waste can contribute to bacteria problems in lakes and rivers impairing recreational and drinking water uses.

State and federal efforts to address water pollution from agricultural operations have primarily relied on a number of voluntary approaches, including:

- conservation tillage - 68% of the state's 3.6 million acres of planted cropland currently use plowing practices to minimize soil disturbance and reduce erosion.[4]
- conservation reserve - this federal program has paid farmers $22 million since 1986 to set aside 379,109 acres of the estimated 1.4 million acres of highly erodible farmlands.[5]
- integrated pest management - this program promotes the use of various strategies to minimize the use of pesticides.
- demonstration projects -Since 1990, $19.2 million of Section 319 Clean Water Act federal grants and matching funds have been awarded to local governments and others to fund more than 100 demonstration projects to address runoff pollution problems.

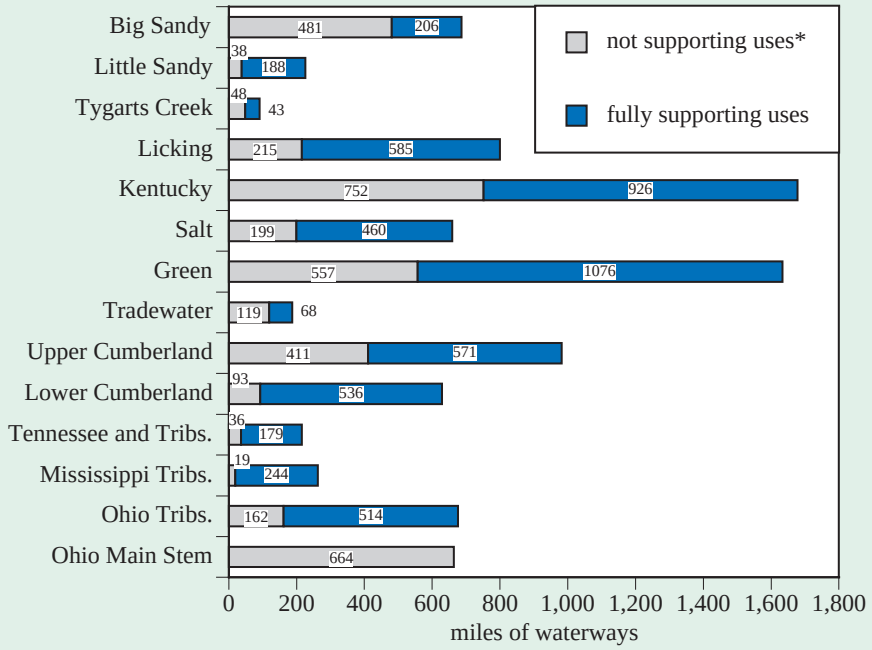
Recognizing that more needed to be done to prevent water pollution from agricultural operations, the state passed the **1994 KY Agriculture Water Quality Act.** The act requires all farm and silviculture operations to prepare plans over the next five years to protect surface and groundwater quality. Farmers will be required to use best management practices such as streamside buffer strips, proper storage and use of pesticides, and livestock waste management systems to prevent water pollution. Operations found in noncompliance with their plans could be subject to "bad actor" provisions including fines unless they remedy the problem through the "corrective measures process."

Big Sandy, Kentucky, Green, Upper Cumberland, Ohio Rivers Have Most Miles of Impaired Monitored Waterways

A closer look at monitored and evaluated waterways by river basin reveals that the Kentucky, Big Sandy, Green, Upper Cumberland, and Ohio rivers led the state with the most miles of impaired waterways during 1994-95 **(Figure 4)**. Data was not collected in a manner to assess long-term water quality of monitored waterways by river basin. However, individual stream assessments conducted by the Division of Water in 1994 have shown a general decrease in the levels of various pollutants including chlorides, nutrients, and nitrates at several monitoring stations. A list of the leading water pollution sources by river basin appears in **Figure 5.**

A closer look at monitored and evaluated waterways by river basin reveals that the Big Sandy, Kentucky, Green, Upper Cumberland, and Ohio rivers led the state with the most miles of impaired waterways.

Figure 4 Stream and River Miles in Kentucky Impacted by Pollution, By River Basin (1994-95)



*Note: Based on waterways monitored and evaluated. *Miles not supporting one or more uses (swimming, fishing, or drinking water) due to pollution.*
Source: 1996 KY Report to Congress on Water Quality

Figure 5 Leading Sources of Water Pollution in Kentucky, By River Basin

River Basin	1st	2nd	3rd	4th
Big Sandy	resource extraction	wastewater*	construction	oil and gas
Little Sandy	wastewater*	oil and gas	—	—
Tygarts Creek	wastewater*	agriculture	stream alterations	—
Licking	agriculture	wastewater*	on-site sewage**	resource extraction
Kentucky	wastewater*	agriculture	resource extraction	on-site sewage**
Salt	agriculture	wastewater*	on-site sewage**	urban runoff
Green	acid mine drainage	agriculture	industry	on-site sewage
Tradewater	acid mine drainage	resource extraction	—	—
U. Cumberland	wastewater*	on-site sewage**	resource extraction	agriculture
L. Cumberland	agriculture	industry	urban runoff	resource extraction
Tennessee & Tribs	agriculture	wastewater*	urban runoff	industry
Mississippi Tribs	agriculture	wastewater*	resource extraction	stream alterations
Ohio Tribs.	wastewater*	urban runoff	on-site sewage**	stream alterations

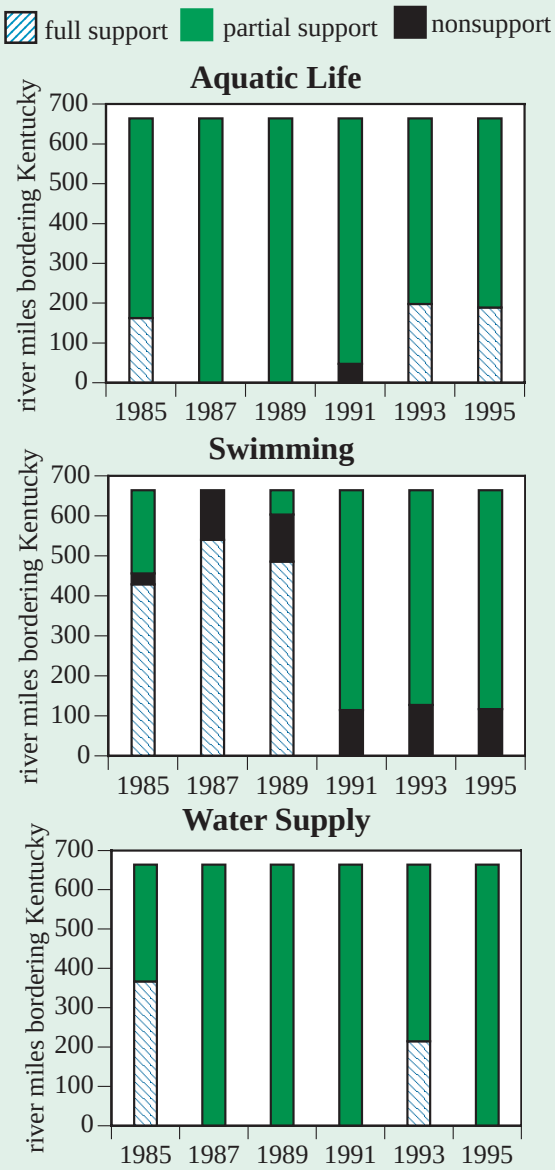
Ohio (KY border)*** agriculture, urban runoff, spills, wastewater*

**Municipal and package wastewater treatment plants, sanitary sewer overflows. **Septic tanks. ***Sources not ranked. Source: 1996 KY Report to Congress on Water Quality, ORSANCO*

Aquatic Habitat Improves in the Ohio River

The Ohio River, which flows 981 miles through six states, has been greatly impaired by pollution but continues to show signs of recovery. Data collected by Ohio River Valley Water Sanitation Commission (ORSANCO), an interstate agency, from 11 monitoring stations along the 664-mile stretch of the Ohio River bordering Kentucky indicate that about 31% of the river can now fully support healthy communities of fish, shellfish, and other aquatic organisms compared to none in 1989 **(Figure 6)**. Improvements in aquatic life conditions are likely due to better monitoring and assessment methodologies as well as improvements in water quality, according to ORSANCO officials. However, contaminated runoff from farms, urban areas, sewers, and spills continues to limit the Ohio River's ability to fully support swimming and drinking water uses **(Figure 5 & 6).**

Figure 6 Ohio River Water Use Support Trends Along the Kentucky Border



Source: Ohio River Valley Water Sanitation Commission

North Fork of KY River Leads as Most Polluted

While overall water quality of monitored waterways appears to be improving, as seen in **Figure 2**, a closer look at individual streams reveals that a number remain degraded. Water quality of waterways varies greatly based on the type and level of pollution. The Division of Water lists 124 polluted streams in its 1996 303 (d) list of impaired waterways. Some of these streams are unfit for swimming due to high levels of bacteria while others cannot support fishing or drinking due to siltation or chemical pollution. **Figure 7** lists 25 of the most severely polluted monitored waterways in the state based on the number of miles not supporting two or more uses (fishing, swimming, or drinking). More than half of these waterways cannot support fishing or swimming due to high pH problems caused by acid mine drainage.

Leading the list of the 25 most polluted monitored waterways is a 96.2 mile stretch of the North Fork of the Kentucky River **(Figure 7)**. The segment is degraded by sewage from treatment plants, septic systems, and illegal straight pipes. Efforts to restore water quality of the North Fork have been ongoing since 1990 when a swimming advisory was issued for the entire length (162.6 miles) due to fecal coliform bacteria. In 1992, the Division of Water stepped up its enforcement efforts in the watershed and found half of the 51 package plants and three of the seven municipal sewage plant exceeded their permit limits for bacteria resulting in $35,000 in fines.[7] Since then, new plants have been built in Jackson and Hindman with new facilities planned in Vicco and Hazard. As a result, water quality improved along 76 miles of the lower drainage, and the swimming advisory for that part of the river was lifted in 1993. However, problems remain, and a swimming advisory was issued for 86 miles of the upper North Fork in 1996. Efforts to bring problem wastewater plants into compliance and educate the public about proper on-site sewage disposal continue in the watershed.

Data collected by ORSANCO from 11 monitoring stations along the 664-mile stretch of the Ohio River bordering Kentucky indicate that about 31% of the river can now fully support healthy communities of fish, shellfish, and other aquatic organisms compared to none in 1989.

Watershed-Based Management Planned in Kentucky River

Continued water quality improvements in the Kentucky, Ohio, and other river basins in Kentucky will require a more focused approach to addressing water pollu-

Figure 7 25 Most Polluted Monitored Waterways Segments in KY

Stream	County/River Basin	Miles Impaired	Source
North Fork	Lee/Kentucky	96.2	resource extraction, sewage
Licking River	Bracken/Licking	92.6	re. extraction, ag., sewage
Floyd's Fork	Bullitt/Salt	68	urban, agriculture, sewage
Drakes Creek	Hopkins/Green	29.8	acid mine drainage
Clear Creek	Hopkins/Tradewater	25.8	acid mine drainage
Rockhouse Creek	Letcher/Kentucky	24.3	resource extraction
Martins Fork	Harlan/U. Cumberland	23.4	resource extraction, sewage
Pond Creek	Muhlenburg/Green	23.8	acid mine drainage
Leatherwood Creek	Perry/Kentucky	20.5	resource extraction
Banklick Creek	Kenton/Licking	19	sewage
Lick Creek	Hopkins/Tradewater	18.1	acid mine drainage
Fleming Creek	Nicholas/Licking	16.5	agriculture
S. Fork Beargrass Cr.	Jeff/Ohio Tribs.	14.6	sewage, metals
L. Fork Straight Cr.	Bell/U. Cumberland	13	sewage
Little Reedy Creek	Butler/Green	12	acid mine drainage
Lewis Creek	Ohio/Green	11.8	acid mine drainage, ag.
Goose Creek	Jefferson/Ohio	11.7	sewage
Caney Creek	Hopkins/Tradewater	11.3	acid mine drainage
Flat Creek	Hopkins/Green	10.6	acid mine drainage
Cypress Creek	McLean/Green	10.4	acid mine drainage
Little Cypress Cr.	Muhlenburg/Green	10.4	acid mine drainage
Fern Creek N. Ditch	Jefferson/Salt	10.1	sewage
Buffalo Creek	Hopkins/Tradewater	8.6	acid mine drainage
Pleasant Run	Hopkins/Green	7.9	acid mine drainage
Little Raccoon Cr.	Laurel/U. Cumberland	7.7	resource extraction

Note: Based on monitored waterway segments not supporting two or more uses by miles impaired. Source: 1996 KY Report to Congress on Water Quality

tion. ORSANCO has developed a Watershed Pollutant Reduction Program to better identify pollution problems, sources, and reductions needed to achieve water quality objectives.

The KY Division of Water also plans to begin to tackle water pollution problems by focusing on each watershed beginning with the Kentucky River Basin. More than 600,000 Kentuckians depend on the river for drinking water.[6] The Kentucky River is also a vital economic resource supporting the economy and tourism. But the basin has been degraded by pollution.

Through a watershed-based approach the Division of Water hopes to gain a better understanding of overall conditions and pollutants impairing the watershed. The premise of the watershed initiative is to target priority pollution problems, involve various agencies and the public in the design of effective solutions, and measure success through monitoring and data gathering. Among some of the activities to occur as part of the watershed approach are:

- Synchronize issuance of water permits and renewals by basin.
- Redesign the ambient monitoring network by basin.
- Track and assess physical impacts to streams and wetlands in the basin.
- Target enforcement efforts to address pollution problems within the basin.
- Conduct drinking water source assessments by basin.

In the summer of 1997, the state will embark on the Kentucky Watershed Management Initiative. An interagency work group, made up of representatives of local, state, and federal agencies and various interest groups, has drafted a framework to guide cooperative efforts in managing and protecting the watershed.

Most Improved Waterways in KY

Waterway (County)	miles
Beech Fork (Washington, Nelson)	15.6
Little River (Trigg)	10.2
Tradewater River (Union, Crittenden)	9.6
Clarks Run (Calloway)	21.5
Levisa Fork (Lawrence)	14.4

Note: Waterway segments improved from non- or partial support to full support between 1994 and 1996.
Source: 1996 KY Report to Congress on Water Quality

120 Public Lakes Assessed, 34 Impaired by Pollution

Determining the health of a lake is not an easy task. Many factors combine to affect the water quality of a lake including geology, lake depth, weather, discharges, flow rates, and land-use activities in the watershed. The best way to assess the health of a lake is to look at each one in-depth over time. Unfortunately, the state does not have the resources to study many lakes in this manner. The Division of Water does routinely test a number of publicly owned lakes every five to seven years which provides a general indicator of their health. During 1994-95, water quality was tested at 13 lakes and earlier data was used to determine the health of another 107 lakes. Of the 120 public lakes reviewed, 34 were impaired by pollution **(Figure 8)**.

Nutrients from Agriculture Leading Cause of Lake Pollution

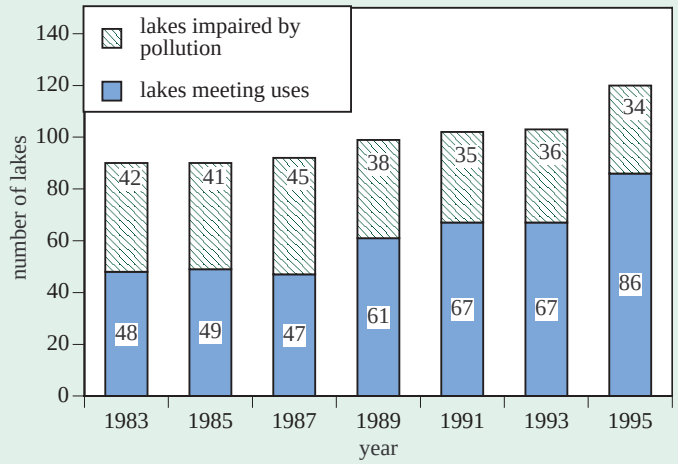
Figure 9 indicates that agriculture is the leading source of lake pollution causing 30% of the problems, followed by natural conditions such as shallow lake basins, a common problem of constructed lakes. Coal mining ranked as the third leading source, contributing 12.5% of the pollution problems found in lakes.

Fertilization is also thought to be causing problems in three of the 34 impaired public lakes **(Figure 10)**. Phosphorus is sometimes added to a lake to increase the populations of zooplankton and phytoplankton. Plankton are the primary source of food for many fish. However, phosphorus can increase filamentous algae and aquatic plants, both of which can impair fishing and swimming uses. The KY Department of Fish and Wildlife, the agency responsible for lake fertilization, indicates that they do not undertake this activity when lakes have high nutrient levels. While the Division of Water lists lake fertilization as the source of impairment to Briggs, Mauzy, and Marion lakes, state Fish and Wildlife officials indicate that the nutrient problems are caused by agriculture. Nutrients are contributing to pollution problems in 28 of the 34 impaired public lakes.

Six lakes are seriously polluted and are indicated in bold in **Figure 10**. Nutrients are the leading pollutant. Aquatic habitat is the major use affected in these lakes, but drinking water supplies are impaired in Loch Mary and Corbin lakes. The city of Corbin must treat Corbin Lake at least monthly with copper sulfate to control algae and weeds to alleviate odor and taste problems in the city's drinking water.

Agriculture is the leading source of lake pollution causing 30% of the problems, followed by natural conditions such as shallow lake basins, a common problem of constructed lakes. Coal mining ranked as the third leading source of lake pollution.

Figure 8 Public Lakes in Kentucky Impaired By Pollution



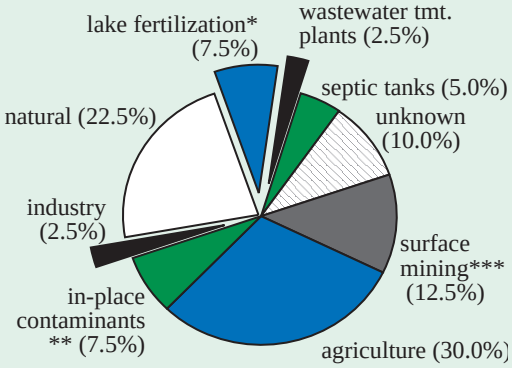
Note: Based on publicly owned lakes monitored and evaluated.
Source: KY Reports to Congress on Water Quality

Water Quality Improves in Seven Lakes

Water quality also improved in seven lakes since 1992 **(Figure 11)**. The water quality of Lake Herrington improved as a result of increased rain in the basin, which flushed out the upper section of the lake, and upgrades at a sewage treatment plant discharging to the lake. The water quality of Martins Fork and Fishtrap lakes improved because of lower amounts of suspended solids (sediment in the water) due to a reduction of coal mining in the area. Carpenter Lake in Daviess County was redesignated to fully supporting swimming and fishing uses after problems with nutrients were resolved using aeration (increasing oxygen levels in the water by mechanical means) and introduction of grass carp by the Department of Fish and Wildlife. Laurel Creek, Liberty, and Morris lakes improved to support drinking water uses after pollution problems affecting taste and odor were resolved.

There are many issues facing lakes and a number of opportunities to protect these important resources. The key to lake protection is dealing with the problem of nutrients. The need to impose stronger phosphorus permit limits for discharges to lakes is being considered by the Division of Water on a case-by-case basis. Some communities have also passed ordinances to protect public lakes. Russellville and Lewisburg passed a joint city ordinance to protect Spa Lake after it was listed as not supporting swimming and fish-

Figure 9 Sources of Lake Pollution in Kentucky



*Note: Based on 34 public lakes assessed (monitored and evaluated) not meeting or partially meeting designated uses. Some of the 34 impaired public lakes may have multiple sources of pollution which are reflected in this chart. *Adds additional nutrients to increase fish stocks. Excessive nutrients can cause a proliferation of weeds and affect aquatic and recreational uses. **Chemicals (PCBs, metals) of unknown origin found in sediment. ***Active, inactive, abandoned coal mines. Source:1996 KY Report to Congress on Water Quality*

Figure 10 Impaired Public Lakes in Kentucky

Lake	County	Listed	Cause	Source
Loch Mary	**Hopkins**	**1980**	**metals,organics**	**acid mine drainage**
Briggs	**Logan**	**1983**	**nutrients**	**lake fertilization**
Corbin	**Laurel**	**1983**	**nutrients**	**wastewater, agriculture**
Metcalfe	**Metcalfe**	**1983**	**nutrients**	**agriculture**
Reformatory	**Oldham**	**1980**	**nutrients**	**livestock**
Mauzy	**Union**	**1991**	**nutrients**	**lake fertilization**
Green River	Adair/Taylor	1990	organics	industrial
Taylorsville	Anderson	1985	nutrients	agriculture
Beshear	Christian	1991	nutrients	natural
George	Crittenden	1991	nutrients	agriculture
Sand Lick	Fleming	1989	nutrients	agriculture
Dewey	Floyd	1980	solids	mining
Caneyville	Grayson	1983	nutrients	natural
Cranks Creek	Harlan	1983	pH	acid mine drainage
Scenic	Henderson	1991	nutrients	sediments
Jericho	Henry	1989	nutrients	agriculture
Grapevine	Hopkins	1990	nutrients	unknown
McNeely	Jefferson	1980	nutrients	in-place contamination
Carr Fork	Knott	1980	solids	mining
Salem	Larue	1983	nutrients	natural
Corbin	Laurel	1983	nutrients	wastewater, agriculture
Wood Creek	Laurel	1989	nutrients	septic tanks
Stanford	Lincoln	1983	nutrients	natural
Spa	Logan	1989	nutrients	agriculture
Wilgreen	Madison	1983	nutrients	septic tanks
Marion County	Marion	1983	nutrients	lake fertilization
Luzerne	Muhlenberg	1990	nutrients	unknown
Washburn	Ohio	1991	nutrients	unknown
Kincaid	Pendleton	1983	nutrients	unknown
Buckhorn	Perry/Leslie	1983	solids	mining
Guist Creek	Shelby	1983	nutrients, metals	agriculture, natural
Shelby County	Shelby	1983	nutrients	agriculture, sediments
Campbellsville	Taylor	1983	nutrients	agriculture
Honker	Trigg	1989	nutrients	natural

Note: Bold lakes are those lakes severely impaired by pollution not supporting uses. Other lakes listed partially support uses. Source: 1996 KY Report to Congress on Water Quality

ing uses in 1989. The ordinance prohibits gas powered boats and livestock in the lake. Studies are also underway at Herrington and Taylorsville lakes which may help set a model for lake protection.

115 Lake Discharges Permitted

There are 115 permits that allow discharges to lakes **(Figure 12)**. Most permits are for small wastewater treatment plants but also include power plants, stone quarries, and coal facilities. Nearly half of the permits are for discharges to Lake Cumberland, Kentucky, and Barkley lakes.

During its triennial review of water quality standards in 1995, the Division of Water considered regulations to prohibit new or expanded discharges to public lakes unless there were no feasible alternatives. However, the Division chose not to move forward with its proposal after various concerns were raised including that the requirements would impose hardships on communities and facilities located near lakes and create barriers to future growth.[8]

Figure 11 Most Improved Public Lakes in Kentucky

Lake	County
Liberty	Casey
Morris	Christian
Carpenter	Daviess
Martins Fork	Harlan
Laurel Creek	McCreary
Herrington	Mercer
Fishtrap	Pike

Note: Lakes where water quality was impaired but has improved since 1992 to support all uses.
Source: 1996 KY Report to Congress on Water Quality

Problems Remain with Enforcing Boat Sewage Rules at Public Lakes

A 1996 survey of 17 public lakes by the KY Department of Fish and Wildlife counted 4,362 houseboats, 40% of which were docked at Lake Cumberland. While sewage from boats is not considered a significant water quality problem in lakes, it can cause aesthetic, public perception, and localized water quality problems. The discharge of sewage from boats is illegal under state and federal law at most public lakes in Kentucky with the exception of Barkley, Cumberland, Kentucky, and Dale Hollow lakes where boats are required to have certified marine sanitation devices to treat and discharge sewage. But legal and other problems have limited the state's ability enforce boat sewage disposal laws. In 1992, the state focused greater efforts on providing access to sewage pump-out stations for boats at some of the 96 marinas in the state. The state secured federal funds of $323,351 for the construction of 13 pump-out stations at 10 public lakes during 1994-97. Of 17 public lakes surveyed in 1996, 33 of 51 marinas reported having a pump-out station. But only 4 of the 10 marinas on Lake Cumberland have boat sewage pump-out facilities.

Groundwater Quality Remains Unknown; Network to Monitor 100 Sites

Groundwater is an important but vulnerable resource. Each year, thousands of domestic water wells are drilled to supply approximately 1.1 million Kentuckians with drinking water **(Figure 13)**.[9] And each day thousands of gallons of groundwater are withdrawn by businesses, industries, and farmers to meet their water supply needs. Groundwater wells have also been drilled to monitor industrial and other sites for contamination **(Figure 13)**. The state required all groundwater monitoring well drillers to be certified beginning in 1991. The increase in the number of monitoring wells in 1996, as seen in **Figure 13**, is attributed to clarification of monitoring well reporting requirements for underground storage tanks.

As EQC reported in its first environmental trends report in 1992, much is still unknown about the overall quality of groundwater in Kentucky. There has been some progress, however, in gaining a better understanding of groundwater quality and pollution threats. The Division of Water has been collecting groundwater quality data at 100 wells and springs since 1995. Water samples are collected quarterly and tested for nutrients, metals, inorganic chemicals, volatile organic chemicals, and pesticides (insecticides, fungicides, herbicides).

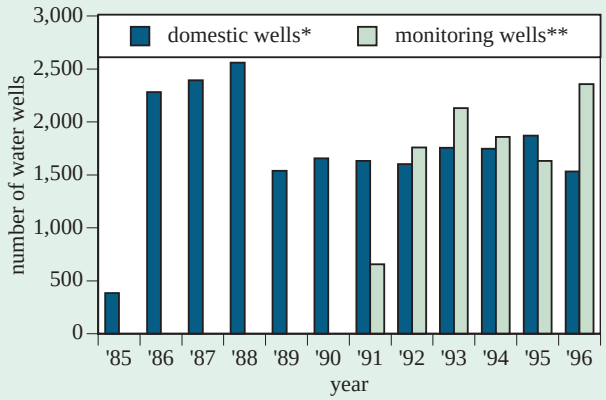
Pesticides Detected in Half of Springs and 16% of Wells Tested

EQC undertook a review of the groundwater network data for pesticides. Findings reveal that pesticides are being detected in wells and springs, but springs appear to be more vulnerable **(Figure 14)**. A review of water samples collected from April 1995 - Oct. 1996 found 54% of the 53 springs tested had detectable levels of pesticides. Sixteen percent of the 44 wells sampled tested positive for pesticides.

Most pesticide detections were below those levels considered to be protective of public health with the exception of atrazine. The presence of atrazine was detected in 37% of the springs sampled and 11% of the wells tested. Two springs exceeded the safe drinking water standard for atrazine **(Figure 14)**. However, six of the ten pesticides detected do not have health-based safe drinking water standards, so it is difficult to determine the degree of risk posed by these pesticides.

An assessment of the groundwater network data by the Division of Water is expected in 1998 which should provide more insight about groundwater quality and pollution threats.

Figure 13 Water Wells Drilled in Kentucky



**Private drinking water, municipal, livestock, irrigation wells. **Wells drilled at hazardous waste sites, underground storage tanks, surface mines, solid waste facilities, landfarms and for environmental audits. Source: KY Div. of Water*

Figure 12 Lake Discharge Permits in Kentucky

Lake	Permits
Barkley	25
Barren River	1
Buckhorn	2
Caneyville	1
Carr Fork	6
Cave Run	4
Cumberland	23
Dale Hollow	3
Dewey	4
Doolin	1
Fishtrap	1
Flemingsburg	1
Game Farm	1
Grayson	1
Greenbo	1
Gunpowder	1
Herrington	5
Kentucky	15
Laurel	2
Lexington	1
Marydale*	1
Nolin	3
Paintsville	1
Railroad	1
Rough River	4
Three Lakes*	1
Valley Lake*	1
Williamstown	1
Willow*	1
Wood Creek	1
Total	**115**

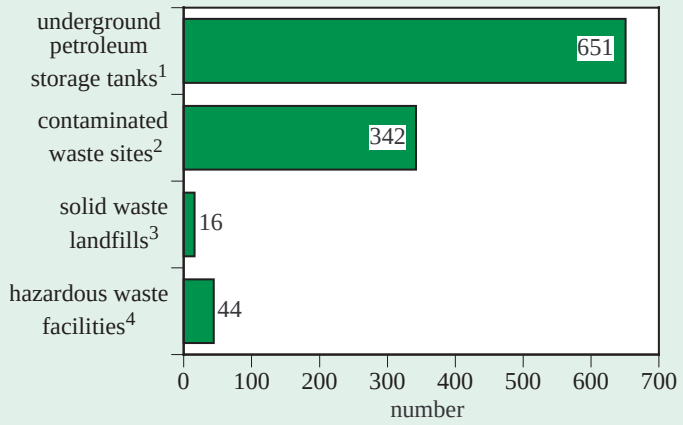
*Note: KPDES permits with discharges to lakes. *Not a public lake. Source: KY Division of Water*

Figure 14 Preliminary Assessment of Samples from Kentucky Ambient Groundwater Monitoring Network

samples	total number	pesticide detects*	atrazine detects	atrazine detects above MCL**
springs	213	103	46	4
wells	107	13	5	0
monitored sites	**total number**	**pesticide detects***	**atrazine detects**	**atrazine detects above MCL****
springs	53	29	20	2
wells	44	7	5	0

*Note: Assessment by EQC of pesticides sampled at groundwater network. *Pesticides detected included atrazine, alachlor, cynazine, enodosulfan I, endosulfan II, linuron, metribuzine, metolachlor, permethrin, simazine. **Atrazine, simazine, and alachlor are the 3 of 10 pesticides detected that have a MCL standard. Atrazine was the only pesticide detected above the safe drinking water MCL (maximum contaminant level) set to protect public health. Source: KY Ambient Groundwater Monitoring Network, April 1995 - Oct. 1996.*

Figure 15 Groundwater Contamination Incidents in KY



[1]Cumulative number of tanks with confirmed groundwater contamination. [2]Cumulative estimate based on 1,100 CERCLA/Superfund sites investigated. [3]Based on 25 active landfills and 56 closed landfills monitoring groundwater. [4]Includes hazardous waste treatment, storage, and disposal RCRA permitted and non-permitted facilities. Source: KY Division of Waste Management

Groundwater Contamination Detected at Tank and Waste Sites

One threat to groundwater is leaking underground storage tanks (USTs). USTs led the state with the most incidents of confirmed groundwater contamination **(Figure 15)**. Of the 6,000 UST sites investigated since 1986, 11%, or 651 tanks, had groundwater contamination requiring remediation.

Waste sites also pose risks to groundwater. The number of state superfund waste sites now number 1,710. Of the 1,100 sites investigated, an estimated 31%, or 342 sites, had groundwater contamination. These sites include the state's 20 federal Superfund sites (those listed by the federal government as some of the worst contaminated sites in the nation), 11 of which have groundwater contamination migrating off-site **(Figure 15)**. And of the 113 hazardous waste facilities with treatment, storage, or disposal units, 44 or 38% have detected groundwater contamination, although some facilities are challenging the status of the contamination. Eleven of these facilities are currently remediating groundwater contamination **(Figure 16)**.

Of the 113 hazardous waste facilities with treatment, storage, or disposal units, 44 have detected groundwater contamination. Eleven of these facilities are currently remediating groundwater contamination.

Monitoring at closed solid waste landfills also indicates groundwater pollution problems. Of the 56 municipal landfills that received closure permits in the spring of 1996, 41% or 23 landfills have detected groundwater contamination. However, groundwater contamination has not been found at the state's 25 active municipal solid waste landfills indicating that new strict construction standards requiring clay or double composite liners appears to be preventing groundwater contamination.

Figure 16 Hazardous Waste Facilities with Groundwater Contamination in Remediation

B.F. Goodrich*	Marshall
Dow Corning	Carroll
Hallmack**	Mercer
Koppers**	Todd
Lexmark	Fayette
Phillips Light *	Boyle
Olin Corp.	Meade
Safety Kleen**	Henry
Safety Kleen**	Boyd
Thomas Ind.	Ohio
Paducah Gas Diffusion Plant*	McCracken

*Note: Permitted RCRA facilities as of 2/97. *On- and off-site contamination. **Off-site contamination under investigation. Source: Division of Waste Management*

Bacteria A Problem Especially in Hand-Dug Water Wells

Groundwater supplies are also threatened by bacteria. Tests by the Division of Water of wells in the Gateway Area Development District and in the Calvert City area several years ago found that almost all the hand-dug wells and 1 out of 10 drilled wells had bacteria contamination. There are some 35,303 hand-dug and 171,220 drilled water wells in Kentucky, according to the 1990 Census. Human and livestock waste are the source of bacteria in contaminated wells. The recent discovery of sewage in an abandoned mine in Floyd County led to an investigation of 30 water wells in the area. All but two wells tested positive for fecal coliform bacteria. The U.S. Environmental Protection Agency suspects that a septic-service operator, whose license expired 12 years ago, illegally dumped 100,000 gallons of raw sewage in the mine for a dozen years. More than 6,000 gallons of contaminated water has been pumped from the mine and water lines have been extended to the area.

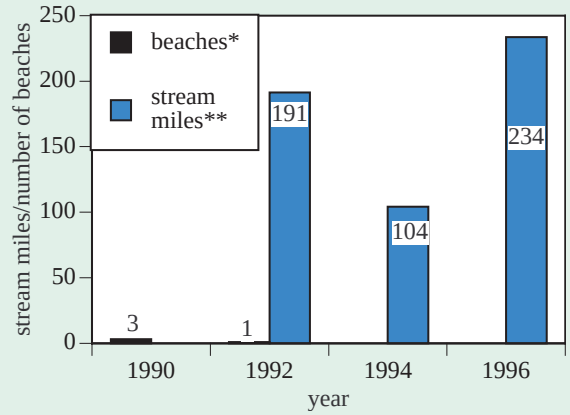
The Department for Health Services regulates septic tank pumpers. Currently, 243 operators are licensed to pump and dispose septic tank sewage. Most septic tank waste is trucked to wastewater treatment plants for disposal; however, a number of pumpers have licenses to land apply wastes. It is not known how much septic waste is illegally disposed or how extensive a problem it is in Kentucky.

In 1994, the state enacted regulations requiring groundwater protection plans for septic tanks and other activities with a potential to pollute groundwater. Plans must identify strategies to prevent groundwater pollution. The Division of Water has reviewed 60 groundwater protection plans, 28 of which have been approved.

Water Issues and Program Trends

Federal and state efforts to clean up Kentucky's water resources have focused on controlling discharges from industries and municipal wastewater plants through regulatory permits as required by the federal Clean Water Act of 1972. The state has issued individual and general water permits, known as Kentucky Pollutant Discharge Elimination System (KPDES) permits, to more than 10,000 industrial, municipal, coal mining, and other facilities. These permits have led to improving water quality conditions across the state, but problems still remain.

Figure 17 Swimming Advisories in KY



**No beach closures in 1994-96. **Advisories were also issued for all urban waterways in 1995 and 1996. Miles of urban waterways not available. Source: KY Div. of Water*

60% of 3,227 Wastewater Treatment Plants Had Violations in 1995

Wastewater treatment plants are the third leading source of water pollution.[10] Sewage from treatment plants and other sources have led to a number of swimming advisories across the state **(Figure 17 & Figure 18)**.

During 1995, 60% of the 3,227 wastewater plants had one or more violations of state water quality regulations **(Figure 19)**. Most of the violations, 27,323, were reporting infractions. Another 9,984 were for monitoring violations. However, 26% of the violations (13,212) were for exceedances of permit limits set to protect public health and the environment. The most common violations of permit limits at wastewater treatment plants were suspended solids (3,259), nitrogen/ammonia (1,754), fecal coliform (1,544), and dissolved oxygen (1,082). Wastewater treatment plant violation trends reveal that Kentucky still has a long way to go in bringing these plants into compliance with state clean water rules. In 1995 alone, more than 50,000 violations were documented at wastewater treatment plants **(Figure 20)**.

Forty percent of the wastewater permit limit violations occurred at small package treatment plants. These prefabricated plants treat wastewater from subdivisions, schools, and mobile home parks. Poor operation and maintenance at package plants has led to state to work with Area Development Districts, sanitation districts, and municipalities to regionalize these plants to improve operations. Regional facilities eliminate discharges from problem package plants by diverting the flow to a larger facility or by combining two or more plants into a regional facility.[11] Between 1990 and 1995, more package plants were deactivated (541) than new plants permitted (306). During 1994-95, the greatest number of package treatment plant deactivations occurred in Northern KY (31) and Jefferson County (30).

Figure 18 Swimming Advisories Issued in Kentucky (1996)

U. Cumberland River
120 miles
North Fork of KY River
86 miles
Licking River
28 miles
Urban Waterways
all urban waterways
Source: KY Division of Water

During 1995, 60% of the wastewater plants had one or more violations of state water quality regulations. Twenty-six percent of the 50,519 violations were for exceedances of permit limits set to protect public health and the environment.

8% of Industries in Significant Noncompliance with Pretreatment Rules

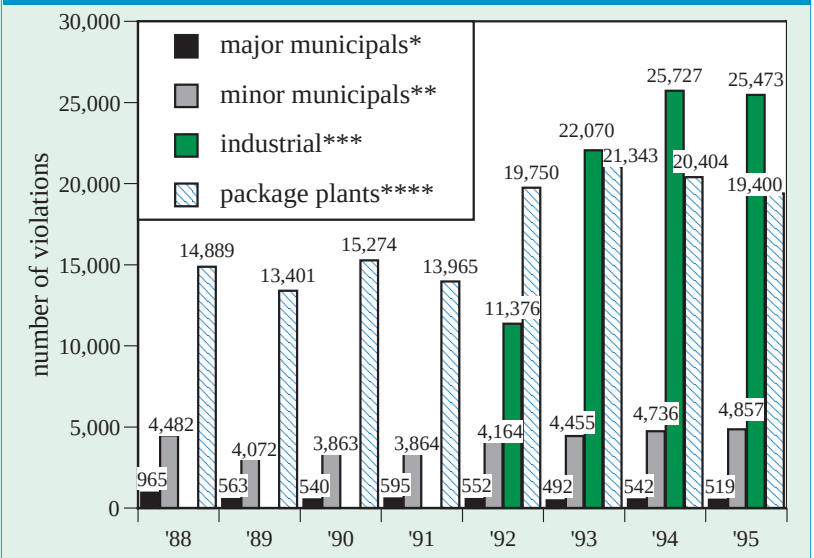
Industrial pretreatment programs are in effect at some 665 industrial facilities in 67 cities. This program requires the pretreatment of industrial wastewater to remove chemicals and other pollutants prior to its discharge to a municipal treatment plant. During 1996, 8% of the in-

Figure 19 Types of Wastewater Treatment Plants Operating in Kentucky and Violations of Regulatory Requirements (1995)

type of plant	number of plants	# of plants in violation	% plants in violation	total violations*	violations of permit limits
Major Municipal	67	52	77%	519	515
Minor Municipal	178	143	80%	4,857	2,127
Industrial	1,276	732	57%	25,743	4,331
Package	1,706	1,016	59%	19,400	6,239
Total	**3,227**	**1,943**	**60%**	**50,519**	**13,212**

**Includes permit, monitoring, reporting violations. Source: KY Division of Water*

Figure 20 Violation Trends at Wastewater Treatment Plants in Kentucky



**Major municipals treat 1,000,000 gallons or more per day. **Minor municipals treat less than 1,000,000 gallons per day. ***Industrial facilities treat industrial related effluent so that it can be discharged to nearby waters. Data on industrial facilites not available prior to 1992. ****Package plants are prefabricated plants of small capacity. Package plants are often used in remote areas or in unincorporated areas and tend to serve subdivisions, schools, institutions, or mobile home parks. Source: KY Division of Water*

Figure 21 Pretreatment Programs in Significant Noncompliance ('96)

wastewater tmt. plant	# industrial users	# in non-compliance
Ashland	7	1
Beaver Dam	8	1
Bowling Green	26	9
Corbin	9	1
Elizabethtown	22	1
Elkton	1	1
Franklin	9	1
Glasgow	15	4
Harrodsburg	5	1
Hopkinsville	15	1
Leitchfield	12	2
Lexington-Town Br.	46	9
London	9	3
Louisville-Mor. For.	93	5
Louisville-West Co.	12	2
Mayfield	5	2
Mount Sterling	5	3
Owensboro-West	22	1
Paris	11	5
Russellville	6	2
Stanford	2	1
Total 21	**340**	**56**

Source: KY Division of Water

Figure 22 Combined Sewer Overflows

Ashland	8
Catlettsburg	14
Campbell & Kenton Counties	74
Frankfort	15
Harlan	3
Henderson	15
Loyall	6
Maysville	11
Morganfield	2
Louisville	118
Owensboro	14
Paducah	10
Pikeville	4
Pineville	6
Prestonsburg	2
Vanceburg	1
Worthington	3

Source: KY Div. of Water, Jefferson County MSD

dustries with pretreatment programs (56 industrial users in 21 cities) were in significant noncompliance with their pretreatment requirements **(Figure 21)**.

Combined Sewer Overflows Number 306 in 17 Cities

Efforts to address combined sewer overflows (CSOs) continue. CSOs are a problem in older cities where stormwater runoff is carried in sanitary sewer pipes. During storms the sewers overflow and discharge raw sewage into receiving waters. The Division of Water has identified 17 cities with a total of 306 CSO outfall points **(Figure 22)**. Louisville, which has the largest number of CSOs in the state (118), has been concentrating on preventing sewage backflow into homes. The city's sewer district has also posted signs at overflow sites warning the public that downstream waters are not safe for recreational use.[12]

Number of Illegal Straight Pipe Sewage Discharges Unknown But Considered Widespread

While most of the focus of the federal Clean Water Act has been on controlling pollution from large municipal and industrial sources, residential septic systems and illegal straight pipe discharges are contributing to pollution problems in many waterways.

About 56% of the state's households are connected to sewers and have their sewage treated at one of the 1,951 municipal or package sewage treatment plants operating in the state. A closer look, however, reveals that in 36 counties less than 25% of the households are connected to sewers **(Figure 23)**. Many households must rely on septic tanks and other on-site systems for wastewater treatment. Since 1982, when the Department of Health was given authority to regulate on-site sewage disposal systems, 140,000 septic systems have been permitted. Each year, an average 10,000 on-site sewage system permits are issued by local health departments. It is not known how many failing septic systems and illegal straight pipes are discharging raw sewage into waterways but it is considered a widespread problem across the state.

Random surveys along some waterways found:

- 1,000 straight pipes along the North Fork of the Kentucky River in Letcher County.
- 660 straight pipes along the Upper Cumberland River in Harlan County.
- 3,100 residences in Floyd County with straight pipes, failing septic systems, and sewers dumping directly into the Cumberland River.
- More than 80% of the 242 households in the Wagerville-Barnes Mountain area of Estill County have straight pipes or failing septic systems.[13] A county-by-county survey would likely reveal that straight pipes and failing septic tanks are a statewide problem.

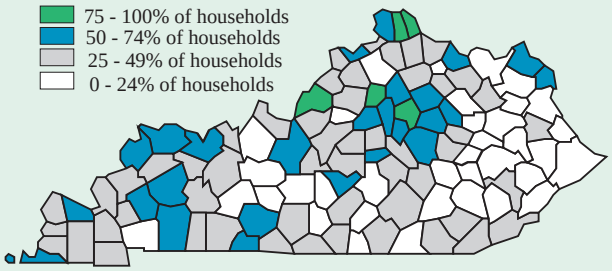
Addressing sewage problems will take state and local solutions. The construction and upgrade of treatment plants and extension of sewer lines is one solution. Funds to finance wastewater infrastructure are available through a number of entities including a low-interest state revolving loan program. Since 1989, 89 projects totaling $193 million have been funded by the loan program **(Figure 25)**. However, the fund falls well short of the projected state wastewater treatment needs of $3.2 billion.[14]

On-site sewage treatment may be a more viable alternative in some areas of the state. A cooperative local/state/federal partnership along the North Fork of the Kentucky River is working to provide education and grants for low-income residents to comply with on-site sewage disposal requirements. On-site sewage disposal demonstration projects are also underway in McLean, Rowan, and Estill counties.

But much more remains to be done to promote proper on-site sewage disposal including stronger enforcement of existing on-site sewage disposal rules, creation of sanitation districts to meet wastewater treatment needs such

About 56% of the state's households are connected to public sewers. Many households must rely on septic tanks and other on-site systems for wastewater treatment. Each year, an average 10,000 on-site sewage system permits are issued by local health departments in Kentucky.

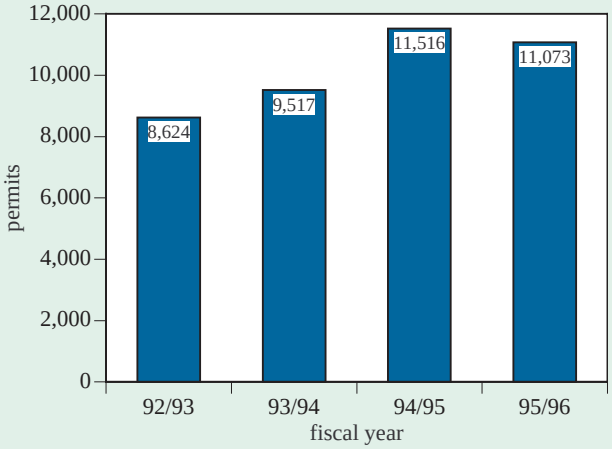
Figure 23 Percent of Households Connected to Public Sewer*



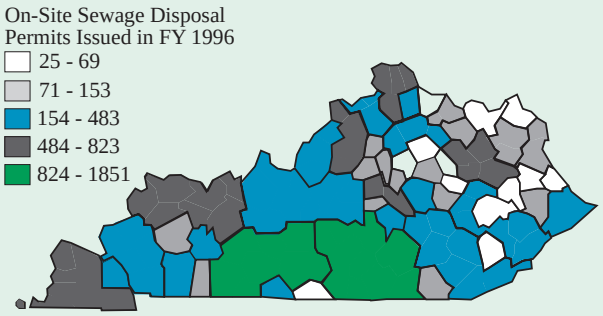
**Public sewer operated by a government body or private organization. Source: U.S. Census, Kentucky Data, 1990*

Figure 24 On-Site Sewage Disposal Permits

On-Site Sewage Disposal Permits Issued

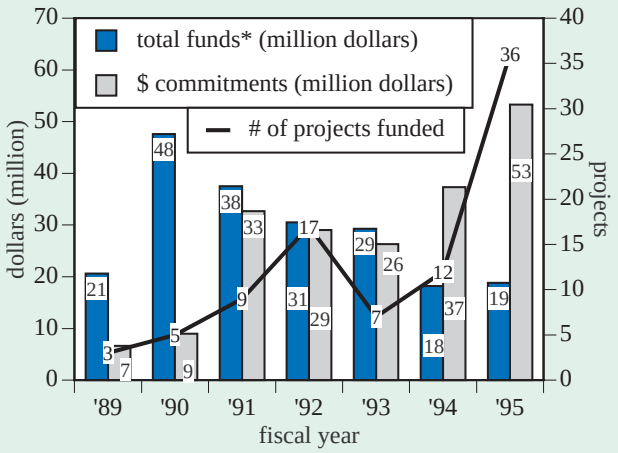


On-Site Sewage Disposal Permits Issued By Health Districts* (FY 1996)



*Note: Data on septic tank permits issued prior to 1992-93 not available. *Larger shaded areas represent multi-county health districts. There are also 37 independent county health districts represented in the chart.*
Source: KY Department for Health Services

Figure 25 Kentucky Wastewater Revolving Loan Fund



**Includes federal grants, state match, and interest incurred. There is also $20 million in principal and interest repayments available for additional projects. Source: KY Division of Water*

Letcher County Adopts Ordinances to Address Sewage Problems

Letcher County is working to address the problem of sewage disposal with a number of recent initiatives. Many rural areas of Letcher County do not have suitable sanitary sewer or septic systems. As such, sewage pollution has had a significant impact on waterways. In May 1996, the county created a special district to better organize and provide water and sewer services to the residents of Letcher County. A committee is in the process of conducting a study to provide county-wide water and sewer service.

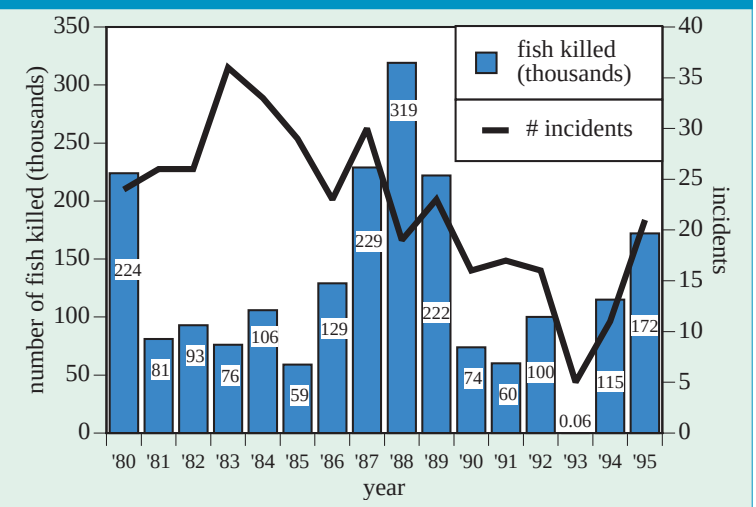
Letcher County officials are also working to address on-site sewage disposal. The county passed an ordinance in February 1996 to better regulate on-site sewage disposal in new dwellings. The ordinance requires proper sewer hook up or an approved septic system before new electric service will be provided. The person requesting state approval of electrical wiring for a new structure must obtain a release from the local health department indicating that the facility is in compliance with sewage disposal laws.

as the 21 existing sewer and five water/sewer sanitation districts in Kentucky, and adoption of local ordinances or agreements requiring proper on-site sewage disposal like those passed by 21 counties[15] **(see shaded box - Letcher County Adopts Ordinances to Address Sewage Problems)**.

Fish Kill Incidents Increase in Past Few Years

An average of ten spills occur each day along Kentucky roadsides and at industrial sites. Some of these spills have degraded water quality and have led to fish kills. **Figure 26** reveals that fish kill incidents steadily declined between 1983 and 1993. However, reports have increased in the past few years. During 1994-95, 31 incidents were reported along 50 miles of streams killing 172,306 fish. Oil and chemical spills were responsible for seven of the fish kill incidents followed by sewage (4), natural causes (3), agriculture (2), and mining (1). Fifteen incidents were of unknown origin.

Figure 26 Fish Kill Incidents in Kentucky



Source: KY Reports to Congress on Water Quality

Fish Kill Incidents By River Basin (1994-95)

Kentucky	12
Licking	5
Salt	5
Green	4
U. Cumberland	2
Tennessee	2
Ohio Tribs.	1
Total	**31**

Source: 1996 KY Report to Congress on Water Quality

Reported Industrial Toxic Water Discharges Decline 77% Since 1988

Each year, thousands of pounds of toxic chemicals are discharged to waterways, impairing water quality and aquatic habitat. The sources of these chemicals are numerous and include industries, waste sites, farmlands, underground storage tanks, transportation spills, and even the pesticides applied to our yards. It is difficult to fully assess the affects these chemicals are having on water quality since only a few of the more than 70,000 chemicals registered for use are monitored at ambient water quality stations, and relatively limited information has been collected on chemical concentrations in stream and lake sediments or in fish tissue.

Industries reported discharging 403,292 pounds of toxic chemicals to state waterways during 1994, the most recent year for which data is available **(Figure 27 & Figure 28, also see EQC Toxics Report)**. But many companies are doing a better job in reducing the generation and release of toxic chemicals. For example, reported industrial toxic water discharges dropped 77% since 1988. The discharge of toxics from industrial facilities to municipal wastewater treatment plants also fell 64%, from 2.8 million pounds in 1988 to 1.8 million pounds in 1994 **(Figure 28)**.

Toxicity testing at municipal wastewater and industrial plants also shows that these facilities are doing a better job in removing chemicals from their effluent prior to discharging it to a waterway **(Figure 29)**. During 1995, 16% of the 81 industrial and 43 municipal plants tested failed to meet toxicity effluent limits.

Toxic Chemicals Detected in Lake Fish

Figure 30 shows that toxic chemicals have found their way into lake fish tissue. Some of the chemicals detected in fish, such as lead and copper, occur naturally in

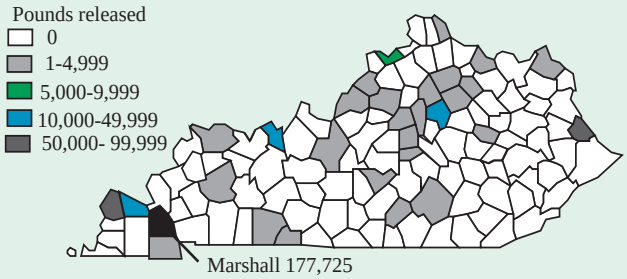
nature or can be produced as a waste byproduct while other chemicals, like PCBs and chlordane, are synthetic. Testing of lake fish has been conducted by the Division of Water at nine public lakes in the past few years. The chemical levels detected in the fish rarely exceeded those set to protect public health with the exception of PCBs in Green River Lake and chlordane in McNeely Lake. There is no trend data on chemical concentrations found in lake fish tissue in Kentucky since testing has only recently been initiated. However, national studies generally indicate that concentrations of several chemicals such as DDT, mercury, lead, cadmium, and arsenic in freshwater fish tissue peaked in 1970 and has since declined.[16]

A fish consumption advisory has been in effect for Green River Lake since 1994 after unsafe levels of PCBs were found in carp and channel catfish. PCBs are highly toxic chemicals that were used as lubricants in transformers and other electrical equipment. PCBs were banned for use in 1977 after they were found to cause harmful health effects.[17] The source of PCBs in the lake is a gas pipeline compressor station. Cleanup of the site is scheduled for the summer of 1997. However, no decision has been made regarding the cleanup of PCBs in Green River Lake sediment. Fish consumption advisories are also in effect at five ponds in Western Kentucky and along 788 miles of waterways **(Figure 31)**.

The Division of Water resampled McNeely Lake in 1996 to verify high chlordane levels found in fish tissue during 1994 **(Figure 30)**. Chlordane is an insecticide primarily used to control termites. It was banned from domestic use in 1988 due to health risks.[18] The 1996 tests found that levels of chlordane in bass, carp, and catfish were below the FDA action levels. It is not known what caused the high chlordane levels in 1994. The Division of Water hopes to retest the lake next year.

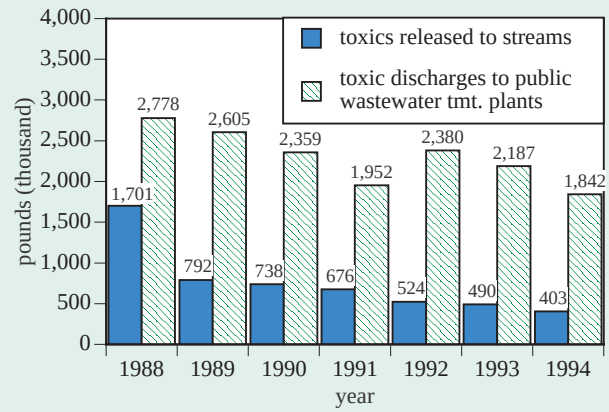
Elevated levels of dioxin in fish and sediment were also discovered in 1996 at Chickasaw Park Lake, an inner-city lake in Louisville. Dioxin levels found in the lake's sediment were 20% higher than the national average. Elevated dioxin levels were also detected in fish tissue. Dioxin can be produced as a by-product in the manufacture of pesticides, paper, and from waste incineration. Waste sites are also a source of dioxin. Exposure to dioxin at certain levels and durations can cause liver damage and reproductive risks.[19] The source of dioxin at the lake is unknown. A risk assessment conducted by the KY Department for Environmental Protection recommended that people eat no more than one crappie per year and that consumption of carp be banned at Chickasaw Lake. The fish were removed from the lake by the KY Department of Fish and Wildlife. The city of Louisville has also posted a fish consumption advisory at Chickasaw Lake and is studying the extent of contamination to determine if further action is needed.

Figure 27 Industrial Toxic Chemical Releases to Waterways in Kentucky (1994)



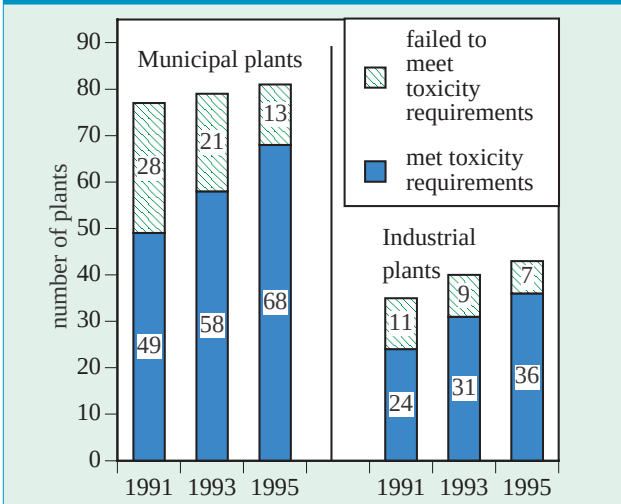
Source: 1994 KY Toxics Release Inventory Report

Figure 28 Industrial Toxic Water Releases and Transfers to Wastewater Treatment Plants in Kentucky



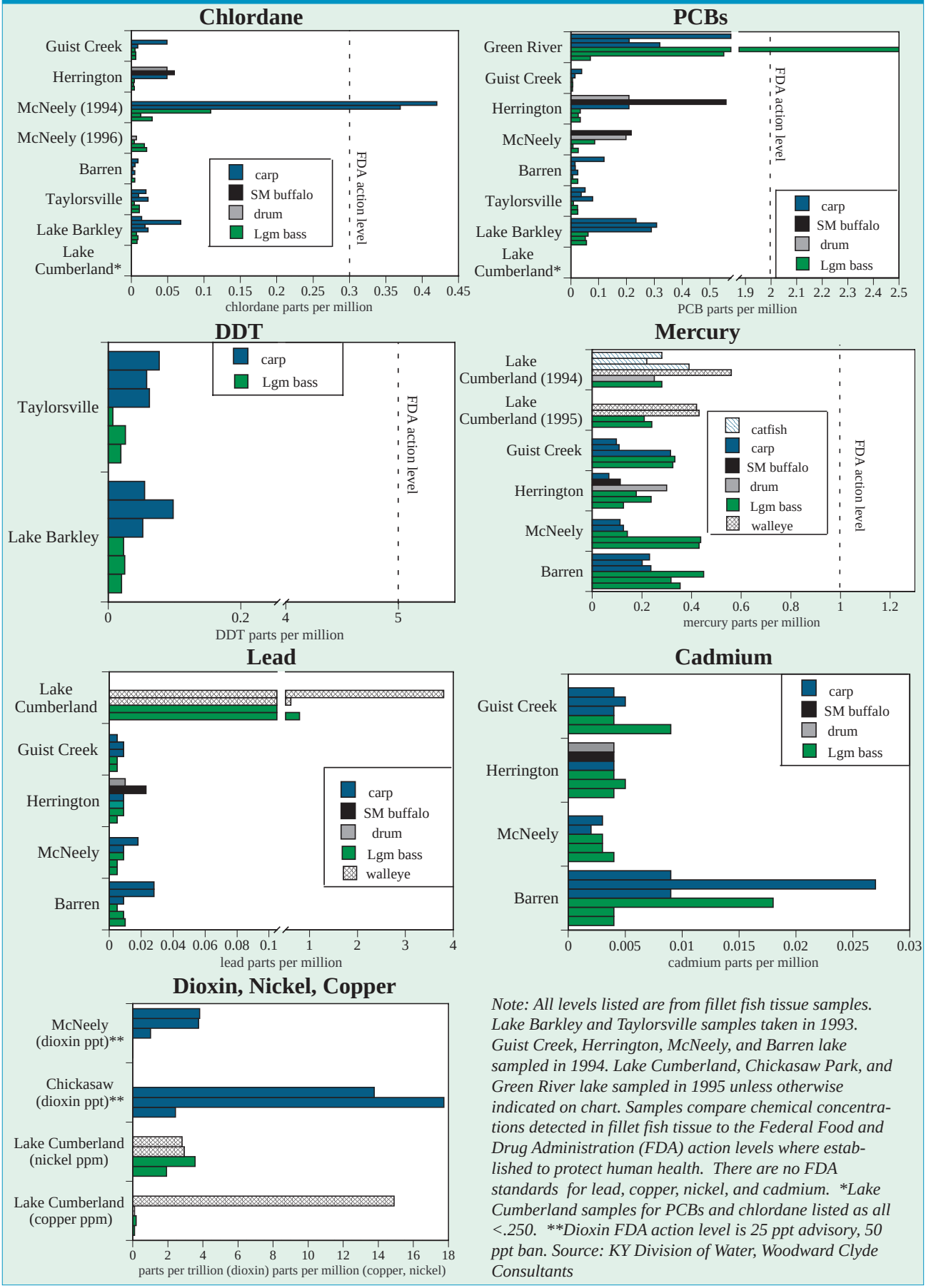
Source: Kentucky Toxic Release Inventory Reports

Figure 29 Toxicity Testing at Wastewater Treatment Plants in Kentucky



Note: Based on bioassay of whole effluent toxicity (WET).
Source: KY Reports to Congress on Water Quality

Figure 30 Contaminants Detected in Fish Tissue at Public Lakes in Kentucky



*Note: All levels listed are from fillet fish tissue samples. Lake Barkley and Taylorsville samples taken in 1993. Guist Creek, Herrington, McNeely, and Barren lake sampled in 1994. Lake Cumberland, Chickasaw Park, and Green River lake sampled in 1995 unless otherwise indicated on chart. Samples compare chemical concentrations detected in fillet fish tissue to the Federal Food and Drug Administration (FDA) action levels where established to protect human health. There are no FDA standards for lead, copper, nickel, and cadmium. *Lake Cumberland samples for PCBs and chlordane listed as all <.250. **Dioxin FDA action level is 25 ppt advisory, 50 ppt ban. Source: KY Division of Water, Woodward Clyde Consultants*

Because FDA has not established action levels for many chemicals, the Division of Water is considering the use of risk-based criteria to determine the need for fish consumption warnings at waterways with elevated levels of contaminants in fish tissue. The risk criteria will weigh chemical concentrations found in fish with health-based considerations when determining the need for fish consumption advisories.

Figure 31 Fish Consumption Advisories in Effect in Kentucky

Stream (county)	pollutant	year listed	miles	source	fish
Town Br./Mud River (Logan/Butler/Muhlenburg)	PCBs	1985	71.5	Dye-cast plant	all species
West Fork Drakes Creek (Simpson, Warren)	PCBs	1985	46.9	adhesive plant	all species
Little Bayou Creek (McCracken)	PCBs	1985	6.5	gas. diff. plant	all species
Ohio River (entire length of KY border)	PCBs chlordane	1989	663.9	industry urban runoff	carp, paddle catfish, bass
W. KY Wildlife Area (McCracken Co.)	mercury	1993	5 ponds	unknown	bass
Green River Lake (Taylor, Adair)	PCBs	1994	entire lake	gas compression station	catfish, carp

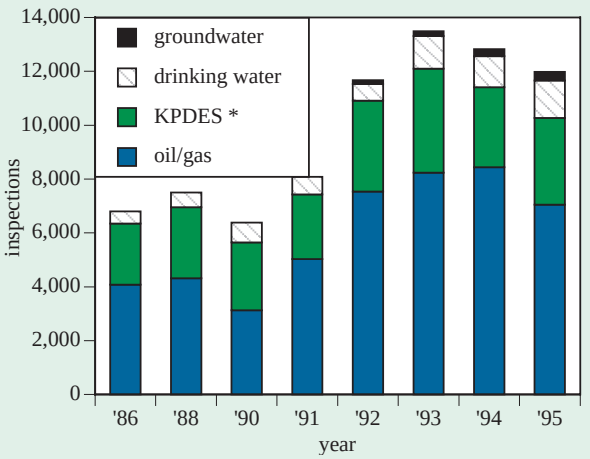
Source: 1996 KY Report to Congress on Water Quality

Water Inspections, Violations, Penalties Decline

Many water quality improvements are due to state enforcement of federal and state clean water rules. **Figure 32** reveals that water inspections hit an all time high in 1993, totaling 13,490. The number of inspections dropped to 11,978 in 1995. Violations cited by inspectors also declined **(Figure 33)**. The drop in inspections and violations are attributed to a reduction in field inspectors (from 67 in 1992 to 60 in 1995), fewer oil wells (oil production in Kentucky fell from 4.6 million barrels in 1993 to 3.4 million barrels in 1996), and a move toward technical assistance as part of the Cabinet's Customer Service Initiative.

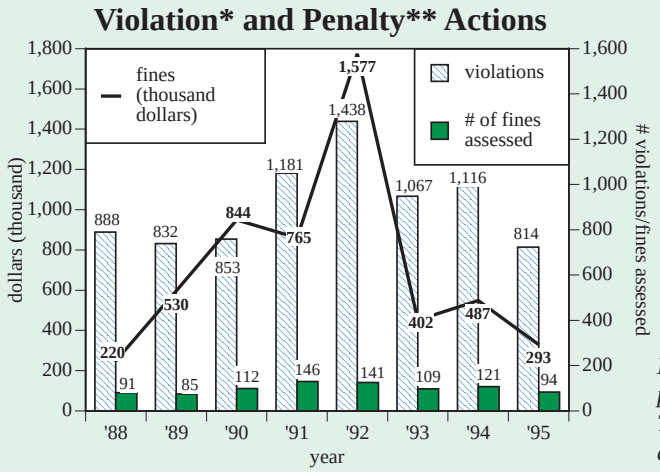
Most of the violations cited are resolved through agreed orders and other means, but some of the more serious infractions result in fines. Penalties assessed against water polluters have varied over the years (**Figure 33**). In 1995, $293,995 in fines were assessed against 94 entities, most

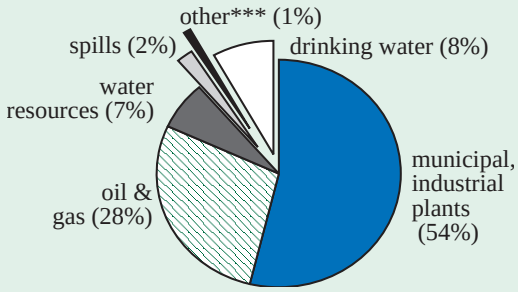
Figure 32 Water Quality Inspection Trends



**Facilities with KY Pollutant Discharge Elimination System permits. Does not include inspections at KPDES permitted coal mines which are conducted by the KY Dept. of Surface Mining. This information will appear in the EQC Resource Extraction Trends report. Source: KY Division of Water*

Figure 33 Water Quality Violation and Penalty Trends





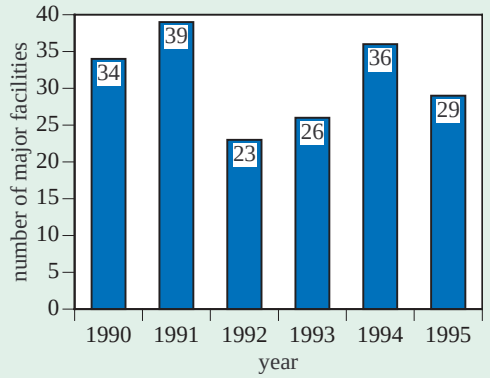
*Note: Does not include coal mine water inspections and penalties. This will be reported in the EQC Resource Extraction Trends report. *Violations cited by field inspectors. **Penalties assessed by the Division of Water Enforcement Branch (does not include drinking water or federal government penalty assessments). Drinking water penalty assessments appear in the EQC Safe Drinking Water Trends Report. ***Includes groundwater, wild river, and agriculture violations.*
Source: KY Division of Water

Figure 34 Major KPDES Facilities in Significant Noncompliance (Feb. 1997)

Facility	County
AK Steel	Boyd
Murray STP	Calloway
North Am. Stainless	Carroll
Greenup Co. Environmental	Greenup
London STP	Laurel
BTR Precision Dye Casting	Logan
Russellville STP	Logan
Lebanon STP	Marion
B.F. Goodrich	Marshall
Hazard STP	Perry
Morganfield STP	Union
Big Rivers Electric	Webster

Note: STP - sewage treatment plant. Significant noncompliance is defined as those major facilities with two to four exceedances of permit limits in a six month period based on type of pollutant. Major facilities currently include 67 major municipal wastewater treatment plants that treat 1 million gallons or more per day and 34 industrial and 4 federal facilities based on chemical and conventional pollutants, flow, and potential to impact health and water quality.
Source: KY Div. of Water

Figure 35 Major KPDES Facilities in Significant Noncompliance with Permits

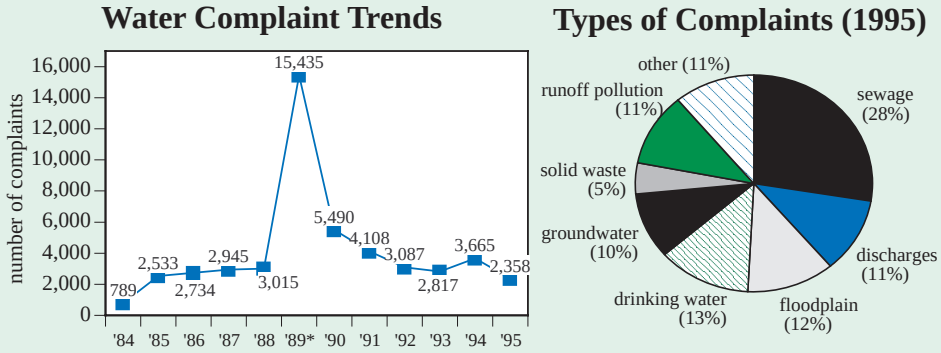


Source: KY Division of Water

of which, 74, were at permitted facilities. As of Feb. 1997, 12, or 11% of the 105 major facilites were in significant noncompliance with their KPDES permits **(Figure 34 and Figure 35)**.[20]

In 1995, citizen water complaints dropped to their lowest recorded since 1984 **(Figure 36)**. Complaints included wastewater treatment plants (320), septic tanks (330), public drinking water (448), floodplains (457), groundwater wells (335), odors (332), landfarming (214), illegal discharges (164), stormwater runoff (149), and open dumping (129).

Figure 36 Citizen Water Complaints in Kentucky



*Note: Complaints received by the Div. of Water. *Increase in complaints attributed to Russell County sewage treatment plant pipeline to Lake Cumberland. Source: KY Division of Water*

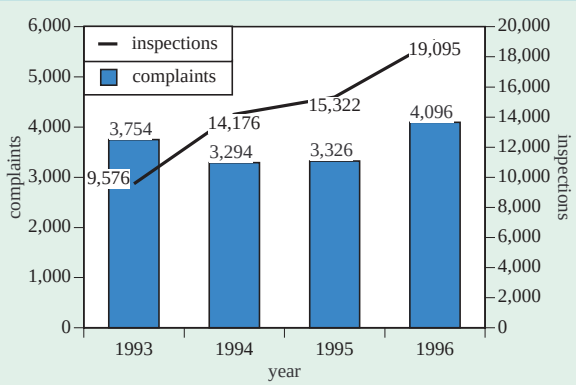
On-Site Sewage Inspections Double in Four Years

Since 1982, the KY Department for Health Services has had authority for ensuring that on-site sewage systems, such as septic tanks, are properly sited and installed. Local health departments issue thousands of on-site sewage permits each year, conduct inspections of systems, and respond to complaints.

The number of on-site sewage disposal inspections conducted by local health departments have doubled in the past four years **(Figure 37)**. This is due to a number of factors, including stepped up enforcement of on-site sewage disposal rules, the adoption of ordinances and agreements in 21 counties requiring verification of approved on-site sewage systems prior to the hookup of electrical service in new dwellings, and greater public awareness of permit requirements. However, the Department for Health Services admits that much more needs to be done to address the problem of illegal straight sewage discharge pipes and older failing septic systems.

The department notes that the state's on-site sewage law does not provide for penalties, nor does it allow the agency to take action against a violator unless there is a written complaint and then only if there is an imminent health hazard. In addition, more support and actions are needed at the state and local level including passage of state laws or local ordi-

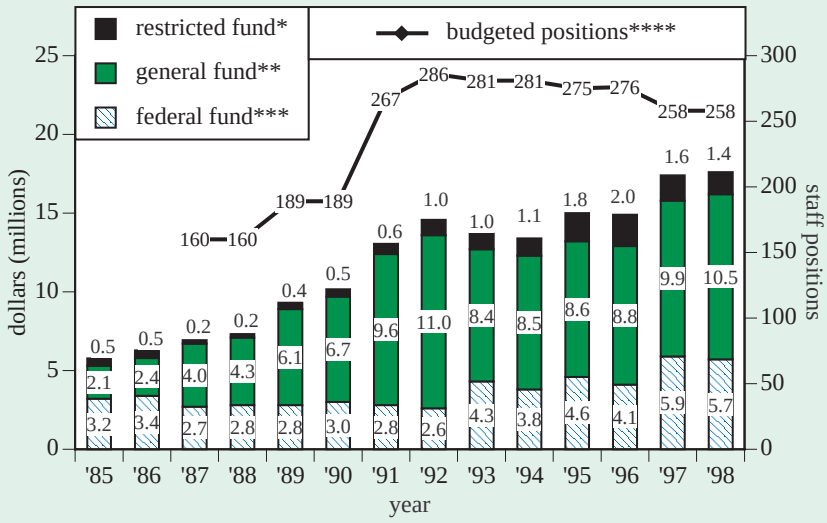
Figure 37 On-Site Sewage Disposal Inspections and Complaints in KY



Source: KY Department for Health Services

nances to promote proper on-site sewage disposal. The Department for Health Services also indicates that there is little interest by local courts to prosecute violators of on-site sewage laws. State and local programs are also needed to educate the public about proper sewage disposal and maintenance of septic systems. Woodford County is the first county to consider an ordinance to require the proper operation and maintenance of septic systems. And the department believes funding is needed to help finance regional and other on-site sewage systems for economically disadvantaged areas.

Figure 38 Kentucky Division of Water Budget Trends

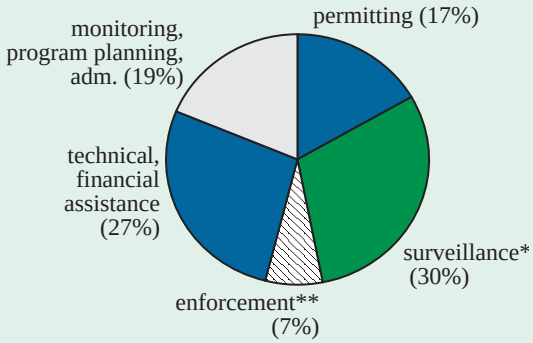


*Note: Based on fiscal year. *Grants, permit fees, and other sources of funds not included in general funds. **General funds appropriated from the state budget. ***Federal grants received to support NREPC water programs. ****Budgeted staff does not necessarily mean that all staff positions have been filled. Source: KY Cabinet for Natural Resources and Environmental Protection, Budget Office*

Water Program Expenditures Amount to $2.66 Per Kentuckian

Carrying out water pollution laws requires financial resources and personnel to protect public health and restore water quality. **Figure 38** reveals a steady increase in funding for KY Division of Water programs between 1985 and 1992. However, in 1993, budget shortfalls in Kentucky resulted in a $3 million reduction in state general fund appropriations for water programs. Since then, the total number of budgeted positions has steadily declined **(Figure 38)**. Consequently, the Division of Water has been forced to cut back on some programs, such as wastewater operator training, drought response, dam inspections, and water monitoring, in order to carry out its core activities of KPDES permitting and enforcement **(Figure 39)**. But the cuts have also impacted permitting and enforcement programs. For example, six field inspector positions have been cut since 1992. The Division of Water currently employs 60 inspectors to monitor thousands of permits and respond to complaints.

Figure 39 KY Division of Water Budget, By Program Area (FY 1997)



*Note: Based on $17,435,200 FY 1997 budget. *Inspections, responding to complaints. **Addressing violations of water rules through agreed orders, fines, other. Source: KY Division of Water*

Federal funds to support state water programs have not kept up with new mandates, according to Division of Water officials. The division reports that the federal funding increases in 1997 and 1998 reflect pass-through grants slated for local runoff pollution demonstration projects. The fiscal year 1997 and 1998 state general-fund appropriation for water programs restores funding back to 1991 levels at about $10 million a year. In 1998, state appropriations of $10.5 million to finance water programs will amount to an expenditure of $2.66 per Kentuckian to protect water quality.[21]

The Division has employed some cost-saving measures to assist the agency in meetings its statutory mandate to protect the waters of the Commonwealth. One measure under consideration is to switch from monthly to bimonthly monitoring at most of the 44 stream stations. This will allow the Division to expand its statewide monitoring network and assist with the watershed-based initiative as discussed on page five of this report. The Division has also been working to streamline water permit requirements and the review process to make it more efficient.

Kentucky Division of Water Budget

Program	1997 Budget
groundwater	$1,401,500
nonpoint	$3,075,500
surface water	$8,069,000
drinking water	$3,003,500
water resources*	$1,885,700
Total	**$17,435,200**

**Dam safety, water quantity, floodplain management programs.*
Source: KY Div. of Water

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20. Significant noncompliance defined as those major KPDES permitted facilities with exceedance of permit limits by 40% for oxygen demand, solids, nutrients, detergents/oil, minerals, and some metals and 20% for the parameters of heavy metals and inorganic chemicals twice in a six-month period. In addition, a facility is in significant noncompliance if it exceeds the permit limit of any parameter four times in a six-month period.
21. $2.66 per capita expenditure based on KY General Fund FY 1998 appropriation of $10.5 million to the Division of Water and the 1997 KY population of 3,941,376 as estimated (high-growth series) by KY State Data Center, Univ. of Louisville.

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State of KY's Environment

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1996-97 State of Kentucky's Environment

Natural Resources

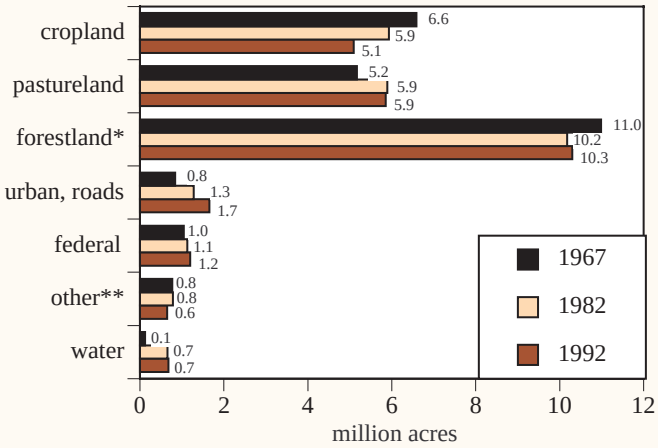
Kentucky's landscape and biological diversity have undergone significant changes during the past two centuries. Vast forests and free flowing rivers once provided habitat to large herds of buffalo and elk, great numbers of black bear, and thousands of species of native plants and animals. Since settlement began, more than 200 years ago, the state's 13 major rivers have been impounded and millions of acres of forests cleared to make way for farms, coal mines, highways, and small and large urban areas. Kentucky's natural landscape has been greatly altered affecting the biological diversity of our natural communities, and is some cases, resulting in the loss of species and entire ecosystems.[1]

Land Use: Cropland Declines by 1.5 Million Acres; 101 Acres a Day Converted to Urban Areas and Roads

Kentucky's 25.8 million acres of land are now primarily comprised of forest, crop, and pasture lands with the remainder covered by roads, urban areas, water, and federal lands **(Figure 1)**.[2] Land use shifts seen during the past two centuries are largely a reflection of a growing population **(Figure 2)** and a changing economy. For example, during the past 25 years cropland declined by 1.5 million acres. Cropland loss is attributed to urban buildup, conversion to water areas, and an increase in crop production costs resulting in the conversion of marginal cropland to pasture.[3] In addition, 28% of these croplands (423,000 acres) were retired from use under the federal Conservation Reserve Program.

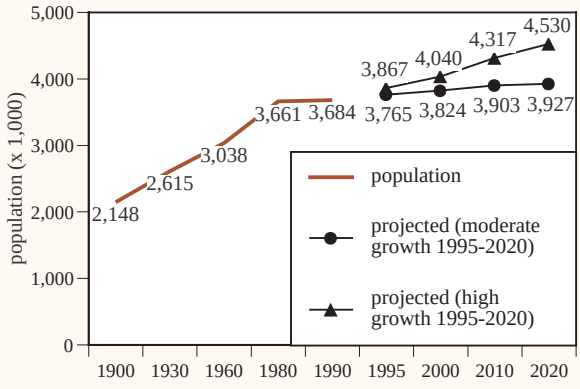
Land use changes are occurring more rapidly in some regions of the state than others.

Figure 1 Land Use Patterns in Kentucky



**Non-federal lands with the exception of Land Between the Lakes. **Farmsteads and other land in farms (ie. greenhouses, nurseries, poultry facilities; barrenland (ie. strip mines, quarries); and marshland. Source: U.S. Natural Resources Conservation Service*

Figure 2 Kentucky Population Trends



Source: U.S. Census

EQC

Environmental Quality Commission

Environmental Indicators Program

Reporting on Environmental Trends and Conditions in Kentucky.

1996-97 Trends Reports
- Safe Drinking Water
- Air Quality
- Waste Management
- Toxics
- Water Quality
- Natural Resources
- Resource Extraction

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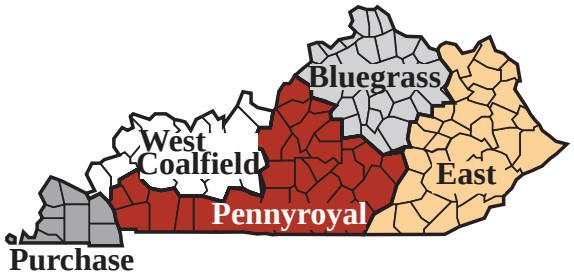
Figure 3 KY's Changing Landscape

Region	1982 acres	1992 acres	1982-92 % change
East			
cropland	347,700	230,200	-34%
pastureland	729,100	1,028,100	+41%
forestland*	5,371,100	5,109,900	-5%
other**	1,410,300	1,490,000	+5%
Bluegrass			
cropland	1,364,200	1,190,400	-13%
pastureland	2,485,800	2,268,100	-9%
forestland*	1,109,500	1,328,100	+20%
other**	682,000	854,900	+25%
Pennyroyal			
cropland	1,890,200	1,702,800	-10%
pastureland	1,700,700	1,681,100	-1%
forestland*	1,908,300	1,943,000	+2%
other**	914,400	1,086,700	+19%
West Coalfield			
cropland	1,570,700	1,382,100	-12%
pastureland	783,500	707,200	-10%
forestland*	1,455,200	1,580,100	+8%
other**	663,900	803,900	+21%
Purchase			
cropland	762,000	586,400	-23%
pastureland	192,800	174,400	-9%
forestland*	336,700	351,000	+4%
other**	183,900	363,600	+98%



**Non-federal forestland with the exception of Land Between the Lakes. **Urban, roads, water, federal, and miscellaneous land. Source: National Resources Inventory, U.S. Natural Resources Conservation Service*

For example, in east Kentucky, cropland declined by a third between 1982-1992, while urban and other areas nearly doubled in the Purchase region **(Figure 3)**.

In some cases, various uses of the land are lost permanently such as when it is converted to urban areas. The U.S. Natural Resources Conservation Service estimates that an average of 101 acres a day are converted to urban areas and roads in Kentucky. The loss of some lands, such as prime farmlands—those lands that produce the best food, feed, and fiber—have raised concern. Between 1982-1992, Kentucky lost 170,000 acres or 3% of its prime farmland to other uses.[4]

State efforts to preserve prime farmland continue as do measures to prevent soil erosion from croplands. Cropland erosion rates have declined 31%, from 10.6 tons/acre/year in 1982 to 7.3 tons/acre/year in 1992.[5] The reduction is attributed to the increasing use of conservation tillage—various plowing methods that disturb less soil. Currently, 68% of the state's active cropland is in conservation tillage.

Land use changes and issues continue to generate much debate. Controversies created by the siting of poultry and commercial hog farms in Western Kentucky, urban sprawl in Central and Northern Kentucky, and increased logging in Eastern Kentucky are among some of the most hotly contested issues of the day. This *State of Kentucky's Environment Report* will review how these and other issues have affected the state's natural resources—specifically our forests, wildlife resources, and biological diversity.

Forest Resources

Private and public forestlands cover an estimated 45% to 48% of the state's land base.[6] These resources form the state's biological and economic base from which we derive jobs, raw materials, environmental quality, cultural heritage, recreational opportunities, and wildlife habitat.

The key to sustaining forest uses and meeting the demands of future generations is the maintenance and enhancement of our forest ecosystems. But little is known about the current state of our forests. The most recent data on the timber resource are ten years old.[7] This is a particular concern due to growing demand for wood products. The U.S. Forest Service predicts that demand for hardwoods will increase 25%, plywood 50%, and paper/paper products 100% by the year 2004.[8] As such, Kentucky's forests are coming under increased harvesting pressure. While data are not available to determine the current extent of logging, regeneration of harvested areas, or the overall health and diversity of our forests, the following information does provide a general picture of trends and issues affecting Kentucky's forest resources.

Private and public forestlands cover an estimated 45% to 48% of the state's land base.[6] The state's forests are largely privately owned, with about 92% in private hands.

Forestland Loss Ranked a High Risk to Biological Diversity

Kentucky is considered the geographic center of the deciduous forests of eastern North America.[9] The state's forests are largely privately owned, with about 92% in private hands. According to the U.S. Natural Resources Conservation Service, forestland declined by 6% in a 25-year time period, from 10.9 million acres in

Figure 4 Ecological and Environmental Risks in KY

Factor	Risk Ranking
forestland conversion	high
wildfires (impact to timber)	medium
woodland grazing (impact to timber)	medium
logging (impact to land)	medium
logging (siltation of surface water)	medium
logging (habitat loss, fragmentation, water flow alteration)	medium

Source: KY Outlook 2000, Executive Summary, May 1997

Logging in Jackson County, Kentucky (early 1900s)

Source: U.S. Natural Resources Conservation Service

1967 to 10.3 million acres in 1992 **(Figure 1)**. However, since 1982, forestland increased by 131,300 acres, from 10.180 million acres in 1982 to 10.312 million acres in 1992. During this time period forestland increased in all regions of the state with the exception of east Kentucky which saw a decline of 261,200 acres **(Figure 3)**. The U.S. Forest Service, reports a greater increase in privately owned forestland, from 10.3 million acres in 1978 to 11.4 million acres in 1994.[10] A state project to rank environmental and ecological risks identified the conversion of forestland to other uses as a high ecological risk in Kentucky **(Figure 4)**.

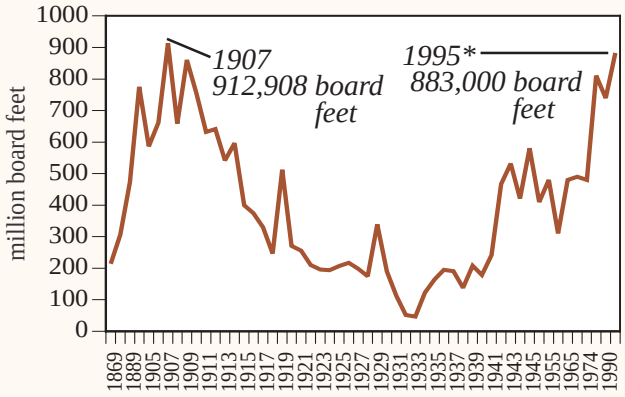
Lumber Production: 1995 Near Record High

Poor logging practices such as those that cause excessive erosion, reduce critical habitat, and remove high quality trees leaving undesirable or damaged trees allowing little room for new growth, have been ranked a medium risk to the state's environmental and ecological health **(Figure 4)**. The most extensive logging of Kentucky's forests began in the 1870s, and reached its peak in the early 1900s **(Logging in Jackson County)**.

Kentucky's forests have had much of this century to recover and timber companies are once again expressing an interest in this resource. In 1987, the most recent year data are available, 58% of timber in Kentucky was sawtimber (9 inches (softwood) 11 inches (hardwood) or larger in diameter with at least one 12-foot sawlog).[11]

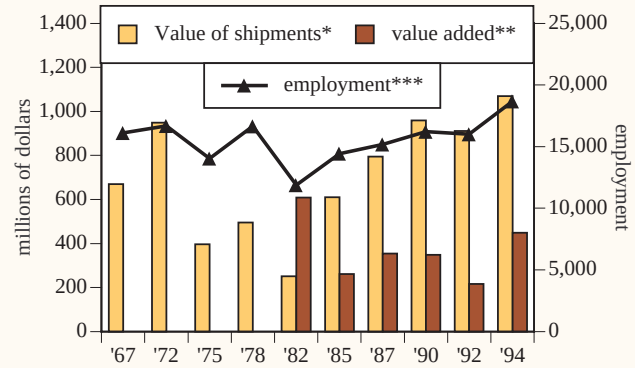
Experts agree that private forests in Kentucky are being cut at increasing rates due to timber availability and worldwide demand. One indicator of this is lumber production. Lumber production in Kentucky was near record levels in 1995 **(Figure 5)**. And lumber and wood industry sales (value of shipments) are on the rise, tripling between 1982 and 1994 **(Figure 6)**.[12]

Figure 5 Lumber Production in Kentucky



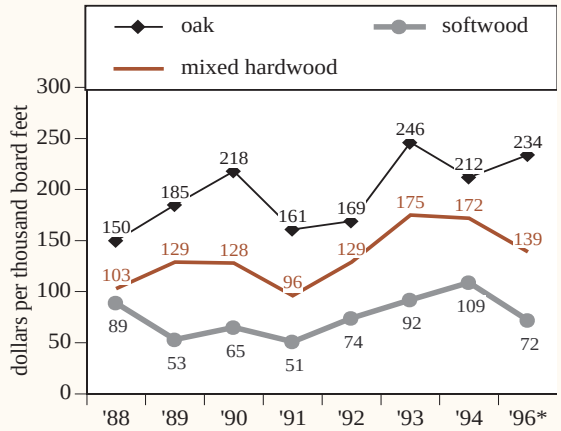
**Preliminary. Source: U.S. Forest Service; KY Div. of Forestry*

Figure 6 Kentucky Lumber and Wood Industry Employment, Value Added, and Value of Shipments



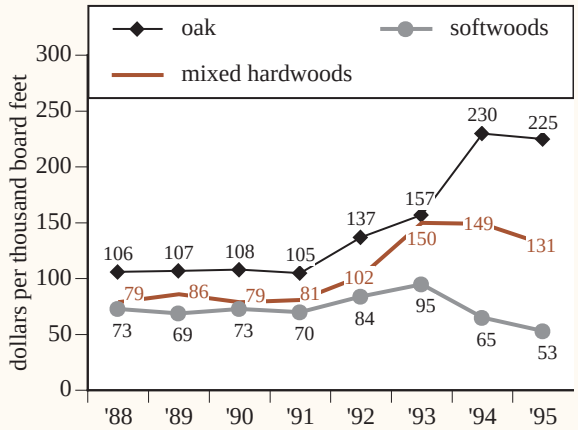
*Note: Adjusted for inflation using the consumer price index for 1994. *Lumber and wood product annual sales (SIC 24). **Lumber and wood products (SIC 24) value of product resulting from the manufacturing process (data prior to 1982 calculated differently so trend comparison cannot be shown). ***Employment in lumber and furniture industry. Source: KY Deskbooks on Economic Statistics; KY Division of Employment*

Figure 7 Timber Stumpage Prices - Private Woodlands in Kentucky



*Note: 1995 data not available. Chart adjusted for inflation using the consumer price index for 1995. *1996 prices based on average stumpage prices in Tennessee. Kentucky data not available for 1996. Source: Timber Mart-South, Stumpage Price Mart; University of Kentucky, Department of Forestry*

Figure 8 Timber Stumpage Prices - Daniel Boone National Forest



Note: Adjusted for inflation using the consumer price index for 1995. Source: U.S. Forest Service

Timber Demand: Stumpage Prices Continue to Increase for Premium Quality Sawlogs

Another indicator of growing demand for wood products is the price paid for timber. Demand continues to drive up stumpage prices for quality oak and walnut sawlogs **(Figure 7, 8, 9)**.

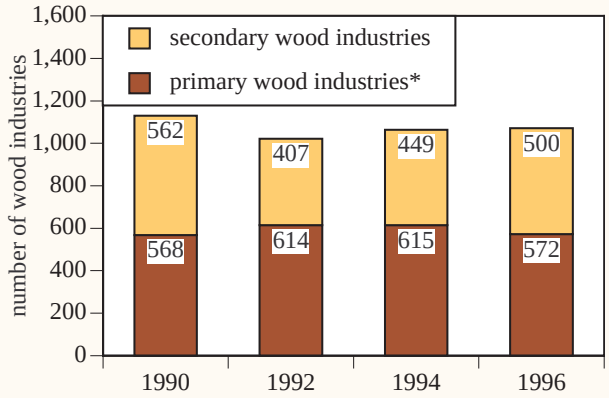
However, **Figure 7 and 8** also show that stumpage prices for mixed hardwoods and pine are showing declining trends in Kentucky after peaking in 1993 and 1994. The decline may indicate a greater volume of lower quality hardwoods being harvested and used by the forest industry, according to Matthew Pelkki, a forestry professor at the University of Kentucky.[13] He notes that with many new wood industries using small, low quality hardwoods for paper and composite wood products, the overall average price for timber is less. Because 65% of Kentucky's sawtimber is considered low quality (grade 3 and 4), the current timber markets offer landowners additional opportunities to sell timber which will likely result in a continued increase in logging in the state.[14]

Figure 9 Average Stumpage Prices- Daniel Boone National Forest Timber Sales (1995)

Species	Stumpage price (1,000 board ft.)
northern red & black oak	$248.77
black walnut	$244.30
white oak	$179.74
yellow poplar	$78.84
other hardwood (>grade 3)	$54.58
yellow pine	$39.25
other hardwood (<grade 3)	$33.32

Source: U.S. Forest Service

Figure 10 Wood Industries in Kentucky



*Note: Primary wood industries such as sawmills and paper mills process logs into materials. Secondary wood industries manufacture a product from wood materials such as furniture. *Includes pallet manufacturers. Source: KY Division of Forestry, KY Wood Products Competitiveness Council*

Forest Industry: Kentucky Secondary Wood Industry Grows 11% in Two Years, Accounts for Only 1% of Nation's Employment

The state's forest industry is composed of primary producers, such as sawmills, and secondary manufacturers which make a product, such as furniture, from wood materials. The primary wood industry has declined 9% between 1994 and 1996 **(Figure 10)**. In 1996, 572 primary wood companies were operating in the state. The decline is attributed to depressed hardwood lumber markets and wet weather making it difficult to get logs to mills, according to state forestry officials.

The state has also seen limited growth in the past of the secondary wood industry, which generally provides more and better paying jobs than the primary producers **(Figure 10)**. While Kentucky is the 4th leading hard-

wood producing state in the country, it accounts for only 1% of the nation's secondary wood industry employment **(Figure 11)**. Recognizing the potential of the secondary wood industry to add jobs and diversify local economies, in 1994 the Legislature created the Kentucky Wood Products Competitiveness Corporation. The corporation was established to enhance the secondary wood products industry and promote "Kentucky made" wood products. Since then, 51 new secondary wood industries have located in Kentucky; an 11% increase in a two-year time period.

A 1996 report by the Roundtable on the Economy and the Environment, a state advisory group to the Economic Development Partnership Board, identified several opportunities to further promote the secondary wood industry including:

- Create a program within the Economic Development Cabinet to identify prospective and expand existing secondary wood operations.
- Provide incentives to secondary wood manufacturers and promote the use of wood products generated in Kentucky.
- Prioritize state financial incentives to manufacturers that demonstrate support for sustainable forest practices.[15]

Figure 11 Employment in the Secondary Wood Industry (Selective States)

State	1980	1994	%*
WV	2,131	3,213	0.4
KY	**8,290**	**9,792**	**1.2**
GA	18,244	20,107	2.5
VA	37,056	32,947	4.1
TN	37,113	34,426	4.3
NC	102,067	111,715	14.0
US	**820,236**	**801,274**	

**Percent of U.S. employment in secondary wood industry. Source: U.S. Bureau of Labor Statistics; KY Economic Development Cabinet*

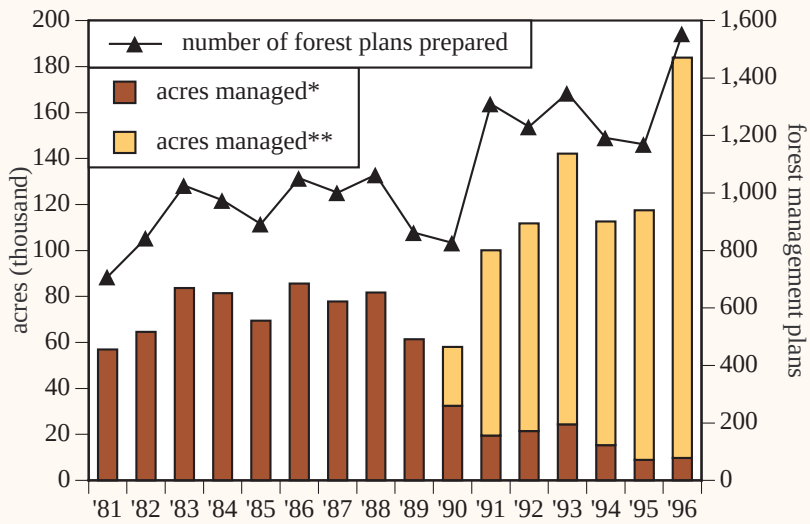
Private Forestlands: 13% Have Management Plans

Many experts agree that managing Kentucky's forests in a sustainable manner and building a diverse forest industry will require a strong program of landowner assistance and education. Government programs to assist forest landowners have been ongoing for many years. But with more than 306,900 forest landowners in the state, assistance has been limited.[16] Currently, the state employs 45 field foresters—that amounts to 6,820 landowners for every state forester.

Between 1981 and 1996, the Division of Forestry worked with landowners to prepare 17,048 stewardship plans covering 1.48 million acres of forestland **(Figure 12)**. This represents 13% of the 11.4 million acres of private forestland in Kentucky (as estimated by the U.S. Forest Service). At this rate, it would take 100 years to service all forest landowners in the state.

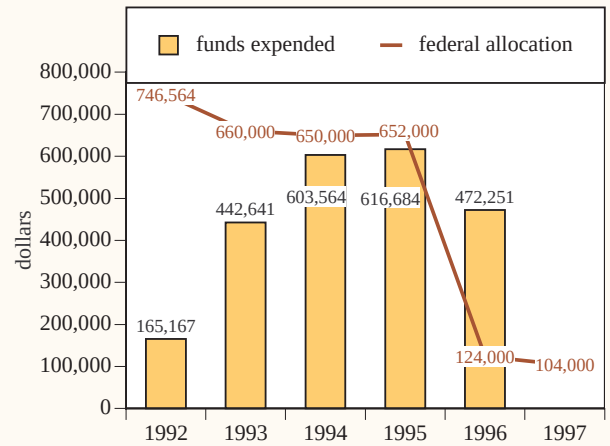
A statewide effort, however, is underway by the Kentucky Division of Forestry to contact every forestland owner in the state by the year 2000. The intent is to build awareness about state forestry programs and educate landowners about forest management opportunities. However, reductions in federal funding for the Forest Stewardship Incentives Program, which helps to finance up to 50% of the landowners costs to manage their forests, will greatly curtail the state's ability to promote sustainable forest management on private forestlands in Kentucky **(Figure 13)**.

Figure 12 Forest Management Plans on Private Woodlands



**Acres with forest management plans. **Acres with plans prepared under the forest stewardship incentives program established in 1990. Source: KY Div. of Forestry*

Figure 13 Funding of Federal Forest Stewardship Incentives Program in Kentucky



Source: KY Division of Forestry

Goals of Sustainable Forestry

- **View forests as ecosystems** to consider all forest life—the forest environment and the complex interaction and processes of forests.
- **Sustain productivity** of the forest to ensure regrowth and productivity.
- **Provide watershed protection** to sustain water flow and quality.
- **Maintain and protect biodiversity** utilizing scientific data, forestry assistance programs, public education, industry training, technology, and forest industry development in a manner to enhance the natural diversity of the forest.
- **Develop a sense of community regarding the forest** that recognizes the important role these resources play in our lives and the need to consider the long-term health of the forest.

Source: William Martin, Commissioner, KY Department of Natural Resources

Proposed Legislation to Promote Sustainable Forestry on Private Lands

Managing Kentucky's forests for present and future generations will require sustainable forestry practices similar to those listed in the shaded box entitled **Goals of Sustainable Forestry**. Sustainable forestry is defined as "the management and utilization of forests to meet the needs of the present without compromising the ability of future generations to meet their own needs."[17]

Statewide efforts to promote sustainable forestry began in 1994 when Governor Brereton Jones convened a statewide summit to assess forest policy and information needs. In 1997, Governor Paul Patton directed the Kentucky Natural Resources and Environmental Protection Cabinet to work with a diverse group of citizens, industry, and environmentalists to develop state legislation to promote sustainable forestry programs and practices on private forestlands.

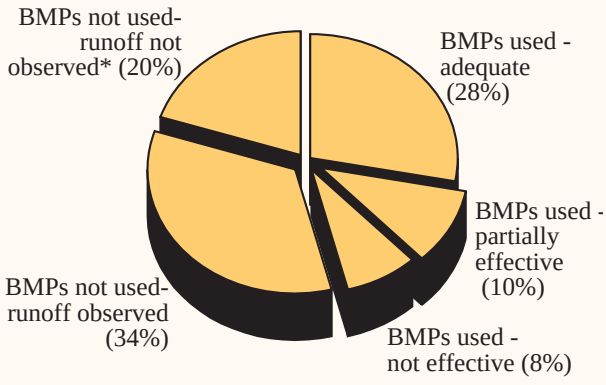
The Kentucky Forest Stewardship Act was drafted in March 1997 and includes the timely collection of information about the health of Kentucky's forests, landowner education and incentives, notification of harvesting operations, and a mechanism to designate "bad actors" who do not follow practices to prevent water pollution and other damage caused by logging operations. A final draft of the legislation is expected in late summer and is expected to be filed in the 1998 legislative session.

The estimated start-up cost for the program is $4 million with an annual cost of $2 million thereafter. Half of the start-up costs will fund a revolving cost-share program to assist landowners manage their forests. Another $1 million is for a forest inventory. A funding mechanism to finance the act has not been determined but options under consideration include allocation of a portion of the state property taxes or establishing a state severance tax on timber.

Logging Practices: 52% of Logging Operations Not Adequately Controlling Runoff Pollution

The proposed Forest Stewardship Act includes measures to address poor logging practices. Logging impacts to land and water have been ranked a medium environmental risk in Kentucky **(Figure 4)**. Soil erosion can degrade water quality and aquatic habitat. According to the U.S. Natural Resources Conservation Service's 1992 National Resource Inventory, four million acres of forestland in Kentucky are in need of conservation treatment to prevent soil erosion and enhance productivity.

Figure 14 Use of Best Management Practices (BMPs) on Logging Operations in KY



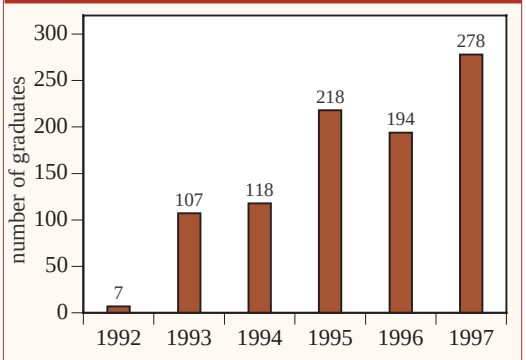
*Note: Preliminary analysis based on random sampling of 100 active harvesting operations (90% on private land) across the state in 1996-97. *Operations were either distant from waterways or set up in a manner that avoided runoff.*
Source: University of Kentucky, Department of Forestry

A 1996-97 study, funded by the Division of Water and conducted by the University of Kentucky, Department of Forestry, found that of the 100 logging operations randomly sampled across the state on private and public lands, 34% did not use Best Management Practices (BMPs) to control erosion **(Figure 14)**. The study also revealed that of the 46% logging operations using BMPs, 18% of those operations either failed or were only partially effective in addressing runoff pollution.

But damage caused by timber harvesting can be easily prevented with better logger training and education. The act includes a provision that requires harvesting operations have at least one logger on site who has completed the Kentucky master logger program. The Kentucky master logger program was established in 1992 by the University of Kentucky and the Kentucky Forest Industry Association to train loggers about practices to prevent erosion, proper harvesting practices, safety, and other issues **(Figure 15)**. Since then, 917 loggers have gradu-

ated from the voluntary program. This represents 30% of the 2,993 loggers operating in Kentucky.[18]

Figure 15 Master Loggers in KY*



*Yearly graduates. Source: KY Div. of Forestry

Public Forests: 8% of Forestland Publicly Owned, Contributes Greatly to Tourism, Ecological Diversity

Publicly owned forests represent an estimated 923,000 acres or 8% of the state's forestland, according to the most recent U.S. Forest Service survey of 1987. State lands include 15 resort, 20 recreational, and nine historic state parks; four state forests; 35 state nature preserves; 33 state wildlife management areas, and thousands of acres of forestland owned by colleges, universities, and local governments. In addition, the federal government owns four national park, historic, and recreation areas composed of 106,390 acres; 17 Army Corp of Engineer properties containing 176,671 acres which are leased to the Department of Fish and Wildlife Resources as wildlife areas; and the 690,987 acre Daniel Boone National Forest.

Not only do these lands help to conserve the state's natural and cultural heritage, they contribute significantly to the state's billion dollar tourism industry. Tourism is the state's third largest industry in spending and its second largest employer.[19] Tourism spending in Kentucky increased from $1.9 billion in 1980 to $7.2 billion in 1997.[20] In 1996 alone, total spending at state parks exceeded $46 million.

Damage caused by timber harvesting can be easily prevented with better logger training. Since 1992, 917 loggers have graduated from the Kentucky master logger program—about 30% of the loggers operating in Kentucky.[18]

Daniel Boone National Forest: Timber Harvests Drop 76%

Kentucky's only national forest, the Daniel Boone National Forest (DBNF) covers 690,987 acres in 21 eastern Kentucky counties **(Figure 16)**. These lands were set aside under federal law in the 1930s for conservation and multiple uses including recreation, water, timber, wildlife, and timber. With its 500 miles of trails, lakes, and wilderness areas, DBNF is one of the most heavily used national forests in the South, with over five million visitors annually.

The DBNF is managed by the U.S. Forest Service. Among some of the current activities on the DBNF are:

- Stream Inventory and Monitoring Program - a stream inventory and monitoring program has been developed to restore and manage 1,200 miles of waterways.
- Wildlife Management - Numerous kinds of wildlife are found on the DBNF including 32 rare, threatened, and endangered species. The U.S. Forest Service enhances wildlife through wildlife openings, prescribed burning, timber harvesting, and reduction of human impact in sensitive areas such as caves and clifflines.
- Land Acquisition - The Forest Service continues to work to acquire rare species habitat and inholdings to consolidate ownership for more effective management.
- Ecosystem Management - Efforts are underway to conduct an assessment of old-growth forest communities, rare species inventories, ecological classifications, restoration of biodiversity, and forest health assessments to manage entire ecosystems.
- Timber Management - The Multiple-Use-Sustained Act of 1960 named timber as a product that should be managed by national forests. Timber harvests have occurred on the DBNF since 1936 **(Figure 17)**. Timber sales reached an all time high in 1989 at 45.1 million board feet, but dropped 76% in 1995 when 10.6 million board feet of timber was harvested from the forest. During the past ten years, 42,859 acres of the DBNF were logged; 6% of the forest's total acreage **(Figure 18)**.

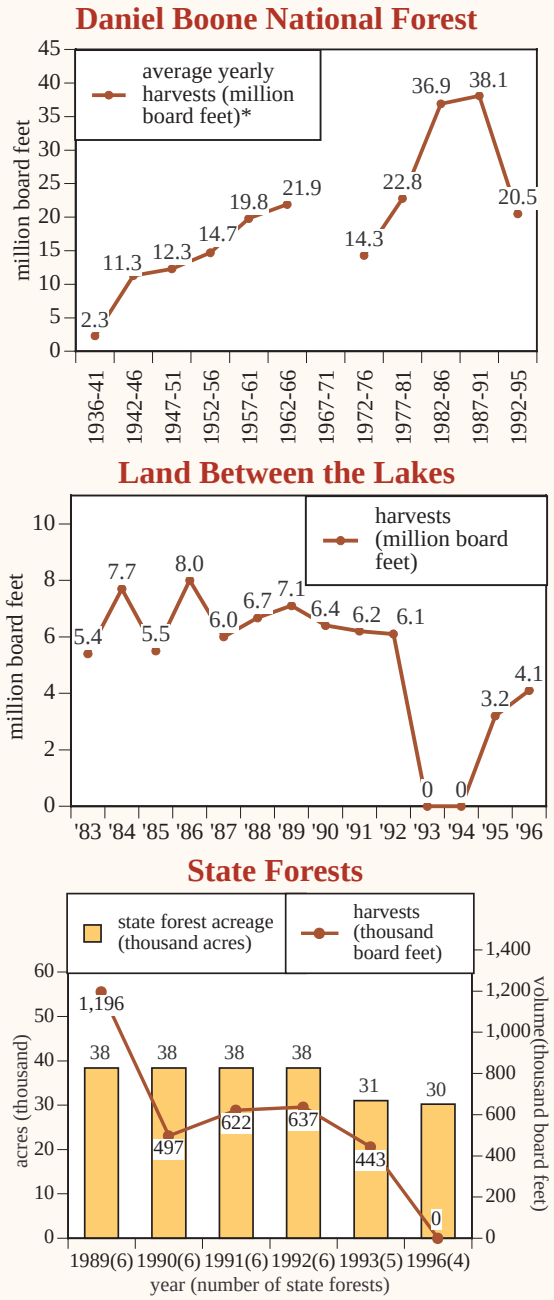
The decline in timber sales in the DBNF is attributed to a change in emphasis to recreation and ecosystem management as well as lawsuits and appeals challenging timber sales. One particular lawsuit has significantly impacted timber operations on the forest. Heartwood, a national group opposed to logging on national forests,

Figure 16 Daniel Boone National Forest Acreage

County	Acreage (% of county's total acres)
Bath	19,301 (13%)
Clay	77,010 (26%)
Estill	5,598 (3%)
Harlan	803 (0.2%)
Jackson	58,375 (26%)
Knox	74 (.02%)
Laurel	62,024 (22%)
Lee	8,587 (6%)
Leslie	52,172 (20%)
McCreary	140,877 (52%)
Menifee	46,109 (35%)
Morgan	12,948 (5%)
Owsley	16,153 (13%)
Perry	2,190 (1%)
Powell	14,723 (13%)
Pulaski	36,789 (9%)
Rockcastle	14,723 (7%)
Rowan	62,495 (35%)
Wayne	642 (0.2%)
Whitley	43,702 (15%)
Wolfe	16,167 (11%)
Total	**690,987**

Source: US Forest Service

Figure 17 Timber Harvesting Trends on Public Forests in Kentucky



**Based on four-year averages. 1936-61 actual harvest volumes. 1976-1995 volume sold under contract. Data not available for 1967-71. Source: US Forest Service; TN Valley Authority; KY Div. of Forestry*

challenged an 199-acre sale in the Leatherwood Creek area. A federal judge ruled in May 1997 that the sale violated the federal Endangered Species Act by not adequately protecting the Indiana bat. The judge also ruled that the Forest Service's cliffline policies to protect bats and other rare species did not provide for the required public input and that the agency failed to prepare an Environmental Impact Statement for the sale as required by law. The Forest Service has since halted all logging on the DBNF while it reviews the ruling.

The Leatherwood sale also drew fire because of its costs—generating $63,000 while costing the U.S. Forest Service $93,000 in road building and other costs, according to the environmental assessment. The White House Council of Economic Advisors estimate national forest timber sales in 1995 generated $616 million but cost $850 million for timber management, reforestation, construction of logging roads, payments to states, and other administrative costs.[21]

The Forest Service, however, reports that timber sales on national forests generated a net revenue of $59 million in 1995.[22] A review of timber data for the DBNF shows that sales generated $1.2 million while the timber program cost $2.5 million in FY1995. But Forest Service officials report that timber harvests on the DBNF also support jobs and the local economy which are not factored into the cost/benefit analysis. Timber sales from the DBNF supported 459 jobs and contributed $11.9 million to the economy in 1995. DBNF timber sales also generated $294,261 in royalties paid to county governments in Kentucky during 1995.

Timber harvesting as well as off-road vehicle use, recreation, and ecosystem management are among the items the U.S. Forest Service will consider as it works to update the DBNF management plan as required by the National Forest Management Act of 1976. The plan will guide the management of the DBNF for the next 10 to 15 years. U.S. Forest Service officials have already received comments from more than 5,000 people. The draft plan is expected to be available for public comment in the fall of 1988.

Land Between the Lakes: Logging Issues Debated

LBL was designated a National Recreation Area in 1963 and encompasses 170,000 acres in western Kentucky and Tennessee. LBL attracts 2.5 million visits each year to camp, hike, and enjoy the area's two public lakes—Kentucky Lake and Lake Barkley. LBL is managed by the Tennessee Valley Authority (TVA), a federal corporation set up to meet the region's electric power needs.

TVA has been exploring options for LBL to be less dependent on government funds. Federal appropriations currently support 65% of the LBL budget. Six million dollars were appropriated by Congress for LBL in 1997. The LBL budget has been flat during the past 15 years which has led to a 30% cutback in staff and the closure of one of two youth education centers.[23] Scenarios considered by TVA to help supplement the LBL budget have included lake front development, hotels, and golf courses. However, these concepts were dropped in 1996 due to public opposition.

TVA is now exploring other options to supplement the LBL budget including user fees. Timber harvests have also been used to generate revenue for LBL. Timber sales accounted for 23% of LBL's total revenue in 1996. Between 1983 and 1992, TVA sold an average of 6.6 million board feet of timber a year from LBL **(Figure 17)**. However, logging was suspended at LBL in 1992 after environmentalists threatened to sue the agency for failing to comply with the National Environmental Policy Act. TVA has since developed the LBL Forest Management Plan and proposes to sell an average of 5.3 million board feet of timber a year over the next decade. This will generate about $400,000 in net income a year.

But environmental critics are threatening to file suit to stop the timber sales which they claim will deplete the forest and spoil LBL's natural beauty. LBL officials, however, indicate that only 30% to 40% of a timber stand will be harvested amounting to an annual cut of about 38,000 trees from 2,800 acres—less than 0.2% of all trees exceeding five inches in diameter at breast height, according to LBL officials. The forest industry also contends that commercial logging in LBL helps to support jobs and local economies. The LBL Environmental Impact Statement estimated that 99 jobs were directly related to timber harvesting on LBL in 1994.

TVA has recently expressed an interest of divesting itself of all non-power programs including LBL by the year 1999. President Clinton and Congress are currently considering options to remove LBL from the authority of TVA, possibly placing it within the national park or national forest system. Governor Patton has recommended that TVA retain its management responsibilities at LBL and a task force be formed, composed of various groups, state officials, and local interests from Kentucky and Tennessee, to advise TVA officials and help oversee operations at LBL.[24]

Figure 18 Acres Harvested on the Daniel Boone National Forest

Year	Acres Logged
1986	4,200
1987	6,750
1988	6,279
1989	4,212
1990	3,456
1991	4,957
1992	4,256
1993	4,938
1994	2,507
1995	1,304
Total	**42,859**

Source: US Forest Service

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State Forests: Inventories, Ecosystem Management Underway

Kentucky has four state owned forests:

- Pennyrile Forest with 14,468 acres in Christian, Hopkins, Caldwell counties.
- Kentucky Ridge Forest with 11,263 acres in Bell County.
- Kentenia Forest with 3,624 acres in Harlan County.
- Tygarts Forest with 800 acres in Carter County.

The state's fifth state forest, Olympia in Bath county, was traded in 1996 for U.S. Forest Service land and offices in Rodburn Hollow in Rowan County to house the Kentucky Division of Forestry Morehead Regional Field Office.

Timber harvests on state forests were suspended in 1996 to reinventory the forests **(Figure 17)**. The inventories will provide data necessary to manage the forests as ecosystems. An ecosystem is defined as the interconnections between a community of living things and the geographic environment in which they interact.[25]

Ecosystem management focuses on the long-term conservation of natural communities while considering environmental, social, and economic consequences. An ecosystem management pilot project is underway on the Pennyrile State Forest to collect data on the forest's various ecosystems. The project will also be used to help develop ecosystem management guidelines for state forests.

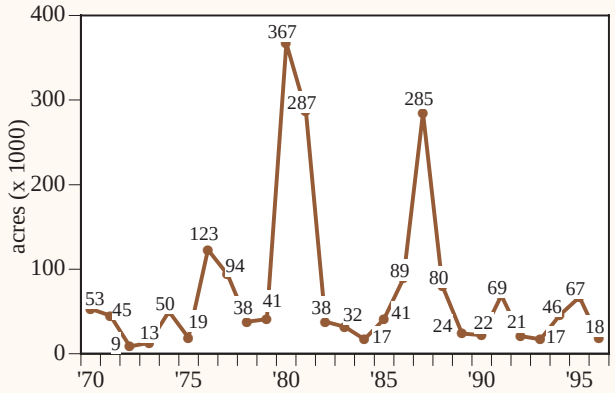
Timber harvests on state forests were suspended in 1996 to reinventory the forests. The inventories will provide the data necessary to manage these forests as ecosystems.

Forest Wildfires: 1996 Season One of Lowest on Record

Kentucky's forests are also at risk from wildfires **(Figure 4)**. The intensity and occurrence of wildfires are primarily a result of dry and windy weather conditions. Forest fire trends reveal that during 1996, private and public forestland acreage burned was among the lowest on record due to wet weather **(Figure 19 & Figure 20)**. While wildfires occur in every county, the heavily forested eastern region leads the state with the most acres burned **(Figure 21)**.

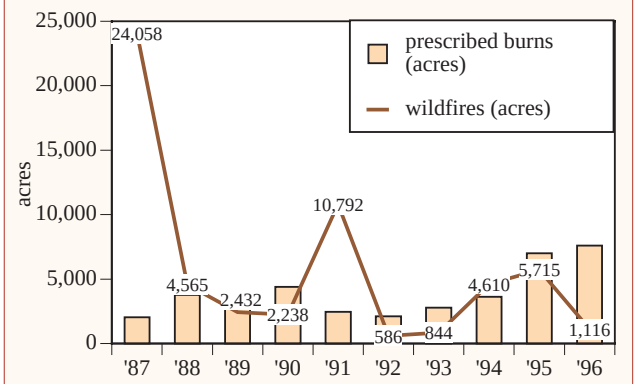
But too many forest fires are still purposely set. **Figure 22** reveals that during the

Figure 19 Forest Wildfires Trends in KY



Note: Excludes federal forestland. Source: KY Div. of Forestry

Figure 20 Wildfire and Prescribed Fire Trends on Daniel Boone National Forest



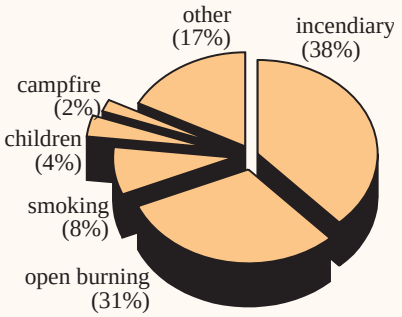
Note: Earlier data not provided. Source: U.S. Forest Service

Figure 21 Forest Acres Burned-Top 25 Counties (1970-96)

County	Acres
Floyd	205,751
Pike	164,177
Breathitt	158,490
Knott	114,080
Perry	95,708
Magoffin	95,095
Johnson	85,294
Knox	85,120
Martin	82,197
Lawrence	70,058
Harlan	65,704
Leslie	65,320
Letcher	61,249
Owsley	59,171
Whitley	47,577
Carter	40,203
Clay	39,647
Greenup	37,838
Bell	35,799
Morgan	31,593
Lee	21,870
Rockcastle	20,500
Lewis	19,945
Boyd	13,433
Ohio	12,087

Source: KY Div. of Forestry

Figure 22 Forest Wildfire Causes in KY (1980-96)



Note: Excludes federal forestland.
Source: KY Division of Forestry

The U.S. Forest Service estimates that the gypsy moth, which has defoliated entire stands of forests in the Northeast, will infest the state by the year 2015.

past 16 years, arson (incendiary) was responsible for more than one-third of the wildfires occurring in the state. A review of 1996 data shows an even more troubling statistic—that 435 or 44.4% of the 979 wildfires occurring on private woodlands were attributed to arson.

Efforts to prosecute arsonists continue. Yet, many arsonists go unpunished. From 1970 through 1996, 18,669 forest wildfires in Kentucky were attributed to arson. However, only 219 felony arson citations were issued during that time period (an average of eight per year). Sixty-seven percent of those felony arson citations resulted in a conviction. Arson is an even greater cause of fire on the Daniel Boone National Forest where it was responsible for 80% of the 70 wildfires that occurred in 1996.

In some cases fire is used as a management tool to prepare a site for tree regeneration or to support a particular habitat. Acres treated with prescribed fires have increased significantly on the Daniel Boone National Forest in recent years from 2,776 acres in 1993 to 7,591 acres in 1996 **(Figure 20)**. U.S. Forest Service officials report that the increase is due to stepped up efforts to restore mature pine-grassland habitat for the Red-cockaded woodpecker, a federally-listed endangered bird found in the southern part of the forest. Prescribed fire is used to maintain the bird's habitat and discourage the regeneration of hardwoods.

Forest Health: Exotic Pests and Diseases Pose Threats

Kentucky's forests are also at risk from disease, insects, and pollution. One only has to look at the fate of the once abundant stands of American chestnut to see the impact disease can have on a forest ecosystem **(see Chestnut in Cove, 1910)**. The chestnut blight fungus, introduced in the United States, all but wiped out this commercially valuable tree species in the 1940s.

There are a number of exotic species that threaten the health of Kentucky's forests and natural communities **(Figure 23)**. For example, the gypsy moth, which has defoliated entire stands of forests in the Northeast, continues to move toward Kentucky. The U.S. Forest Service estimates the moth will infest the state by the year 2015 and could lead to a 60% decline in oak species. A few moths were found in

Louisville and near Cincinnati in 1991 and 1992. While little can be done to prevent the invasion of the gypsy moth, monitoring and eradication of populations in the state can slow its spread.

Forest disease threats also include hemlock woolly adelgid. This disease could be devastating, resulting in the loss of the commercially important eastern hemlock while significantly altering forest ecosystems, particularly along streams and north facing slopes in eastern Kentucky.[26] Another forest disease threat is butternut canker. In West Virginia and Virginia, the disease has killed up to 70% of the butternut trees.[27] At least five counties in Kentucky have trees infected with the butternut canker. Due to its potential threat, the U.S. Forest Service has designated the butternut tree as a forest sensitive species. The agency hopes to breed disease resistant trees to help restock forests.

Ozone pollution, a pollutant associated with exhaust fumes from cars and industrial solvents, is also recognized as a growing threat to forests, leading to a decrease in tree vigor, dieback, and decline.[28] Ozone pollution and other stress-inducing factors including droughts are attributed to the decline of oaks across the southern Appalachians.[29]

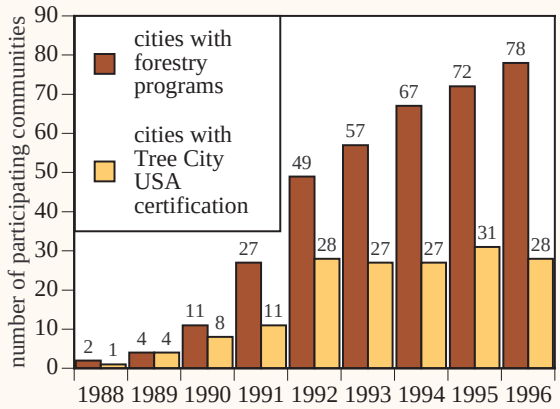
Urban Forests: Local Programs Increasing

With 52% of the state's population now residing in urban areas, interest remains high in providing urban forestry settings such as parks, greenways, and other lands to enhance recreational opportunities and improve the quality of life in a community. There are now 78 cities with urban forestry programs and 28 communities are certified as a Tree City USA **(Figure 24 & 25)**.

Chestnut in Cove, 1910

Source: American Lumberman

Figure 24 Urban Forest Programs in KY



Source: KY Division of Forestry

Figure 23 Exotic Species of Concern in Kentucky

Forest Threats
Chestnut blight
Dutch elm disease
Dogwood anthracnose
Hemlock woolly adelgid
Butternut canker*

Plant Threats
Japanese honeysuckle
Kudzu
KY 31 fescue
Bush honeysuckle
Multiflora rose
Winter creeper
Asiatic bittersweet

Insect Threats
Asian tiger mosquito
Gypsy moth
Japanese beetle

Wildlife Threats
Zebra mussel
European starling

**Origin of Butternut canker unknown, may be exotic. Source: KY Nature Preserves Commission; KY Department of Fish and Wildlife Resources; U.S. Forest Service; University of KY, Department of Forestry*

Figure 25 Urban Forestry Programs in Kentucky (1996)

Anchorage*
Ashland*
Barbourville
Bardstown*
Beattyville
Bellevue*
Benton
Berea
Bowling Green*
Cadiz
Calvert City*
Campbellsville*
Carrollton*
Cold Spring*
Columbia
Corbin
Covington
Crescent Springs
Crestview Hills
Crofton
Cynthiana
Danville*
Dawson Springs
Dayton
Dry Ridge
Edgewood
Elizabethtown*
Elkhorn City
Elsmere
Flatwoods
Florence*
Fort Knox*
Fort Wright
Fort Mitchell*
Fort Thomas*
Frankfort
Frenchburg
Georgetown
Harrodsburg*
Hazard
Henderson*
Highland Heights
Hopkinsville
Jackson
Jamestown
Jenkins
LaGrange
Lebanon
Lexington*
Louisa
Louisville*
Madisonville
Mayfield
Maysville
McKee
Middlesboro
Middletown
Monticello
Morehead
Mount Sterling
Munfordville
Murray*
Newport
Nicholasville
Olive Hill
Owensboro*
Paducah*
Park Hills
Perryville
Pewee Valley*
Pikeville*
Prestonsburg
Princeton
Radcliff
Russell Springs
Russell
Russellville
Seneca Gardens
Shelbyville*
Southgate
Springfield
Warren County*
Waterson Park
Wilder
Wilmore
Winchester*

**Tree City USA communities. Source: KY Division of Forestry*

Figure 26
Species Presumed Extinct or Extirpated from KY

Mammals
American bison
Gray wolf
Red wolf
Elk
Eastern cougar
Birds
Anhinga
Golden eagle*
Ivory-billed woodpecker
Black tern*
Carolina parakeet
Passenger pigeon
Am. swallow-tailed kite
Greater prairie-chicken
Bachman's warbler
Fish
Crystal darter
Gravel chub
Least darter
Scaly sand darter
Flame chub
Harelip sucker
Greater redhorse
Blotchside logperch
Mussels
Dromedary pearly mussel
Sugarspoon
Angled riffle shell
Leafshell
Yellow blossom
Tan riffle shell
Acornshell
Forkshell
White catspaw
Round comb shell
Tennessee riffle shell
Wabash riffle shell
Cumberland leaf shell
Tubercled blossom
Cracking pearly mussel
Scaleshell
White wartyback
Winged mapleleaf
Rough rockshell
Reptiles
Eastern coach**whip**
Insects
Robust pentagenian
Burrowing mayfly
Plants
Marsh marigold
Stipuled scurf-pea
Slender dragon-head
Prairie parsley

**Extirpated as a nesting species. Source: KY Nature Preserves Commission*

Biodiversity: Native Species, Natural Communities, Ecosystems

Biodiversity—the genes, species, and ecosystems making up the diversity of life on Earth—is key to sustaining humanity by providing food, clean water, shelter, and medicine while also sustaining economic, recreational, and spiritual values.[30] But the biological diversity of our natural communities is at risk.

A recent initiative to rank environmental and ecological risks in Kentucky identified the loss of biodiversity as a medium to high ecological risk in the state.[31] In this section, trends and conditions affecting the health of our fish and wildlife resources, natural communities, and ecosystems will be reviewed to determine the status of Kentucky's biodiversity.

Species At Risk: 48 Native Species Extinct/Extirpated, 34 Threatened or Endangered; Habitat Loss, Pollution Principal Causes

It has been estimated that there may be upwards of 100,000 native species in the United States.[32] And thousands of other species, especially insects and microorganisms, have yet to be described and classified. While the exact number of native species remains unknown, some groups of plant and animal life have been documented and are relatively well known. It is this data that provides us with a baseline from which to measure the status of Kentucky's native species.

Experts have documented that more species of plants, animals, insects, and aquatic life are now at risk than in any other period of time since the demise of the dinosaurs 65 million years ago.[33] Although most species extinctions are in areas with rich biodiversity, such as tropical rainforests, accelerated species loss is also occurring throughout the U.S. Since the time of settlement, an estimated 288 species have become extinct in this country. And The Nature Conservancy estimates that an additional 416 species may also be lost to extinction. In Kentucky, 48 native species such as the Ivory-billed woodpecker, gray and red wolf, and eastern cougar no longer exist in the state **(Figure 26)**.

There are numerous reasons why species go extinct. Some are naturally rare and have been so historically. However, many extinctions have been the result of overharvesting, pollution, and habitat alteration and destruction. In Kentucky, the primary cause of species loss in the past was unregulated hunting. This is the case for some extinct birds and mammals including the passenger pigeon and the American bison. However, more recently, habitat destruction and fragmentation, pollution, and exotic species have become the greatest threats to native species in the state.

Efforts to conserve the nation's biodiversity have focused on identifying threatened and endangered species and initiating measures to protect critical habitats under the provisions of the federal Endangered Species Act. Since the passage of the act in 1973, 5% of the 18,949 known native species of plants, fish, mussels, amphibians, reptiles, birds, and mammals in the U.S. have been federally-listed as threatened or endangered **(Figure 27)**. In Kentucky, 34 or 1% of its species have been federally-listed as threatened or endangered **(Figure 27 & Figure 28)**.

Federally-listed threatened and endangered species are known to occur in 78 counties **(Figure 29)**. Pulaski, Whitley, Hart, Edmonson, Livingston, and McCreary counties have the greatest number of listed species. Pulaski and McCreary counties also lead the state with the greatest diversity of endangered and threatened species (plants, mammals, fish, and mussels). This may be due to the fact that this region, which includes the Cumberland River and the cliffs of the Cumberland Plateau, is considered to be one of the most biological diverse in the state.

Figure 27 Species At Risk in the U.S. and Kentucky (1997)

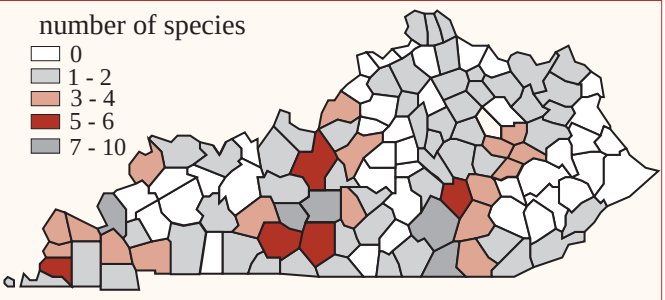
	vascular plants	freshwater fish	mussels	amphibians/ reptiles	birds	mammals	total
United States							
total species	16,108	822	305	520	776	418	18,949
endangered & threatened	613	106	57	46	90	64	976
rare species*	5,267	303	209	142	248	70	6,239
(% of total)	(33%)	(37%)	(68%)	(27%)	(32%)	(17%)	(33%)
Kentucky							
total species	2,262	230	103	103	347	69	3,114
endangered & threatened	9	4	14	0	4	3	34
extinct/ extirpated	4	8	19	1	9	5	46
rare species**	334	67	41	29	51	16	538
(% total)	(15%)	(29%)	(40%)	(28%)	(15%)	(23%)	(17%)

*Note: Does not include insects, arachnids, snails, crustaceans. *Includes species extinct, possibly extinct, critically imperiled (GH), imperiled (G2), vulnerable (G3). **Species considered rare and of special concern in Kentucky (but not all necessarily rare in other states); federally-listed threatened and endangered; extinct; and extirpated species. Source: KY State Nature Preserves Commission, The Nature Conservancy Natural Heritage Central Databases*

Native Plant and Animals: 17% Rare

There are a number of species, while not federally-listed as threatened or endangered, deemed to be rare in Kentucky. The Natural Heritage Database, the primary source of native species information in the state, currently lists a total of 538 bird, fish, mussels, plant, mammal, and amphibian/reptile species that are considered rare, of special concern, federally threatened and endangered, extinct, and extirpated—that's 17% of all these species in the state **(Figure 27)**.

Figure 29 Federally-Listed Threatened and Endangered Species in Kentucky (1996)



Source: KY Nature Preserves Commission

According to data supplied by the U.S. Fish and Wildlife Service, Kentucky ranks 12th in the nation in the number of threatened, endangered, and extirpated species **(Figure 30)**. This ranking is the result of several factors including the high level of biodiversity found in the state and the extensive alteration of natural ecosystems. This has likely led to the high state ranking for species at risk.

Rare species are known to occur in almost every county of the state **(Figure 31)**. The greatest concentrations have been found in the Jackson Purchase and the Upper Cumberland and Green River basins, which are considered among some of the most biologically diverse regions of the state. This may also be due to the fact that these areas have been more intensively surveyed than others in the state, and as such, are better known.

Figure 28 Threatened and Endangered Species in Kentucky (1997)

Mammals
Indiana bat
Virginia big-eared bat
Gray bat

Birds
Bald eagle
Peregrine falcon
Least tern
Red-cockaded woodpecker

Fish
Blackside dace
Relict darter
Palezone shiner
Pallid sturgeon

Mussels
Clubshell
Fanshell
Cumberland bean pearly mussel
Cumberland elktoe
Cumberlandian combshell
Little-wing pearly mussel
Pink mucket pearly mussel
Purple cat's paw mussel
Rough pigtoe
Fat pocket book
Northern riffle shell
Ring pink mussel
Orange-footed pearly mussel
Oyster mussel

Plants
Cumberland rosemary
Cumberland sandwort
Price's potato-bean
Rock cress
Running buffalo clover
Short's goldenrod
Virginia spirea
White-haired goldenrod
Eggert's sunflower

Source: KY Nature Preserves Commission

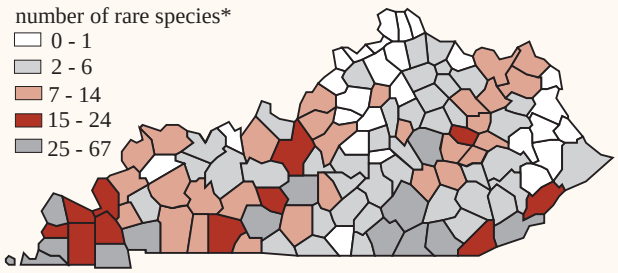
Figure 30 Top 15 States with Most At Risk Species (1996)

state	# species*	state	# species*
1. Hawaii	302	9. North Carolina	58
2. California	184	10. Georgia	56
3. Florida	97	11. Arizona	49
4. Tennessee	91	**12. Kentucky**	**43**
5. Alabama	86	13. Utah	38
6. Puerto Rico	73	14. South Carolina	38
7. Texas	72	15. Mississippi	38
8. Virginia	58		

**Includes federally-listed threatened, endangered, extirpated species. Source: U.S. Fish and Wildlife Service*

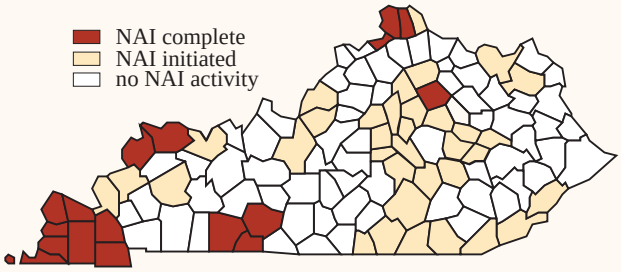
For the past 20 years, the Kentucky Nature Preserves Commission has been inventorying the state for natural areas. The information collected is essential to understanding the state's biodiversity and identifying opportunities to balance conservation with human needs. However, the commission has funds to complete only two county surveys per year. At this rate, it will take another 50 years to inventory Kentucky for natural areas. To date, inventories have been completed in 17 counties and are underway in 34 **(Figure 32)**. Natural area inventories are conducted using a multistep process that includes the use of aerial photos to identify potential areas, helicopter flights to confirm conditions of a site, and on-site evaluations to determine a site's significance.

Figure 31 Rare Species in Kentucky (1996)



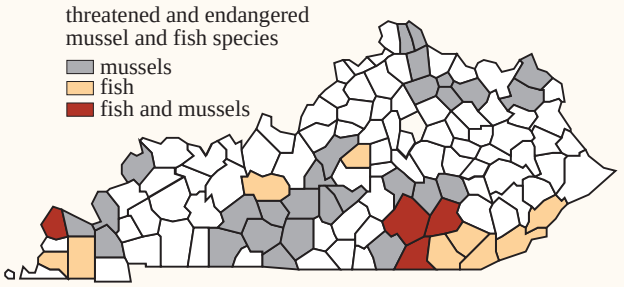
**Rare, special concern, federally threatened and endangered.*
Source: KY Nature Preserves Commission

Figure 32 Status of Natural Areas Inventory (NAI) in Kentucky (1996)



Source: KY Nature Preserves Commission

Figure 33 Federally-Listed Threatened and Endangered Fish and Mussels in KY (1996)



Source: KY Nature Preserves Commission

Mussels: 40% of State's Native Species Rare

Freshwater mussels are the most at risk species in the U.S. and Kentucky **(Figure 27 & Figure 28)**. Some 305 species of freshwater mussels are found in the U.S., which is the greatest diversity in the world. But 68% of these native mussels are now considered rare.

Kentucky has a great diversity of mussels with 103 native species, or one-third of the mussels that exist in the U.S. However, 40% of the state's mussels are rare **(Figure 28)**. Threatened and endangered mussels have been found in 32 Kentucky counties **(Figure 33)**.

The loss of native mussels is linked to water pollution and ecosystem alterations such as dams. Another growing threat to native mussels is the exotic zebra mussel which can attach to native species and prevent feeding and reproduction. Zebra mussels have been found in several waterways including the Kentucky and Ohio rivers, Lake Barkley and Kentucky Lake.

At one time, Kentucky's rare mussels were also threatened by the harvesting of commercial species. However, during the past several years, state officials have restricted musseling in several areas where threatened and endangered species have been found. Eight mussel sanctuaries have been established and musseling is banned on certain waterways including the Cumberland, Green, and Barren rivers and in four areas of the Ohio River. Kentucky's commercial mussels are sustaining viable populations, according to state fish and wildlife officials. **Figure 34** reveals that 2,056,862 pounds of mussels were legally harvested from lakes and rivers in 1996, down from 4,844,862 pounds in 1995. Most mussels harvested in Kentucky are purchased for the cultured pearl industry in Japan. The decline in mussel harvests is attributed to limited markets for higher quality shells. Illegal poaching of mussels also remains a problem, with 200 citations issued in 1996 by state law enforcement officials.

The future does not look bright for several native mussel species, according to Ronald Cicerello with the Kentucky Nature Preserves Commission.[34] He notes that

habitat degradation will likely continue. Future efforts to conserve freshwater mussels and other aquatic resources will depend on protecting entire watersheds. An example of such an effort is a joint initiative between The Nature Conservancy and the Daniel Boone National Forest in the Horse Lick watershed in Jackson County to purchase critical habitat to restore the endangered little winged pearly mussel and other rare species.

Freshwater Fish: 29% of Species Rare

Several species of freshwater fish are also at risk. Of the 230 fish species native to Kentucky, 29% are rare. Threatened and endangered fish occur in 13 counties in Kentucky **(Figure 33)**. Among those is the Blackside dace, which was federally-listed as threatened in 1987. This rare three-inch fish is only found in 30 creeks in the Cumberland River Basin in Kentucky and Tennessee. Kentucky counties where the fish occurs are Bell, Harlan, Knox, Laurel, Letcher, McCreary, Pulaski, and Whitley.

Pollution is not only impacting rare fish but is also affecting the state's million dollar commercial fishing industry. Information is not available on commercial fish harvests in Kentucky, but licenses show a declining trend **(Figure 35)**. For the eighth consecutive year, a fish consumption advisory has been issued along the 664-mile stretch of the Ohio River bordering Kentucky; a major commercial fishing river. Commercial fishing is expected to continue to decrease on open bodies of water and increase in aquaculture settings. There are currently 70 aquaculture operations permitted in Kentucky.

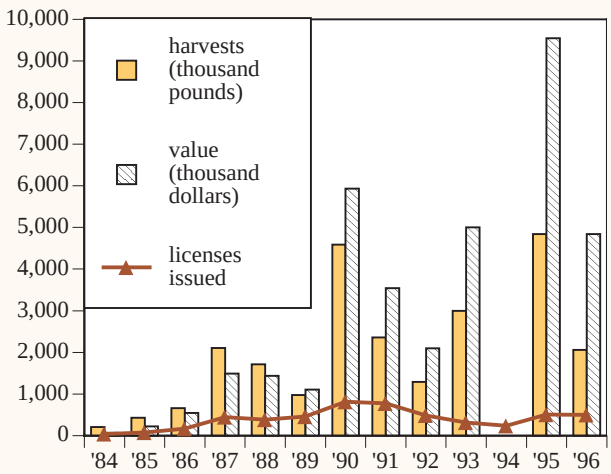
Bats: Flood Kills 3,000 Endangered Indiana Bats, Virginia Big-Eared Bats Increase Due to Cave Protection Efforts

The Indiana, Gray, and Virginia big-eared bats are the state's only federally-listed endangered and threatened mammals. Endangered Indiana bat populations continue to decline in Kentucky due to habitat loss and environmental factors **(Figure 36)**. Populations were dealt a severe blow in 1997 when an estimated 3,000 Indiana bats hibernating at Bat Cave in Carter Caves State Resort Park drowned during the March flood.

Best available data on Gray bats in Kentucky reveal populations may be decreasing. Approximately 200,000 of these bats hibernate in one cave in Edmonson County —about one fifth of the known population. It is hoped that Gray bat populations will increase with the gating of bat's primary hibernation cave and the purchase and management of maternity caves in Allen, Adair, and Hart counties by state and federal agencies.

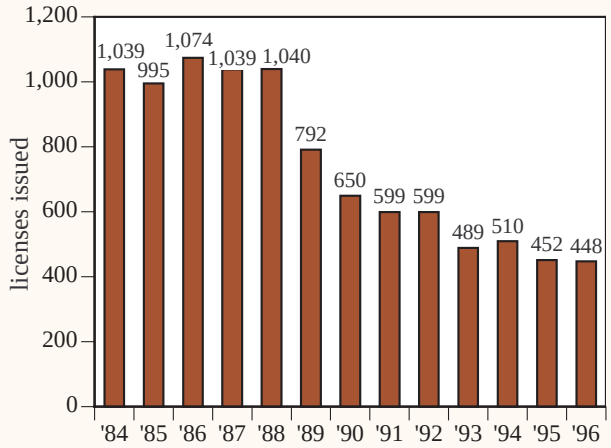
The only endangered bat that appears to be recovering is the Virginia big-eared bat. Populations have

Figure 34 Commercial Mussel Harvesting Trends in Kentucky



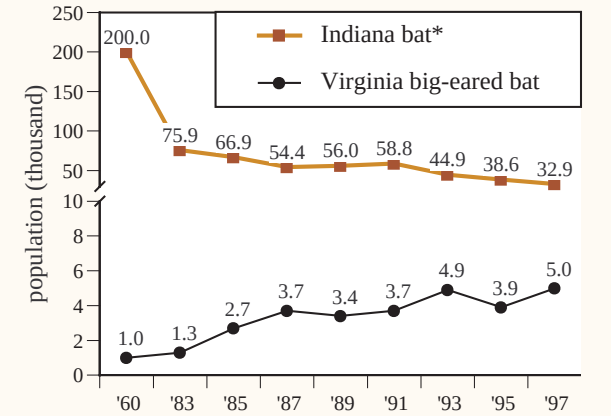
Note: 1994 harvest and value data not available.
Source: KY Department of Fish and Wildlife Resources

Figure 35 Commercial Fishing License Trends in Kentucky



Source: KY Department of Fish and Wildlife Resources

Figure 36 Federally-Listed Endangered Bat Population Trends in Kentucky



**Based on bat populations at 3 primary caves - Bat Cave (Carter County), Hundred Dome and Dixon Caves (Edmonson County). 1997 populations include estimated loss of 3,000 bats due to floods. Source: KY Nature Preserves Commission*

The Indiana, Gray, and Virginia big-eared bats are the state's only federally-listed endangered and threatened mammals. Indiana bat and Gray bat populations continue to decline in Kentucky. The only endangered bat that appears to be recovering is the Virginia big-eared bat due to the purchase and protection of cave habitats in Lee County.

steadily increased since 1989 after the purchase and protection of cave habitats in Lee County by the U.S. Forest Service and the Kentucky Chapter of The Nature Conservancy **(Figure 36)**.

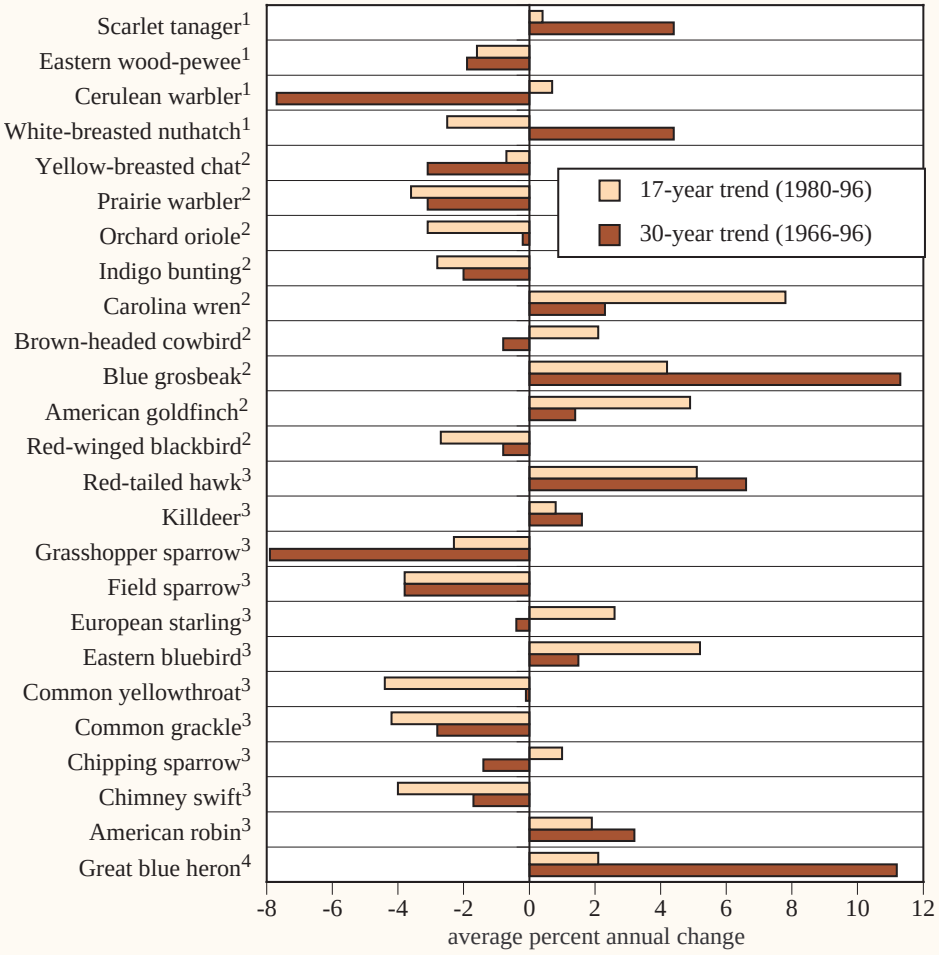
Birds: 15% of Native Species Rare; Bald Eagle Nests Produce 17 Fledglings in 1996

There are 347 species of birds known to occur in Kentucky, 15% of which are considered rare **(Figure 27)**. The best overall data on bird population trends in the state are collected as part of the national North American Breeding Bird Survey. While the survey is limited by several factors including small sample size, it still serves as an important tool to identify native bird species at risk.

The Breeding Bird Survey reveals that 28 of the 83 bird species with a statistically valid sample size show a long-term (30-year) decline in populations in Kentucky while 20 species are increasing with the remainder showing no significant change. It is difficult to determine why various bird species are declining since there are many complex factors affecting populations including weather, pollution, food supply, and changes in land use. However, unquestionably one of the most significant factors in the decline of many migratory songbird species is habitat loss. For some species, like the Cerulean warbler, which has declined an average of 7.7% annually for the past 30 years, loss and fragmentation of breeding grounds (mature hardwood bottomland forests) and wintering habitat (tropical forests of South America) have contributed to the decline **(Figure 37)**. Some grassland birds, like the Grasshopper sparrow, may also be declining in Kentucky due habitat loss and conversion of grassland to row crops.

Efforts to restore federally-listed endangered and threatened bird species found in Kentucky continue with mixed results **(Figure 38)**. One of the most successful bird recovery efforts to date has been the Bald eagle. In fact, national efforts have been so successful that the federal government in 1995 upgraded the status of the bird from endangered to threatened. There are now 4,500 nesting pairs of Bald eagles nationwide, up from 417 in the 1970s. The banning of DDT along with laws to protect habitat and prohibit hunting are credited for the comeback of the Bald eagle.

Figure 37 Selective Bird Population Trends in Kentucky



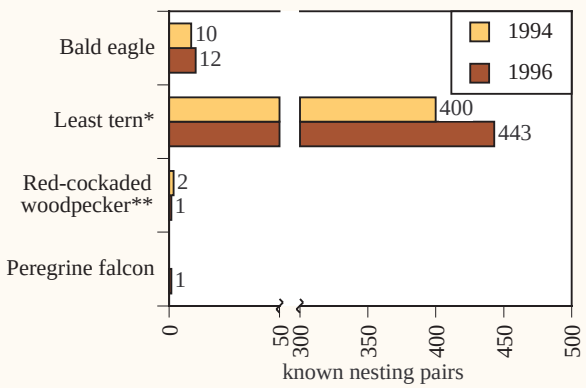
Note: Species with statistically significant long-term or short-term trends. [1]Woodland habitat. [2]Brush/mixed habitat. [3]Farm/open land habitat. [4]Water/marsh habitat.
Source: U.S. Fish and Wildlife Service Breeding Bird Survey; KY Nature Preserves Comm.

In 1996, there were 12 nesting pairs of Bald eagles located in Ballard, Carlisle, Fulton, Henderson, Hickman, Lyon and Trigg counties. Eight of these nests produced 17 fledglings in 1996 and Bald eagles are now considered to be capable of sustaining a viable population in the state.

But efforts to restore other federally-listed bird species in Kentucky have not been as successful, including those to restore the endangered Red-cockaded woodpecker. The U.S. Forest Service hopes to improve the chances for recovery of the woodpecker with measures to enhance the bird's mature pine-grassland community on the Daniel Boone National Forest. Among the measures to be used are prescribed fire and the removal of midstory trees. There is one nesting pair of woodpeckers on the forest **(Figure 38)**.

State officials also hope to reestablish the Peregrine falcon in Kentucky. Between 1993 and 1996, 46 falcons were released in Lexington and at Lake Herrington. The goal is to establish at least three breeding pairs in the state. A pair of Peregrine falcons from similar efforts in nearby states has taken up residence in Louisville and has successfully bred there since 1995 **(Figure 38)**.

Figure 38 Status of Endangered and Threatened Bird Species in Kentucky



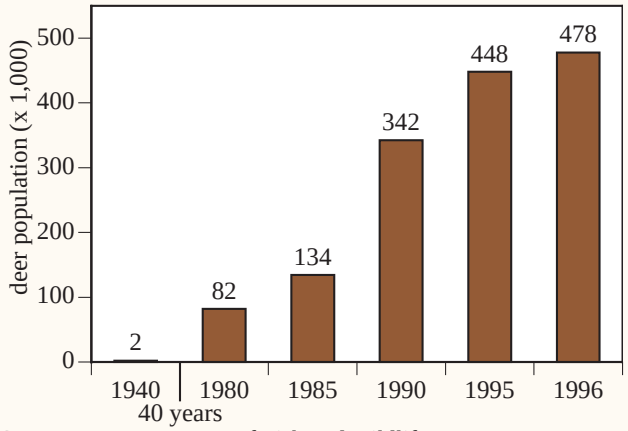
*Note: Earlier and historic data not available. *Based on site surveys and estimates. **1997 data shown for 1996. Source: KY Nature Preserves Comm.; KY Dept. of Fish and Wildlife Resources; U.S. Forest Service*

White Tail Deer: Populations Reach All Time High

Some of the most successful wildlife restoration efforts have been for game species. For example, white tail deer populations reached an all time high in 1996 at 478,000. This is a significant increase since 1940 when unregulated hunting reduced deer populations to 2,000 **(Figure 39)**.

The distribution of deer ranges from a low of 485 in Fayette County to a high of 13,861 in Carter County **(Figure 40)**. The largest concentrations of deer are in the west central region of the state. This is attributed to a patchwork of habitat including soybean and corn fields, reclaimed strip mines, and forestland. White tail deer populations are expected to increase in the east and remain stable in the west. While state officials estimate that sustainable deer populations could reach as high as 1.7 million, the state goal is to control populations not to exceed 807,000.

Figure 39 White Tail Deer Trends in Kentucky



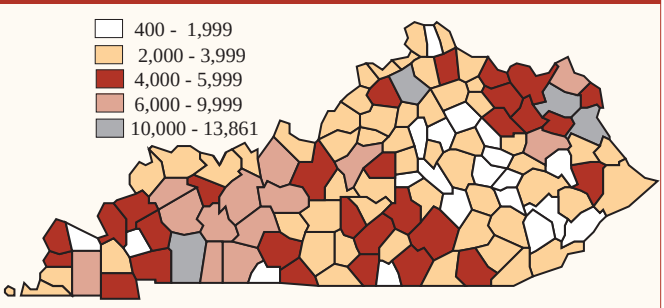
Source: KY Department of Fish and Wildlife Resources

Wild Turkey: Populations Increase From 70,000 in 1994 to 106,000 in 1996

Another game species that has made substantial gains from near extirpation levels is the wild turkey. In 1959, only 800 wild turkeys were known to exist. State restoration efforts, which began in 1978, resulted in the release of 6,750 turkeys at 430 sites across the state. By 1996, turkey populations had increased to 106,000 **(Figure 41 & Figure 42)**. State officials estimate that wild turkey populations will likely peak in the next ten years at 200,000 to 250,000 birds.

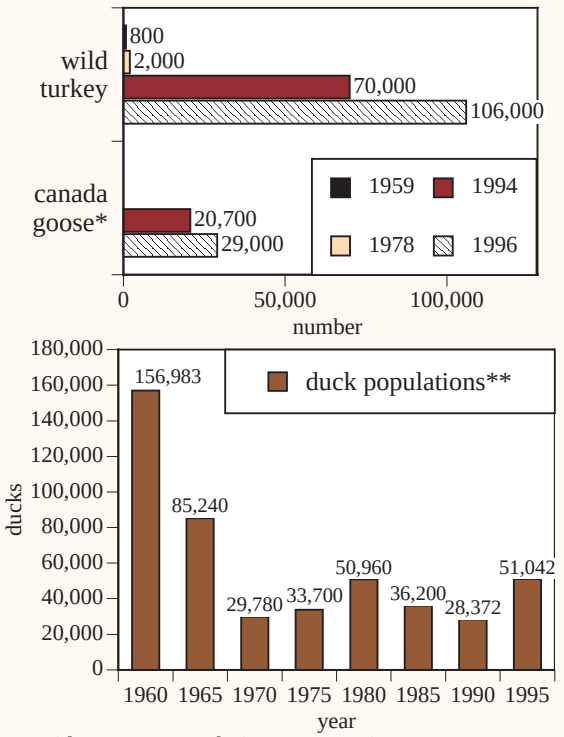
Kentucky has also become home to a growing number of resident Canada geese **(Figure 41)**. Flocks of resident geese were established from releases that oc-

Figure 40 White Tail Deer Populations (1996)



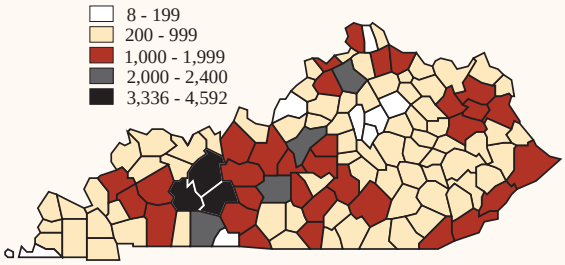
Source: KY Department of Fish and Wildlife Resources

Figure 41 Wild Turkey, Canada Goose, Duck Trends in Kentucky



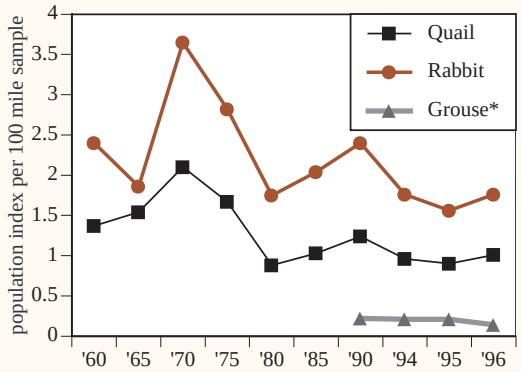
**Resident geese populations. Data prior to 1994 not available. **Migratory populations based on mid-winter surveys. Source: KY Dept. of Fish and Wildlife Resources*

Figure 42 Wild Turkey Populations



Source: KY Department of Fish and Wildlife Resources

Figure 43 Quail, Rabbit, Grouse Population Trends in Kentucky



**Field surveys at grouse drumming route listening posts. Source: KY Dept. of Fish and Wildlife Resources*

curred across the state in the late 1970s and early 1980s. Surveys also reveal that duck populations have increased since the 1970s. The decline of duck populations in the past is attributed to the accelerated loss of wetlands and bottomland forest habitat, according to state fish and wildlife officials. Wetland conservation and protection of important habitats have contributed to an increase in duck populations in Kentucky since the 1970s **(Figure 41)**. The decline in duck populations during 1985-1990 is attributed to droughts that affected habitat.

Rabbit, Quail, Grouse: Habitat Loss Results in Long-Term Decline, Present Populations Stable

The state also monitors populations of grouse, cottontail rabbit, and quail; three other popular game species. Populations of quail and rabbit steadily declined between 1970 and 1980 **(Figure 43)**. The decline in rabbit and quail populations is largely attributed to loss of habitat and a shift in vegetation on hay and paturelands from native grasses to species like KY 31 Tall Fescue which provides little nutritional or nesting value to rabbits and quail. In fact, fescue can be toxic to rabbits inflicting the animal with an endophyte fungus when consumed. KY 31 Tall Fescue is now the dominant vegetation on hay and pastureland in Kentucky. Since the mid-1980s quail and rabbit populations have been fairly stable.

Grouse populations are declining in the Southern Appalachian states based on long-term monitoring data. While grouse population trends cannot be fully assessed in Kentucky since data have only been collected since 1988, some experts believe that a similar trend is occurring **(Figure 43)**. Grouse populations have been declining in recent decades due to a loss of habitat. Grouse thrive in young forests, but most of Kentucky's woodlands are now more than 60 years old.

Osprey, Otter, Bear, Elk: Restoration Underway

Federal and state efforts are also underway to restore osprey, elk, black bear, and river otter in Kentucky. Between 1981 and 1991, 133 osprey were released at Land Between the Lakes (LBL), Laurel Lake, and other sites. Osprey is considered to be on the road to recovery in Kentucky with 20 active nests in 1996.

LBL and Tennessee officials have proposed releasing 260 elk over a four year period in the Tennessee portion of LBL. This will likely recolonize elk in the Kentucky portion of LBL. And state fish and wildlife officials plan to release 1,800 elk in 14 southeastern Kentucky counties during the next nine years, beginning in 1998. Last year, federal officials also released a dozen black bear in the Big South Fork National Recreation Area on the Kentucky-Tennessee border to determine if the bears will adapt to the area.

The Kentucky river otter restoration program began in 1991. Once abundant in Kentucky, river otters fell victim to

unregulated harvesting, habitat destruction, and pollution. During 1991-1995, state officials released 355 otters at 14 sites in the eastern Kentucky. Because monitoring river otter populations is difficult, the success of the restoration effort to date is not fully known.

Figure 44 Most Endangered Ecosystems in Kentucky

Bluegrass woodland savanna
Mountain bogs
Tallgrass prairie
Glades
Old-growth forests
Bottomland hardwood forests
Wetlands
High quality aquatic systems

Source: KY Nature Preserves Commission; KY Division of Water; KY Biodiversity Task Force

Ecosystems: Old-Growth Forests Among Most Endangered

Kentucky's biological resources are dependent upon the health of the ecosystems which they inhabit. But much of Kentucky's natural ecosystems have been altered. It has been estimated that less than one-half of one percent of Kentucky remains in an undisturbed state.[35] Kentucky, along with other southern states, has the greatest number of endangered ecosystems in the nation, according to the National Biological Service.[36]

Some ecosystems are more threatened than others **(Figure 44)**. For example, Kentucky once had two million acres of tallgrass prairie, but less than 200 acres remain. Several forest ecosystems are endangered as well. A 1994 survey by The Nature Conservancy reveals that Kentucky has six endangered forest ecosystems.[37] One of the most threatened is the Bluegrass Woodland Savanna. This ecosystem once covered central Kentucky but now only a few remnants remain.[38]

Kentucky's old-growth forests are also endangered. Old-growth forests are those that have characteristics of presettlement conditions with minimal human disturbance. Close to 90% of Kentucky was once covered by forests. Today, about half of the state's land remains forested; virtually all of which is second or third growth. The only known tracts of old-growth forest of any size left in the state are Blanton Forest (2,350 acres in Harlan County), Lilley Cornett Woods (252 acres in Letcher County), and Big Woods (200 acres at Mammoth Cave National Park in Edmonson County) **(see Efforts to Save Kentucky's Old Growth Forests Continue)**.

Efforts to Save Kentucky's Old-Growth Forests Continue

State conservationists continue to work to protect the few tracts of old-growth forests left in Kentucky. Private fund-raising efforts matched by state monies have generated $219,000 to purchase 1,425 acres of old-growth forest contained in the 6,500 acre tract making up Blanton Forest in Harlan County. An additional $300,000 has been set aside by the Kentucky Natural Land Trust to help manage the forest. The Kentucky Nature Preserves Commission is currently negotiating with landowners in an attempt to acquire additional tracts of the Blanton Forest.

However, the protection of Lilley Cornett Woods in Letcher County remains uncertain. The state purchased the 550-acre tract in 1969 to preserve the 252 acre old-growth forest. The forest currently serves as a research site and outdoor laboratory for Eastern Kentucky University. While the right to strip mine the coal under the woods was ceded to the state by the coal companies that held them, underground mining rights have remained in private hands.

The two companies that own the underground mining rights—DLX and Enterprise Resources—have been denied permits to mine the coal based on potential subsidence and impacts to underground water supplies. However, DLX Inc. filed a lawsuit in 1997 alleging that the permit denial was a unconstitutional taking of its property. The company is seeking compensation of $5 million, the value it alleges the coal is worth. Kentucky officials are currently assessing the extent of mineable coal reserves on the Woods contending the value is far less than $5 million.

Enterprise Resources is also seeking one million dollars from the Eastern Kentucky University to buy its minerals beneath the forest. The University has applied to the Heritage Land Conservation Board for funds to purchase the minerals. The board, however, has asked the university to assess the amount of recoverable coal prior to consideration of the application.

Wetland Ecosystems: 75% of Original Acreage Destroyed

Bottomland hardwood forests are also ranked as one of the state's most endangered ecosystems due to the conversion of wetlands to other uses. It is estimated that Kentucky once had 1.6 million acres of wetlands. By 1977, 929,000 acres had been drained and converted to farmland and other uses. Today, only 400,000 acres of wetlands remain in Kentucky, 20% of which is forested.[39] The greatest wetland losses occurred in Western Kentucky where 52% of the state's bottomland forests were cleared between 1957 and 1974.

There has been a net gain in wetlands in Kentucky during the past five years. Between 1991 and 1996, 1,105 acres of wetlands were converted to non-wetland status under a Clean Water act permit while 2,329 acres were created or restored.[40]

Wetland ecosystems not only provide critical habitat to many endangered species and waterfowl, they reduce the severity of floods and improve groundwater

quality by filtering contaminants. National and state efforts to conserve wetlands were initiated in the 1980s and 90s. Among the measures was a nationwide policy, adopted in 1991, that specifies no net loss of wetlands. Federal and state regulations require that for every acre of wetland destroyed, two or more acres must be created to compensate for the loss. On a national level, the country has yet to reach its goal of no net loss of wetlands, but experts expect to meet this goal in the near future.[40] In Kentucky, there has been a net gain in wetlands in the past five years. Between 1991 and 1996, 1,105 acres of wetlands were converted to non-wetland status under a Clean Water act permit while 2,329 acres were created or restored.[41]

Another national initiative to conserve wetlands is the federal Wetland Reserve Program. Under this program, the federal government compensates farmers who set aside original wetland acreage from farming in an effort to restore these important ecosystems. Since 1991, 325,000 acres have been enrolled in the Wetland Reserve Program nationwide —1,700 acres of which are in Kentucky.[42]

Aquatic Ecosystems: 1.2% of Waterways Considered High Quality

High quality waterways are also on the list of most endangered ecosystems in Kentucky. Most waterways have been degraded by pollution, impairing their ability to fully support healthy and diverse communities of aquatic life.

Nationwide, 2% of the country's streams are clean enough to be designated as wild rivers.[43] In Kentucky 1,044 miles of waterways are deemed of high enough quality to be classified as Outstanding Resource Waters, Reference Reach Streams, State Wild Rivers, or National Wild and Scenic Rivers.[44] This is 1.2% of the 89,431 miles of waterways in the state. The Upper Cumberland basin has the greatest number of high quality waterways in the state with 541 designated miles.

Many experts agree that watershed-based management is the best approach to preserving aquatic ecosystems. The Division of Water has embarked on a watershed pilot project in the Kentucky River basin. The goal is to collect data and work with local communities to restore water quality across the watershed.

Cave Ecosystems: Habitat to 50 Rare and Endangered Species

Caves are important but vulnerable ecosystems. There are 3,800 mapped caves in 87 counties in Kentucky.[45] These include the Mammoth Cave, the most extensive cave system in the world **(see Mammoth Cave National Park)**. Caves provide habitat to nine of the state's federally-listed threatened and endangered species and another 39 rare ones.[46]

Caves are threatened by pollution and vandalism. Federal and state efforts to gate and protect caves have helped. But just last year, a federal judge sentenced three people to prison and three people to 500 hours of community service after they were caught removing 600 pounds of cave formations from the Floyd Collins' Crystal Cave in Mammoth Cave National Park and selling these to gift shops in the area for a dollar a pound.[47] Damage to the cave exceeded $100,000 and destroyed some of its most rare formations. Eight gift shops were also cited by the State Police for selling the stolen cave formations, a misdemeanor under state law since 1988. State police admit, however, that enforcement of Kentucky's cave protection laws has been a low priority and more should be done to protect this important natural resource.

The good news is that several polluted caves are being restored. For example, Hidden River Cave, a famous tourist attraction near Horse Cave, was severely polluted by sewage.[48] By the 1980s, federal agencies and local citizen groups began working to address the pollution problems at the cave. A new regional sewage treatment plant was built which has aided in the recovery of the river and cave.

Mammoth Cave National Park: An International Biosphere Reserve

The 52,830 acre Mammoth Cave National Park (MCNP), located in central Kentucky, has the most extensive cave system in the world, with more than 345 surveyed miles of cave passageways.

MCNP attracted nearly two million visitors in 1996 and contributed $116 million in spending to the local and regional economy. But just as important, MCNP is an important and fragile ecosystem providing habitat to 1,000 plant and 700 animal species.

MCNP was designated an International Biosphere Reserve, one of 41 in the U.S. and 70 in other countries, in 1990 because of its unique natural environment. Each biosphere reserve represents a place for research, monitoring and education. Among the initiatives underway at MCNP are:

- Water Quality Project - a partnership with farmers, universities, and others to protect the Mammoth Cave watershed by promoting sustainable agriculture.
- Economic Studies - a joint project with the West Kentucky Corporation to assess suitable/unsuitable development sites near the park and formulate regional sustainable tourism plans.
- Fire Management Plan- The Nature Conservancy has been contracted to develop a plan to address wildfires and the reintroduction of prescribed fire at the park to promote native grassland communities.

Natural Areas: 9% of State's Land Managed as Natural Areas

According to the Kentucky Natural Heritage Database, 2,225,450 acres of land, about 9% of the total state acreage, is considered to be managed as natural areas **(Figure 45)**. But the level of protection of these lands varies. For example, only 107,996 acres of these natural areas (0.4% of the state's acreage), are considered fully protected. These include the state's 35 nature preserves **(Figure 46)**, federal wilderness areas, and land owned by The Nature Conservancy.

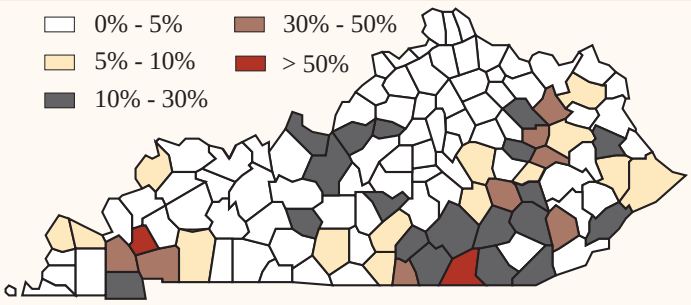
Other natural areas in Kentucky are identified as managed but not necessarily protected from human disturbance. These include 33 state wildlife management areas **(Figure 47)**, university lands, and much of the 690,987 acres of the Daniel Boone National Forest.

Private efforts to set aside natural areas have also been initiated by several companies in Kentucky including Cyprus-Amax (16,000 acres), Kimball International (3,200 acres), Peabody Coal (30,000 acres), and Westvaco (30,000 acres). The Kentucky Business Conservation Partnership was also recently created by the Kentucky Chamber of Commerce, Economic Development Cabinet, and the Department of Fish and Wildlife Resources to promote stewardship on industry land. Charter members include Commonwealth Aluminum, Hampshire Chemical, National Southwire, Willamette Industries, Alcoa, and World Source Coil Coating.

The Department of Fish and Wildlife Resources also works with private landowners to create high quality habitat. Between 1987 and 1996, the agency assisted 3,252 landowners manage 738,680 acres under the state Habitat Improvement and Kentucky Stewardship Incentive programs.

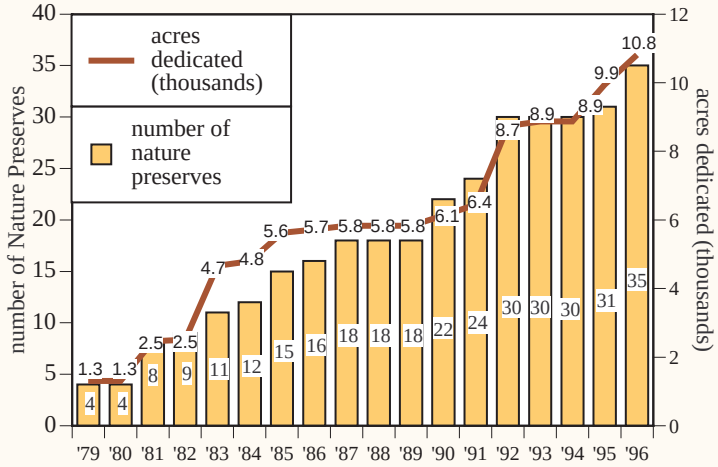
Federal efforts are also underway to purchase 20,000 acres along the East Fork of Clarks River in western Kentucky to create a National Wildlife Refuge. Clarks River is one of the few remaining unchannelized bottomland hardwood ecosystems remaining in Kentucky. The protection of the area is expected to enhance and protect an important part of the Mississippi flyway corridor—the largest corridor for migratory waterfowl and birds. The cost to purchase land in the Marshall, McCracken, and Graves counties is estimated at $15 million. Congress has appropriated $3 million to fund the first year of acquisition which is expected to begin in late 1997 or 1998.

Figure 45 Managed Natural Areas in KY (1996)



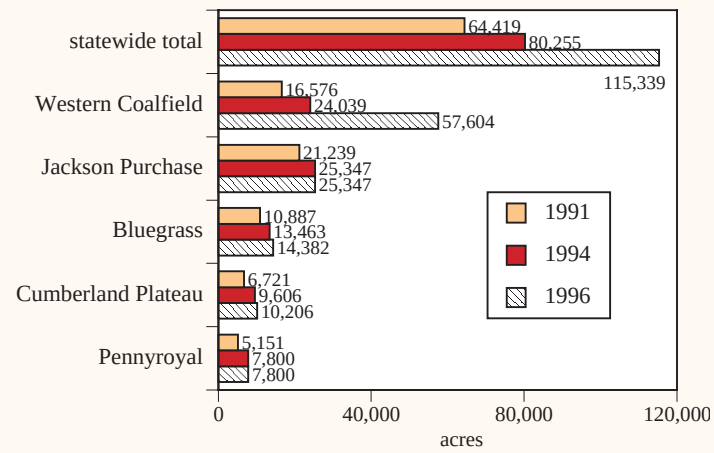
Note: Includes federal, state, private land either protected, semiprotected, or unprotected but managed as a natural area.
Source: KY Natural Heritage Database

Figure 46 State Nature Preserves in Kentucky



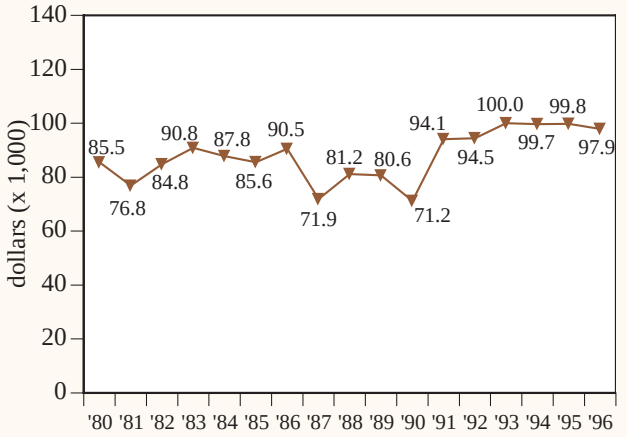
Source: KY Nature Preserves Commission

Figure 47 Wildlife Management Areas in Kentucky



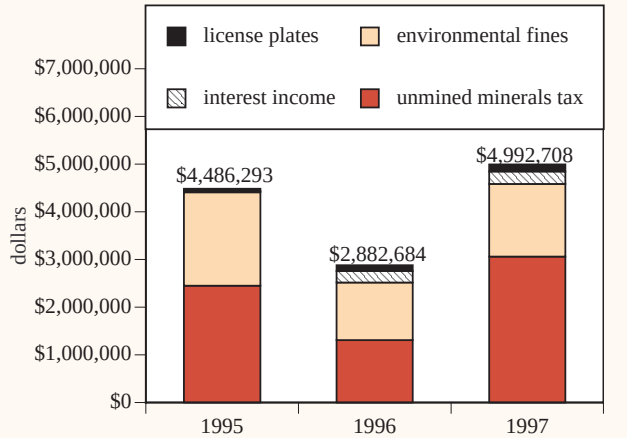
Source: KY Department of Fish and Wildlife Resources

Figure 48 Donations to Kentucky Income Tax Checkoff Nature and Wildlife Fund



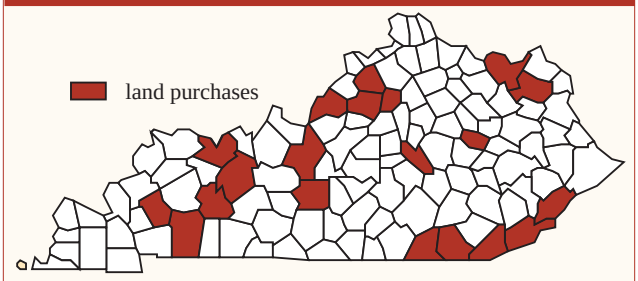
Source: KY Nature Preserves Commission

Figure 49 KY Heritage Conservation Fund



Source: KY Heritage Land Conservation Fund Board

Figure 50 KY Heritage Land Conservation Purchases (Jan. 1995- March 31,1997)



Note: Lands purchased and lands approved for purchase.
Source: KY Heritage Land Conservation Fund Board

Heritage Land Conservation Fund Generates $12 Million to Purchase Natural Areas

Kentucky has primarily relied on the generosity of its citizens to purchase important natural areas. The only funding source for many years was donations made to the Kentucky Income Tax Checkoff Program Nature and Wildlife Fund **(Figure 48)**. The Kentucky Nature Preserves Commission and the Department of Fish and Wildlife Resources divide the proceeds from the program to support a variety of programs.

However, in recent years, Kentucky has taken great strides to improve the protection of natural areas. The Kentucky Heritage Land Conservation Fund was created in 1990 and funded by the Legislature in 1994 to provide a permanent source of monies to purchase natural areas from willing sellers. The fund is managed by a board appointed by the governor.

The fund is financed by revenues from the state portion of the unmined minerals tax, environmental fines, the sale of nature license plates, and interest earned on undistributed funds **(Figure 49)**. The sale of 18,243 nature license plates has generated $310,000 since 1995 and has become one of the most popular specialty license plates in the state. The yearly fluctuations of the fund are attributed to a backlog in the collection of the unmined minerals tax.

Priority for land purchases is given to natural areas that possess unique features such as rare, endangered, and migratory bird habitat; areas that perform important natural functions such as wetlands; and areas to be preserved in their natural state for public use, outdoor recreation, and education.

Half of the fund is allocated to five state agencies: Nature Preserves Commission, Division of Forestry, Department of Fish and Wildlife Resources, Department of Parks, and the Wild Rivers Program. The remainder is made available to state agencies, local governments, state colleges, and universities. As of March 31, 1997, the fund had generated $12.3 million. To date, 26 natural areas totaling 15,521 acres in 20 counties have been or in the process of being purchased at an estimated cost of $8.1 million **(Figure 50)**.

Copperbelly Snake Agreement Offers New Cooperative Approach to Protecting Critical Habitats in Kentucky

The national debate on how best to protect rare species and critical habitats has given way to the notion of managing ecosystems in a more holistic and proactive manner. As such, the country has begun to move away from the more prescriptive measures as specified in the federal Endangered Species Act to the use of voluntary conservation agreements.

In January 1997, such an agreement was signed by state, federal, and private interests to protect the rare copperbelly water snake. The agreement sets out a frame-

work for protecting the snake's wetlands habitat in western Kentucky and southern Indiana and Illinois. In return, the U.S. Fish and Wildlife Service will not list the southern populations of the copperbelly water snake as a threatened species under the federal Endangered Species Act.

Since most of the snake's remaining habitat in Kentucky is in 14 western coalfield counties (Butler, Caldwell, Christian, Crittenden, Daviess, Hancock, Henderson, Hopkins, Logan, McLean, Muhlenburg, Ohio, Union, Webster counties), coal companies have agreed to avoid, curtail, or modify mining in some key snake areas and implement reclamation practices after mining to enhance habitat. State agencies in Illinois, Indiana, and Kentucky have also agreed to place a high priority on acquiring and improving copperbelly water snake habitat, avoiding the degradation of wetlands unless mitigation is carried out, and conducting research on the snake.

Biodiversity Council Coordinates Efforts to Conserve Natural Resources

The Kentucky Biodiversity Council was created in 1995 by Executive Order to coordinate efforts to conserve the state's natural resources. The Council was among the recommendations of the Biodiversity Task Force, a 34-member board established by Governor Brereton Jones in 1994 to assess biodiversity status and needs. The task force developed 16 strategies and 40 action plans to sustain biodiversity **(Figure 51)**. The Biodiversity Council is currently working to coordinate the collection and mapping of natural resource data in Kentucky. In addition, the group is working to educate the public about biodiversity through a bi-yearly newsletter.

Figure 51 Elements to Sustaining Biodiversity in KY

- Conduct a comprehensive inventory of biodiversity in Kentucky.
- Establish a sustained public education program about the values of biodiveristy.
- Promote incentives to support biodiversity on private lands.
- Support economic development strategies that promote sustainable industries.
- Coordinate statewide efforts to conserve biodiversity.

Source: Kentucky Alive! Report of the KY Biodiversity Task Force, 1995

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1996-97 State of Kentucky's Environment

Resource Extraction

The mineral resources of Kentucky contribute greatly to meeting the state's energy needs. For example, each day the average Kentuckian consumes 1.2 million Btu of energy at home, work, and at play—that's 22% more than the national average of 934,000 Btu. Kentucky ranks 8th in the nation in energy consumption per person.[1]

Kentucky's mineral resources also help to support the state and local economies. During 1995, the value of the coal, natural gas, petroleum, and other minerals mined in Kentucky was approximately $4.4 billion.[2] The mining and quarrying industry employed 25,300 people that year, earning $965 million in wages and income; a majority of which was attributed to the coal industry.[3]

But with this mineral and economic wealth comes environmental concerns. Resource extraction activities remain a major source of water pollution in Kentucky.[4] Efforts to address and minimize pollution impacts from coal mines and oil and gas operations continue. This *State of Kentucky's Environment Report* will review mineral production and energy consumption trends, enforcement and compliance issues at mine and drilling operations, and the status of abandoned sites.

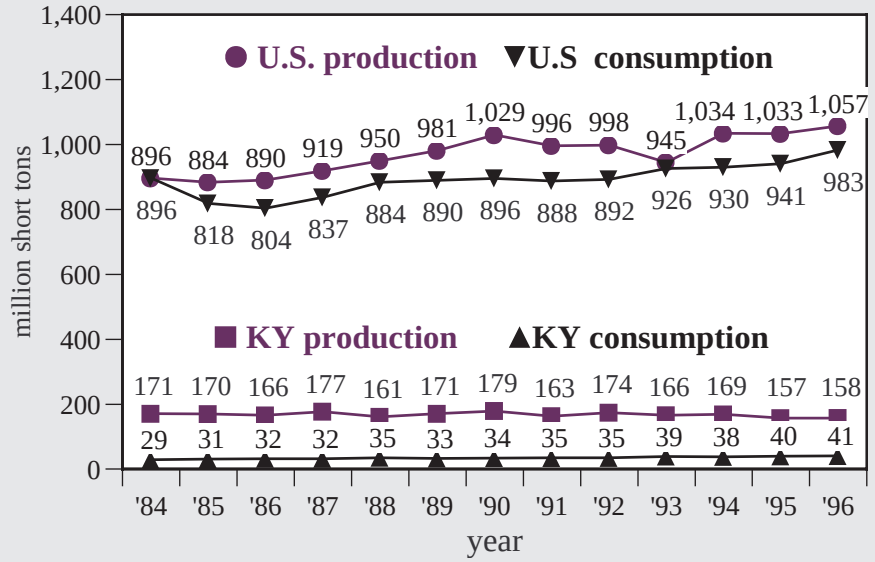
Coal Mining

Kentucky Ranks Third in Nation in Coal Production

U.S. coal production reached record levels in 1996 at 1,057 million short tons.[5] During 1996, Kentucky ranked third in the nation in coal production, supplying 15% of the nation's coal at 158 million tons **(Figure 1 & Figure 2)**. More than 83% of Kentucky's coal is sold out-of-state.

Nearly 83% of the coal produced in the nation is consumed by power plants to

Figure 1 Coal Production and Consumption in Kentucky and U.S.



Note: Does not include consumption by independent power producers. Source: KY Geological Survey, U.S. Energy Information Administration, KY Department of Mines and Minerals

EQC

Environmental Quality Commission
Environmental Indicators Program
Reporting on Environmental Trends and Conditions in Kentucky.

1996-97 Reports
- Safe Drinking Water
- Air Quality
- Waste Management
- Toxics
- Water Quality
- Natural Resources
- Resource Extraction

EQC is a seven-member citizen commission created under state law with a mission to monitor environmental trends and conditions, promote partnerships to improve and protect the environment, provide a public forum for the discussion of environmental issues, and advise state officials on environmental matters.

EQC Commissioners
Aloma Dew, Owensboro
Bob Riddle, Midway
Patty Wallace, Louisa
Harold Benson, Frankfort
Betsy Bennett, Lexington
C.V. Bennett, III, Harlan
Gary Revlett, Shelbyville

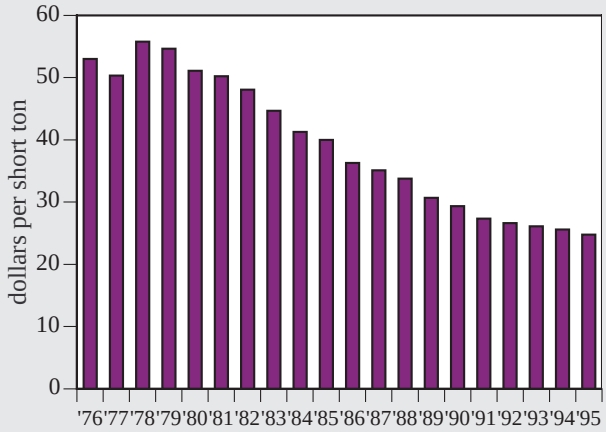
EQC Staff
Leslie Cole, Ex. Director
Scott Richards, Asst. Dir.
Erik Siegel, Research Asst.
Frances Kirchhoff, Adm. Asst.

Figure 2 Top 10 Coal Producing States

State	1,000 short tons 1995	1996	%*
WY	264	278	+5.3
West Va.	163	166	+2.6
KY	**157**	**158**	**+0.6**
Penn.	62	68	+9.6
Texas	53	55	+5.0
Illinois	48	46	-4.5
Montana	39	38	-3.9
Virginia	34	36	+4.7
N. Dakota	30	30	+0.2
Indiana	26	30	+15
top 10	**873**	**972**	**+2.7**
U.S.	**1,033**	**1,057**	**+2.3**

**Percent change 1995-96. Totals rounded. Source: U.S. Energy Information Adm.*

Figure 3 Average Price for Kentucky Coal Delivered to Electric Utilities



Note: Adjusted for inflation using the consumer price index for 1995. Source: U.S. Energy Information Adm.

generate electricity.[6] About 56% of the nation's and 95% of Kentucky's, electricity is generated by coal-fired power plants. Average electricity costs in Kentucky during 1996 were 4.1 cents/kilowatt-hour, the second lowest in the U.S.

Record coal production in 1996 drove down the national average price for coal delivered to electric utilities to an all time low of $26.45 per short ton.[7] The 1996 average price paid for Kentucky coal by power plants was $24.43 per short ton **(Figure 3 & Figure 4)**.

Increasing competition from western states, where the coal is easier to mine and more plentiful, will continue to present significant economic challenges to Kentucky coal, according to state experts.[8] This added competition has further depressed Kentucky coal prices and resulted in lower profit margins. However, many predict that Kentucky coal will continue to compete in the marketplace due to its high heat content. The average heat content of Kentucky coal is 12,200 Btu per pound compared to 8,650 Btu per pound for Wyoming coal.[9]

Figure 4 Average Price for Coal Delivered to Electric Utilities - Top Ten Coal Producing States (1996)

State	Average price
Wyoming	$14.33
W. Va.	$30.94
Kentucky	**$24.43**
Penn.	$34.07
Texas	$19.27
Illinois	$32.17
Montana	$11.90
Virginia	$35.73
N. Dakota	$9.72
Indiana	$24.67
U.S. average	**$26.45**

Source: U.S. Energy Information Administration

7.4 Billion Tons of Coal Mined In Kentucky; Some Experts Predict 20 to 30 Years of Recoverable Reserves Remain

Coal is found in two regions of the state; the Eastern Kentucky Coalfield and the Western Kentucky Coalfield. More than 7.4 billion tons of coal has been mined in these coalfields during the past 200 years—about half this amount being extracted within the past 25 years.[10]

An estimated 32.5 billion tons in demonstrated coal reserves remain in the state **(Figure 5)**. But a 1993 study of the coal resource of Eastern Kentucky indicates about half of the reserves are not recoverable given current technology, land use restrictions, and other factors.[11] Of the 12.86 billion tons of demonstrated reserves in Eastern Kentucky, only 7.1 billion tons are recoverable.

Officials with the Kentucky Geological Survey predict that recoverable coal reserves in Kentucky will significantly decline in the next two to three decades. Kentucky Coal Association officials, however, indicate that other factors, such as national demand, new technologies, and expanded markets for coal, such as specialty steel and chemical markets, will determine how much coal is mined in Kentucky.[12] It is certain, however, that the coal reserves in several principal beds in Kentucky may be significantly diminished in the near future. The resources that remain are more likely to be thinner, of poorer quality and more challenging in terms of mining conditions.[13]

Figure 5 Coal Reserve Base-Top 10 Coal Producing States (1995)

State	billion tons
Wyoming	68.495
W. Va.	35.983
Kentucky	**32.564**
Penn.	28.867
Texas	13.064
Illinois	89.956
Montana	119.773
Virginia	2.327
N. Dakota	9.470
Indiana	9.990
top 10	**410.489**
Total U.S.	**495.665**

Note: Demonstrated reserve base. Includes anthracnite, bituminous, subbituminous, lignite coal. Source: U.S. Energy Information Administration

The coal reserves in several principal beds in Kentucky may be significantly diminished in the near future. The resources that remain are more likely to be thinner, of poorer quality, and more challenging in terms of mining conditions.[13]

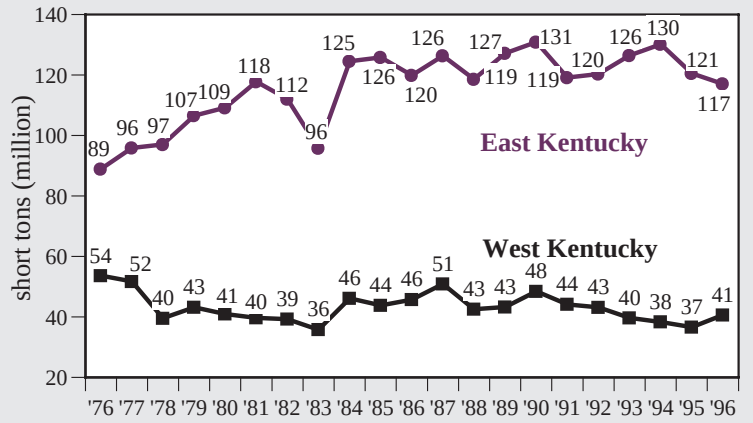
74% of Coal Mined in East Kentucky, Pike County Leads in Production

In 1996, 74% of the coal extracted in the state was mined in the Eastern Kentucky Coalfield **(Figure 6)**. This coalfield contains 40 mineable beds and covers more than 10,400 square miles.[14] The average heat content of the coal is about 13,000 Btu per pound with a sulfur content of 1% to 2%.[15]

In the Western Kentucky Coalfield there are less than 20 mineable coalbeds. The heat content is slightly lower than in the eastern field and the sulfur content is higher at about 3% to 4%.[16] Because of the differences in coal quantity and quality, the Eastern Kentucky Coalfield has become the state's primary source of coal production.

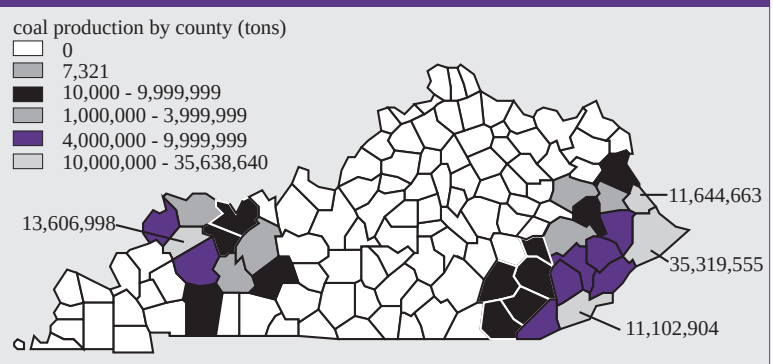
In 1996, seven counties (Pike, Webster, Martin, Harlan, Perry, Hopkins, Leslie) accounted for 63% of the coal mined—100.1 million short tons **(Figure 7)**. Pike County remains the leading coal producer in the state with 35.3 million tons mined in 1996; a quarter of the coal output in the state.

Figure 6 Regional Coal Production in Kentucky



Source: KY Department of Mines and Minerals

Figure 7 Coal Production by County (1996)



Source: KY Department of Mines and Minerals

Underground Mines Account for 63% of Coal Produced in 1996

Underground mines have become the principal method used in Kentucky to extract coal. Nearly 63% of the coal mined in Kentucky during 1996 was from underground mines **(Figure 8)**.

Between 1987 and 1996 surface mine production in the Western Kentucky Coalfield declined 44% while underground production increased 56% **(Figure 9)**. This trend may be due to diminished surface-minable reserves in the region.[17]

In the Eastern Kentucky Coalfield, significant surface mine production did not occur until the 1970s triggered by new developments in contour surface mine technology and high demand for coal as a result of the OPEC oil embargo.[18] Surface mining production began to decline in the region as high quality surface reserves diminished and regulatory costs increased after the passage in 1977 federal Surface Mine Control and Reclamation Act. Between 1978 and 1995, trends reveal that surface mining had declined 12% in the Eastern Kentucky Coalfield, while underground mining increased 62% **(Figure 9)**.

In 1996, seven Kentucky counties (Pike, Webster, Martin, Harlan, Perry, Hopkins, Leslie) accounted for 63% of the coal mined—100.1 million short tons.

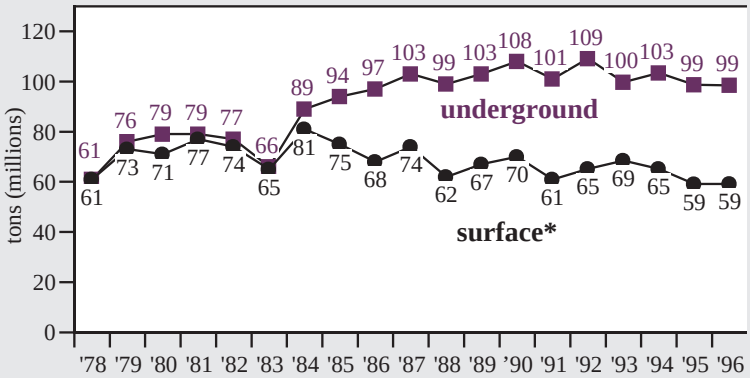
Kentucky Mines Continue to Decline, Production Per Mine Increases

Kentucky has the largest number of mines in the U.S. with 544 active operations in 1996 compared to West Virginia's 386 and Wyoming's 27.

Figure 10 shows that the number of Kentucky mines fell from 1,858 in 1985 to 544 in 1996. The drop is attributed to several factors including the repeal of the state's two-acre mine exemption in 1987 and a shift from small independent coal companies to large diversified firms. Many small firms left the industry or merged as coal prices fell and companies could not recover their costs. In recent years the number of mines continue to decline due to the consolidation of operations into

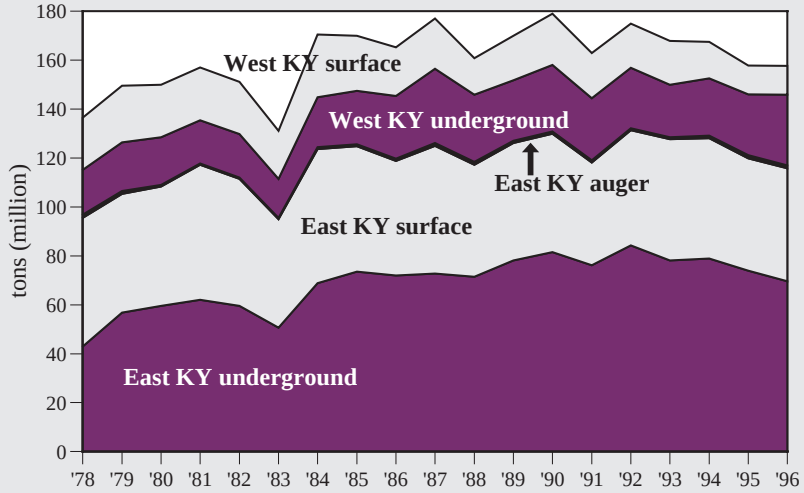
Kentucky has the largest number of mines in the U.S. with 544 active operations in 1996, compared to West Virginia's 386 and Wyoming's 27.

Figure 8 Coal Mining Methods in Kentucky



*Includes strip, auger, and auger/strip.
Source: KY Department of Mines and Minerals

Figure 9 Coal Mining Methods by Region in Kentucky



Note: Surface mining is primarily the use of mountain top and contour mining in East Kentucky and area mining in West Kentucky. Underground mining is primarily the use of room and pillar, long wall, and drift mining techniques. Auger mining is used in East Kentucky and extracts coal from underneath the remaining mountain or hill top. Source: KY Department of Mines and Minerals

larger mining operations. In 1996, the average permitted surface mine was 343 acres and the average permitted underground mine was 900 acres.[19]

While the number of mines have declined in the past 10 years, coal production has remained stable. This is attributed to increased efficiency in the extraction of coal brought about by larger, more productive mining machinery and a greater emphasis on productivity. Coal production per mine has more than tripled since 1985 and now averages 279,000 short tons per year **(Figure 10)**.

A closer look at coal production in 1996 reveals that nearly 64% of the state's coal production came from 31 mines which produced an average of 1.7 million tons per year. The state's largest mine, Arch of Kentucky Number 37 in Harlan County, produced 4.5 million short tons in 1996 **(Figure 11)**. As mines have become more mechanized employment has fallen 38% in the past nine years, from 31,503 employees in 1988 to 19,372 in 1996.[20]

1,157 Underground, 1,144 Surface Mine Permits Active in 1997

The environmental impacts of coal mining have been regulated to some degree in Kentucky since 1966. But it was not until the passage of the 1977 federal Surface Mining Control and Reclamation Act (SMCRA) that the state began to more fully address the impacts of mining to the environment.

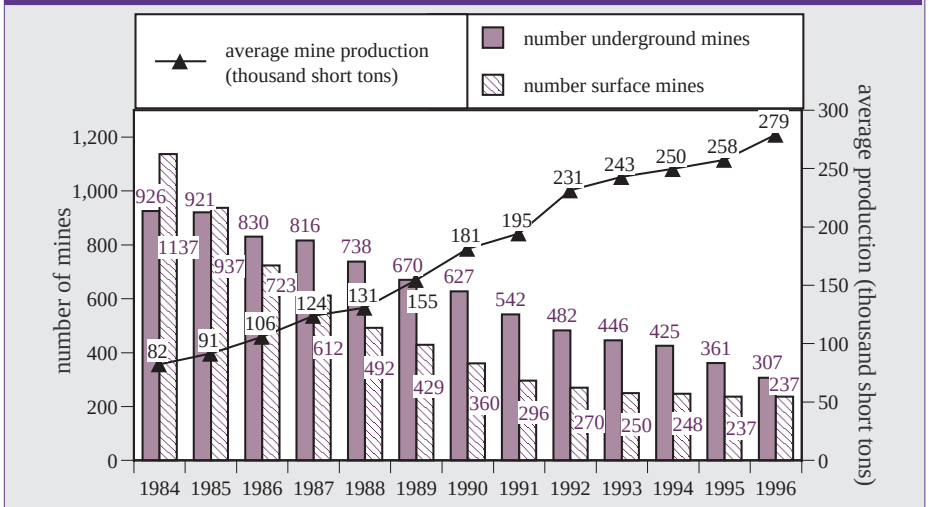
Since the mid 1980s, underground mines have become the principal method used in Kentucky to extract coal. Nearly 63% of the coal mined in Kentucky during 1996 was from underground mines.

Kentucky obtained federal authority to carry out the provisions of the SMCRA in 1982. Since then, the Kentucky Department of Surface Mining Reclamation and Enforcement (DSMRE) has been the primary regulatory authority while the U.S. Office of Surface Mining (OSM) has maintained an oversight role to ensure compliance with the federal law. The role of OSM has come under fire by coal industry and state officials in recent years claiming the enforcement authority of the agency is duplicative. Last year the OSM budget was cut by $24 million—from $316 million in 1995 to $292 million in 1996, resulting in layoffs of 164 of its 894 employees. An additional 83 vacant positions were also eliminated. In the Kentucky OSM field office staff fell 37%, from 54 people in 1995 to 34 in 1997. The reductions in the Kentucky office primarily targeted administrative positions. However, the agency did lose five of its 19 field inspectors.

Coal mining activities are required to be permitted by DSMRE before operations can begin. The permit process specifies operation and reclamation requirements for a mine site. The permit process has become increasingly complex over

the past two decades. For example, operations must now collect baseline environmental data and conduct groundwater modeling and, in some cases, archeological studies. While permit costs and timeframes vary based on the type of facility, some average costs are as follows.[21] The average time to get an underground coal mining permit (1,000-acre room and pillar) in Kentucky is 6-8 months at an average cost of $25,000. For a 500-acre surface operation the permit time ranges from 10-12 months at a cost of $40,000. A coal preparation plant permit of 100 acres with 25 houses takes 10-12 months to receive and costs $30,000 while a coal refuse disposal and slurry impoundment permit of 150 acres costs $250,000 and takes 1-2 years to permit due to the design requirements as specified under state and federal law to protect public safety and the environment. Recent state efforts have focused on improving the efficiency of the permitting program through the electronic submittal of applications to DSMRE. The first priority of the Electronic Permitting Initiative is to develop electronic transmission of water quality data.

Figure 10 Number of Coal Mines, Average Production in KY



Source: U.S. Energy Information Administration

As of June 30, 1997, Kentucky had 2,931 active or temporarily inactive coal mine permits on private and federal land as follows:

- 1,157 surface mine permits.
- 1,144 underground mine permits.
- 630 other facilities.

Figure 11 Top 10 Producing Mines in Kentucky (1996)

Company/ (County)	mine	million tons
Arch of KY (Harlan)	#37	4.5
Costain Coal (Webster)	#13	4.0
Martiki Coal (Martin)	#11598	3.1
Peabody Coal (Union)	Camp #11	3.1
Star Fire (Knott)	Knott City*	3.0
Elk River (Leslie)	#18	2.9
Peabody Coal (Union)	Camp #1	2.9
Webster Coal (Webster)	Dotiki mine	2.7
Leexo Inc. (Perry)	#63	1.5
Solid Energy (Pike)	#1	1.4
Total top 10		**29.2**

**Mine number 11040, 16299, and 16876.*
Source: U.S. Energy Information Adm.

1.56 Million Acres Permitted for Coal Mines Since 1978

Between 1978 and 1996, 1.56 million acres, about 6% of the state's 25.8 million acres of land, have been permitted for coal mining. It should be noted that not all surface acreage permitted for coal mines is actually disturbed. For example, acreage overlaying underground mines must be included in permits. Most underground mines actually disturb very little surface acreage.[22] Unfortunately, historical data is not available to determine the total acreage of land actually disturbed by coal mining.

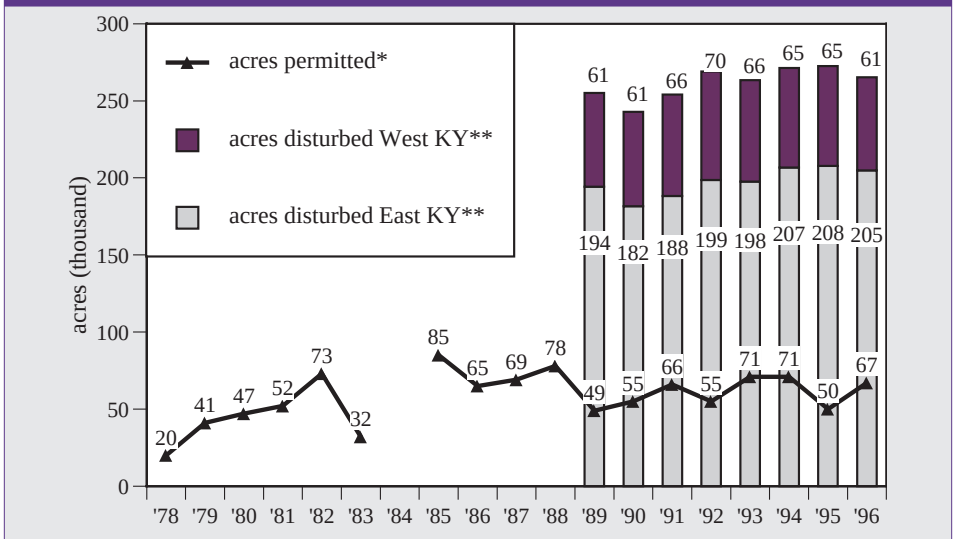
Data, however, is available beginning in 1989 on yearly acreage disturbed by coal mines **(Figure 12)**. In 1996, 273,000 acres of land were disturbed by coal mining (being mined or in some stage of reclamation). A majority of this acreage, 76%, was in Eastern Kentucky. Yearly acreage permitted for coal mining during the past six years averaged 63,000 acres per year **(Figure 12)**.

Nearly 64% of the state's coal production in 1996 came from 31 mines which produced an average of 1.7 million tons of coal per year.

Half Million Acres of Mine Land Fully Reclaimed Since 1984

Since 1984, 544,000 acres of permitted mine lands have been reclaimed in Kentucky **(Figure 13)**. While data are not available to determine post-mine reclamation land use, DSMRE reports that most mine lands are reclaimed to hay and pastureland.

Figure 12 Coal Mine Acres Permitted and Disturbance in Kentucky



**Acres only reflect those permitted acres actually disturbed through original applications issued during those calendar years. Does not include acreage added under permit revisions or amendments. 1984 acreage not shown (517,000 acres repermitted in 1984 as a result of transition from interim to permanent program which also includes acreage permitted for the first time that overlays underground mine workings). **Acreage disturbed by permitted mines either actively mining or in some stage of reclamation as of December 30 for each year provided. Earlier data not available. Source: KY Dept. of Surface Mining*

About 6% of the state's 25.8 million acres of land has been permitted for coal mining. In 1996, 273,000 acres were disturbed (being mined or in some stage of reclamation). A majority of this acreage, 76%, was in Eastern Kentucky.

Coal companies prefer to reclaim with grasses because it is easier to establish a groundcover and meet coal mine bond release requirements. Reclaiming mines to grassland is often the preference of landowners as well, according to DSMRE.

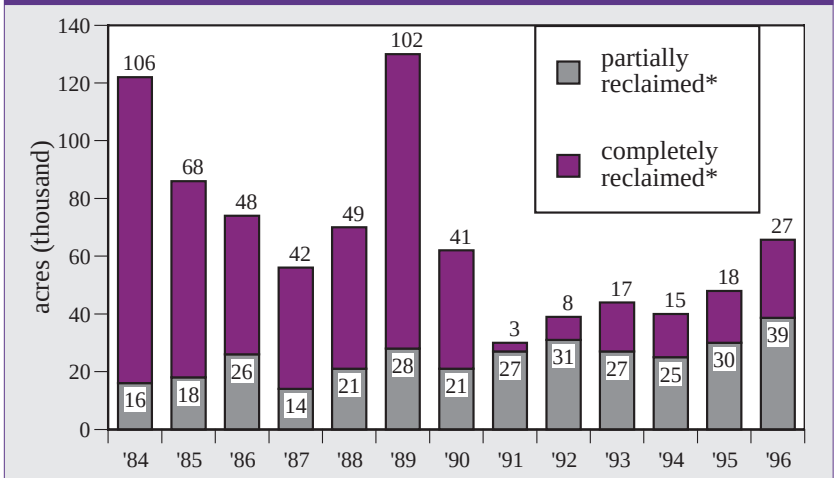
Efforts to promote forests as a post-mine reclamation land use became a state priority in 1996 after the Environmental Quality Commission (EQC) issued a resolution to Governor Paul E. Patton. EQC found that current reclamation practices discouraged the use of trees as a reclamation option due to excessive soil compaction and other requirements.

In response, the Natural Resources and Environmental Protection Cabinet established a work group to review current reclamation practices that impact tree survival and develop guidance that would promote trees on mined lands. On March 10, 1997, DSMRE issued a Reclamation Advisory Memorandum (RAM) #124 to promote reforestation of mine lands which includes:

- Selection methods for growth medium to encourage tree root development.
- Avoidance of soil compaction by leveling in separate operations.
- Procedures for compatible ground cover to avoid competition with seedlings.
- Fertilization requirements based on soil tests and tree species.
- Tree species based on approved post mining land use and site characteristics.
- Proper tree planting procedures.

DSMRE has conducted eight outreach and training reforestation sessions with the coal industry, field inspectors, and permitting personnel. Additional training sessions are being scheduled. It is anticipated that promoting forests as a post mining land use will become a standard practice for DSMRE.

Figure 13 Coal Mine Acres Reclaimed in Kentucky



**Based on partial or full coal mine bond releases.*
Source: KY Department of Surface Mining Reclamation and Enforcement

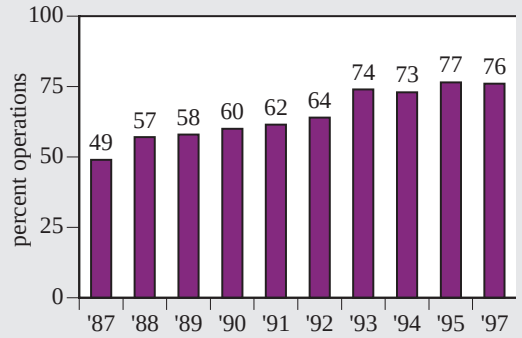
76% of Coal Mine Operations in Compliance with Permits

Trends indicate that compliance with coal mining rules in Kentucky has improved over the past 10 years based on a general assessment conducted by OSM as seen in **Figure 14**.

The compliance rating is based on random oversight inspections conducted by OSM. The number of over-

sight inspections have varied in recent years from 430 in 1994, 273 in 1995, 158 inspections in 1996, and 374 in 1997. Due to changes in oversight inspections procedures, the compliance data for 1996 was not included in **Figure 14**.

Figure 14 Compliance of Kentucky Coal Mine Operations



Note: Based on random oversight inspections conducted by the federal Office of Surface Mining. 1996 data not included due to changes in inspection procedures. Source: U.S. Office of Surface Mining Annual Evaluation Reports

Sediment Control Leading Coal Mining Citation, 13% of Permits Had One or More Citations

A review of coal mine violations reveals that sediment control leads as the most frequently cited performance standard violation at coal mines in Kentucky **(Figure 15)**. Sediment control violations pertain to the construction and maintenance of sediment ponds and silt fences. Off-site disturbances ranked second in the number of violations. A review by OSM of 178 off-site violations found that about half impacted surface water impairing 33.4 miles of streams. The agency also found off-site impacts to ten wells and 146 acres of land.[23] Backfilling and grading was the third most cited violation and includes erosion, highwall settlement, slumpage, and improper material placement. OSM found that in 1995, 89% of the violations were on-the-ground as opposed to paperwork violations.[24]

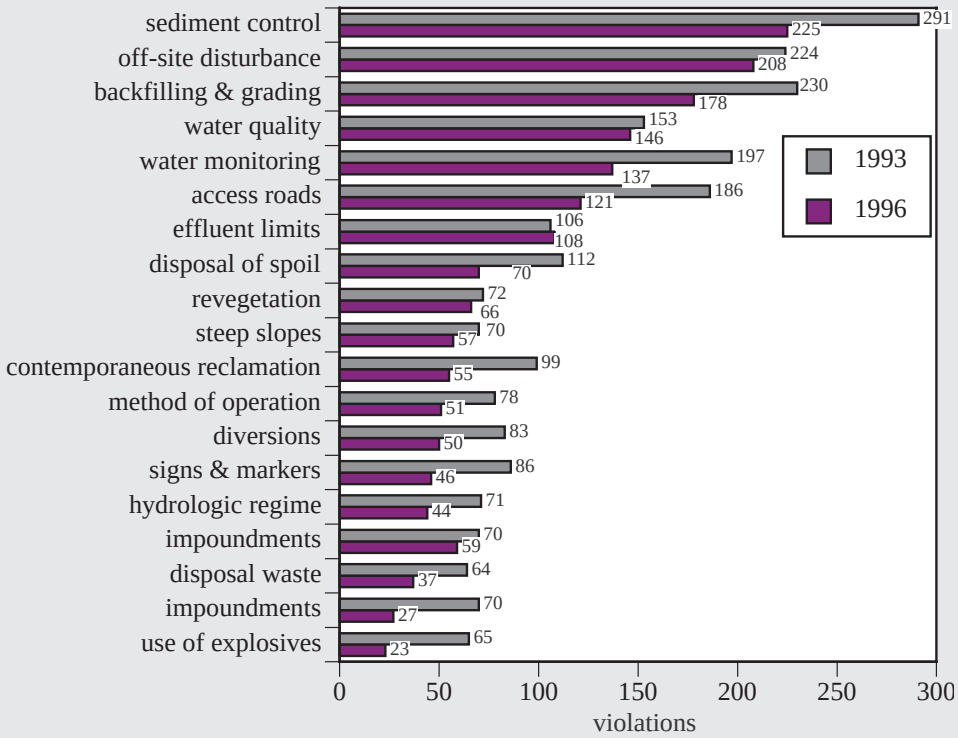
Trends indicate that compliance with coal mining rules in Kentucky has improved over the past 10 years. Sediment control leads as the most frequently cited violation at coal mines in Kentucky.

Figure 16 reveals that the number of citations cited by DSMRE dropped by 24%, from 2,356 in 1995 to 1,801 in 1996. During 1996, about 13% of the active coal mine permits had one or more citations of coal mining performance standards. This continued drop in citations is attributed to a decline in permits, improved compliance of operators, and a stronger state emphasis on preventative enforcement. DSMRE primarily attributes the increase in violations in 1994 to wet weather conditions.

Penalties assessed against violators show declining trends as well **(Figure 17)**. Many fines cannot be collected due to bankruptcies or a lack of company assets. The penalties collected have remained fairly constant during the past several years **(Figure 17)**. In fiscal year 1997, $1.5 million in coal mine penalties were collected. Currently, about $6.3 million in outstanding penalties await collection.

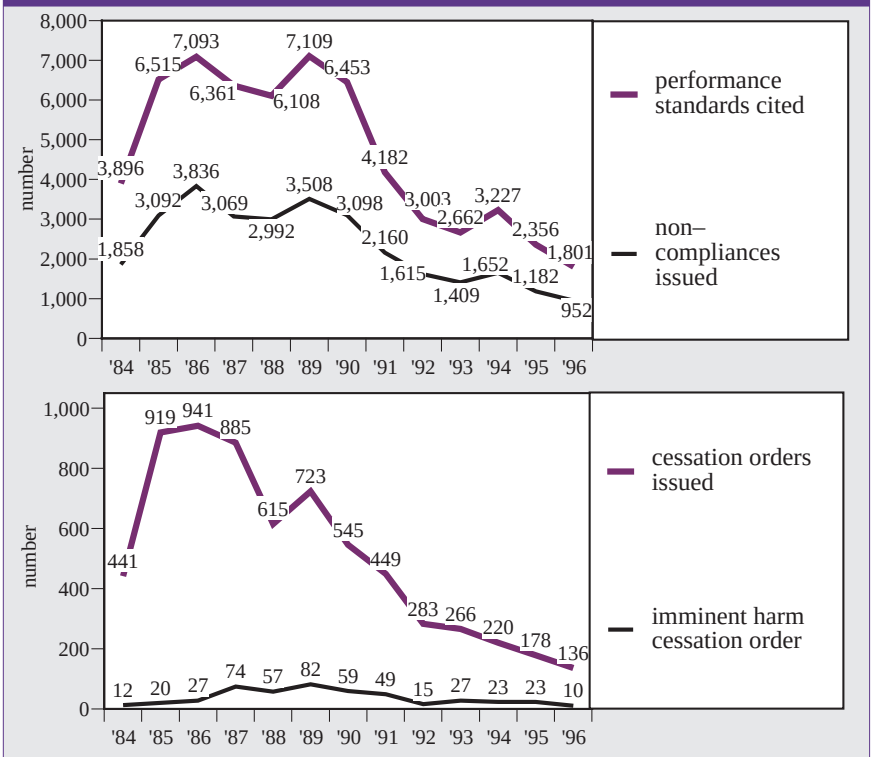
The state is required by law to conduct eight partial and four complete inspections on each active coal mine permit per year. **Figure 18** indicates that inspections have been decreasing since

Figure 15 Most Frequently Cited Coal Mine Violations in KY



Note: Based on leading violations of performance standards established to protect the environment. Source: KY Department of Surface Mining Reclamation and Enforcement

Figure 16 Coal Mining Enforcement: Violations in KY



Note: Performance standards - specific standards that must be met according to state and federal rules. Noncompliance - documents violations, remedial measures, and schedules for completion of actions. Cessation order - requires operator to cease operations for failure to abate violation and until violation is corrected. Imminent harm cessation order - requires operator to cease operations due to imminent harm or potential danger to the public and environment.
Source: KY Dept. of Surface Mining Reclamation and Enforcement

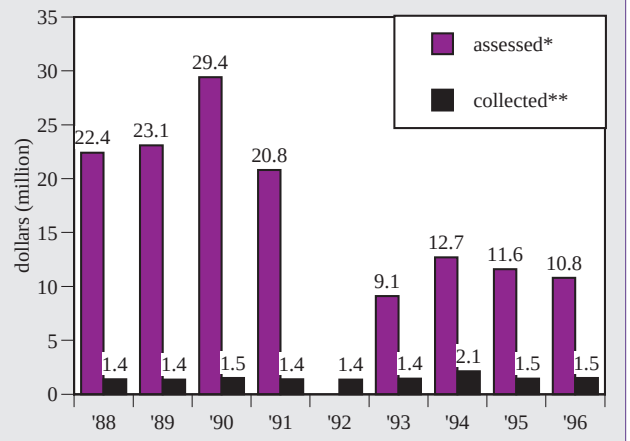
1986. This is primarily due to the decline in the number of mines and a shift from active to inactive mine sites due to the completion of mining and reclamation. OSM reported in 1997 that DSMRE had a good record in regard to mine inspections—inspecting 99% of the permits as required by law.[25]

391 Water Violations Cited at Mine Sites in 1996

Coal mines are contributing to water pollution in Kentucky, according to the 1996 Kentucky Report to Congress on Water Quality. Active, inactive, and abandoned coal mines were responsible for impairing 963 miles of waterways, about 31% of the 3,119 miles of assessed waterways with major impacts.

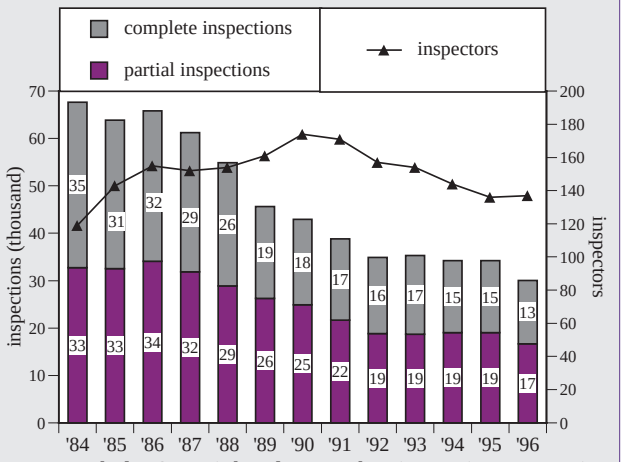
Siltation from coal mines can impair water quality and destroy aquatic habitat. Siltation is the second leading cause of water pollution in Kentucky. Contaminated runoff from mines is also contributing to acidity and elevated levels of toxic metals found in some monitored streams. Information is not available to determine how much of this pollution is caused by active mines versus abandoned mines. However, data does reveal that acid mine drainage is responsible for about 34% of the 963 miles of assessed streams

Figure 17 Coal Mine Enforcement: Penalties Assessed and Collected in KY



**1992 data not available due to computer problems. **Collections may include assessments from any given year since the inception of the state surface mining program.*
Source: NREPC, Office of Administrative Hearings

Figure 18 Coal Mining Enforcement: State Inspectors and Mine Inspections

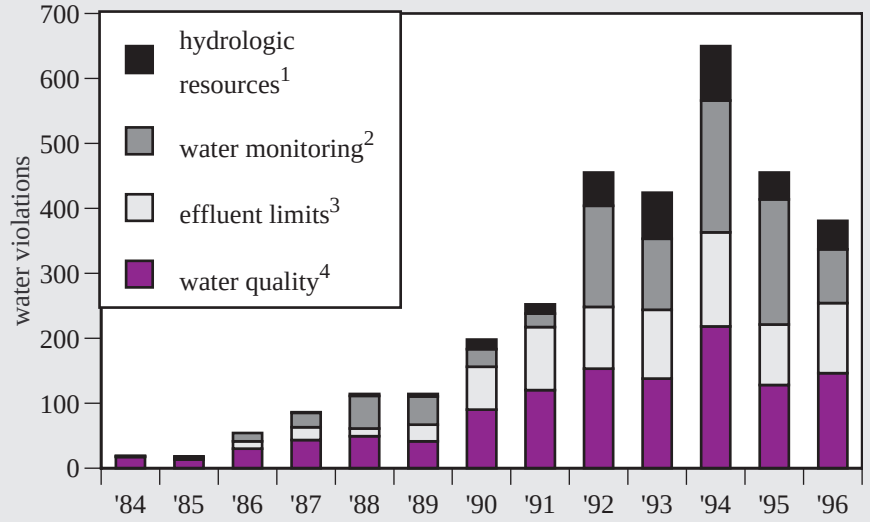


Note: Includes 8 partial and 4 complete inspections per active coal mine permit each year. Data also include inspections of inactive and abandoned mines. Source: KY Dept. of Surface Mining Reclamation and Enforcement

and rivers impaired by coal mining in Kentucky. Acid mine drainage is primarily associated with abandoned coal mines. Abandoned minelands may also be contributing to sedimentation problems found in a number of waterways.

A review of the 1,801 violations cited in 1996 at active coal mines in Kentucky reveals that 381, or 22%, were water-related. **Figure 19** shows that since 1984, water-related violations cited at mine sites have increased. DSMRE officials indicate that the increase in water violations is due to better enforcement and improved water sampling methods. They note that the high number of water violations cited in 1994 was likely due to wet weather which contributed to runoff and other water control problems at mine sites.

Figure 19 Coal Mine Water Violations in Kentucky by Type



1. Hydrologic resources - violations concerning drainage, discharge, or anything which may contaminate the water systems associated with the permitted area. 2. Water monitoring - violations concerning sampling and analyses of surface and groundwater associated with and affected by a permitted area. 3. Effluent limits - violations concerning substandard discharges which are required to be reported under KPDES water discharge permits. 4. Water quality - violations concerning substandard discharges and discharges which have not passed through an approved sediment control facility. Source: KY Dept. of Surface Mining Reclamation and Enforcement

A review of the 1,801 violations cited in 1996 at active coal mines in Kentucky reveals that 381, or 22%, were water-related. DSMRE reports that the increase in water violations is due to better enforcement and improved water sampling methods.

952 Coal Mine Complaints Received in 1996; 5% Result in Violations

In 1996, 952 citizen complaints concerning coal operations were received by state officials; the second lowest number recorded since 1984 **(Figure 20)**. Most complaints concern coal mine blasting. Kentucky leads the nation in the use of explosives **(Figure 21)**. In 1996, 2.4 million metric tons of explosives were sold in the U.S.—356,000 tons of which were sold in Kentucky.[26] Coal mining accounts for about two-thirds of total U.S. explosive sales.[27]

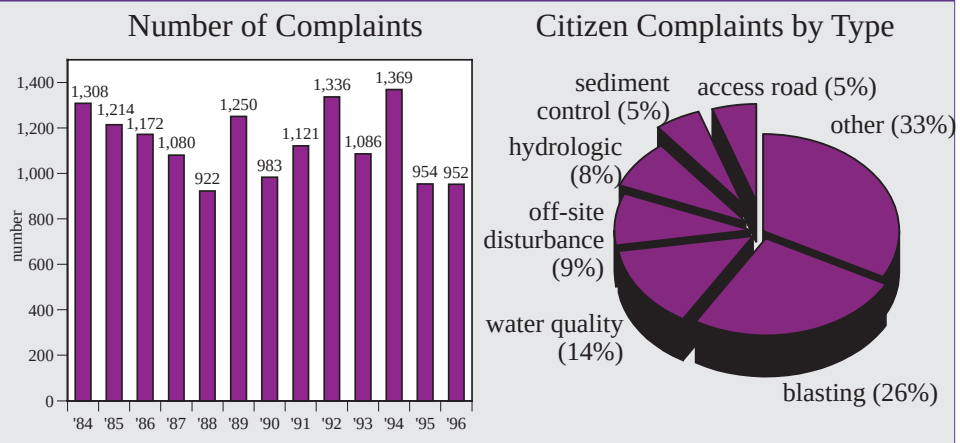
State surface mine officials received 247 blasting and 133 water-related complaints during 1996. On average, about 5% of citizen complaints result in a coal mining operation being cited for a violation, according to DSMRE. Blasting and water complaints often concern damage to private water supplies. The federal surface mine law provides that water supplies damaged by surface mines must be replaced. However, damage to water supplies caused by underground mines was not included in the law. In 1992, the federal law was amended to require all underground coal mining operations to promptly replace certain identified water supplies adversely affected by subsidence from underground coal mining operations. In response to the new federal requirements, the Kentucky General Assembly passed a bill in 1994 requiring replacement of water supplies lost due to underground mining. Between 1994 and Oct. 1997, 330 cases alleging underground coal mining damage to water supplies have been filed under the provisions of the law.

Most of the coal mine complaints received by DSMRE concern blasting. Kentucky continues to lead the nation in the use of explosives. In 1996, 2.4 million metric tons of explosive were sold in the U.S.—356,000 tons of which were sold in Kentucky. [26]

Coal Mine Bond Forfeitures Continue to Decline

The forfeiture of coal mine permits and bonds due to the failure to properly operate or reclaim a site continues to decline in Kentucky **(Figure 22)**. In 1996, $1.9 million in bonds were forfeited under 91 coal mine permits containing 1,302 acres. This forfeited acreage represents about 2% of the 66,000 acres completely or par-

Figure 20 Citizen Complaints Regarding Coal Mining in Kentucky



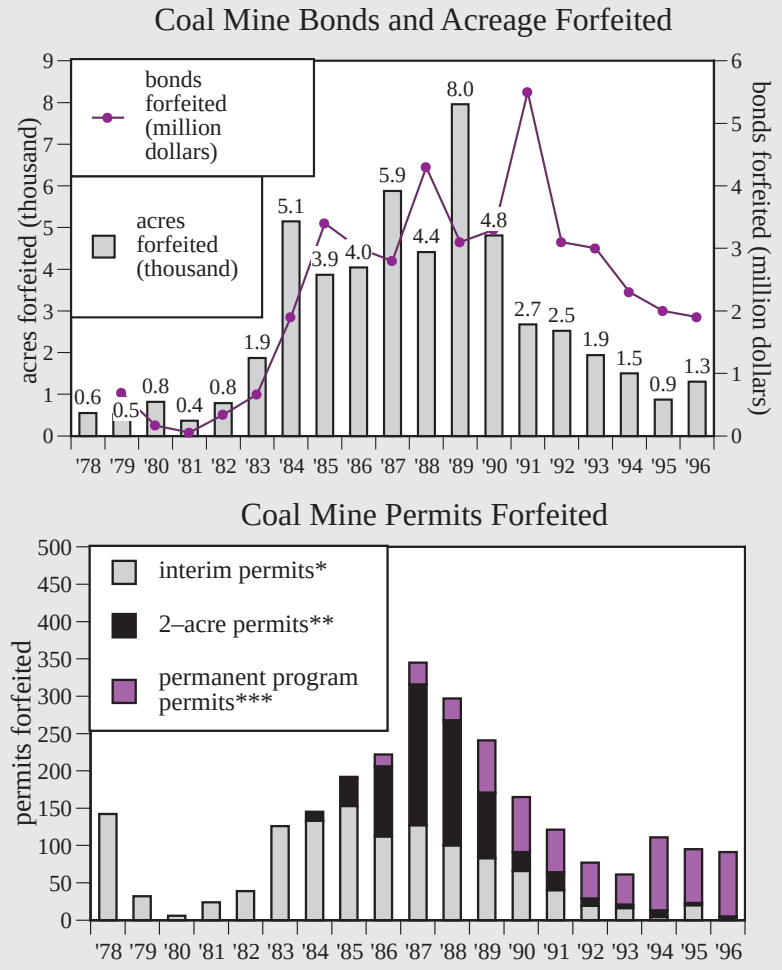
Source: KY Dept. of Surface Mining Reclamation and Enforcement

Figure 21 Leading States for Explosives Consumption (1996)

State	metric ton
Kentucky	**356**
W. Virginia	243
Wyoming	189
Virginia	148
Pennsylvania	142
Indiana	127
Arizona	127
New Mexico	85
Ohio	75
Nevada	73

Source: Institute of Makers of Explosives

Figure 22 Coal Mine Bond Forfeiture Trends in KY



**Interim permits - issued to coal mines in operation from 1978 to 1992. **2-acre permit exemptions - issued to 2-acre mine operations from 1982 to 1987 which exempted operations from performance standards. The 2-acre exemption was repealed in 1987 due to mining abuses. ***Permanent program permits - cover operations that were active on or that began after 1982.*
Source: KY Dept. of Surface Mining Reclamation and Enforcement

tially reclaimed in Kentucky that year.

The $1.9 million in coal mine bonds forfeited in 1996 was the lowest recorded in the state since 1984. In the past, concerns have been expressed that coal mine bonds were inadequate to reclaim a site. A 1993 study commissioned by the state found that 36% of the 42 mines assessed were considered to have inadequate reclamation bonds. In response, the state created a Supplemental Assurance Fund in 1994 to assure reclamation of sites with approved highwalls in excess of regulatory requirements. Monies posted by the permittee are in addition to and distinct from the reclamation bond required under federal law. Monies are returned to the permittee once rough backfilling and grading have been completed. As of September 1996, DSMRE held $38.3 million in supplemental assurance funds.

Legislation was also introduced in the 1994 and 1996 Kentucky legislative session to create a bond forfeiture fund financed by interest accrued from forfeited bonds and penalties. The fund would be used to supplement bonds that are inadequate to reclaim a forfeited mine site. The measure failed to pass due to fiscal concerns. DSMRE plans to pursue passage of the legislation in the 1998 session.

19,100 Acres of Abandoned Coal Mines Reclaimed, 1,100 Projects Funded Under AML Program Since 1978

The goal of the federal Abandoned Mine Land Reclamation Program is to restore lands mined and abandoned prior to 1982. Kentucky received federal authority to carry out this program in 1982. The national program is supported by a fee of 35 cents per ton of surface mined coal, 15 cents per ton of coal mined underground, and 10 cents per ton of lignite. This money is held in an interest bearing Abandoned Mine Reclamation Fund (AML Fund) by the federal government and allocated back to states and tribes for mine reclamation purposes.

Expenditures from the AML Fund are authorized through the regular congressional budgetary and appropriations process. Federal law specifies that 50% of the AML fees collected be returned to the state of origin for reclamation projects. The remainder of the fees are retained by the federal government to support administrative costs of the program, emergency reclamation projects, and additional discretionary grants to the states based on historical coal extraction.

Since 1978, Kentucky has reclaimed 19,100 acres of abandoned mine lands using AML Funds and more than 1,100 projects have been completed to address abandoned mine land problems **(Figure 23)**. There are an estimated 80,000 to 150,000 acres of abandoned mine lands in Kentucky that are potentially eligible for reclamation.[28] The actual acres of abandoned lands are unknown because they have not been inventoried. This is not a problem unique to Kentucky as most states have not inventoried abandoned mine lands. As such, the full extent abandoned mine lands are contributing to environmental problems in Kentucky is difficult to determine.

There are an estimated 80,000 to 150,000 acres of abandoned mine lands in Kentucky that are potentially eligible for reclamation.[28] The actual acres of abandoned lands are unknown because they have not been inventoried.

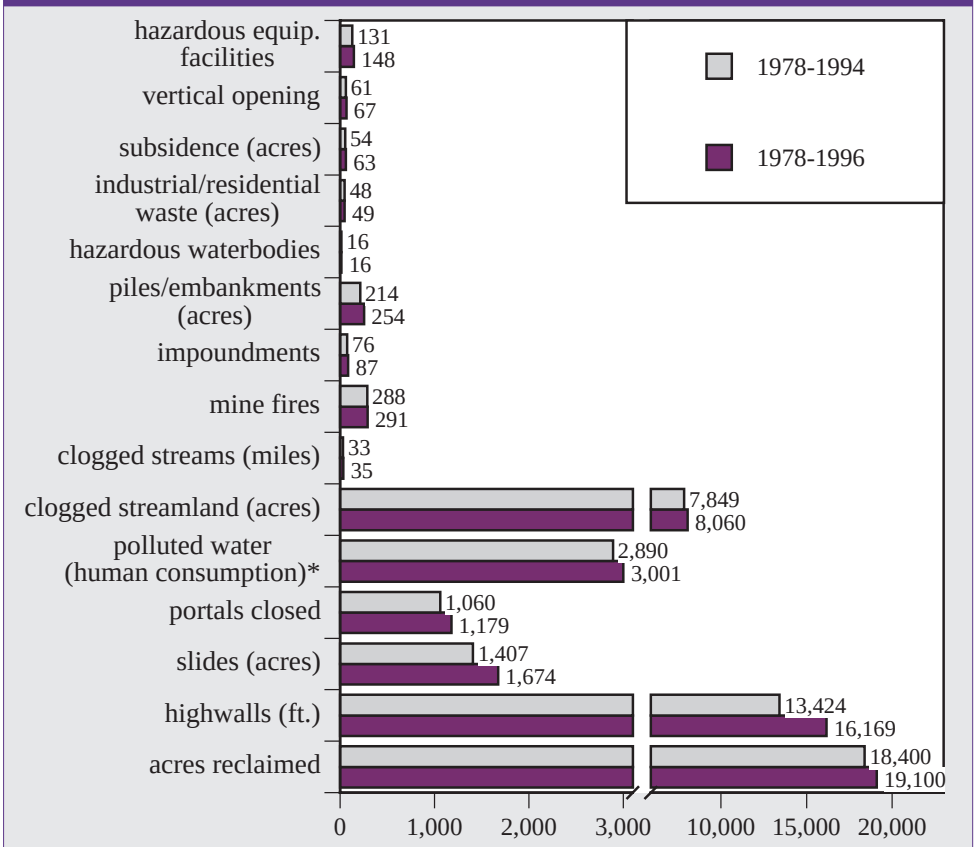
AML projects target those sites that pose an immediate threat to human health. These projects often include stabilizing landslides or the restoration of damaged drinking water supplies.

39% of AML Fees Collected in State Returned to Kentucky

Since 1978, Kentucky has paid $655.6 million in fees to the AML Fund and received back $254.8 million in state grants—a 39% return **(Figure 24)**. Consequently, the state's share balance (what is owed to the state and held in trust by Congress) is $83.6 million. The state also received $57.8 million in discretionary AML Funds based on historical coal extraction. These discretionary funds are used to supplement state AML grants.

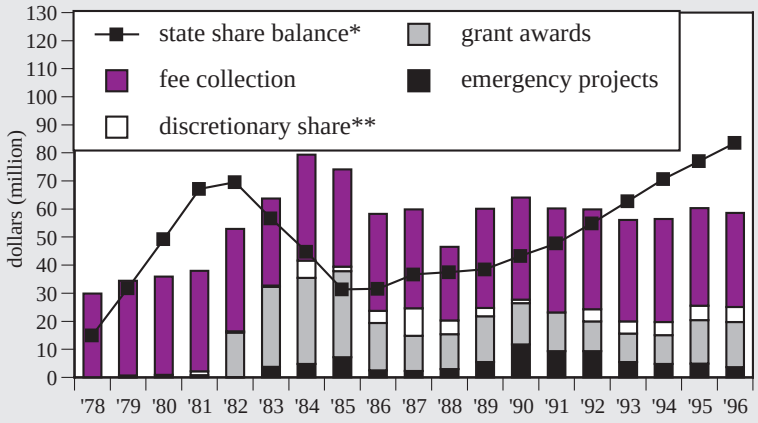
AML projects target those sites that pose an immediate threat to human health. These projects often include stabilizing landslides or the restoration of damaged water supplies. A

Figure 23 Abandoned Mine Land Projects in Kentucky*



**Selected state AML priority 1 & 2 (protection of public health, safety, and general welfare) and federal AML emergency projects. *Customers served. Source: U.S. Office of Surface Mining*

Figure 24 Abandoned Mine Land Funding in KY



**Cumulative balance of fees collected and not returned to Kentucky as specified under federal AML law. **Additional AML Funds based on historical coal extraction. Source: KY Dept. of Surface Mining Reclamation and Enforcement*

Figure 25 AML Fund Disbursement - 13th Annual Grant for Kentucky

Receipts

■ AML Grants*	$16,384,125

Expenditures

■ Program Adm.	$ 2,402,225
■ Project costs	$13,981,900
projects funded	*units*
clogged stream	0.2 miles
clogged stream land	7 acres
7 water lines	50 miles/932 meters**
impoundments	2
portals closed	14
highwalls	900 feet
slides	40 acres
subsidence	0.3 acres
vertical openings	2
piles/embankments	18.4 acres
haz. equip & facilities	10
hazardous waterbody	2

*Note: Based on 13th annual grant receive in 1994 and obligated over a 3-year period. Grant closed out in 1997. *Includes AML grant awards and discretionary AML Funds. **Customers served. Source: KY Dept. of Surface Mining Reclamation and Enforcement*

review of the disbursement of $16.3 million received by Kentucky from the AML Fund in 1994 reveals that $2.4 million was used for administrative costs (agency salaries, rent, and equipment). The remaining $13.9 million financed 31 projects **(Figure 25)**.

Since 1979, the federal government has also expended $84 million in AML Funds to finance 621 emergency projects in the state.[29] A review of funding for OSM emergency projects in Kentucky, however, reveals a steady decline—from $11.8 million in 1990 to $3.7 million in 1996. This decline is due to a cap set by Congress in 1992. The cap limits federal emergency spending in Kentucky to about $4.5 million per year. The limited funding has resulted in the referral of remaining reclamation work by OSM to the state after the completion of minimum reclamation on federal emergency projects.[30]

Many people charge that the AML Fund monies are being held to help offset the federal deficit.[31] As of March 31, 1997 a total of $4.6 billion had been collected and deposited into the AML Fund of which $3.5 billion has been appropriated—leaving a balance of $1.1 billion. Since 1992, Congress also directed the fund be used for United Mine Workers of America pension benefits owed due to bankrupt union coal companies. During 1996, $47 million was appropriated from the AML Fund for this purpose. National interests such as the Citizens Coal Council and the United Mine Workers as well as the Kentucky Coal Association, Kentuckians for the Commonwealth, and state officials continue to call upon Congress to release the $1.1 billion balance of the AML Fund to help clean up old mine sites. The Citizens Coal Council reports that $4.2 billion is still needed to fund those sites where no or only partial reclamation has been done—$394.7 million of which is needed in Kentucky.[32] Kentucky officials indicate that the financial need is much greater in the state since this figure represents only inventoried sites and many new sites are discovered every year.

A review of the disbursement of $16.3 million Kentucky received from the AML Fund in 1994 reveals that $2.4 million was used for administrative costs and $13.9 million financed 31 projects.

Acid Mine Drainage Impacting 52 Streams

Acid mine drainage is caused by water passing over or through mines, spoils, and refuse piles where it becomes acidic and/or laden with metals such as iron, manganese, and aluminum. Acid mine drainage can impact the pH of a stream and cause serious environmental damage as well as add to the cost of treating water used for public water supplies. Acid mine drainage can coat stream beds with iron resulting in reddish-orange or yellow stains. The Division of Water lists 52 streams that are impaired by acid mine drainage **(Figure 26)**.

Little has been done in the past decade to assess and address the impact of acid mine drainage in Kentucky and other coal mining states. In response, the Appala-

chian Clean Streams Initiative (ACSI) was created in 1994 by the U.S. Department of Interior to encourage cooperative efforts to eliminate acid mine drainage from abandoned mine lands. Fifteen states, including Kentucky, are participating in the ACSI. The Initiative uses both public and private funds to finance cooperative restoration projects. Kentucky has two ACSI projects underway:

■ East Diamond Tipple, Hopkins County - 150-acre refuse and slurry site polluting Flat Creek. ACSI will provide Andalex Resources $100,000 of the $535,000 earmarked for the completion of this remining project.

■ Brier Creek, Muhlenberg County - 100-acre site where erosion and failure of a sediment pond have filled 2,500 feet of Brier Creek. The cost of the project is $700,000 with ACSI providing $225,000.

Two more projects have been proposed by the state:

■ Spewing Camp Branch, Floyd County - 86-acre site impacting Spewing Camp Branch.

■ Ketchup Lake, Hopkins County - 280-acre site impacting Greasy Creek.

Figure 26 KY Waterways Impaired by Acid Mine Drainage*

County/ waterway	miles
Bell	
Turkey Creek	2.7
LF Straight Cr.	1.3
Butler	
Little Reedy	12.0
Daviess	
Render Creek	6.1
Edmonson	
Dismal Creek	2.3
Floyd	
LF Middle Cr.	5.3
Buck Branch	0.7
Harlan	
Martins Fork	10.0
Hopkins	
Cane Creek	3.4
Caney Creek	11.3
Fox Run	2.1
Lambs Creek	4.9
Lick Creek	18.1
Pond Creek	4.6
Sugar Creek	5.3
Pond Creek	30.1
Pleasant Run	7.9
Crab Orchard	7.6
Jackson	
Indian Creek	4.0
Knott	
Clear Creek	5.5
Laurel	
Little Raccoon	7.7
Letcher	
Rockhouse Cr.	24.3
McCreary	
White Oak Cr.	4.2
Rock Creek	4.1
Ryans Creek	5.3
Lick Creek	5.7
Barren Fork	5.3
Bear Creek	3.2
Bucks Branch	2.0
Cane Creek	2.0
Copperas Cr.	3.8
Crummies Cr.	6.4
Devils Cr.	2.4
McLean	
Cypress Cr.	10.4
Ohio	
Williams Cr.	5.3
Issacs Creek	5.8
Flat Creek	10.6
Muhlenberg	
Thompson Cr.	6.0
Nelson Creek	4.3
Little Hazel Cr.	3.9
L. Cypress Cr.	10.4
Harris Branch	2.6
Beech Creek	3.4
Brier Creek	4.7
Caney Creek	7.0
Perry	
Leatherwood C	20.5
Pike	
Lick Fork	2.0
Long Fork	5.1
Stinking Creek	2.3
Hurricane Cr.	2.4
Pulaski	
Wildcat Branch	2.1
Lacy Fork	1.0
total	**331.4**

**Based on assessed waterways. Source: KY Div. of Water, 1996 Report to Congress on Water Quality as updated by Division of Water 10/22/97.*

State Issues Seven Permits to Remine and Reclaim Abandoned Mine Lands

Abandoned mine lands are contributing to environmental problems in Kentucky. However, many of these sites have not been remediated due to a lack of resources. In an effort to clean up abandoned mine lands, Kentucky has begun issuing permits to allow coal mining companies to remine old sites by providing alternative effluent standards for remining operations.

During 1996, seven remining permits were issued: Black Diamond, Webster County (340 acres); Beech Creek, Muhlenberg County (105 acres); Warrior Coal Company, Hopkins County (233 acres); Andalex Resources Pleasant View, Hopkins County (5 acres); Peabody Coal Company, Ohio County (40 acres); Ison Coal Company, Letcher County (400 acres); and Andalex Resources East Diamond Tipple, Hopkins County (150 acres). Five more remining permits are pending in Bell, Clay, Letcher, and Pike counties.

The Andalex Coal Company's East Diamond complex near Madisonville is an example of how remining may improve environmental quality while saving taxpayers money. Polluted runoff from this abandoned 150-acre site has polluted Flat Creek, which subsequently flows through the White City Wildlife Area. Andalex Coal Company activated a permit to remine this area after signing a Memorandum of Agreement in August 1997 with DSMRE and OSM. The company hopes to recover 300,000 tons of coal as it removes 3 million cubic yards of acid refuse and slurry from the site. The company also plans to extract 1.5 million tons of coal underground over a three-year period. If the state and federal government were to pay to reclaim this site, it would cost more than $4 million. Instead, Andalex will remine and reclaim the area using $435,000 of AML money and $100,000 of ACSI funds.

Oil and Natural Gas

Kentucky and the nation consume large amounts of petroleum and natural gas to meet our energy needs. In fact, the U.S. is the world's greatest consumer of petroleum—consuming two to three times more than any other country.[33] In Kentucky, the consumption of petroleum for transportation alone rose 188% between 1960 and 1994 **(Figure 27)**. This trend reflects the increased mobility of Kentucky's growing population as well as expansion of airports and increased airline traffic.

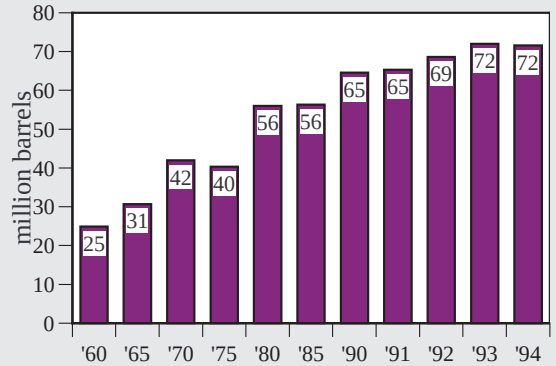
Kentucky has produced oil and natural gas since the early to mid 1800s. An estimated 170,000 oil and gas wells have been drilled in the state, according to Kentucky Geological Survey records. The following indicators measure oil and gas production and consumption trends in the state as well as efforts to address environmental problems caused by drilling activities.

The U.S. is the world's greatest consumer of petroleum—consuming two to three times more than any other country.[33] In Kentucky, the consumption of petroleum for transportation alone rose 188% between 1960 and 1994.

Oil Production Continues to Decline; Gas Production Remains Steady

More than half of the petroleum consumed in the U.S. is imported. **Figure 28** reveals that daily U.S. crude oil production of six million barrels in 1996 falls well short of the 18 million barrels of refined petroleum products consumed each day. Kentucky's and the nation's consumption of finished petroleum products continues to increase. For example, between 1986 and 1996, U.S. petroleum use rose by 12% while Kentucky use increased by 25% **(Figure 28)**.

Figure 27 Consumption of Petroleum for Transportation in Kentucky

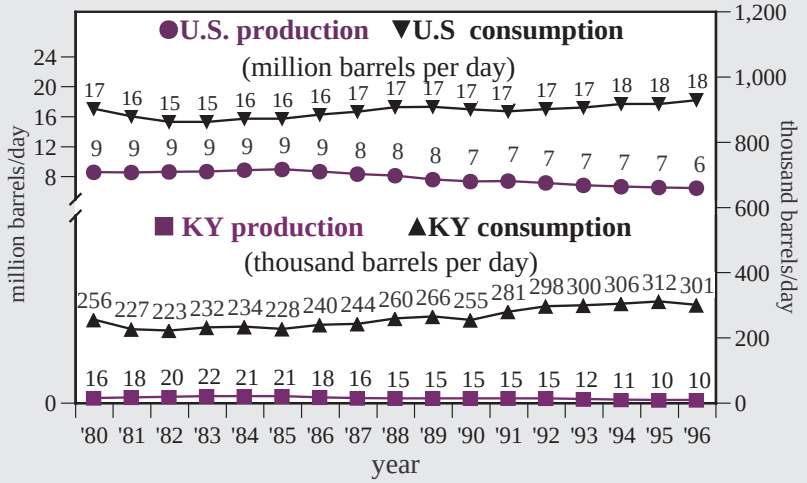


Note: 1994 data most recent.
Source: U.S. Energy Information Adm.

Kentucky ranks 20th among 31 states with oil production.[34] The state produced 3.6 million barrels in 1996, about 0.15% of the 2.3 billion barrels produced in the U.S. that year. Oil production occurs in 53 counties. During 1996 49% of oil production occurred in West Kentucky **(Figure 29)**. Crude oil production levels have been steadily declining in the state, dropping from 17,704 barrels a day in 1986 to 9,424 barrels a day in 1996. This decline is attributed to the low and variable price of crude oil on the world market.

Kentucky ranks 17th among 33 states with natural gas production.[35] In 1996, the state produced 83 billion cubic feet; 0.34% of the nation's 24 trillion cubic feet of gas **(Figure 30)**. Growth in natural gas production has been fueled by rising market prices and increased demand which is attributed to the cleaner burning characteristics of natural gas. There are 24 active natural gas fields covering 29 counties. Nearly all natural gas production, about 99%, occurs in the eastern part of the state **(Figure 31)**.

Figure 28 Oil Production/Consumption in U.S. and KY



**Crude oil production. **Refined petroleum products consumed. Totals rounded.*
Source: U.S. Energy Information Administration

88,313 Oil and Gas Permits Issued Since 1960

In 1960, the Department of Mines and Minerals, Division of Oil and Gas (DO&G) was established to foster conservation, exploration, protect

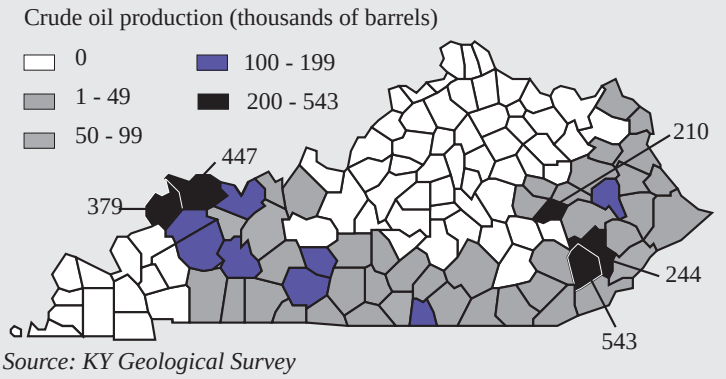
the rights of land and mineral owners, and regulate construction/operation of oil and gas wells. Between 1948 and 1960 the Department of Mines and Minerals required operators of oil and gas wells in coal regions to register with the agency.

DO&G began permitting oil and gas wells in 1960. Since then, 88,313 oil and gas permits have been issued of which 46,500 are currently productive wells. The total number of oil and gas permits issued each year continues to decline **(Figure 32)**. For example, permits fell from 1,169 in 1992 to 756 in 1996, primarily due to reduced oil production.

During 1996, DO&G's 16 inspectors conducted more than 3,000 inspections at oil and gas operations **(Figure 33)**. At least four inspections are conducted during the life of a well to ensure proper construction, operation, and plugging. DO&G officials note that the increase in inspections during 1993 was likely the result of an oil boom in Clinton County that year after the discovery of a new oil field **(Figure 34)**. And the increase in inspections during 1995 was the result of state legislation passed in 1994 requiring three additional inspections per well site where there is a severance of the mineral and surface ownership.

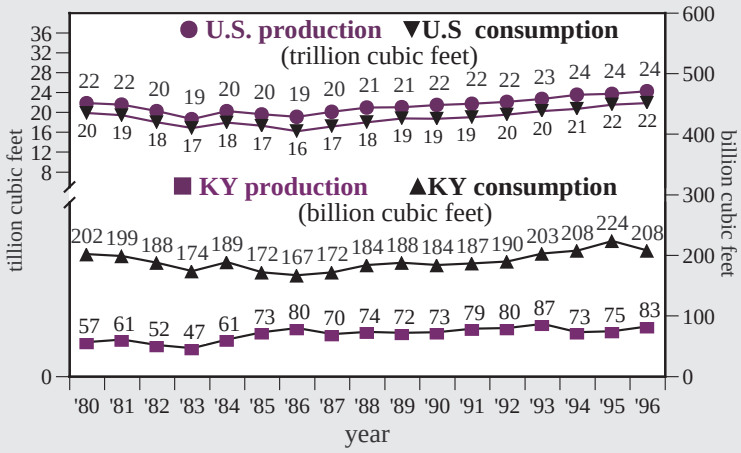
DO&G also responds to citizen complaints. Since 1993, when a more formal complaints system was developed, complaints have averaged about 69 per year **(Figure 33)**. DO&G reports that they receive few complaints. Only 66 complaints were received in 1996; a low number considering there were 46,500 producing oil and gas wells. Most complaints concern abandoned wells, groundwater, or dust.

Figure 29 Crude Oil Production in KY (1995)



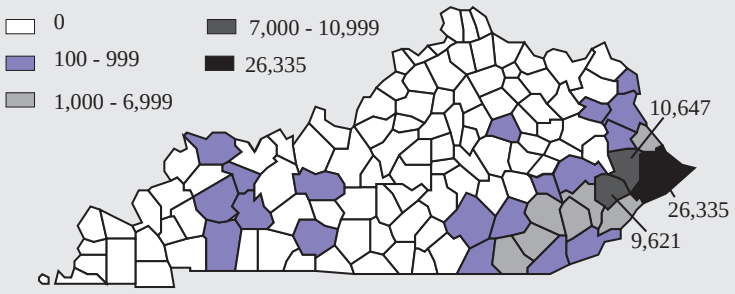
Source: KY Geological Survey

Figure 30 Natural Gas Production/Consumption in U.S. and Kentucky



Source: U.S. Energy Information Administration

Figure 31 Natural Gas Production (1995)



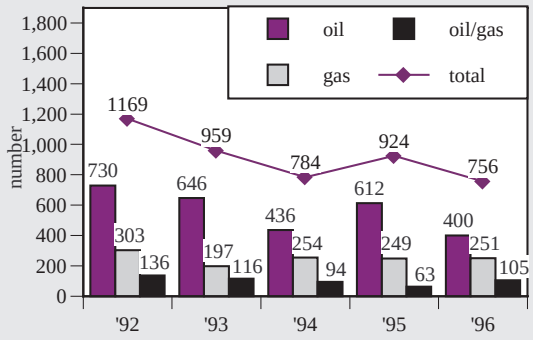
Source: KY Geological Survey

Violations at Oil and Gas Wells Double Between 1995 and 1996

During 1996, 957 violations were cited at oil and gas wells by DO&G inspectors **(Figure 33)**. Between 1995 and 1996 violations nearly doubled from 532 to 957. DO&G officials believe the increase in violations may be due to an improved computer system to track oil and gas operations.

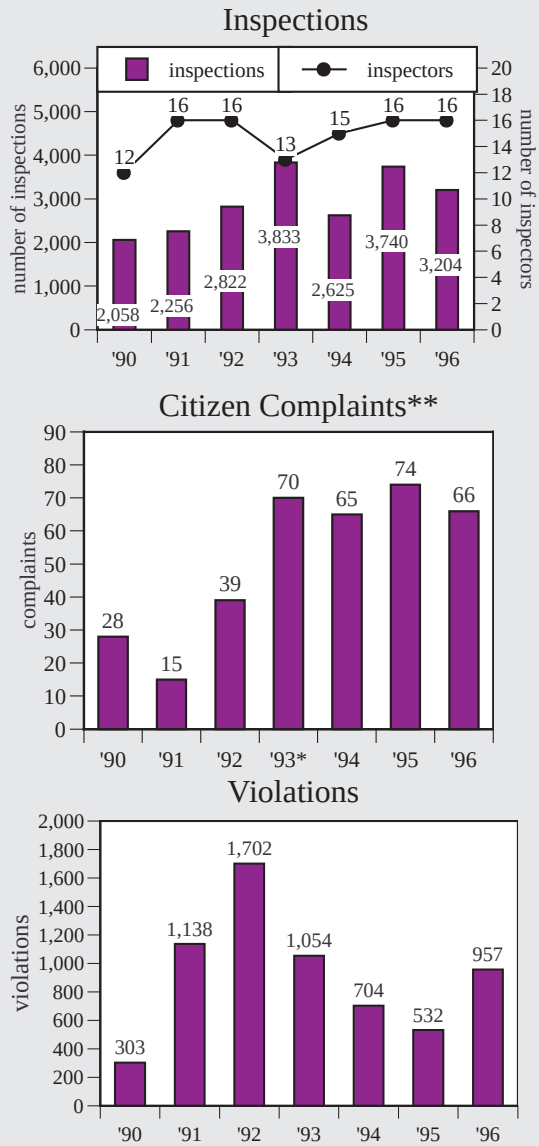
A closer look at violations reveals that 56% were for improper plugging while 14% were for operating without proper bonding **(Figure 35)**. The greatest number of the violations cited in 1996 occurred in Clay County (171 violations), followed by Ohio County (43 violations), Christian County (37 violations), Edmonson County (35 violations), Clinton County (34 violations), and Floyd County (29 violations).

Figure 32 Oil and Gas Permits*



*As issued by Div. of Oil and Gas. Data prior to 1992 not available. Source: KY Dept. of Mines and Minerals

Figure 33 Oil and Gas Compliance: Operation and Closure of Wells*



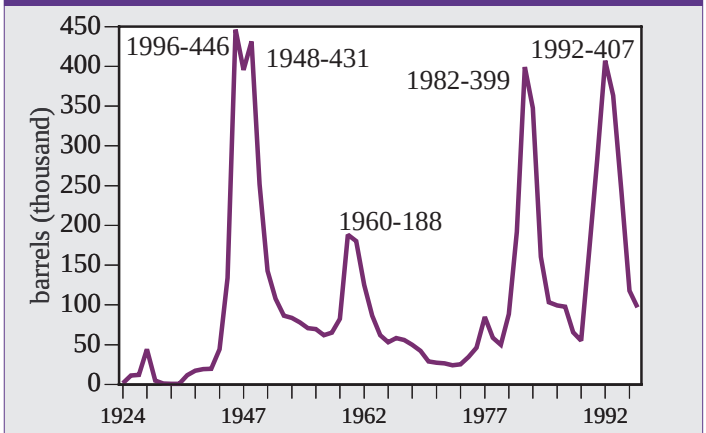
*As cited by Div. of Oil and Gas. **Formal interoffice complaints form developed by the Div. of Oil and Gas in 1993. Source: KY Dept. of Mines and Minerals

Pollution From Oil Wells Impacting 70 Miles of Assessed Waterways in Kentucky

DO&G reports that most environmental problems occur at older oil wells and small independently-owned wells. Pollution from oil and gas wells can be caused by oil, grease, and brines associated with production. Brine, which can contain more salt than sea water, is currently impairing water quality in five river basins **(Figure 36)**. Oil and gas operations are causing 2% of the known water pollution problems in Kentucky; polluting 70 miles of assessed waterways in the state **(Figure 37)**.

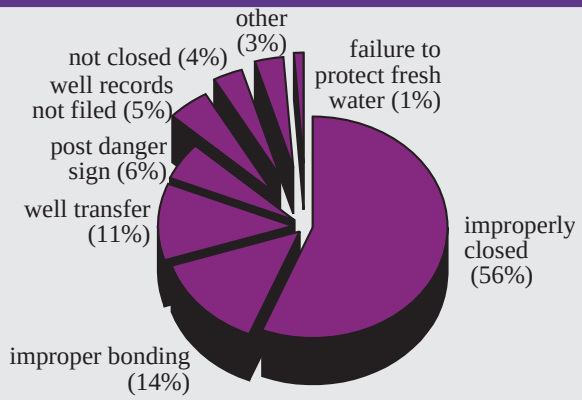
Water discharges from drilling operations and related production facilities are regulated by the U.S. Environmental Protection Agency (EPA) and the Kentucky Division of Water. The state established a water quality chloride standard of 600/1000 (chronic/acute) milligrams per liter in 1985 to control brine discharges. The Division of Water currently regulates brine and associated oil and gas discharges to waterways through 25 KPDES permits. Most oil and gas operations are not required to have a KPDES permit. During 1996, 7,120 inspections were conducted at oil and gas wells and 82 water quality violations were cited that year **(Figure 38)**.

Figure 34 Oil Booms in Clinton County, KY



Source: KY Geological Survey

Figure 35 Oil and Gas Violations Types (1996)



*Based on 957 violations cited by Div. of Oil and Gas. Source: KY Dept. of Mines and Minerals

Figure 36 Chloride Pollution in Assessed Streams in KY By Basin

River Basin	Miles not supporting uses				
	1987*	1989*	1991	1993	1995
Licking River	13	36	37	32	0
Kentucky River	60	83	44	84	15.1
Big Sandy	66	34	0	9	13.5
Little Sandy	31	12	12	12	12
Green River	0	52	18	0	0.6
Upper Cumberland	21	59	3	0	2.6
Total	**191**	**276**	**114**	**137**	**43.7**

**Includes monitored and assessed waterways partially supporting and not supporting designated uses. Source: KY Div. of Water, Reports to Congress on Water Quality*

Division of Water officials report that a strong enforcement presence combined with better industry compliance and a decline in oil production have reduced violations and the level of chlorides in several waterways. A water quality analysis conducted by the Division of Water in 1994 found chloride levels decreased significantly at 19 stream monitoring stations and increased at two.[36]

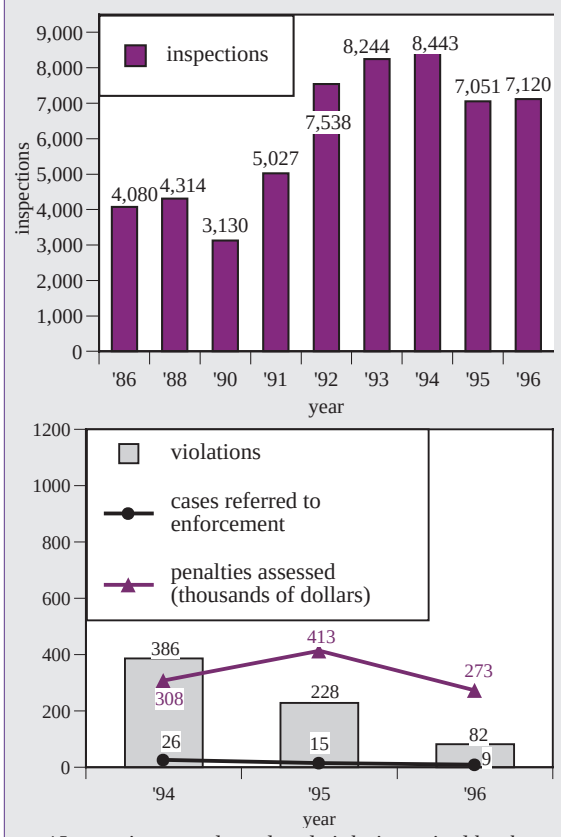
The U.S. EPA issues Underground Injection Control (UIC) permits to regulate the injection of fluids and disposal of brine at 2,066 wells in Kentucky **(Figure 39)**. During 1996, 59 enforcement actions were taken against operators for failure to comply with UIC rules.

102 Oil and Gas Bonds Forfeited in 1996, 213 Released

Because the state does not have the authority to assess fines against violators of oil and gas rules, it must rely on bond forfeitures as its primary enforcement tool. **Figure 40** reveals that 102 bonds were forfeited in 1996, the lowest number since 1991 when EQC began to report on oil and gas bond forfeitures.

DO&G attributes the recent decline in bond forfeitures to market pressures which have forced many marginal operators out of business. Once an operator has forfeited a bond, it is up to DO&G to determine whether that operator will be granted a new permit. In most cases, DO&G does not grant blanket bonds for multiple wells to operators who have forfeited a bond but will consider issuing individual permits. The agency has not compiled information on how many operators who have forfeited bonds have subsequently received new permits.

Figure 38 Oil and Gas Compliance: Water Quality Inspections/Violations*



**Inspections conducted and violations cited by the Division of Water Field Operations Branch. Earlier data not available. Source: KY Division of Water*

Figure 37 Streams Impaired by Oil and Gas Pollution*

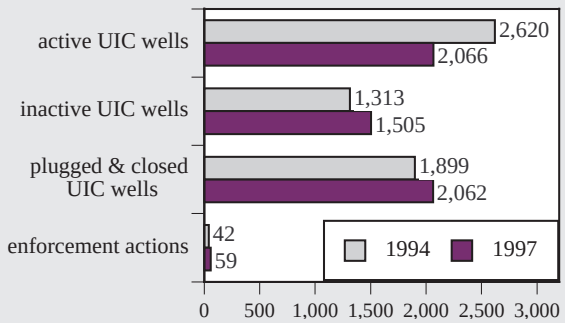
County/ waterway	miles
Clinton	
Spring Cr.	3.6
Elliott	
Newcombe Cr.	11.9
Green	
SF Russell Cr.	0.6
Laurel	
Robinson Cr.	4.1
Lawrence	
RF Blaine Cr.	6.2
Leslie	
Cushin Cr.	28.8
Powell	
Sand Lick Fk.	5.0
SF Red River	10.1

**Includes monitored and assessed waterways partially supporting and not supporting designated uses. Source: KY Div. of Water, 1996 Report to Congress on Water Quality*

Oil and gas operations are causing 2% of the known water pollution problems in Kentucky; polluting 70 miles of assessed waterways in the state.

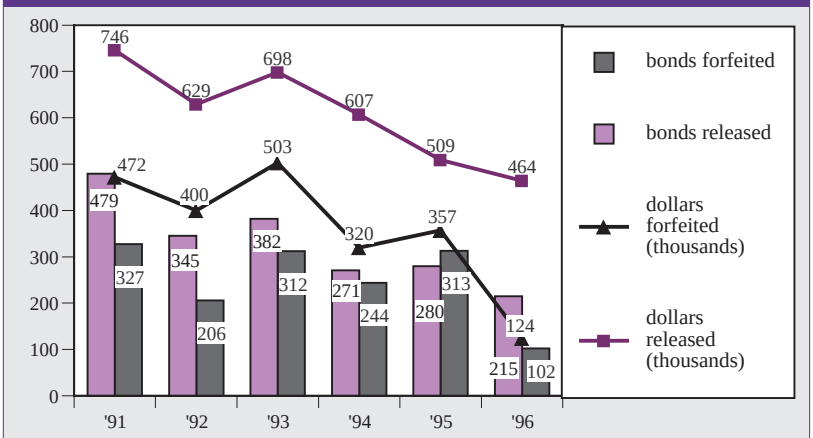
Division of Water officials report that a stronger enforcement presence combined with better industry compliance and a decline in oil production have reduced violations cited at oil and gas operations and the level of chlorides in several waterways.

Figure 39 Oil and Gas UIC Wells in KY



Note: Underground Injection Control wells used to inject produced brine by oil and gas wells. Source: U.S. EPA

Figure 40 Oil and Gas Bond Forfeitures /Releases in KY



Source: KY Dept. of Mines and Minerals

Oil and gas bond forfeiture rates still remain high in Kentucky. In 1996, for example, 213 bonds were released while 103 were forfeited. Bond amounts were increased in 1994 and now range from $500 for an individual well to $10,000 for multiple wells (based on well depth). However, DO&G officials indicate that bond amounts still do not cover the complete cost of plugging and reclaiming a well site.

11,595 Abandoned Wells in Kentucky; 1,162 Plugged

According to the Interstate Oil and Gas Compact Commission, there are an estimated 285,000 idle wells in the U.S.[37] About 5% are abandoned. Kentucky has an estimated 11,595 abandoned wells.

Abandoned oil and gas wells are plugged using interest accrued from bonds and bond forfeitures. The money generally raises $400,000 a year—enough money to plug about 200 wells. As of 1996, DO&G had plugged 1,162 abandoned oil and gas wells **(Figure 41)**. During 1996, 212 wells were plugged by DO&G, well above the 90 plugged in 1995 and 88 plugged in 1994. Abandoned wells are prioritized and plugged based on potential hazards to the environment.

Because the state does not have the authority to assess fines against violators of oil and gas rules, it must rely on bond forfeitures as its primary enforcement tool. Division of Oil and Gas officials attribute the recent decline in bond forfeitures to market pressures which forced many marginal operators out of business.

Efforts Underway to Cleanup Radioactive Materials From Oil Fields

Another environmental threat posed by certain oil wells is naturally occurring radioactive materials (NORM). Naturally occurring radionuclides are pervasive in the materials that make up the earth. Certain rock and soil formations have higher concentrations of NORM. Products made from or fluids in contact with these materials naturally include part of their inherent radioactivity. In the case of oil drilling, NORM is brought to the surface through the forced injection of water into a well to increase the level of recoverable oil or through naturally produced water. Generally, it takes years for NORM to become concentrated or "technically enhanced" in oil pits and at tank batteries.

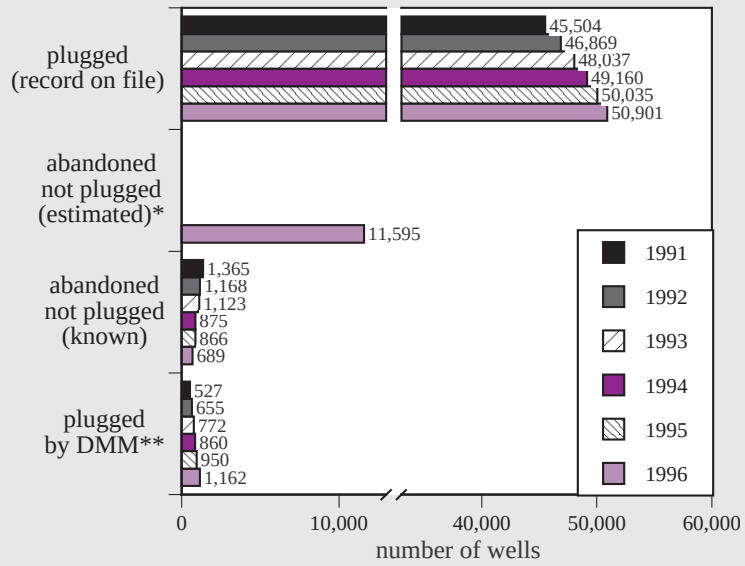
NORM was discovered in Kentucky in 1988 in the Martha Oil Fields in Lawrence and Johnson counties. While the state does have regulations governing the handling and disposal of radioactive materials in Kentucky, presently, there are no regulations that specifically address the cleanup, storage, and disposal of NORM. Remediation and storage standards were drafted by the Kentucky Cabinet for Health Services (CHS) in 1994 but have not been finalized.

In 1995, CHS negotiated an agreement with Ashland Exploration Inc. to remediate certain NORM-impacted areas of the Martha Oil Field. Remediation levels of 5 picoCuries per gram (pCi/g) were established by CHS.[38] Since the agreement, some 90,000 tons of NORM contaminated soil with an average concentration of 16 pCi/g has been excavated from 200 well sites and stored in temporary facility at the Johnson-Lawrence County border. In 1996, Ashland proposed disposing the waste in the Blue Ridge Landfill in Estill County. Estill County community leaders opposed the proposal and filed a lawsuit in June to stop Waste Management Inc., the owner of the landfill, from seeking a permit to accept the waste. The suit asked for

legal interpretation of a host agreement between Estill County and Waste Management Inc. The suit charges that NORM is a toxic waste and is prohibited by the agreement. In late August, local government and landfill officials entered into an agreement to ban the disposal of NORM at the landfill. Waste Management subsequently withdrew its permit application.

It is not known how extensive a problem NORM is in Kentucky and more studies are needed to assess its impacts on the environment and public health. According to CHS, Kentucky also needs to promulgate regulations for the remediation of NORM-impacted areas and conditions for storage. The position of CHS has been to delay action on the regulations until the remediation of the Martha Oil Field is complete.[39]

Figure 41 Number of Plugged and Abandoned Oil and Gas Wells in Kentucky



**Earlier data provided by Div. of Oil & Gas that appeared in previous State of Kentucky's Environment reports now considered inaccurate.*
***Cumulative total of oil and gas wells plugged by Div. of Oil & Gas.*
Source: KY Dept. of Mines and Minerals

State Passes Measures to Address Oil and Gas Disputes

In many cases, the owners of the oil and gas reserves do not own the surface rights. Landowner concerns about the impact of oil and gas operations to land and water led to the passage of two laws in the 1994 General Assembly.

One of the measures focused on resolving disputes between well drillers and surface landowners. The bill provides that where there is a complete severance of the ownership of the oil and gas from the ownership of the surface to be disturbed, the oil and gas operator must:

- Submit a plan to the Department of Mines and Minerals to prevent erosion.
- Provide a description of the location of all areas to be disturbed including roads, well sites, tanks, and other storage facilities.
- Provide an agreement by the surface owner to the operation/reclamation plan.

Between July 1994 and July 1997, 366 severed mineral permits have been issued by the Department of Mines and Minerals. To date, 30 of the 366 agreements have been unsigned by landowners, 10 of which have gone to mediation.

The other law passed in 1994 requires oil and gas operators to remediate or compensate owners for damage caused to surface and groundwater. It is up to the landowner to prove the water supply was damaged or impaired by an oil or gas operation. Neither the Department of Mines and Minerals nor the Division of Water monitor the number of water damage claims filed pursuant to this law so the effect of the law cannot be readily determined.

Kentucky has an estimated 11,595 abandoned oil and gas wells. Abandoned wells are plugged using interest accrued from bonds and bond forfeitures. The money generally raises $400,000 a year—enough money to plug about 200 wells.

During 1996, 212 wells were plugged by the Division of Oil and Gas, well above the 90 plugged in 1995 and 88 plugged in 1994. Abandoned wells are prioritized and plugged based on potential hazards to the environment.

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Acknowledgments

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