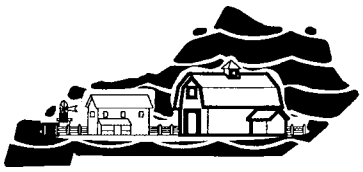

KY • A • Syst

Home and Farmstead
Water Quality Assessment

Assessing and Reducing the Risk of Groundwater Contamination from

MILKING CENTER WASTEWATER TREATMENT

Why should I be concerned?

Kentucky's groundwater is one of its most vital resources. It supplies drinking water for hundreds of thousands of Kentuckians. Groundwater is the source of water for drinking water wells, springs, and some municipal, or "city," water supplies. All of us do things at our homes every day which can possibly pollute the groundwater. Nobody wants to pollute the groundwater, but if we are not careful and educated about how we manage our day-to-day home or farmstead activities, we can do just that– pollute the groundwater that serves as drinking water for many families. Even if nobody in your community uses groundwater for drinking water, you need to be concerned. This is because groundwater that underlies your home may travel a long way and eventually end up as another family's drinking water.

Dairy wastewater is usually considered a dairy sanitation problem. If not carefully managed, however, dairy wastewater can contaminate both groundwater and surface water.

The amount of wastewater generated varies with milking preparation, equipment used, and the number of cows. A typical 100-cow, free-stall operation uses an estimated 835 to 1,335 gallons of water per day in the milking center alone.

Milking center wastewater is contaminated with organic matter, nutrients, chemicals, grit, and microorganisms. Poorly designed and/or mismanaged dairy waste disposal systems can contaminate water with ammonia, nitrate, phosphorus, detergents, and disease-causing organisms. These pollutants can contaminate groundwater supplies by directly entering a groundwater supply via an abandoned well, an improperly protected well located near the wastewater discharge, or through sinkholes. Groundwater supplies also can be polluted by first allowing the dairy wastewater to pollute surface water supplies which in turn enter groundwater supplies.

The goal of KY•A•Syst is to help you protect the groundwater that supplies drinking water for many families.

How will this publication help me protect the groundwater?

Part I of this publication will help you protect the groundwater by asking you questions about your milking center wastewater treatment practices. These questions will help you identify activities or structures on your property which may put groundwater at a high risk of being contaminated. Part II of the publication will give suggestions on how to reduce the risk of groundwater contamination by improving your milking center wastewater treatment practices.

The KY•A•Syst program is for your benefit only. No information from this publication needs to leave your home. KY•A•Syst does not attempt to offer legal advice or solutions to individual problems but rather to raise general awareness about groundwater protection strategies. Questions about individual problems should be addressed to the appropriate professional.

Part I. *Assessing* the Risk of Groundwater Contamination from Milking Center Wastewater Treatment

Instructions:
Circle the number in front of the appropriate item that **best** describes your home or farmstead. (Skip and leave blank any categories that don't apply to your home or farmstead.)

MILKING CENTER CLEANUP PRACTICES

Describe your milking cleanup practices.

4 Waste milk never poured down drain. Manure and excess feed removed from parlor before wash-down.
3 Waste milk poured down drain 10% of the time. Manure and excess feed usually removed before wash down.
2 Waste milk poured down drain 50% of the time. Manure and excess feed often washed down drain.
1 All waste milk poured down drain. Manure and excess feed frequently washed down drain.

DISPOSAL OF MILKING CENTER WASTEWATER

***Option #1* – Answer this question if all milking center wastewater goes to a manure storage area (with waste applied to cropland or pasture). If not, go on to Option #2.**
Is there discharge from the manure storage?

4 Wastewater delivered directly to liquid manure storage (holding pond/pit). Manure storage area (holding pond/pit) is designed with capacity to hold milking center wastewater. All waste from manure storage area applied to cropland or pasture.
3 Wastewater delivered to two-stage lagoon system and then applied to cropland or pasture.
2 ----------
1 Wastewater delivered to leaking manure storage. All waste from manure storage area applied to cropland or pasture.

***Option #2* – Answer this question if discharge is allowed to run directly from the milking center to a specially designated grass-covered area. If not, go on to Option #3.**
Describe the application of the wastewater to the grass-covered area.

4 Applied in sheet to slowly permeable soil (clay, silty clay loam). Vegetation removed regularly (at least three times per year). No runoff from area.
3 Applied in sheet to moderately permeable soil (silt loam). Vegetation removed sometimes (one or two times per year). No runoff from area.
2 Applied in sheet to moderately permeable soil (silt loam). Vegetation not removed. Any runoff released is at least 250 feet from any well, spring, sinkhole, stream, drainageway, etc. Absolutely no wastewater reaches any stream or other water resource.
1 Applied in sheet to moderately permeable soil (silt loam). Vegetation not removed. Any runoff released is less than 250 feet from any well, spring, sinkhole, stream, etc. Any amount of wastewater that reaches a stream, or other water resource, violates Kentucky regulations and may result in fines.

***Option #3* – Answer this question if milking center wastewater is discharged directly from the milking center to a municipal sewage system. If not, go on to Option #4.**
Do you have the necessary permits/pre-treatment for disposal of wastewater to the municipal sewage system?

4 Wastewater discharged with required pre-treatment and necessary permits.
3 ----------
2 ----------
1 Wastewater discharged without required pre-treatment or necessary permits (this practice may violate Kentucky law).

***Option #4* – Answer this question if discharge is released directly from the milking center to a soil absorption/lateral field. If not, go on to Option #5.**

4 ----------

3 ----------

2 ----------

1 This practice puts groundwater and surface water at a high risk of being contaminated because these systems are often unsuccessful.

***Option #5* – Answer this question if you do not have a system for the proper disposal of your milking center wastewater. Consult the Soil Conservation Service for help in designing a system for the proper disposal of your milking center wastewater.**

4 ----------

3 ----------

2 Milking center wastewater is discharged directly from the milking center to the ground (straightpipe). Point of discharge is at least 250 feet downslope from any well, spring, sinkhole, stream, or other water resource. Point of discharge is grass-covered area. Absolutely no wastewater reaches any stream, drainageway, etc.

1 Milking center wastewater is discharged directly from the milking center to the ground (straightpipe). Point of discharge is less than 250 feet from any well, spring, sinkhole, stream, or other water resource. Any amount of wastewater that reaches any stream or other water resource violates Kentucky regulations and may result in fines.

LOCATION OF DISCHARGE

What is the distance from milking center discharge to any well, spring, sinkhole, stream, or other water resource?

4 More than 250 feet downslope from any of those areas.

3 More than 250 feet upslope from any of those areas.

2 More than 150 feet from any of those areas.

1 Less than 100 feet from any of those areas.

SITE EVALUATION

What type of soil is on your property?

4 Fine-textured or "heavy" soils (clays).

3 Medium-textured soils (silt loam).

2 Medium- to coarse-textured soils (loam, sandy loam).

1 Coarse-textured soils (sands).

After a 1-inch rain in April, how long do you (or farmers in your area) have to wait to get into the field?

4 More than 4 days.

3 Four days.

2 Three days.

1 Zero to two days.

How sensitive is your region of the state to groundwater contamination (see map at end of publication)?

4 Low sensitivity.

3 Moderate sensitivity.

2 High sensitivity.

1 Very high sensitivity.

Does your property lie above or near any active/abandoned underground coal mines?

4 No underground mining is being done below or near your property.
3 Underground mining is currently being done.
2 An underground mine was abandoned underneath or near your property more than ten years ago.
1 An underground mine was abandoned underneath or near your property more than twenty years ago.

If your property does lie above or near any active/abandoned underground coal mines, what type of mine is it, and how deep is the mine? (See Part II for more information.)

4 No underground mining is being done below or near your property.
3 Underground mine is more than 400 feet deep.
2 Underground mine is 200 to 400 feet deep.
1 Underground mine is less than 200 feet deep. Mine is a "longwall" type mine.

What do I do with these rankings?

Take a look at your rankings for the individual questions you answered.

For Questions Where You Received A:	The Risk of Contaminating Groundwater Is:
4	Low
3	Low to Moderate
2	Moderate to High
1	High

Use this table to list any questions from Part I where you received a "1" (high risk activity or structure), or which were identified as being against Kentucky regulations. Next, write down the first step that can be taken to better the situation. Then read Part II of this publication, "Reducing the Risk of Groundwater Contamination by Improving Milking Center Wastewater Treatment." This will help you to improve any problem areas (1's or 2's) which were identified.

Activity or structure identified as high risk (“1”)	**What is the first step that can be taken to solve the problem?**
Example: all waste milk poured down the drain.	*Start to utilize waste milk; feed to calves when appropriate.*

Part II. *Reducing* the Risk of Groundwater Contamination by Improving Milking Center Wastewater Treatment

Wastewater from the dairy milking center includes wastes from the milking parlor and milkhouse. As with livestock manure, milking center wastewater may either be a waste or an asset, depending on how it is handled. Milking center wastewater that is allowed to run off uncontrolled from the milking center may contaminate groundwater or surface waters. This wastewater is a potential groundwater and surface-water pollutant because it contains milk solids, fat, casein, detergents, manure, soil particles, and other substances. Milking center wastewater that is properly utilized may serve as a source of nutrients to cropland or pasture.

Dairy operators must devise a milking center wastewater treatment system that is environmentally acceptable, cost effective, and easy to operate and maintain. Dairies that do not have a system for dealing with their wastewater may contaminate the groundwater that serves as drinking water for many families.

MILKING CENTER CLEANUP PRACTICES

The first step in preventing groundwater and surface water contamination from milking center wastewater is to consider your milking center cleanup practices. Proper cleanup practices will minimize the amount of wastewater that leaves the milking center.

Waste milk can contribute to wastewater if it is not properly handled. Waste milk includes residual milk leftover from pipelines, colostrum milk, and milk from cows treated with antibiotics. Milk from pipelines can be fed to calves or pigs, while colostrum milk should be fed to newborn calves. Milk from cows treated with antibiotics can also be fed to animals, but a veterinarian should be consulted prior to using this practice. Manure and excess feed should be directed to a manure storage area, and not washed down the drain. These practices make use of the waste milk, manure, and excess feed and avoid turning them into pollutants. In addition to preventing water pollution, these are good sanitation practices and protect herd health.

DISPOSAL OF MILKING CENTER WASTEWATER

Several options exist for the proper disposal of the milking center wastewater that does leave your milking center. These include: 1) Directing wastewater to a manure storage facility and then spreading it on cropland or pasture; 2) Direct disposal to a specially designated grass-covered area; 3) Disposal to a municipal sewage system; 4) Disposal to a soil absorption/lateral field.

Disposal of milking center wastewater to a manure storage facility

The most effective and practical way to dispose of milking center wastewater is to direct the wastewater to a livestock manure storage facility, such as a holding pond or storage pit (see the KY•A•Syst publication *Assessing and Reducing the Risk of Groundwater Contamination from Livestock Waste Storage* for more information about livestock waste storage and handling).

Combining milking center wastes with manure has the advantage of allowing a common collection system for both types of waste. A liquid manure storage facility, properly constructed and sized, provides the flexibility for storing wastes until they can be applied at the right time to the right sites. (Figure 1) The milking center wastewater can be directed to a holding pond/pit which contains both manure and wastewater (manure is handled as liquid or a pumpable slurry). With some systems, the parlor wastewater can be added at the barn to aid in transporting the manure to the storage area. The extra storage volume necessary to hold the milking center wastewater must be included when designing the manure storage area.

An even more effective option would be to build a shallow settling basin between the milking center and the manure holding pond/storage pit. This settling basin allows heavier solids to settle and may provide some pretreatment for the wastewater. This basin should have a concrete bottom and sides and be wide enough to allow a tractor with loader to remove settled solids. Locate the basin convenient to manure cleaning operations to facilitate cleanout as part of the barn-scraping operation. The volume of the basin should allow for solid accumulation and about 1 inch of liquid depth. This basin should be cleaned frequently to prevent the overflow of solids into the manure-holding pond/storage pit.

If a stack pad is used to separate manure solids from liquids, the wastewater should bypass the stack pad and run directly to the holding pond (or settling basin, if one is used).

While these options add to transportation and spreading costs, nutrients from dairy wastewater can be used to meet crop requirements, thus reducing commercial fertilizer costs. Groundwater and surface

water are protected because the soil and crops/pasture use up the nutrients from the wastewater.

Apply milking center wastes with manure to fields at rates that do not exceed crop needs for nutrients (N,P,K) by using soil tests and manure/milk center wastewater tests. This will reduce the risk of groundwater contamination from nitrate-nitrogen. These applied nutrients should be credited to your fertilizer program. Care must be taken to keep soil phosphorus levels from accumulating to levels harmful to crops. Consult your county Extension agent for help in determining proper rates of milking center wastewater disposal to cropland or pasture.

The wastewater should be applied to a field that is being actively cropped. It should not be applied to frozen soil, as it would run off into streams. Take care not to saturate areas that can allow rapid percolation to groundwater or runoff to surface water.

Wastewater can be transferred from the holding pond/pit to cropland or pasture by using irrigation equipment or a liquid manure spreader.

To maximize the efficiency of this system, harvest the crop or other vegetation. After harvesting the vegetation, feed it to livestock, if appropriate, or use it as bedding. If left on the ground, nutrients remain available to move toward groundwater. Test the soil yearly for proper application rates for N, P, and K. Forest, windbreak, or woodlot application also may be suitable, in which case harvest is not needed.

Disposal of milking center wastewater directly from the milking center to a specially designated grass-covered area

Another alternative for small- to medium-size operations is to release wastewater from the milking center to a settling basin/pond, and then to a specially designated grass-covered area. This practice is not as effective as those previously discussed, but can still be effective if developed with expert assistance. It is the only option for milking centers which generate fewer than 500 gallons of wastewater/day. This generally means an operation which has 50 cows or less. Soils suitable for these areas range from silt loams to clays. Sandy soils are not suitable, as infiltration is too rapid. Subsurface drainage should be installed to allow drying and aeration of the soil. Surface disposal should not be used when the land is frozen, necessitating that a holding area be large enough for some accumulation during these periods. As with application to cropland, the use of a settling basin/pond would serve to separate solids and prevent the waste-

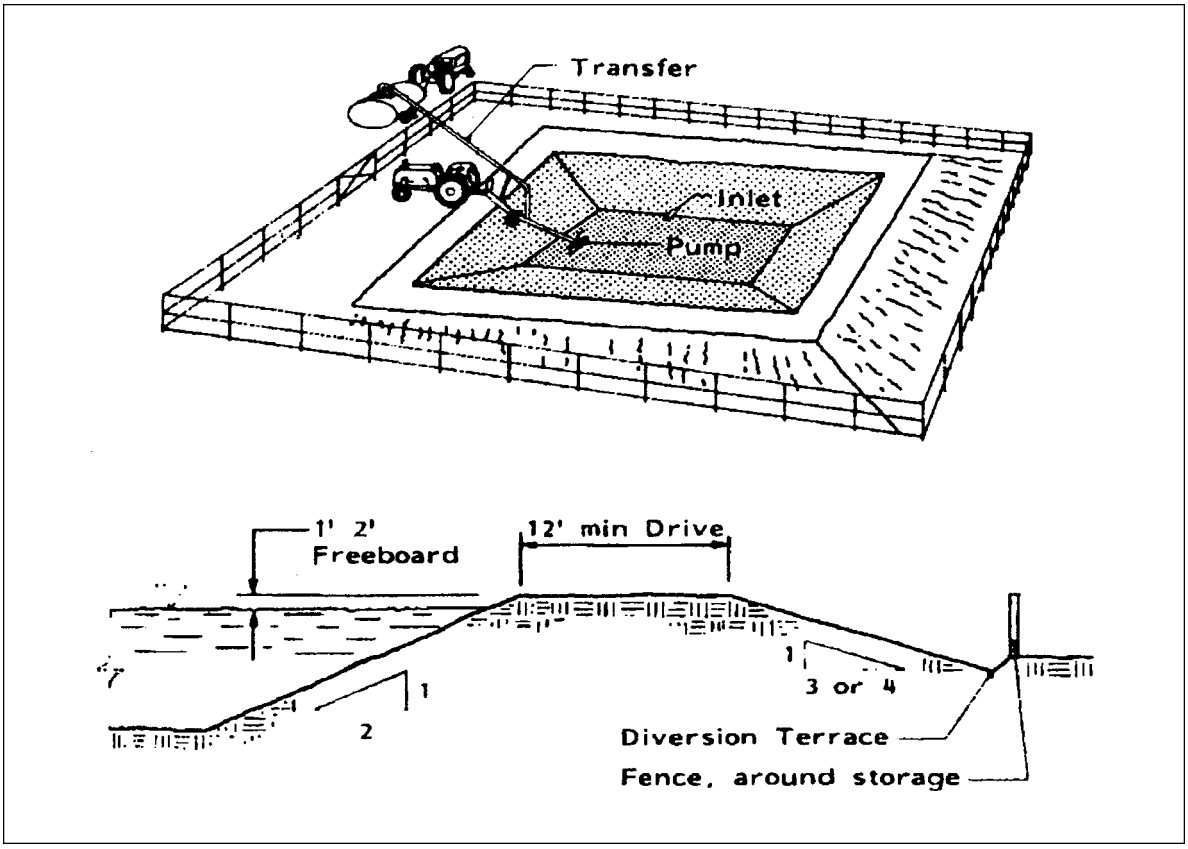

Figure 1. Basins for manure and dairy wastewater storage. *Source: Dairy Housing and Equipment Handbook, MWPS-7, Midwest Plan Service.*

water from ponding on the soil surface. A minimum subsurface depth of 30 inches is desirable beneath the infiltration area. Any subsurface drains installed as part of the infiltration area should not outlet directly to streams. A well-designed surface disposal system is free of ponding water. The area should have complete infiltration, and surface water must be diverted around the area.

Flat infiltration bed systems are similar to flood irrigation. The surface of the bed must be graded flat, free of depressions. A 12-inch berm with side slopes 4 to 1 or shallower should be constructed. Narrow spacing subsurface drains need to be installed to remove excess water. An area of 1 to 2 sq ft per gallon of wastewater generated per day is recommended, with the larger area for clay soils, and the smaller area for loam soils. Infiltration beds should be cropped, if site conditions permit. When cropped, two infiltration beds are necessary so they may be alternated. Application of water must consider the ability of the crop to accept the hydraulic and nutrient loads expected. Periodic rebuilding of the berms is required.

Infiltration areas should be prepared and seeded at least one growing season prior to use. Reed canary grass or tall fescue is suggested for the area. Grass growing on the infiltration area should be mowed **and** removed regularly as in hay harvesting. Cattle should be fenced out of the infiltration area. Application to the infiltration area should not occur more often than once every three days. A settling basin with at least three days' storage will allow this loading.

Disposal of milking center wastewater to a municipal sewage system

The possibility of discharging milking center wastewater into a municipal sewage system should not be overlooked, depending on availability, use charges, necessary permits, and required pre-treatment. In suburban areas this may be a satisfactory disposal alternative. Contact your local sewer authority about any necessary pre-treatment or permits required.

Toilet facilities

All sewage from toilets or restrooms must be handled in a separate treatment system. Sewage may contain disease-causing organisms and must not be combined with the milking center discharge. The quantity from these facilities is usually small and should be discharged into a septic tank or other approved disposal system. Information pertaining to septic tanks can be obtained from the local Department of Health offices in each county.

Belowground lateral/absorption field

While belowground lateral/absorption fields have been recommended for milking center wastewater disposal in the past, experience has shown that these systems often fail and are generally unsuccessful. Natural processes, failure to remove solids from the wastewater, or the release of large quantities of milk into the system can cause the soil to become clogged and allow wastes to back up through the drains. The wastewater may collect on the surface until it evaporates or flows into a field or drainageway. Surface discharge could violate both dairy sanitation regulations and surface water quality standards.

A FEW WORDS ABOUT YOUR SITE

The way home or farmstead practices such as milking center wastewater treatment affect the groundwater depends in part on the type of soil and bedrock that is on your property.

How do soils affect the potential for groundwater contamination?

Soil characteristics are important in determining whether a contaminant breaks down to harmless compounds or leaches into groundwater. In general, the soil on your property may act as a filter that prevents contaminants from reaching the groundwater. Different soils have different abilities to "filter" contaminants. Areas with soils that let water flow through them quickly have a greater risk of groundwater contamination. This is because the soil doesn't get a long enough chance to absorb or "grip" the contaminant, and it may flow to the groundwater with leaching rainwater. On the other hand, soils that allow water to flow through slowly will do a better job of protecting the groundwater, but pose a higher risk of contaminating streams because the water will run off and may carry pollutants with it.

Sandy soils have large spaces between individual particles and therefore let water pass through quickly. Contaminants from your property can flow with this water. Because of this, sandy soils have a greater potential to pollute groundwater than clays.

Clay soils, on the other hand, have smaller spaces between individual particles, and therefore water passes through slowly. Slower-moving water allows contaminants a greater chance to be absorbed by or "grip" onto the soil. Because of this, clays do a better job of protecting the groundwater. Since water moves through a clay soil slowly, there is a higher chance of runoff. This can result in surface water (stream) contamination. In other words, there is a tradeoff between groundwater and sur-

face water protection. If your site has a clay soil, it will do a better job of protecting the groundwater, but you must also look out for surface water contamination.

In Kentucky, the type of bedrock on your property is more important than the type of soil in determining your site's ability to protect the groundwater.

How does the bedrock on your site affect the potential for groundwater contamination?

Bedrock is the rock that lies underneath the soil on your property. Like the soil, different types of bedrock have different abilities to protect (or not protect) the groundwater from pollution. Knowing the bedrock which underlies your property is therefore important because it can tell you if you live in an area that is sensitive to groundwater contamination. Many areas of Kentucky have large springs, sinkholes, caves, and "disappearing" or "losing" streams. These areas are called karst and are especially sensitive to groundwater contamination. This is because the bedrock is dissolved by water, and large conduits and caves are formed underground. These conduits and caves allow pollution to flow very quickly from the surface to the groundwater. Basically, karst areas may act like a sewer system that connects your home or farmstead to the groundwater. Look at the map at the end of this publication to see if you live in a region of the state which has a low, medium, high, or very high sensitivity of groundwater contamination. If you live in an area which has a high or very high sensitivity (karst areas), you need to be especially careful with how you manage your home or farmstead pollution sources. This means being very careful around sinkholes and water resources (wells, springs, streams, etc.). **Do not dump garbage into sinkholes, or you will contaminate the groundwater that serves as drinking water for many families.**

Potential Effects of Underground Mining

Underground coal mining done underneath or near your property may result in the subsidence, or settling of your property. This settling may cause damage to structures as well as put groundwater at risk of being contaminated. The settling causes cracks in the land that can then allow pollution from the soil surface to enter the groundwater. The chance of subsidence occurring on your property depends on when the underground mining occurred, the depth of the mine, and what type of mining was done.

Depending on the type of underground mining done, different precautions are taken by mining companies to prevent subsidence. "Room and pillar" mining leaves pillars in the mines that support the land above when the mine is abandoned. As time passes, there is a greater risk that these pillars can degrade and result in the subsidence, or settling, of the land above. Certain types of "longwall" mines do not provide pillars. Therefore, these mines have a greater chance of resulting in subsidence. The depth of the mining also affects the chance that subsidence will occur. Deeper mines (greater than 400 feet) are less likely to cause subsidence than shallow mines (less than 200 feet). Information regarding the type and depth of underground coal mines may be obtained from the Department of Mines and Minerals at 606-254-0367 (ask for the Map Room). Be prepared to describe the location of your property in as much detail as possible (use a topographical map if possible).

CONTACTS AND REFERENCES

Who to call about...

Livestock waste management

County Extension agent . . . . . check local listing
Soil Conservation Service . . . . . check local listing

Milkhouse waste and related water quality issues

Univ. of KY, Dept. of Animal Sciences 606-257-7543
(Bill Crist)

What is KY•A•Syst?
KY•A•Syst is a series of publications which will help you assess *and improve* how effectively your home or farmstead practices protect the groundwater. The publications ask you about your home or farmstead structures and activities. Your answers will help you see how your practices might be affecting the groundwater. Each publication then gives suggestions about things you can do to improve your home or farmstead practices to better protect the groundwater.

The topics of the program include:
- Drinking Water Well Condition
- Agricultural Chemical Storage and Handling
- Petroleum Product Storage
- Household Waste Management
- Household Wastewater Treatment
- Livestock Waste Storage
- Livestock Yards Management
- Silage Storage
- Milking Center Wastewater Treatment

Some of these topics apply only to people who have farms, and others apply to both farm owners and non-farm owners. ***This program is a completely voluntary program: it is an assessment you can perform in the privacy of your own home. No information from the publications needs to leave your home. The goal of KY•A•Syst is to help you protect the groundwater that supplies drinking water for many families.***

Edited and compiled by Mark Dravillas, former Extension Associate for Water Quality, and Tom Ilvento, former Associate Extension Professor in Sociology, University of Kentucky Cooperative Extension Service. Based on materials from the National Farm•A•Syst Program, University of Wisconsin (author: Brian J. Holmes, Dept. of Agricultural Engineering, University of Wisconsin, Madison). Special thanks to Bill Crist, Department of Animal Sciences, University of Kentucky; Bill Thom, Department of Agronomy, University of Kentucky; and Glenn Mackie, Department of Agricultural Programs, University of Kentucky, for technical review and comments.

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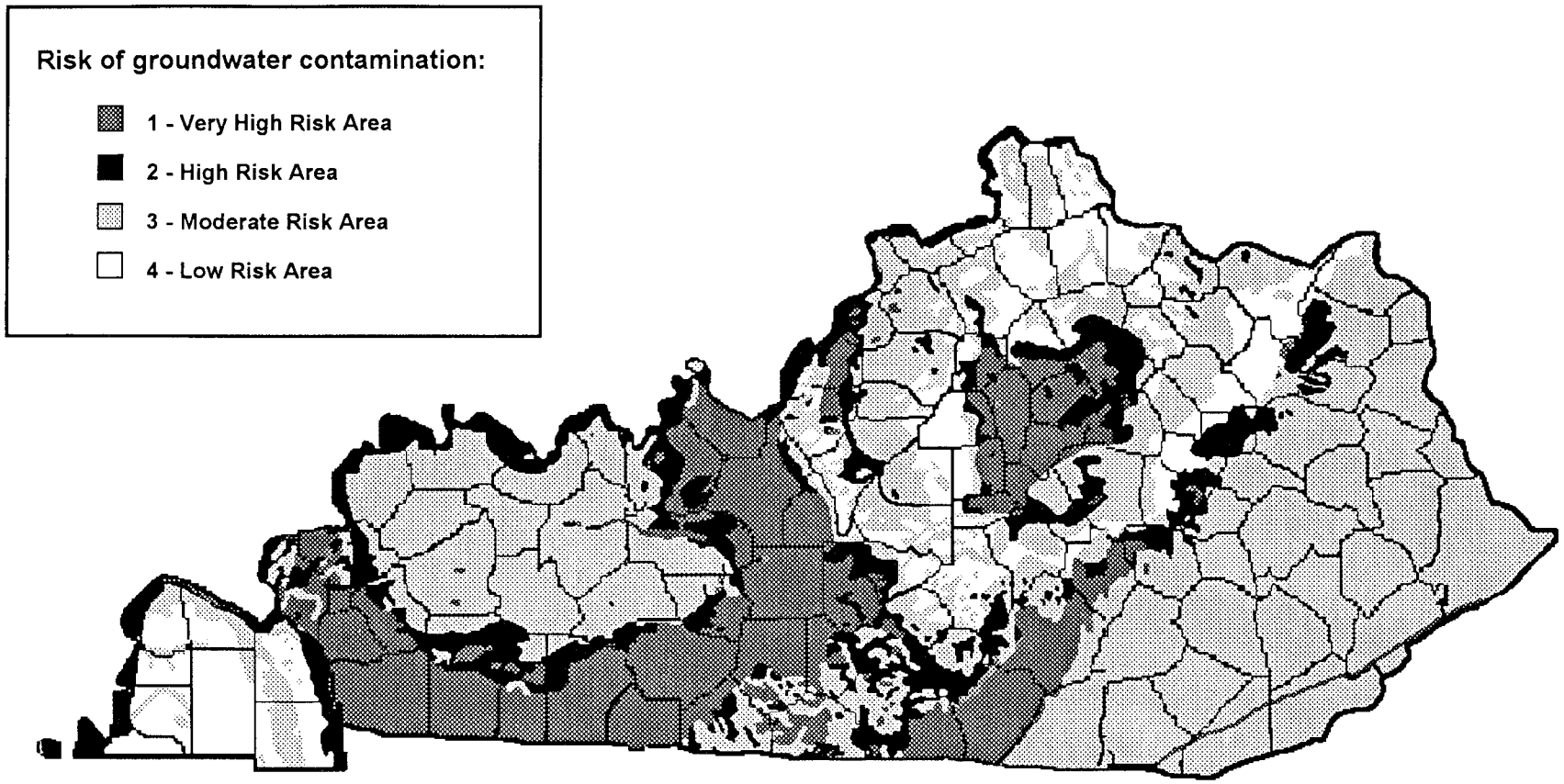
The KY•A•Syst project is coordinated by the Kentucky Cooperative Extension Service in collaboration with various Kentucky state and federal organizations and agricultural commodity and environmental groups.

KY•A•Syst publications can be obtained at your county Cooperative Extension Service office. For additional information on the KY•A•Syst program, contact Marla Barnett at (606) 257-2735 or Dr. Curtis W. Absher at (606) 257-1846.

Groundwater Sensitivity Map



Reproduced from a map created by Division of Water - Groundwater Branch : Frankfort, Ky.

This map shows the potential for groundwater contamination in the different areas of Kentucky. Find the county you live in to determine how sensitive your region is to groundwater contamination.