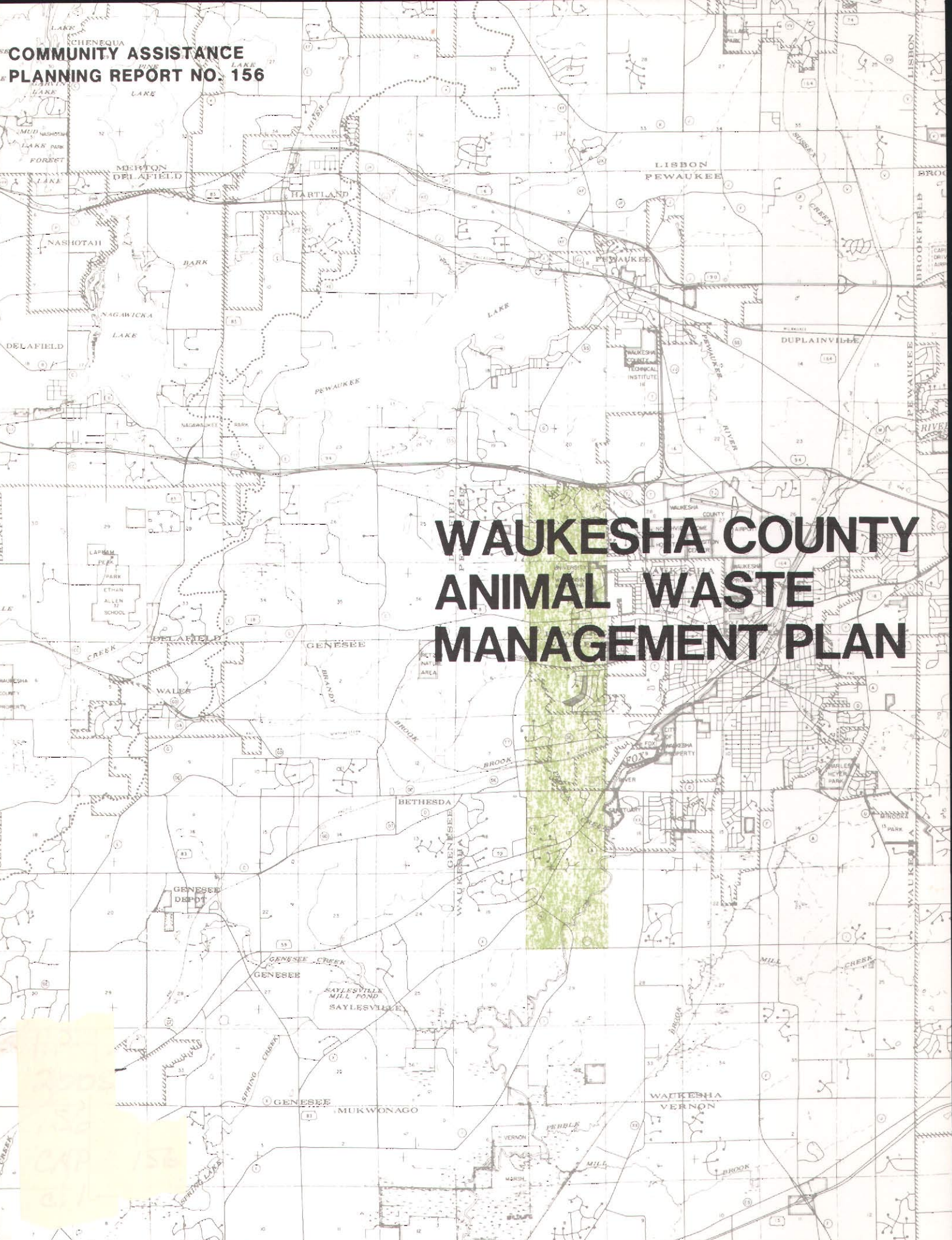
COMMUNITY ASSISTANCE
PLANNING REPORT NO. 156

WAUKESHA COUNTY ANIMAL WASTE MANAGEMENT PLAN



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COMMUNITY ASSISTANCE PLANNING REPORT
NUMBER 156

WAUKESHA COUNTY ANIMAL WASTE MANAGEMENT PLAN

Prepared by the

Southeastern Wisconsin Regional Planning Commission
P. O. Box 1607
Old Courthouse
916 N. East Avenue
Waukesha, Wisconsin 53187-1607

August 1987

Inside Region: $3.00
Outside Region: $6.00

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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August 1, 1987

Ms. Betty J. Cooper, Chairperson
Waukesha County Board of Supervisors
Waukesha County Courthouse
515 W. Moreland Boulevard
Waukesha, Wisconsin 53188

Dear Ms. Cooper:

Recognizing the need to control animal waste water pollution problems in Waukesha County and recognizing further the desirability of making state assistance available to farmers within the County for such control, the Waukesha County Board in 1985 directed that a County animal waste management plan be prepared. The County Board requested the assistance of the Southeastern Wisconsin Regional Planning Commission in the preparation of the plan. This report presents the requested plan.

The preparation of the county animal waste management plan included the identification of watersheds, and critical areas within those watersheds, having the greatest potential for livestock-related water pollution; an analysis and subsequent rank ordering of livestock operations within the identified critical areas in terms of attendant water quality impacts; and the formulation of recommendations for the abatement of the identified animal waste water pollution. The animal waste management plan includes recommendations for barnyard improvements needed to remedy the identified problems; the use of available state cost-sharing funds to assist barnyard operators in financing needed improvements; and the development and adoption of a county animal waste management ordinance to minimize the creation of additional animal waste water pollution problems.

Adoption by the Waukesha County Board of the animal waste management plan presented in this report, together with the adoption of an animal waste management ordinance as recommended in the plan, should satisfy the basic eligibility requirements for the Wisconsin Farmers Fund cost-share assistance program. Implementation of the barnyard improvement and related cost-sharing recommendations set forth in the plan should contribute materially toward the abatement of animal waste water pollution problems within the County, complementing similar efforts being undertaken in certain areas of the County under the Wisconsin Department of Natural Resources Priority Watershed Program. Adoption of a county animal waste management ordinance should, in turn, help prevent the creation of animal waste water pollution problems in the future.

The Regional Planning Commission is pleased to have been able to be of assistance to the County in this important planning effort. The Commission, of course, stands ready to assist the County on request with plan implementation.

Sincerely,

Kurt W. Bauer
Executive Director

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF MAPS

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Chapter I

INTRODUCTION

BACKGROUND

Many sources of pollution threaten the surface water and groundwater resources of Waukesha County. Although much of that pollution is attributable to urban sources, a significant amount may be attributed to rural sources, including livestock operations.

When Waukesha County and southeastern Wisconsin were first being settled, it was advantageous to erect a farmstead near a readily available source of water, often a stream or river. Not only was the water necessary for the livestock, but also, before the invention of refrigerated holding tanks, streamwater was often used to cool and store milk. At present, a number of livestock operations are still located near streams and lakes, constituting potentially significant sources of water pollution.

The current trend in livestock operations is to maintain larger herds on smaller numbers of acres, resulting in an increasing concentration of animal wastes. Livestock feeding practice in southeastern Wisconsin has gradually shifted from larger open grazing practices to barnyard, or even building-confined, animal operations. Barnyard water pollution problems may arise when barnyards are located close to surface waters, thus providing short distances for runoff water to travel; when runoff from barnyards is not properly filtered through vegetation before entering surface waters; and when runoff upslope of the barnyard is allowed to flow across, rather than being diverted around, the barnyard.

The controlled spreading of manure on cropland is a generally accepted and sound method for the disposal of animal wastes in southeastern Wisconsin. Land provides a natural treatment system for animal wastes, which are a source of organic materials and nutrients for crops. The land spreading of manure must, however, be properly managed in order to minimize surface water pollution. Where and when manure is applied to farm fields has a bearing on the amount of animal waste that may reach nearby surface waters. Spreading manure on a floodplain can result in manure entering the stream directly if flooding should occur. Winter manure spreading on fields with steep slopes also causes a problem when the spring thaw washes the manure from the frozen fields, or from fields so saturated with meltwater that any additional rain or meltwater cannot infiltrate.

Animal waste runoff pollutes surface waters by enriching the water, causing increased growth of aquatic plant life and algae populations. As those plants and algae die, oxygen is consumed during the process of decomposition, which in turn causes a reduction in the oxygen supply in the water to levels which may be inadequate for higher forms of aquatic life, such as trout and other gamefish. Runoff from improperly managed barnyards and feedlots also contains high levels of fecal coliform and other organisms which pose health risks to human populations.

In addition to being a surface water pollution problem, animal waste may pollute groundwater. Groundwater pollution may occur when runoff from concentrated amounts of animal waste leaches through thin or coarse-textured soils into shallow groundwater or into fractured bedrock. Fractures in the bedrock may allow pollutants to quickly reach a deeper groundwater supply. Manure storage pits pose a special risk of groundwater contamination owing to excavation of soil, thereby attenuating its natural filtering properties.

LIVESTOCK OPERATIONS IN WAUKESHA COUNTY

The most recent countywide information regarding livestock operations in Waukesha County was developed by the U. S. Bureau of the Census as part of the 1982 federal census of agriculture. Information from the 1982 census of agriculture regarding the number and size of cattle, swine, and sheep operations in Waukesha County is presented in Table 1. As indicated in Table 1, there were about 27,400 head of cattle and calves on a total of 478 farms; about 6,300 head of hogs and pigs on a total of 81 farms; and about 1,200 head of sheep and lambs on a total of 62 farms in Waukesha County in 1982. The 1982 census of agriculture also indicated that there were 1,748 horses on 214 farms in the County in 1982.

THE WISCONSIN FARMERS FUND PROGRAM

Because of an increasing concern about animal waste water pollution problems in the State, the Wisconsin Legislature amended Chapter 92 of the Wisconsin Statutes, establishing an animal waste water pollution control grant program known as the Wisconsin Farmers Fund. The Wisconsin Farmers Fund program provides grant money, in the form of cost-sharing dollars, to farmers to help defray the costs of installing animal waste management improvements designed to minimize water pollution. The authority and responsibility to administer the program was delegated by the Legislature to the Wisconsin Department of Agriculture, Trade and Consumer Protection.

Under the Wisconsin Farmers Fund program, certain actions must be undertaken by the concerned county government in order for a farmer to be eligible for cost-share assistance. First, the county must prepare an animal waste management plan identifying animal waste water pollution problems in the county and establishing a priority ranking of the problems. This ranking is intended to provide the basis for the allocation of cost-share funds to barnyard operations within the county. The ranking set forth in the plan is intended to be reviewed and updated annually by the county.

The second county requirement is the preparation and adoption of an ordinance regulating the design and construction of earthen manure storage facilities. Such an ordinance must require that all new earthen manure storage facilities be constructed and designed in compliance with standards and specifications established by the U. S. Soil Conservation Service.

Farmers whose livestock operations are assigned a high priority ranking under the county animal waste management plan become eligible for cost-share assistance. Examples of the types of improvements which may be funded include barnyard runoff systems such as diversions, filter strips, and settling basins, as

Table 1

SIZE OF OPERATIONS FOR SELECTED LIVESTOCK IN WAUKESHA COUNTY: 1982

Cattle and Calves		Hogs and Pigs		Sheep and Lambs	
Size of Inventory	Number of Farms	Size of Inventory	Number of Farms	Size of Inventory	Number of Farms
1 - 9 Animals.....	123	1 - 9 Animals.....	26	1 - 24 Animals.....	45
10 - 19 Animals.....	57	10 - 49 Animals.....	30	25 - 99 Animals.....	16
20 - 49 Animals.....	110	50 - 99 Animals.....	10	100 or More Animals...	1
50 - 99 Animals.....	114	100 - 199 Animals.....	3		
100 - 199 Animals.....	53	200 - 499 Animals.....	10		
200 - 499 Animals.....	18	500 or More Animals...	2		
500 or More Animals...	3				
Total Number of Farms	478	Total Number of Farms	81	Total Number of Farms	62
Total Number of Animals	27,410	Total Number of Animals	6,268	Total Number of Animals	1,200

Source: U. S. Bureau of the Census.

well as animal waste storage systems. Under state program guidelines, upslope diversions and barnyard runoff controls will generally be favored over manure storage systems because they are more cost-effective in controlling water pollution. The cost-share program pays up to 70 percent of the design and construction costs of the needed improvements. The maximum grant in support of animal waste storage facilities is $10,000. There is no grant ceiling on cost-share assistance for barnyard runoff control systems.

THE WAUKESHA COUNTY ANIMAL WASTE MANAGEMENT PLAN

Recognizing the need for increased efforts to control animal waste water pollution problems in Waukesha County, and in an effort to make cost-share assistance from the Wisconsin Farmers Fund available to farmers within the County, the Waukesha County Board in 1985 requested the assistance of the Southeastern Wisconsin Regional Planning Commission in the preparation of an animal waste management plan. The plan presented herein was prepared by the Regional Planning Commission in conjunction with the Waukesha County Land Conservation Department under the guidance of the Waukesha County Land Conservation Committee. The Land Conservation Department and the Commission staff were assisted in the preparation of the plan by a Technical Advisory Committee consisting of county farmers, representatives of the Waukesha County Park and Planning Commission, and state and federal agency personnel assigned to the County. A full committee membership list is set forth in the inside front cover of this report.

The preparation of the plan followed the procedures set forth in Guide to County Animal Waste Management Plans, prepared by the University of Wisconsin-Madison Institute for Environmental Studies for the Wisconsin Department of Agriculture, Trade and Consumer Protection. This guide is intended to provide a standardized approach to the preparation of animal waste management plans among the counties in Wisconsin. The Department of Agriculture, Trade and Consumer Protection strongly encourages counties to adhere to the procedures outlined in the planning guide and requires that any deviations from the planning guide be well established and documented.

One of the purposes of a county animal waste management plan is to ensure the best use of funds which are made available for the abatement of animal waste water pollution problems under the Wisconsin Farmers Fund. The plans are intended to assist counties in targeting cost-share funds in a manner which will maximize water quality benefits, thereby making the most efficient use of limited funds. To this end, state planning guidelines call for a planning program which includes a generalized analysis of the severity of the livestock-related water pollution problems among the watersheds in a county; the selection of one or more watersheds as priority areas; a detailed inventory and analysis of individual livestock operations within the priority watershed; and a ranking of these operations based upon their water quality impacts and potential for improved management.

SCHEME OF PRESENTATION

The Waukesha County animal waste management plan is herein presented in five chapters. Following this introductory chapter, Chapter II, "Identification of Critical Areas," presents a generalized analysis of the relative severity of livestock-related water pollution problems among watersheds in the County; identifies those watersheds that were selected as priority watersheds for purposes of the Wisconsin Farmers Fund; and identifies critical areas within the priority watersheds having the greatest potential for livestock-related water pollution problems.

Chapter III, "Evaluation of Barnyards in Critical Areas," presents the results of a detailed analysis of barnyards within the identified critical areas, including an analysis of the pollution potential of the barnyards concerned and an analysis of the amount of suitable land available to the barnyard operator for the winter spreading of manure. Based upon this analysis, a priority ranking of barnyard operations as candidates for cost-share assistance under the Wisconsin Farmers Fund program is presented.

Chapter IV, "Recommended Animal Waste Management Plan," identifies the type and cost of the improvements needed in the barnyards within critical areas, and sets forth recommendations regarding use of the Wisconsin Farmers Fund and related funding programs in support of the needed improvements. This chapter also recommends other means of preventing animal waste pollution problems in the County, including adoption of a county ordinance regulating the design and construction of animal waste storage facilities, information-education efforts, and technical assistance activities.

Chapter V, "Summary," presents a brief summary of the salient findings and recommendations of the Waukesha County animal waste management plan program.

Chapter II

IDENTIFICATION OF CRITICAL AREAS

INTRODUCTION

As noted in Chapter I, the development of the Waukesha County animal waste management plan followed the planning procedures set forth in the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) planning guide entitled, Guide to County Animal Waste Management Plans. The planning approach recommended by the DATCP in the preparation of county animal waste management plans includes two phases of inventory and analysis work. The first phase involves a generalized analysis of the severity of livestock-related water pollution problems among watersheds in the County and the potential for improvements in water quality; the selection of one or more watersheds as priority areas; and the identification of critical areas within the priority watersheds where the potential for livestock-related water pollution problems is greatest. The second phase involves a detailed evaluation of livestock operations within the identified critical areas.

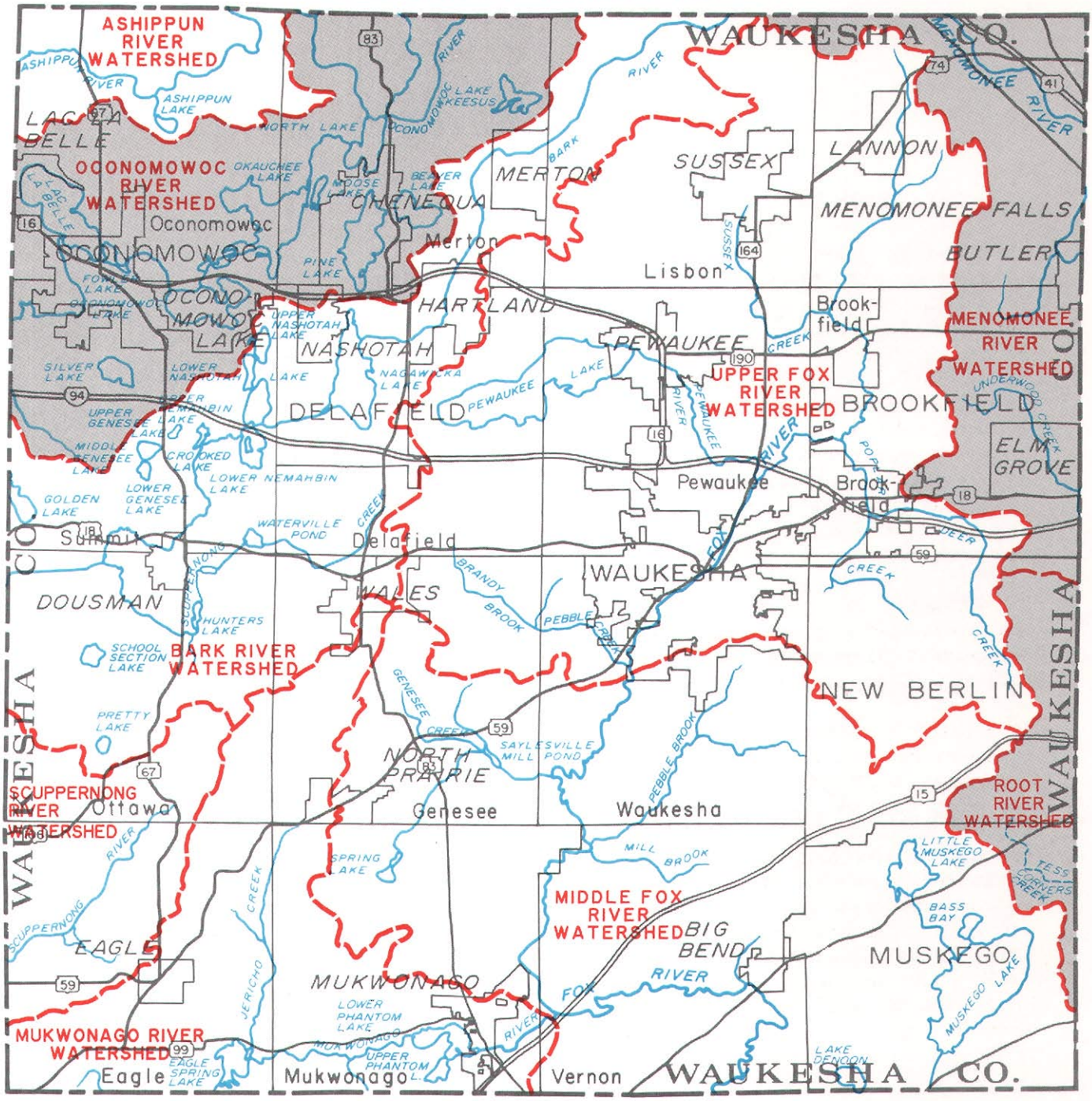
This chapter describes the methodology and findings of the first phase of the inventory and analysis work conducted under the Waukesha County animal waste management planning program. The second inventory and analysis phase is described in Chapter III of this report.

It should be noted that under Wisconsin Department of Agriculture, Trade and Consumer Protection planning guidelines, watersheds in which animal waste water pollution problems are already being addressed under other programs--namely, the Wisconsin Department of Natural Resources Priority Watershed Program or the Small Watershed Protection and Flood Prevention Act (PL 83-566) program--are not to be identified as priority watersheds and, consequently, are not to be included in the watershed evaluation. Waukesha County includes all or parts of nine watersheds (see Map 1).[1] For three of these--the Menomonee River, Oconomowoc River, and Root River watersheds--Department of Natural Resources priority watershed planning programs have been recently completed or are presently underway. Since cost-share funds for animal waste management improvements have been or will be made available to landowners within these three watersheds, they are generally ineligible for funding under the state animal waste grant program. Moreover, very few livestock operations remain in the portions

[1]Waukesha County includes all or parts of the Ashippun, Bark, Menomonee, Mukwonago, Middle Fox, Oconomowoc, Root, Scuppernong, and Upper Fox River watersheds. It should be noted that the Ashippun River watershed, as identified on Map 1, includes a small--approximately 1.8-square-mile--area located in Sections 3, 4, 5, and 6 of U. S. Public Land Survey Township 8 North, Range 17 East, which drains to the Rock River directly or indirectly through Davy Creek, rather than through the Ashippun River.

Map 1

WATERSHEDS IN WAUKESHA COUNTY



Source: SEWRPC.

of the Menomonee River and Root River watersheds within Waukesha County. In accordance with DATCP planning guidelines, these watersheds were not included in the analyses described in the balance of this chapter.

EVALUATION OF LIVESTOCK-RELATED WATER POLLUTION PROBLEMS AND POTENTIAL FOR IMPROVEMENT

Watersheds in Waukesha County differ in the extent and severity of livestock-related water pollution problems. In order to compare the watersheds in terms of the severity of livestock-related pollution problems and the potential for improvement, a mathematical index was calculated for each watershed in accordance with DATCP planning guidelines. This mathematical index is a composite number, calculated as the sum of four individual index numbers developed for each watershed pertaining to the following: 1) animal density and proximity to surface water; 2) significance of animal waste pollution relative to all non-point sources of pollution; 3) soil characteristics; and 4) water quality and use. The balance of this section describes the results of the index number calculations for the six watersheds under consideration--namely, the Ashippun River, Bark River, Middle Fox River, Mukwonago River, Scuppernong River, and Upper Fox River watersheds. The composite index presented at the conclusion of this section (Table 10) provides part of the basis for the selection of the priority watersheds under the county animal waste management planning program.

It should be recognized that the procedure recommended by the Department of Agriculture, Trade and Consumer Protection relies upon secondary data sources in compiling the number and distribution of livestock in Waukesha County. Under this approach, the actual field survey of livestock operations is limited to those watersheds which, on the basis of the composite index, appear to have the greatest potential for livestock-related water pollution problems.

Livestock Shoreline Index

The livestock shoreline index provides an indication of the livestock density within shoreland areas. The index--developed for watersheds and townships in Wisconsin by the Wisconsin Department of Natural Resources in the late 1970's --is expressed as the number of animal units per square mile in shoreland areas.[2] A livestock shoreline index for the Waukesha County portions of the watersheds concerned was estimated based upon the township level livestock shoreline index numbers developed by the Department of Natural Resources. In accordance with DATCP planning guidelines, the watershed livestock shoreline index values were subsequently adjusted as indicated in Table 2. The adjustment is a technique recommended by the Department of Agriculture, Trade and Consumer Protection to obtain a reasonable weighting of the livestock shoreline index relative to the other indices included in the composite watershed index.

As indicated in Table 3, among the six watersheds under consideration, the adjusted livestock shoreline index ranged from 2.0 in the Upper Fox River watershed to 25.0 in the Ashippun River watershed.

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[2]An animal unit is a measure of livestock numbers based on the equivalent of a 1,000-pound slaughter steer. For example--one animal unit equals approximately 10 sheep, 2 horses, or 2.5 swine.

Table 2

ADJUSTED LIVESTOCK SHORELINE INDEX CALCULATION PROCEDURE

$$\text{Adjusted watershed livestock shoreline index} = \frac{LSI - 4}{2}$$

Where LSI is the livestock shoreline index for the watershed concerned.[a]

Note: If result is less than or equal to 0, the adjusted livestock shoreline index is 0. If result is greater than or equal to 25, the adjusted livestock shoreline index is 25.

[a]A livestock shoreline index for the Waukesha County portions of the respective watersheds was estimated from township level livestock shoreline index numbers developed by the Wisconsin Department of Natural Resources.

Source: Wisconsin Department of Agriculture, Trade and Consumer Protection.

Table 3

LIVESTOCK SHORELINE INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	Livestock Shoreline Index as Determined by DNR	Adjusted Livestock Shoreline Index
Ashippun	74.2	25.0
Mukwonago	23.0	9.5
Bark	15.7	5.9
Scuppernong	15.4	5.7
Middle Fox	9.7	2.9
Upper Fox	7.9	2.0

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Animal Waste-Nonpoint Source Pollution Index

The animal waste-nonpoint source pollution index indicates the significance of livestock-related water pollution relative to all major nonpoint sources of pollution in each watershed, including cropland soil erosion and urban nonpoint sources as well as animal waste pollution. In general, the higher the index number, the greater the significance of animal waste as a source of water pollution relative to other nonpoint sources of pollution. The procedure and data sources used in the calculation of the animal waste-nonpoint source pollution index are set forth in Table 4. As indicated in Table 4, the data used in the index calculation include the livestock shoreline index developed by the Department of Natural Resources; estimates of cropland soil erosion developed by the Department of Natural Resources; and land use data developed by the Regional Planning Commission.

As indicated in Table 5, among the six watersheds under consideration, the animal waste-nonpoint source pollution index ranged from 0.9 in the Upper Fox River watershed to 5.0 in the Ashippun River watershed.

Table 4

ANIMAL WASTE-NONPOINT SOURCE POLLUTION INDEX CALCULATION PROCEDURE

$$\text{Watershed animal waste-nonpoint source pollution index} = \frac{A/2}{A/2 + B + C} \times 10$$

Where A is the unadjusted watershed livestock shoreline index;[a]

B is the percentage of the watershed covered by cropland eroding at an annual rate of more than five tons per acre, as estimated by the DNR;[b] and

C is the percentage of the watershed in urban use, as determined by SEWRPC.[a]

Note: Index value may not exceed 5.0.

[a]Data pertain to the Waukesha County portions of the respective watersheds.

[b]Data pertain to the entire area of the respective watersheds, including portions lying outside Waukesha County.

Source: Wisconsin Department of Agriculture, Trade and Consumer Protection.

Table 5

ANIMAL WASTE-NONPOINT SOURCE POLLUTION INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	Livestock Shoreline Index	Percentage of Watershed Covered by Cropland Eroding at Annual Rate of More than 5 Tons per Acre	Percentage of Watershed in Urban Use	Animal Waste-Nonpoint Source Pollution Index
Ashippun	74.2	13.6	1.4	5.0
Scuppernong	15.4	11.9	1.8	3.6
Bark	15.7	7.7	15.7	2.5
Mukwonago	23.0	21.0	15.5	2.4
Middle Fox	9.7	12.3	14.2	1.6
Upper Fox	7.9	11.8	27.5	0.9

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Soils Index

The soils index is a composite indicator of soil characteristics which may have a bearing upon the water pollution potential of livestock operations. The procedures and data sources used in the calculation of the soils index are set forth in Table 6. The calculations required to develop the soils index for the watersheds under consideration are set forth in Appendices A and B.

The soils index--which, as indicated in Table 6, incorporates such factors as soil hydrologic characteristics, slope, and erodibility--is designed to measure the potential for groundwater and surface water contamination. The indexing technique assigns relatively high values to areas susceptible to groundwater contamination as evidenced by the presence of coarse soils and shallow soils

Table 6

SOILS INDEX CALCULATION PROCEDURE

Watershed soils index = sum of [A x B] for all soil associations in watershed

Where A is the percent of the watershed encompassed by a given soils association;[a] and

B is a value developed for the given soil association as follows:

B = Sum of [C x D x E x F] for all major soil series in the soil association

Where C is the percent of the soil association covered by a given soil series;[b]

D is a hydrologic soil group factor for the given soil series;[c]

E is a slope factor for the given soil series;[d] and

F is the erodibility factor for the given soil series.[e]

[a]Measured from the General Soil Map presented in the U. S. Soil Conservation Service (SCS) soil survey report for Waukesha County.

[b]Obtained from the SCS soil survey report for Waukesha County. Percentages for the major series in each association were adjusted upward proportionately to equal 100 percent; minor series were excluded.

[c]The hydrologic soil group is a classification of each soil series into one of four groups identified by the U.S. Soil Conservation Service--A, B, C, and D--according to properties which influence soil runoff potential, including depth to seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. For purposes of this index number calculation, multiplier values of 1, 3, and 2 were assigned to soils in hydrologic soil groups B, C, and D-nonlithic, respectively. Soils in hydrologic soil groups A and D-lithic were assigned a multiplier value of 50 because of their susceptibility to groundwater contamination.

[d]A slope factor was calculated for each series in hydrologic soil groups B, C, and D-nonlithic. For this purpose, 0 to 6 percent slopes were assigned a slope factor of 10; 6 to 12 percent slopes, a slope factor of 50; and slopes of 12 percent or more, a slope factor of 100. A weighted average slope factor was developed for each series based upon the proportion of the series within each of these slope ranges. Series in hydrologic soil groups A and D-lithic were assigned a nominal value of 1.

[e]Erodibility factor--known as the K factor--developed by the Soil Conservation Service for each soil series. In general, the more erosive the soil, the higher the K value. In the index calculation, K factors were assigned to series in hydrologic soil groups B, C, and D-nonlithic. Series in hydrologic soil groups A and D-lithic were assigned a nominal value of 1.

Source: Wisconsin Department of Agriculture, Trade and Consumer Protection.

over bedrock. The indexing procedure also assigns relatively high values to areas covered by erodible soils and areas of steep slopes--conditions which may promote the conveyance of animal wastes from barnyards to nearby surface water.

As indicated in Table 7, among the six watersheds under consideration, the soils index ranged from 12.8 in the Ashippun River watershed to 24.1 in the Scuppernong River watershed.

Table 7

SOILS INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	Soil Index
Scuppernong	24.1
Mukwonago	19.4
Bark	18.8
Middle Fox	15.9
Upper Fox	13.8
Ashippun	12.8

Source: U.S. Soil Conservation Service; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Water Quality-Use Index

The water quality-use index is a composite indicator of water quality and of the extent of opportunities for, and level of, public use of surface water resources in the respective watersheds. The procedures and data sources used in the calculation of this index are set forth in Table 8. The calculations required to develop the index are set forth in Appendices C, D, and E. Appendix F is a map showing the lakes and streams considered in calculating the water quality-use index for the six watersheds included in the study.

As indicated in Table 8, the water quality-use index includes a lake component and a stream component. The lake component incorporates factors reflecting the extent of opportunities for, and level of, public use of the lake; the trophic status of the lake; and the likelihood that the lake undergoes thermal stratification each year. This component of the water quality-use index assigns relatively high values to those lakes with public parks and beaches and a high level of recreational use; to lakes which have been classified as mesotrophic and which are, accordingly, considered to be potentially most responsive to animal waste control measures; and to lakes which may be expected to thermally stratify each year and which, accordingly, are more susceptible to fish kills.

The stream component of the water quality-use index incorporates factors reflecting the extent of opportunities for, and level of, public use and the quality of the fisheries of streams in the watersheds under consideration. The stream component of the index assigns relatively high values to those stream segments which flow through public parks or which have a high level of recreational use, and to streams having a high-quality fishery, having been identified as Class I or Class II trout streams.

As indicated in Table 9, among the six watersheds under consideration, the composite water quality-use index ranged from 11.5 in the Upper Fox River watershed to 17.1 in the Scuppernong River watershed.

Table 8

WATER QUALITY-USE INDEX CALCULATION PROCEDURE

$$\text{Watershed water quality-use index} = \frac{A + B}{C + D}$$

Where A is the watershed stream index calculated as indicated below;
B is the watershed lake index calculated as indicated below;
C is the number of stream segments in the watershed;[a] and
D is the number of lakes in the watershed.[b]

The watershed stream index--A--is calculated as follows:

$$A = \text{Sum of } [(E + F) \times G \times C] \text{ for all stream segments in watershed}$$

Where E is a value which reflects the existing fishery status of the stream segment;[c]
F is a value which reflects the extent of public use of the stream segment;[d]
G is the stream segment length as a percentage of the total length of all streams in the watershed; and
C is the number of stream segments in the watershed.

The watershed lake index--B--is calculated as follows:

$$B = \text{Sum of } [H + I + J) \times K \times D] \text{ for all lakes in the watershed}$$

Where H is a value which reflects the trophic status of the lake;[e]
I is a value which reflects the stratification potential of the lake;[f]
J is a value which reflects the extent of public use of the lake;[g]
K is the lake area as a percentage of the total area of all lakes in the watershed; and
D is the number of lakes in the watershed.

[a]Pertains to perennial streams; perennial streams were segmented based upon the differences in fishery status and public use.

[b]Pertains to lakes greater than 20 acres in area and at least 8 feet in depth.

[c]Each stream segment was assigned a value reflecting its fishery status. For purposes of this index calculation, a value of 15 was assigned to Class I and II trout streams, a value of 10 to stream segments supporting warmwater fisheries, and a value of 5 to stream segments supporting marginal or impaired fisheries. Information regarding the fishery status of perennial streams was obtained from the DNR report entitled Wisconsin Trout Streams, dated 1980; from SEWRPC Planning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000; and from personal communication with the Wisconsin Department of Natural Resources area fish manager.

[d]Each stream segment was assigned a value reflecting the opportunities for public use. The values recommended by the DATCP for this purpose are as follows: streams or rivers designated as National or State Wild and Scenic Rivers--5; streams flowing through or adjacent to federal, state, county, or municipal parks or with heavy recreational use--4; streams with public frontage such as state fishing grounds or wildlife refuges, or with substantial residential development--3; streams with developed public access areas--2; streams with no public access, except road crossings--1. Values were assigned to stream segments based upon an analysis of public outdoor recreation and open space site information from Regional Planning Commission files.

[e]Each lake was assigned a value reflecting its potential for water quality improvement based upon the lake trophic status. Mesotrophic lakes receive the highest score because they may be expected to be the most responsive to animal waste control measures. The index values recommended by the DATCP for this purpose are as follows: eutrophic--7; mesotrophic--10; oligomesotrophic --7; and oligotrophic--5. Information regarding the trophic status of lakes was extracted from SEWRPC Planning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin: 2000, and the DNR report entitled Wisconsin Lakes - A Trophic Assessment Using Landsat Digital Data.

[f]Each lake was assigned an index value reflecting its likelihood to thermally stratify each year. Lakes which are likely to stratify each year were assigned an index value of 5 and other lakes an index value of 0. The stratification potential was determined from the lake area and maximum depth.

[g]Each lake was assigned a value reflecting the opportunities for public use. Values were assigned as follows: lakes with public parks, beaches, and high recreational use--5; lakes with parks and beaches but relatively low recreational use--4; lakes with no public parks, but with public frontage--3; lakes with no parks, but with public access areas--2; and lakes with no public access--1. Values were assigned to lakes based upon an analysis of public outdoor recreation and open space site information from Regional Planning Commission files.

Source: Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Table 9

WATER QUALITY-USE INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	Water Quality-Use Index
Scuppernong	17.1
Bark	14.7
Ashippun	14.5
Middle Fox	14.3
Mukwonago	12.6
Upper Fox	11.5

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Table 10

COMPOSITE WATERSHED INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	Adjusted Livestock Shoreline Index	Animal Waste-Nonpoint Source Pollution Index	Soils Index	Water Quality-Use Index	Composite Watershed Index
Ashippun	25.0	5.0	12.8	14.5	57.3
Scuppernong	5.7	3.6	24.1	17.1	50.5
Mukwonago	9.5	2.4	19.4	12.6	43.9
Bark	5.9	2.5	18.8	14.7	41.9
Middle Fox	2.9	1.6	15.9	14.3	34.7
Upper Fox	2.0	0.9	13.8	11.5	28.2

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Composite Index

The four indices presented individually above are presented together in Table 10. Also presented in Table 10 is the composite watershed index, which is calculated as the sum of the individual index numbers and which is intended to provide part of the basis for selection of one or more priority watersheds for purposes of the animal waste management plan.

As indicated in Table 10, of the six watersheds under consideration, the Ashippun River watershed had the highest composite watershed index (57.3), followed by the Scuppernong River watershed (50.5), and the Mukwonago River and Bark River watersheds (43.9 and 41.9, respectively). The Upper Fox River and Middle Fox River watersheds both had relatively low composite watershed indices--28.2 and 34.7, respectively.

PRIORITY AREAS

As noted in Chapter I, one of the primary purposes of the county animal waste management planning program is to ensure the best use of cost-share assistance available under the Wisconsin Farmers Fund program. Because cost-share funds are limited, state planning guidelines require that each county plan identify priority watersheds where animal waste water pollution problems are the most severe and where the use of cost-share assistance will maximize water quality benefits.

After careful deliberation, the Technical Advisory Committee selected four watersheds--the Ashippun River, Bark River, Mukwonago River, and Scuppernong River watersheds--as priority areas for purposes of the Waukesha County animal waste management plan. These watersheds were selected on the basis of their relatively high composite watershed index scores. As previously noted, the Ashippun River had the highest score--its high score being largely attributable to a relatively high livestock shoreline index, indicating a concentration of livestock near surface waters. The Scuppernong River watershed had the second highest composite watershed index, due to a relatively high water quality-use index and a relatively high soils index--the latter reflecting the fact that a large portion of the watershed is covered by soils having a high potential for groundwater or surface water pollution from any livestock operations present. It should be noted that, despite its high composite watershed index, the portion of the Scuppernong River watershed located within Waukesha County contains relatively few livestock operations. In order to ensure the identification of a sufficient number of eligible operations, two additional priority watersheds--the Bark and Mukwonago River watersheds--were selected.[3] As indicated in Table 10, the Bark River and Mukwonago River watersheds had similar composite watershed index scores.

It should be noted that animal waste water pollution problems within the Oconomowoc River and Root River watersheds are currently being addressed under the Oconomowoc River and Root River Priority Watershed Programs. Moreover, such problems will be addressed within the Menomonee River watershed under the Milwaukee River priority watersheds program. Selection of the Ashippun, Bark, Mukwonago, and Scuppernong River watersheds as priority watersheds under the animal waste management plan, in conjunction with priority watershed programs for the Menomonee, Oconomowoc and Root River watersheds, provides a basis for remedying livestock-related water pollution problems within approximately 297 square miles of the County, or 51 percent of the total area of the County.

CRITICAL AREAS

In order to further target resources available for remedying livestock-related water pollution problems, and in accordance with state planning guidelines, critical areas were identified within each of the four priority watersheds. Critical areas were identified as the portions of the priority watersheds having the greatest potential for surface water and groundwater pollution.

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[3]State planning guidelines suggest that county animal waste management plans identify 15 to 30 operations which need improvement and the owners of which are eligible for, and willing to participate in, the Wisconsin Farmers Fund program.

Surface Water Critical Areas

Critical areas relative to surface water were identified as those areas lying within 1,000 feet of a lake or well-defined stream, including areas within 1,000 feet of wetlands adjacent to lakes and streams. Areas so identified within the Ashippun, Bark, Mukwonago, and Scuppernong River watersheds are shown on Map 2. These areas encompass 51,500 acres, or 45 percent of the total area of the priority watersheds, and include 26 livestock operations.

Groundwater Critical Areas

Groundwater resources constitute an extremely valuable element of the natural resource base of Waukesha County and the Southeastern Wisconsin Region. Three major aquifers exist in the County and Region: 1) the sand and gravel deposits in the glacial drift; 2) the shallow dolomite strata in the underlying bedrock; and 3) the deeper sandstone, dolomite, siltstone, and shale strata. Because of their relative nearness to the land surface, and because of the hydraulic interconnection, the first two aquifers are commonly referred to collectively as the "shallow aquifer," while the latter is referred to as the "deep aquifer."

Protection of the deep sandstone aquifer was of primary concern in the preparation of the county animal waste management plan. That aquifer represents a major source of water for municipal and industrial use in southeastern Wisconsin. It is essential that all reasonable precautions be taken to avoid the contamination of the deep sandstone aquifer from urban and rural sources of pollution--including, potentially, livestock operations.

The principal source of recharge to the sandstone aquifer is precipitation percolating downward through glacial deposits into the aquifer. Such areas occur in portions of the western half of Waukesha County--generally in areas not overlain by the relatively impermeable Maquoketa shale. Groundwater in the deep aquifer beneath the Region moves in a generally easterly direction from the primary western recharge areas toward Lake Michigan. Most of the water withdrawn from the deep sandstone aquifer by communities and industries in the Southeastern Wisconsin Region originally entered the aquifer via recharge areas in Waukesha and Walworth Counties.

In the identification of critical areas under the animal waste management planning program, recharge areas to the deep sandstone aquifer within the Ashippun, Bark, Mukwonago, and Scuppernong River watersheds were identified on the basis of available bedrock geology information. Within the recharge areas, areas covered by soils poorly suited for barnyard operations because of the potential for groundwater pollution were identified using U. S. Soil Conservation Service (SCS) soil survey interpretations.[4] The resulting critical areas are shown on Map 2. These areas encompass 27,000 acres, or 24 percent of the total area of the priority watersheds, and include a total of 18 livestock operations.

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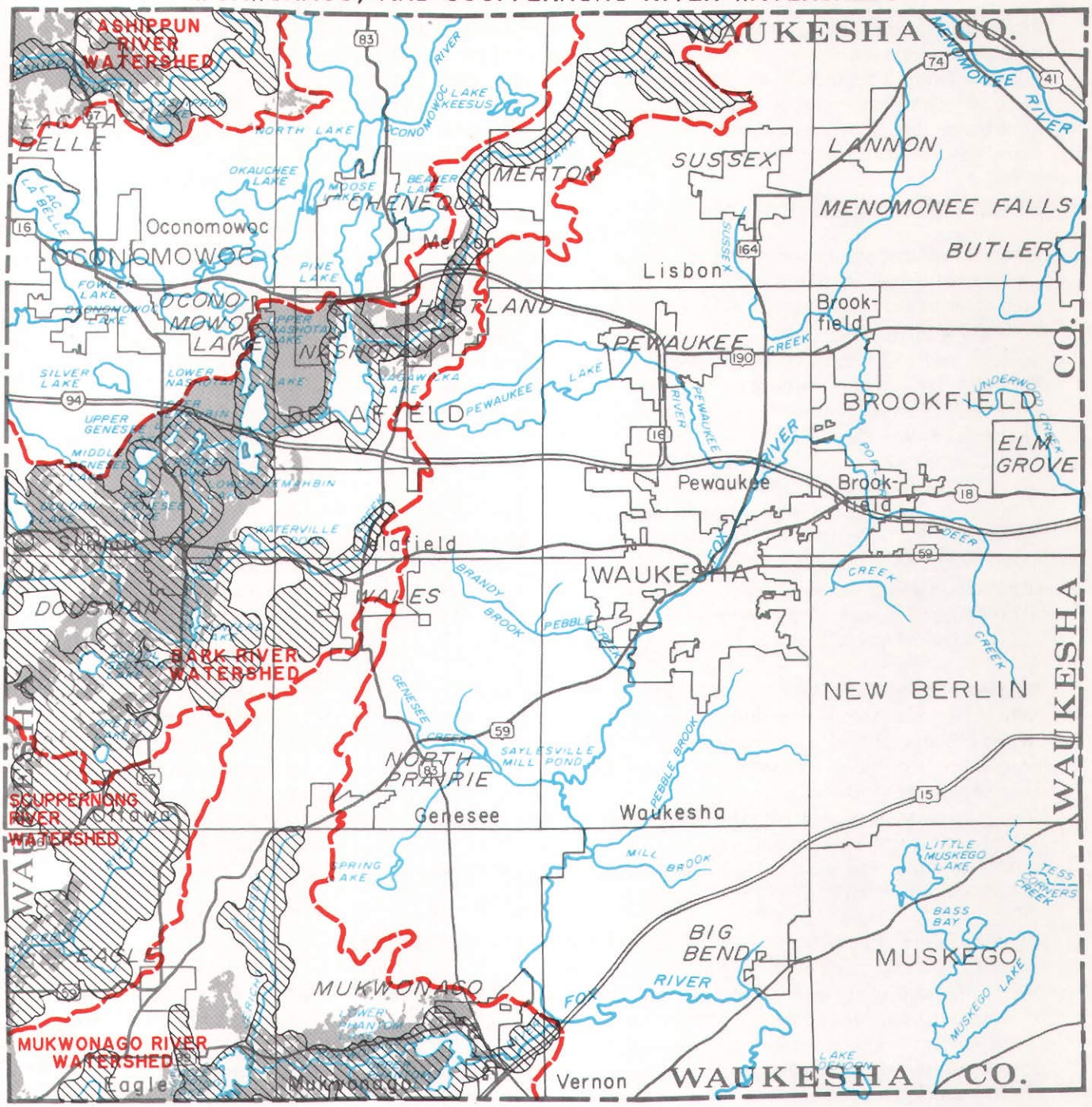
[4]Soil suitability for barnyard operations was based upon SCS soil suitability interpretations for soil absorption sewage disposal systems. Soils were deemed poorly suited for barnyard operations if they were identified as having severe limitations for soil absorption sewage disposal systems because of poor filtering capability, shallow bedrock, or shallow groundwater--provided the shallow groundwater is not due to slow percolation.

Map 2

CRITICAL AREAS WITHIN THE ASHIPPUN, BARK, MUKWONAGO, AND SCUPPERNONG RIVER WATERSHEDS



LEGEND

CRITICAL AREAS RELATIVE TO SURFACE WATER (AREAS LYING WITHIN 1,000 FEET OF A LAKE OR STREAM, INCLUDING AREAS WITHIN 1,000 FEET OF ADJACENT WETLANDS)

CRITICAL AREAS RELATIVE TO GROUNDWATER (AREAS OF RECHARGE TO THE DEEP SANDSTONE AQUIFER COVERED BY SOILS POORLY SUITED FOR BARNYARD OPERATIONS)

Source: SEWRPC.

PUBLIC INFORMATIONAL MEETINGS

Two public informational meetings were conducted during the course of the animal waste management planning program. A countywide meeting was held on June 19, 1986, at the Waukesha County office building to provide information to the public concerning both the county animal waste management plan and the county soil erosion control plan. The meeting was announced in area newspapers and in the U. S. Agricultural Stabilization and Conservation Service Newsletter. A copy of the meeting agenda is attached as Appendix G. Although it was well publicized, the meeting was attended by just one farmer, a member of the Technical Advisory Committee for the animal waste management and soil erosion control planning programs.

A second informational meeting, specifically targeted toward livestock operators within the priority areas, was held at the Oconomowoc City Hall on October 20, 1986. Letters of invitation to the meeting were sent to each livestock operator within the priority watersheds. A copy of that letter is attached as Appendix H. At this meeting, County Land Conservation Department staff and Regional Planning Commission staff provided information regarding the animal waste management planning program, the Wisconsin Farmers Fund cost-share assistance program, the process of selecting priority watersheds for the animal waste management plan, and the general nature of animal waste water pollution problems in the County. Three individuals other than staff attended this meeting--a farmer from Waukesha County, a farmer from Jefferson County, and an interested party who was not a farmer. The Waukesha County farmer expressed interest in participating in the Wisconsin Farmers Fund program.

Additional efforts to disseminate information on the animal waste management program were made through person-to-person contact with barnyard operators by the Regional Planning Commission staff and the staff of the Waukesha County Land Conservation Department during the course of the field survey work within the identified critical areas.

CONCLUDING REMARKS

The identification of priority watersheds and critical areas within those watersheds, as documented in this chapter, was an important step in the development of the animal waste management plan, for it is those areas to which cost-share assistance available to remedy livestock-related water pollution problems under the Wisconsin Farmers Fund program will be directed. The next step in the planning process, a detailed analysis of the pollution potential of individual livestock operations within the identified critical areas, is documented in the next chapter of this report.

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Chapter III

EVALUATION OF BARNYARDS IN CRITICAL AREAS

INTRODUCTION

As indicated in Chapter II of this report, the preparation of a county animal waste management plan involves two inventories and analyses. This chapter documents the findings of the second inventory and analysis--the detailed evaluation of livestock operations within the identified critical areas in terms of their water pollution potential and the need for barnyard improvements. The inventory and analysis work under this phase was conducted for all livestock operations consisting of 10 or more animal units. It should be noted that, while the primary focus in this work was on livestock operations within the identified critical areas, several isolated operations located outside the critical areas were also included in the inventory. These operations were included because they were considered by county and federal agency staff familiar with livestock operations within the County to be potentially significant sources of water pollution warranting further analysis. This chapter concludes with a rank ordering of individual livestock operations in terms of potential water pollution impacts, need for improvements, and potential for improved management.

EVALUATION OF SURFACE WATER IMPACTS

Livestock Operations in Surface Water Critical Areas

The analysis of livestock-related surface water impacts included an initial screening of all barnyards in the identified surface water critical areas to determine whether there was a significant potential for surface water pollution. A mathematical model, described below, was subsequently applied to all barnyards for which the initial screening indicated a possibility for surface water pollution. As part of the initial screening, each operation within the critical area was inspected to determine whether there was a significant potential for surface water pollution, considering the type and size of the operation, existing barnyard runoff controls, and the drainage pattern in the vicinity of the barnyard. Where this initial screening clearly indicated no significant surface water pollution potential--for example, where runoff was flowing away from, rather than toward, the stream--no further analysis was undertaken.

Where the initial screening indicated a significant potential for surface water pollution, surface water impacts were analyzed through application of the U. S. Department of Agriculture, Agricultural Research Service (ARS) model. That model uses a mathematical approach to estimate the barnyard pollutant loading, thereby providing a uniform means of comparing barnyards. The model estimates the chemical oxygen demand (COD) and phosphorus (P) contribution of animal feedlot runoff to the receiving surface water. The model establishes a numeric rating for each barnyard, indicating its relative pollution potential, based

upon the estimated COD and P contributions. The ratings may range from zero, indicating virtually no pollution potential, to 100, indicating very severe pollution potential. Key factors in the model include the number and kind of animals on the lot, the lot area, the watershed area draining through the lot, the distance to surface water, and the type of flow to surface water--be it channelized or overland flow--as well as the type of vegetation present where overland flow occurs. In the application of this model, the channelized or overland flow distance was measured to the point where the flow enters the receiving surface water or adjacent wetland.

The results of this analysis are summarized in Table 11. The analysis indicated that 12 of the 26 operations within the identified surface water critical areas are potentially significant sources of water pollution. Eleven of these operations require barnyard improvements--the ARS model ratings for these operations ranging from 8 to 60. In addition, the analysis identified a livestock operation in the Ashippun River watershed which currently has effective barnyard runoff controls and accordingly has an ARS model rating of zero, but which requires improvements in the form of fencing and a cattle watering ramp in order to better manage the livestock in areas located immediately adjacent to the Ashippun River. Accordingly, this operation should also be considered for cost-share assistance under the animal waste management plan.[1]

Livestock Operations Identified by the Land Conservation Committee

As already noted, the Waukesha County Land Conservation Committee staff and the staff of the U. S. Department of Agriculture, Soil Conservation Service, assigned to Waukesha County, based upon their knowledge of livestock operations in the County, recommended that several livestock operations located outside the identified critical areas be analyzed in a similar manner. As a result, four additional operations were identified as potential significant sources of water pollution requiring barnyard improvements.[2] For three of these

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[1]While secondary source information developed by the Wisconsin Department of Natural Resources in the late 1970's indicated a relatively high concentration of livestock in shoreland areas of the Ashippun River watershed, the field survey of existing operations in 1986 revealed few livestock-related water pollution problems. The low incidence of problems in the Ashippun River watershed is partially attributable to changes in livestock operations--including the installation of barnyard runoff controls at some barnyards and the termination of operations of others. Moreover, it was found that certain other operations within the surface water critical area of the Ashippun River do not constitute water quality problems because of drainage patterns under which barnyard runoff flows away from, rather than toward, the river.

[2]It should be noted that these operations are located within areas which are currently designated or anticipated to be designated as a priority watershed under the Wisconsin Department of Natural Resources Priority Watershed Program. Livestock operations receiving cost-share funds for animal waste management improvements under the priority watershed program are generally ineligible for funding under the state animal waste program. Since work on these priority watersheds has not as yet been initiated, and may, in fact, never be initiated because of pending changes in legislation concerning the state Priority Watershed Programs, such operations have been included in the county animal waste management plan.

Table 11

BARNYARD SURFACE WATER POLLUTION PROBLEMS IDENTIFIED UNDER THE WAUKESHA COUNTY ANIMAL WASTE MANAGEMENT PLAN

Area	Barnyards Not Constituting a Surface Water Pollution Problem	Barnyards Constituting a Surface Water Pollution Problem	
		Number	ARS-Model Rating
Surface Water Critical Areas			
Ashippun River Watershed.....	6	2	0,[a] 11
Bark River Watershed.....	4	5	28, 28, 30, 32, 60
Mukwonago River Watershed.....	2	3	8, 12, 12
Scuppernong River Watershed...	2	2	13, 53
Other Areas[b]			
Upper Fox River Watershed.....	N/A	1	49
Middle Fox River Watershed....	N/A	3	0,[c] 5, 15,

NOTE: N/A indicates not available.

[a]The analysis identified an operation in the Ashippun River watershed which currently has effective barnyard runoff controls, and which, accordingly has an ARS model rating of zero, but which requires improvements in the form of fencing and a cattle watering ramp in order to better manage the livestock in areas located near the barnyard, immediately adjacent to the Ashippun River.

[b]Within the surface water critical areas, all livestock operations were evaluated with regard to potential water quality impacts. In contrast, within "other areas" of the County, the analysis was limited to those livestock operations which the staffs of the Land Conservation Committee and U. S. Soil Conservation Service, based upon their experience working in the County, identified as having potential water quality problems. Accordingly, the results presented in this table for other areas of the County represent only the "known" livestock-related water pollution problems.

[c]One of the operations in the Middle Fox River watershed received an ARS model rating of zero, based upon field investigation in November 1986. There is, however, general agreement among the county and federal agency staff familiar with the operation that the operation is a significant source of water pollution at least during periods of heavy rainfall, particularly in the spring.

Source: Waukesha County Land Conservation Department and SEWRPC.

operations--one located in the Upper Fox River watershed and two located in the Middle Fox River watershed, the ARS model ratings ranged from 5 to 49 (see Table 11). The fourth operation, also located in the Middle Fox River watershed, received an ARS model rating of zero. Field investigation of the operation in November 1986 indicated that runoff from this barnyard approached the shoreland area of Lake Denoon, but did not flow into the lake. There is, however, general agreement among county and federal agency staff familiar with the operation that runoff from the barnyard does enter Lake Denoon during periods of heavy rainfall, particularly in spring, and that given the large number of animals involved and the large upslope area draining into and through the barnyard, the operation does, in fact, constitute a significant source of water pollution. Denoon Lake is a medium-size--162-acre--fairly deep natural lake in the City of Muskego in Waukesha County. It enjoys a good recreational

reputation based on its depth, sandy shores, and clear water, and serves large numbers of bathers, boaters, and picnickers. A newly developed city park encompassing 53 acres, including a boat launch area, is located on the northwest shore of the lake. Approximately 75 percent of the shoreland is in residential use. The important recreational values of the lake warrant the protection and wise use of this resource, including, where necessary, the funding of animal waste management improvement projects to protect lake water quality.

EVALUATION OF BARNYARDS IN GROUNDWATER CRITICAL AREAS

As previously noted, within the four priority watersheds, critical areas relative to groundwater were identified as areas of recharge to the deep sandstone aquifer which are covered by soils poorly suited for barnyard operations. As part of this analysis, each livestock operation within the identified critical areas was inspected for features which might indicate a livestock-related groundwater pollution problem--including outcrops of bedrock, evidence of a high water table, and internally drained areas where a large volume of runoff water collects and infiltrates downward through soils determined to exhibit poor filtering characteristics. Of a total of 18 livestock operations within the identified critical areas, two operations--one located in the Ashippun River watershed and the other located in the Bark River watershed--were identified in this manner as having the potential for adverse groundwater impacts.[3]

As noted in Chapter II of this report, protection of the deep sandstone aquifer was of primary concern in the preparation of the Waukesha County animal waste management plan. The planning program did not include a detailed evaluation of barnyard impacts on the shallow aquifer.[4] Any shallow aquifer contamination problems attendant to livestock operations should be addressed by the County as they become evident.

LAND AVAILABILITY FOR WINTER SPREADING OF MANURE

In accordance with the Wisconsin Department of Agriculture, Trade and Consumer Protection planning guidelines, the livestock operations determined to be a potential source of surface water and groundwater pollution were further analyzed to determine whether the farm encompasses enough suitable land to accommodate the disposal of manure through spreading in winter or whether some form of manure storage is needed. For each farm, land suitable for winter spreading was identified as cropland on 0 to 6 percent slopes not located within 200 feet of a river or stream. The amount of manure produced by each herd during the six-month winter period was estimated, and the amount of land needed for winter spreading was determined based upon the U. S. Department of Agriculture, Soil Conservation Service, guideline that no more than 25 tons of manure per acre should be spread without being incorporated into the soil--as is the case during winter months. By comparing the acreage required for winter

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[3]Six of these 18 are also located in the identified surface water critical areas.

[4]In an effort to further identify livestock-related groundwater problems, the Wisconsin Department of Natural Resources staff reviewed Department files regarding well contamination from all sources in Waukesha County. That review did not identify any well contamination which could be directly related to livestock operations.

spreading and the acreage suitable for spreading for each farm operation, it was determined that all of the farm operations concerned have sufficient land available for winter spreading of manure.

The detailed analysis of livestock operations did, nevertheless, identify the need for an animal waste storage facility at one operation. The storage facility is required because there is insufficient area at the site in question for solids separation and runoff treatment, given the proximity of the barnyard to a stream and adjacent wetlands, and because most of the operation is in grain crops, with little or no land available for spreading during the growing season.

The analysis described above focused on the availability of suitable land for the spreading of animal wastes in winter. It should be recognized that the need for additional storage facilities--given existing cropping practices and related management problems--may become evident as detailed site planning is undertaken for the operations concerned. The animal waste management plan is intended to be flexible in this regard, and would not preclude the provision of cost-share assistance in support of animal waste storage facilities, the need for which becomes apparent as the plan is implemented.

RANK ORDERING OF LIVESTOCK OPERATIONS

A key element of the animal waste management plan is a rank ordering of livestock operations, which is intended to serve as a basis for allocation of funds available under the Wisconsin Farmers Fund program. To facilitate this rank ordering, a mathematical index was calculated for each livestock operation which has been determined to be a potential source of surface water and groundwater pollution, in accordance with the Department of Agriculture, Trade and Consumer Protection planning guidelines. This index is a composite number--the sum of four individual index numbers for each livestock operation pertaining to the critical area priority, the need for barnyard improvements, the need for manure storage facilities, and the management potential of each operation. Each component of the index is described below.

1. Critical Area Priority
   Under this component, scores were assigned according to the relative significance of the water or wetland area receiving the barnyard runoff. Thus, 30 points were assigned to livestock operations where barnyard runoff enters a major stream or lake; 20 points were assigned to operations where barnyard runoff enters tributaries of the major stream network; and 10 points were assigned to operations where barnyard runoff enters wetlands adjacent to the lake and stream network, and to operations considered to be a groundwater problem.

2. Need for Barnyard Improvements
   Under this component, operations that were identified as potential sources of surface water pollution were assigned scores of zero to 30 based upon application of the ARS model. Operations that were identified as potential groundwater pollution problems were assigned 5 points in accordance with a recommendation by the Wisconsin Department of Agriculture, Trade and Consumer Protection staff.

3. Need for Manure Storage Facilities
   Under this component, all operations, with one exception, were assigned a value of zero inasmuch as each operation was determined to have sufficient cropland suitable for the disposal of manure by spreading in winter. The single exception is an operation which, as previously noted, requires an animal waste storage facility because of site area limitations and because of insufficient land for spreading during the growing season. Ten points were assigned to that operation under this component.

4. Management Potential
   Under this component, up to 10 points were assigned based upon staff perceptions regarding the operator's interest in the Wisconsin Farmers Fund program, the inclination and ability of the operator to manage an animal waste system effectively, and the cost-effectiveness of the needed improvements.

The resulting index value for each of the 18 livestock operations under consideration is presented in Table 12. Also shown in Table 12 is the rank ordering of operations based upon the index values. As noted above, the rank ordering will be used in developing recommendations for the allocation of cost-share assistance available under the Wisconsin Farmers Fund program.

CONCLUDING REMARKS

This chapter has documented the findings of the analysis of livestock operations within identified critical areas of the Ashippun, Bark, Mukwonago, and Scuppernong River watersheds, as well as certain livestock operations in other areas of the County considered by county and federal agency staff to be potentially significant sources of water pollution. Based upon this analysis, 18 livestock operations within those watersheds were identified as potential significant sources of surface water or groundwater pollution. These 18 operations were evaluated and a ranking has been assigned to each, based upon the need for improvements, the type of waters affected, and the management potential of the operation. The rank ordering of operations was incorporated into the recommended strategy for the allocation of cost-share assistance available under the Wisconsin Farmers Fund program, as documented in the next chapter of this report.

Table 12

PRIORITY RANKING OF ANIMAL OPERATIONS

Watershed	Operation Number	Critical Area Priority (0-30 Points)	Need for Barnyard Improvements (0-30 Points)	Need for Storage (0-30 Points)	Management Potential (0-10 Points)	Total Score (0-100 Points)	Rank
Bark	1	30	14	0	6	50	2
	2	10	30	0	9	49	3
	3	10	14	0	5	29	15
	4	10	15	0	4	29	15
	5	10	5 [a]	0	5	20	18
	6	10	16	0	7	33	14
Ashippun	7	30	0 [b]	0	9	39	11
	8	30	6	0	8	44	4
	9	10	5 [a]	0	6	21	17
Scuppernong	10	20	7	10	4	41	7
	11	20	27	0	5	52	1
Mukwonago	12	30	6	0	4	40	9
	13	30	4	0	4	38	12
	14	30	6	0	4	40	9
Upper Fox	15	10	25	0	6	41	7
Middle Fox	16	30	8	0	4	42	5
	17	30	3	0	9	42	5
	18	30	0 [c]	0	5	35	13

[a] These barnyards did not receive a rating from the ARS model, but were assigned 5 points because of groundwater pollution potential as recommended by the Wisconsin Department of Agriculture, Trade and Consumer Protection staff.

[b] This barnyard has effective barnyard controls in place and, accordingly, has an ARS model rating of zero. However, additional work in the form of fencing and a cattle watering ramp is still needed to better manage the livestock in areas located near the barnyards, immediately adjacent to the Ashippun River.

[c] One of the operations in the Middle Fox River watershed received an ARS model rating of zero, based upon field investigation in November 1986. There is, however, general agreement among the county and federal agency staff familiar with the operation that the operation is a significant source of water pollution at least during periods of heavy rainfall, particularly in the spring.

Source: Waukesha County Land Conservation Department and SEWRPC.

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Chapter IV

RECOMMENDED ANIMAL WASTE MANAGEMENT PLAN

INTRODUCTION

The detailed evaluation and subsequent rank ordering of barnyards located within critical areas of Waukesha County, as documented in Chapter III of this report, provided the basis for the development of a recommended county animal waste management plan. That plan, as presented in this chapter, consists of recommendations regarding the barnyard improvements needed to remedy the identified problems; the use of available cost-share funds to assist barnyard operators in financing the needed improvements; and the development and adoption of a county animal waste management ordinance to minimize the creation of additional animal waste water pollution problems.

RECOMMENDED IMPROVEMENTS

Chapter III of this report identified livestock-related water pollution problems within the identified critical areas of the Ashippun, Bark, Mukwonago, and Scuppernong River watersheds, as well as at isolated sites in other areas of the County. Most of the identified problems can be remedied through the installation of appropriately designed barnyard runoff control measures.

An effective barnyard runoff control system includes measures which divert clean water away from the barnyard, collect the barnyard runoff, remove manure solids from the barnyard runoff through sedimentation, and treat the runoff through vegetated filter strips or other means. The major components of an effective barnyard runoff control system are described in Table 13.

Under the animal waste management planning program, for each of the 18 operations causing livestock-related water pollution problems, a preliminary determination was made of the barnyard runoff controls and related management measures, such as fencing and cattle crossings, required to protect riverine areas. A summary of the required improvements and the attendant costs are set forth in Table 14. Installation of the required improvements, including engineering costs, would approximate $248,800. The specific improvements required for each operation are presented in Appendix I. Improvement costs per operation range from $1,710 to $38,920. It should be noted that the recommendations regarding the needed improvements and the attendant cost estimates are preliminary in nature and would be refined as part of the detailed design work to be undertaken for each site during plan implementation.

As indicated in Chapter III, the 18 livestock operations under consideration generally have sufficient cropland suitable for the disposal of manure by spreading in winter. As indicated in Table 14, a concrete manure storage facility is, nevertheless, recommended for one livestock operation. The storage facility is required because there is insufficient area at the site in question for solids separation and treatment of runoff, given the proximity of the

Table 13

MAJOR COMPONENTS OF BARNYARD RUNOFF CONTROL SYSTEM

Clean Water Diversion

Terraces, diversions, and ditches upslope of the barnyard reduce the volume of water in contact with manure and place less demand on runoff collection and treatment systems. Larger tributary areas and steeper slopes require larger and deeper diversions. Upslope diversions are highly effective in all but flat areas. Installing gutters and downspouts on barn roofs prevents roof runoff from entering the yard. Although the downspouts commonly discharge water directly to the ground, they can be attached to a solid PVC pipe or tile line which carries the runoff under the barnyard and discharges it elsewhere.

Barnyard Runoff Collection

Runoff can be contained by reshaping the yard and installing concrete curbs or plank fences around the barnyard. V-shaped channels, terraces, and waterways direct barnyard runoff to treatment areas. Where there is sufficient area between the barnyard and the stream, an earthen downslope diversion may replace the plank fence and concrete curbing. However, a downslope diversion is difficult to maintain unless solids are filtered out at the barnyard edge.

Solids Separation

Shallow sedimentation basins effectively remove manure solids by detaining runoff and letting water drain gradually. They can be constructed next to the barnyard or within the yard. Reshaping the yard and installing a plank fence and/or concrete curb creates an effective sediment basin. Mesh screens, picket dams, or filter fences at the basin outlet retain solids but allow liquids to discharge slowly to vegetated filter fields and strips. Filters must be cleaned periodically so they do not clog with manure. Scraping the yard frequently reduces the volume of solids in the runoff. A settling basin should always precede the filter field so that the filter is not overloaded with solids.

Liquids Treatment

Broad flat vegetated areas slow down and spread out barnyard runoff. This allows the water to come in contact with vegetation and infiltrate into the soil. Nutrient concentrations decrease as plants use nitrogen and phosphorus in the runoff. These areas, called filter strips, can be square or rectangular surfaces or long flat-bottomed strips about 50 by 200 feet. Grassed waterways, also called switchbacks or serpentine channels, do not treat runoff as effectively because channelized flow does not allow runoff adequate contact with vegetation. The extensive length needed for treatment equivalent to a filter strip usually makes a grassed waterway an impractical alternative for barnyard runoff control.

Holding Ponds

Infrequently, even releasing water slowly from a sedimentation basin may not provide enough water quality protection. In these cases, a holding pond, sized to provide several months of runoff storage, can be constructed until the runoff can be pumped out and applied to the land.

Source: Wisconsin Department of Agriculture, Trade and Consumer Protection, Guide to County Animal Waste Management Plans, 1985.

barnyard to a stream and adjacent wetlands, and because most of the operation is in grain crops, with little or no land available for spreading during the growing season.

FUNDING STRATEGY

Several state and federal cost-share programs are available to assist owners and operators of livestock operations in Waukesha County in implementing practices that will result in improved water quality. These include the Wisconsin Farmers Fund program, the state Priority Watershed Program, and the federal

Table 14

BARNYARD RUNOFF CONTROLS AND RELATED IMPROVEMENTS RECOMMENDED UNDER THE WAUKESHA COUNTY ANIMAL WASTE MANAGEMENT PLAN

Improvement Category	Number of Units Needed	Cost per Unit[a]	Estimated Cost
Roof Runoff System[b]	--	$ --	$ 17,305
Diversion	1,870 feet	3-18 per foot	18,710
Concrete Slab	813 cubic yards[d]	80 per cubic yard	65,040
Concrete Curb	890 feet	6.50 per foot	5,785
Concrete Wall	310 feet	8.50 per foot	2,635
Picket Wall	500 feet	7-16 per foot	7,460
Outlet Box	7 boxes	300 per box	2,100
Weir (spreader box)	8 weirs	250 per weir	2,000
Filter Strip	32,400 square feet	0.25 per square foot	8,100
Pump	2 pumps	5,000 per pump	10,000
Transfer Pipe	500 feet	12 per foot	6,000
Concrete Settling Pad	103 cubic yards[d]	80 per cubic yard	8,240
Concrete Storage Structure	1 structure	--	14,740
Fill	1,050 cubic yards	6 per cubic yard	6,300
Grading[c]	--	--	26,130
Fencing	10,000 feet	1.25 per foot	12,500
Seed and Mulch	43 acres	120 per acre	5,160
Miscellaneous	--	--	7,990
Engineering	--	--	22,610
Total	--	$ --	$248,805

[a] Unit costs were provided by the Waukesha County Land Conservation Department based upon its experience with barnyard runoff controls and related improvements in the County and are expressed in 1986 dollars.

[b] Roof runoff control systems include building gutters and downspouts along with tile lines or other facilities which carry roof runoff away from the barnyard.

[c] Grading for buffer strips and miscellaneous grading.

[d] Cubic yards of concrete required.

Source: Waukesha County Land Conservation Department and SEWRPC.

Agricultural Conservation Program. Such programs provide a means of sharing the financial burden for water quality improvements which benefit both the landowners and the general public.

Wisconsin Farmers Fund

It is anticipated that the Wisconsin Farmers Fund program will be the primary source of cost-share assistance for the improvements recommended in the pre-

vious section. The Wisconsin Farmers Fund program, jointly administered by the Wisconsin Department of Agriculture, Trade and Consumer Protection and Wisconsin counties, provides cost-share assistance to owners and operators of livestock operations in support of improvements recommended in county animal waste management plans. This program pays for up to 70 percent of the total design and construction costs of the needed improvements. The maximum grant in support of animal waste storage facilities is $10,000. There is no grant ceiling on cost-share assistance for barnyard runoff control systems. Cost-share assistance under the Wisconsin Farmers Fund program may be supplemented by cost-share assistance from other programs.

A proposed schedule to guide the use of cost-share assistance under the Wisconsin Farmers Fund program in Waukesha County is presented in Table 15. As previously noted, the improvement cost estimates are preliminary and may be expected to be refined as part of detailed design work for each site. Moreover, the schedule may be adjusted during plan implementation to reflect the financial situation and personal circumstances of the individual operators concerned. The administrative rules governing the Wisconsin Farmers Fund program--Chapter Ag 165 of the Wisconsin Administrative Code--indicate that the priority rankings for funding should be reviewed and updated annually.

Priority Watershed Program

Cost-share assistance for conservation practices designed to improve water quality, including livestock operation improvements, is also available under a program administered by the Wisconsin Department of Natural Resources, known as the Priority Watershed Program. Under that program, cost-share assistance for the abatement of nonpoint source water pollution becomes available within designated priority watersheds after completion of a detailed nonpoint source water pollution abatement plan. Such plans have been completed for the Oconomowoc River and Root River watersheds, and a plan is currently being prepared for the Menomonee River watershed. Under the Priority Watershed Program, assistance is available for up to 70 percent of the total cost of barnyard runoff controls. Assistance for manure storage facilities is available at a 70 percent rate--up to a maximum of $6,000 for short-term storage facilities and $10,000 for long-term storage facilities.

The county animal waste management plan attempts to properly coordinate the Priority Watershed Program and the Wisconsin Farmers Fund program in Waukesha County--particularly by minimizing overlap between the target areas. Thus, as indicated in Chapter II of this report, because of the availability of the cost-share assistance under the Priority Watershed Program in the Menomonee River, Oconomowoc River, and Root River watersheds, these areas were excluded from consideration for funding under the Wisconsin Farmers Fund program.

It should also be noted that preparation of a nonpoint source water pollution abatement plan for the Upper Fox River watershed has been scheduled by the Department of Natural Resources to begin in 1987. Completion of that plan will provide a basis for the provision of cost-share assistance for the improvement of livestock operations and other conservation practices designed to improve water quality in that watershed.

Agricultural Conservation Program

The Agricultural Conservation Program, administered by the U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service, provides cost-share assistance for conservation practices, including livestock opera-

Table 15

PROPOSED IMPLEMENTATION SCHEDULE FOR IMPROVEMENTS RECOMMENDED UNDER THE WAUKESHA COUNTY ANIMAL WASTE MANAGEMENT PLAN

Year	Operation Number	Rank Order (from Table 12, Chapter III)	Estimated Cost of Improvements	Wisconsin Farmers Fund Cost Share[a]
1987	11	1	$ 9,900	$ 6,930
	1	2	11,140	7,800
	2	3	23,110	16,180
	Subtotal		$ 44,150	$ 30,910
1988	8	4	11,800	8,260
	16	5	3,545	2,480
	17	5	2,625	1,840
	15	7	11,170	7,820
	10	7	38,920	25,890
	Subtotal		$ 68,060	$ 46,290
1989	12	9	14,385	10,070
	14	9	1,710	1,200
	7	11	2,380	1,670
	13	12	7,960	5,570
	18	13	30,370	21,260
	Subtotal		$ 56,805	$ 39,770
1990	6	14	15,985	11,190
	3	15	7,920	5,540
	4	15	25,015	17,510
	9	17	19,950	13,970
	5	18	10,920	7,640
	Subtotal		$ 79,790	$ 55,850
Total	--	--	$248,805	$172,820

[a]Assumes a general cost-share rate of 70 percent under the Wisconsin Farmers Fund program. It was assumed that the storage structure recommended at Operation No. 10 would be cost shared at a rate of 70 percent up to a grant amount of $10,000, and that other improvements at this site would be cost shared at the 70 percent rate with no maximum grant amount.

Source: Waukesha County Land Conservation Department and SEWRPC.

tion improvements, throughout the County. Assistance is available for up to 50 percent of the project costs, up to a maximum of $3,500. Assistance to individual operators may exceed $3,500 under certain circumstances, as provided in long-term agreements between the Agricultural Stabilization and Conservation Service and the landowner. Cost-share assistance under the Agricultural Conservation Program is allocated to applicants from within the County by the Agricultural Stabilization and Conservation Service based upon its analysis of the need for, and cost-effectiveness of, the proposed practices.

The Agricultural Conservation Program represents a potential additional source of cost-share assistance for the improvements recommended under this plan. In this regard, Agricultural Conservation Program funds could be used to supplement the Wisconsin Farmers Fund program funds in those situations where, without the supplemental funds, the operator would be unable to afford his share of the improvement costs. Agricultural Conservation Program funds could also be used as the primary source of cost-share assistance in those situations where the funding requirements are relatively low. It is therefore recommended

that the Agricultural Stabilization and Conservation Service give due consideration to the barnyard improvements and funding requirements identified in this plan in its allocation of cost-share assistance under the Agricultural Conservation Program.

ANIMAL WASTE MANAGEMENT ORDINANCE

Because of the potential for surface water and groundwater pollution, the design and construction of manure storage facilities should be properly regulated in the public interest. As indicated in Chapter I, in order to be eligible for cost-share assistance under the Wisconsin Farmers Fund program, counties must adopt an ordinance which regulates, at a minimum, the design and construction of earthen manure storage pits. Sound land management warrants that the design and construction of above-ground manure storage structures also be appropriately regulated. Moreover, sound land management dictates that the disposal of manure through land application be appropriately regulated to minimize surface water and groundwater impacts. As a practical matter, only limited regulation of land application may be feasible; for example, land application may be regulated on those farm operations where new manure storage facilities are authorized for construction.

Animal Waste Management Ordinance Options

Wisconsin Statutes provide several alternatives for county adoption of animal waste-related ordinances, as indicated below.

Wisconsin Statutes, Section 59.97: Counties may adopt regulations governing the design and construction of earthen manure storage facilities and above-ground storage structures, and land application of manure, under Section 59.97 of the Wisconsin Statutes by incorporating such regulations into the county zoning ordinance. Because eight towns in Waukesha County are not under the jurisdiction of the county zoning ordinance, animal waste management regulations adopted under Statute 59.97 would not be countywide in nature, as is required under the Wisconsin Farmers Fund program.

Wisconsin Statutes, Section 92.16: Counties may adopt regulations governing the design and construction of earthen manure storage facilities under Section 92.16 of the Wisconsin Statutes. While the regulatory authority granted under this section is countywide, the authority is limited to the regulation of earthen manure storage facilities. Section 92.16 does not grant authority to regulate above-ground storage structures or land application of manure.

Wisconsin Statutes, Section 59.07(51): Section 59.07(51) of the Wisconsin Statutes enables counties to adopt building and sanitary codes. Through the adoption of a sanitary code under this section, a county may regulate the design and construction of earthen manure storage facilities and above-ground storage structures, as well as land application of manure. The regulations adopted under Section 59.07(51) would not apply within any cities, villages, or towns that adopt ordinances covering the same subject matter.

Recommended Animal Waste Management Ordinance

After careful consideration of the options available, the Technical Advisory Committee recommended that the Waukesha County Board adopt an ordinance regulating the design and construction of all animal waste storage facilities--

including earthen manure storage facilities, consisting of impoundments made by excavation or earthfill, and above-ground manure storage structures fabricated from concrete, steel, or other materials. The Technical Advisory Committee recommended that the ordinance be adopted under Section 92.16 and Section 59.07(51) of the Wisconsin Statutes. Ordinance provisions governing the design and construction of earthen manure storage facilities would be in effect countywide, thereby meeting the minimum requirements of the Wisconsin Farmers Fund program. Ordinance provisions pertaining to the design and construction of above-ground storage structures would also be in effect countywide, except where a city, village, or town has adopted an ordinance governing the same subject matter.

It is recommended that the ordinance incorporate U. S. Soil Conservation Service Technical Guide Standard No. 425 pertaining to earthen manure storage facilities and Standard No. 313 pertaining to fabricated manure storage structures. Standard No. 425 includes requirements regarding how earthen manure storage facilities should be located relative to the source of animal waste and to the location of wells and reservoirs. Section 425 in addition sets forth requirements regarding such aspects of design as sealing requirements, particularly as related to soil characteristics and depth to bedrock and groundwater, and regarding methods to be used in separating solids and disposing of liquids. Similarly, Standard No. 313 establishes guidelines for the location, design, and construction of fabricated manure storage structures.

Under the proposed ordinance, a permit would be required for the construction, reconstruction, or substantial alteration of an animal waste storage facility. Each application for a permit would be required to include a plan which would specify the number and kinds of animals for which storage is to be provided; a site plan showing the proposed location of the facility; pertinent structural details; pertinent information on soils, depth to groundwater, and depth to bedrock; proposed provisions for adequate drainage and control of runoff; a time schedule for construction; and a plan for utilization of animal waste, including a description of the amount of land available for the application of waste and the identification of areas where the waste will be spread. The waste utilization plan would be required to conform with the guidelines of the U. S. Soil Conservation Service Technical Guide Standard No. 633. Standard No. 633 sets forth guidelines for determining permissible levels of application of animal waste, the levels being indexed to soil types and vegetative cover.

Administration and Enforcement

There are several options available for administering and enforcing an animal waste management ordinance in Waukesha County. These options are administration and enforcement by the County Park and Planning Department, with technical assistance from the County Land Conservation Department; administration and enforcement by the County Health Department, with technical assistance from the County Land Conservation Department; and administration and enforcement entirely by the County Land Conservation Department. The Waukesha County Board should review these and other possible options, and determine which option would best serve the County.

PLAN IMPLEMENTATION

The cooperation of a number of agencies and units of government is necessary for effective implementation of the animal waste management plan recommenda-

tions set forth above. The most important implementation activities are summarized by agency below.

County Level

Waukesha County Board of Supervisors: It is recommended that the Waukesha County Board of Supervisors:

1. Adopt the county animal waste management plan as part of the County's overall strategy to reduce animal waste water pollution problems within the County.

2. Prepare and adopt an animal waste management ordinance regulating earthen manure storage facilities and above-ground storage structures and regulating, in addition, land application of manure, on those operations receiving county authorization for new storage facilities.

Waukesha County Land Conservation Committee: It is recommended that the Waukesha County Land Conservation Committee:

1. Adopt the county animal waste management plan as part of the County's overall strategy to reduce animal waste water pollution problems within the County.

2. Through its staff, disseminate information to livestock operators regarding the need for barnyard improvements designed to eliminate water quality problems and regarding the availability of cost-share and technical assistance in support of such improvements.

3. Through its staff, administer the Wisconsin Farmers Fund program within Waukesha County in accordance with the priority recommendations set forth in this chapter.

State Level

Wisconsin Land Conservation Board: It is recommended that the Wisconsin Land Conservation Board:

1. Recommend approval of the Waukesha County animal waste management plan to the Wisconsin Department of Agriculture, Trade and Consumer Protection for the purposes of the Wisconsin Farmers Fund program.

Wisconsin Department of Natural Resources: It is recommended that the Wisconsin Department of Natural Resources:

1. Continue to provide cost-share assistance for the abatement of animal waste water pollution problems in Waukesha County under the state Priority Watershed Program.

Federal Level

U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service: It is recommended that the U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service:

1. Give due consideration to the barnyard improvements and funding requirements identified in the county animal waste management plan in its allocation of cost-share assistance under the Agricultural Conservation Program.

U. S. Department of Agriculture Soil Conservation Service: It is recommended that the U. S. Department of Agriculture, Soil Conservation Service:

1. Assist the Waukesha County Land Conservation Committee staff in administering the Wisconsin Farmers Fund program--in particular by assisting in the design work attendant to the needed barnyard improvements.

CONCLUDING REMARKS

This chapter has presented a county animal waste management plan. The plan consists of recommendations for improvements needed to remedy the animal waste water pollution problems that have been identified within the Ashippun, Bark, Mukwonago, and Scuppernong River watersheds, as well as at isolated sites in other areas of the County; for the use of available cost-share funds to assist barnyard operators in financing the needed improvements; and for the adoption of a county animal waste management ordinance. Implementation of the barnyard improvement and cost-share recommendations set forth in this chapter will contribute toward the abatement of the animal waste water pollution problems within the County, complementing similar efforts being undertaken in certain areas of the County under the state Priority Watershed Program. Adoption of a county animal waste management ordinance, as recommended in this chapter, will help prevent the creation of additional animal waste water pollution problems.

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Chapter V

SUMMARY

Many sources of pollution threaten the surface water and groundwater resources of Waukesha County. Although some of that pollution may be attributed to urban sources, a significant amount may be attributed to rural sources, including livestock operations.

Recognizing the need to control animal waste water pollution problems in Waukesha County, and the desirability of making state assistance available to farmers within the County for the control of pollutant runoff from livestock operations, the Waukesha County Board in 1985 determined to prepare a county animal waste management plan. The County Board requested the assistance of the Southeastern Wisconsin Regional Planning Commission in the preparation of the plan. That plan, as presented in this report, was prepared under the aegis of the Waukesha County Land Conservation Committee, assisted by the staff of the Regional Planning Commission, and by a Technical Advisory Committee consisting of county farmers, representatives of concerned county agencies, and state and federal agency personnel assigned to the County.

One of the purposes of the county animal waste management plan is to ensure the best use of funds which are available for the abatement of animal waste water pollution problems under the Wisconsin Farmers Fund program. That program provides state grants on a cost-sharing basis to farmers to help defray the costs of animal waste management improvements designed to minimize water pollution. The animal waste management plan is intended to assist the County in targeting state funds in a manner which will maximize water quality benefits, thereby making the most efficient use of the limited funds available.

The county animal waste management plan was prepared following procedures promulgated by the Wisconsin Department of Agriculture, Trade and Consumer Protection. Those procedures are intended to provide a uniform approach to the preparation of county animal waste management plans throughout the State. In accordance with those procedures, the preparation of the Waukesha County animal waste management plan included the identification of priority watersheds and critical areas within those watersheds having the greatest potential for livestock-related water pollution; an analysis and subsequent rank ordering of livestock operations within the identified critical areas in terms of water quality impacts; and the formulation of recommendations for the abatement of the identified animal waste water pollution. The major findings and recommendations of the county animal waste management planning program are summarized below.

IDENTIFICATION OF CRITICAL AREAS

Watersheds in Waukesha County differ in the extent and severity of livestock-related water pollution problems. In order to compare watersheds in terms of livestock-related water pollution potential, an index was calculated for each

watershed. This index is a composite number, calculated as the sum of four individual index numbers developed for each watershed, pertaining to the following: 1) animal density and proximity to surface waters; 2) significance of animal waste pollution relative to all nonpoint source pollution; 3) soil characteristics; and 4) water quality and use. The procedure used to calculate the individual index numbers and the composite index is described in Chapter II. Based upon the index scores, the Ashippun River, Bark River, Mukwonago River, and Scuppernong River watersheds were selected by the Technical Advisory Committee as priority areas for county animal waste management.

In order to further target the resources available for remedying livestock-related water pollution, critical areas were identified within each of the four priority watersheds. Critical areas were identified as those portions of each of the watersheds having the greatest potential for surface water and groundwater pollution. Critical areas relative to surface water pollution were identified as those areas lying within 1,000 feet of lakes or streams, including areas within 1,000 feet of wetlands adjacent to lakes and streams. Critical areas relative to groundwater pollution were identified as those areas lying in the recharge zone of the deep sandstone aquifer underlying the County and covered by pollutant-transmissive soils.

EVALUATION OF LIVESTOCK OPERATIONS--SURFACE WATER IMPACTS

All barnyards within the identified surface water critical areas were screened to determine whether, based on existing topographic conditions and barnyard characteristics, there was a significant potential for surface water pollution. A mathematical model, known as the Agricultural Research Service model, was subsequently applied to all barnyards for which the initial screening indicated a possibility for surface water pollution. The model establishes a numeric rating for each barnyard indicative of its relative pollution potential, the rating being based upon estimated chemical oxygen demand and phosphorus contributions.

The analysis indicated that 12 of the 26 livestock operations existing within the critical surface water pollution areas of the four priority watersheds in 1986 were potentially significant sources of water pollution, and that 11 of these operations required barnyard improvements. The single remaining operation, located in the Ashippun River watershed, was found to have effective barnyard runoff controls, but required improvements in the form of fencing and a cattle watering ramp in order to better manage the livestock in areas located immediately adjacent to the Ashippun River.

Certain livestock operations located outside the identified critical areas were also analyzed in this manner. These operations were included in the analysis because they were considered by county and federal agency staff familiar with livestock operations within the County to comprise potentially significant sources of surface water pollution. Based upon this analysis, four additional operations were identified as potentially significant sources of surface water pollution requiring barnyard improvements.

EVALUATION OF LIVESTOCK OPERATIONS--GROUNDWATER IMPACTS

Each livestock operation within the identified groundwater critical area was inspected for features which might indicate a livestock-related groundwater pollution problem--including outcrops of bedrock, evidence of a high water table, and internally drained areas where a large volume of runoff water collects and infiltrates downward through soils with poor pollutant removal characteristics. Of a total of 18 livestock operations existing within the identified critical groundwater pollution areas in 1986, two operations--one located in the Ashippun River watershed and the other located in the Bark River watershed--were found to have the potential for adverse impacts on groundwater quality.

RANK ORDERING OF LIVESTOCK OPERATIONS

A key element of the county animal waste management plan is a rank ordering of livestock operations intended to serve as a basis for the allocation of funds available under the Wisconsin Farmers Fund program. To facilitate this rank ordering, a mathematical index was calculated for each livestock operation which had been determined to constitute a potential source of surface water and groundwater pollution. The methodology used to compute this index is described in Chapter III, and the resulting rank ordering of livestock operations is set forth in Table 12 of Chapter III.

ANIMAL WASTE MANAGEMENT PLAN RECOMMENDATIONS

The animal waste management plan recommends barnyard improvements needed to remedy the identified problems, and includes recommendations regarding the use of available state cost-sharing funds to assist barnyard operators in financing needed improvements, and the development and adoption of a county animal waste management ordinance to minimize the creation of additional animal waste water pollution problems.

Recommended Improvements

For each of the 18 operations identified as causing livestock-related water pollution problems, a preliminary determination was made of the barnyard runoff controls and related management measures, such as fencing and cattle crossings, required to reduce pollutant runoff and protect water quality. The cost of installation of the required improvements, including engineering costs, was estimated to be $248,800. Estimated improvement costs per operation ranged from about $1,700 to about $38,900.

Funding Strategy

It was assumed that the Wisconsin Farmers Fund program would constitute the primary source of cost-sharing assistance for the improvements recommended in the plan. This program pays up to 70 percent of the total design and construction costs of needed improvements. The maximum grant in support of animal waste storage facilities is $10,000. There is no such grant limitation on assistance for barnyard runoff control systems.

A proposed schedule for implementation of the barnyard improvement recommendations, with primary cost-sharing assistance provided under the Wisconsin Farmers Fund program, was developed as part of the animal waste management plan. That schedule anticipates that cost-share assistance under the Wisconsin Farmers Fund program would total $172,800. That schedule further anticipates that the recommended improvements would be completed by the end of 1990 (see Table 15 in Chapter IV).

Cost-sharing assistance under the Wisconsin Farmers Fund program may be supplemented by other assistance programs. The Agricultural Conservation Program administered by the U. S. Department of Agriculture, Agricultural Stabilization and Conservation Service, represents a potential additional source of assistance for improvements recommended under the plan. Agricultural Conservation Program funds could be used to supplement the Wisconsin Farmers Fund program in those situations where, without the supplemental funds, the operator would be unable to afford his or her share of the improvement costs. Agricultural Conservation Program funds could also be used as the primary source of cost-sharing assistance in those situations where the funding requirements are relatively low. The plan, therefore, recommends that the Agricultural Stabilization and Conservation Service give due consideration to the barnyard improvements and funding requirements identified in the county animal waste management plan in its allocation of cost-share assistance under the Agricultural Conservation Program.

Cost-sharing assistance for conservation practices designed to improve water quality, including livestock operation improvements, is also available under a program administered by the Wisconsin Department of Natural Resources known as the Priority Watershed Program. The county animal waste management plan provides a basis for coordinating the Wisconsin Department of Natural Resources Priority Watershed Program with the Wisconsin Farmers Fund program in Waukesha County--minimizing any overlap between the target areas. Thus, as indicated in Chapter II, because of the availability of cost-share assistance under the Priority Watershed Program in the Menomonee River, Oconomowoc River, and Root River watersheds, these areas were eliminated from consideration for funding under the Wisconsin Farmers Fund program.

Animal Waste Management Ordinance

The county animal waste management plan recommends that the Waukesha County Board adopt an animal waste management ordinance regulating the design and construction of earthen manure storage facilities as well as above-ground storage facilities, and the land application of manure on those operations for which a storage facility permit is issued. Ordinance provisions pertaining to the design and construction of earthen manure storage facilities would be adopted under Section 92.16 of the Wisconsin Statutes and would be in effect countywide. Ordinance provisions pertaining to the design and construction of above-ground storage structures and to the land application of manure would be adopted under Section 59.07(51) of the Wisconsin Statutes and would be in effect countywide, except where a city, village, or town adopted an ordinance covering the same subject matter.

CONCLUDING REMARKS

As indicated in Chapter I, under the Wisconsin Farmers Fund program, in order for individual farmers to be eligible for cost-sharing assistance, certain actions must be undertaken by county government. First, the County must prepare an animal waste management plan identifying animal waste water pollution problems in the county and establishing a rank order of the problems. Second, the county must prepare and adopt an ordinance regulating the design and construction of earthen manure storage facilities.

Adoption by the Waukesha County Board of the animal waste management plan as presented in this report, and preparation and adoption of an animal waste management ordinance as recommended herein--and subsequent approval of the plan and ordinance by the Wisconsin Land Conservation Board--should satisfy these basic eligibility requirements for the Wisconsin Farmers Fund program. Implementation of the barnyard improvement and related cost-sharing recommendations as set forth in this report should contribute materially toward the abatement of animal waste water pollution problems within the County, complementing similar efforts being undertaken in certain areas of the County under the Wisconsin Department of Natural Resources Priority Watershed Program. Adoption of a county animal waste management ordinance should, in turn, help prevent the creation of animal waste water pollution problems. Adoption and implementation of this plan should thus contribute to maintaining and improving surface water and groundwater quality within the County, thereby providing a better environment in which to live and work.

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APPENDICES

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Appendix A

CALCULATION OF SOIL INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	Association Name	Percent of Association in Watershed	x	Association Score (from Appendix B)	=	Weighted Association Score
Ashippun	Houghton-Palms-Adrian	5.0		50.0		2.5
	Fox-Casco	46.6		11.4		5.3
	Hochheim-Theresa	48.4		10.4		5.0
					Watershed Soil Index	12.8
Bark	Houghton-Palms-Adrian	13.0		50.0		6.5
	Fox-Casco	51.8		11.4		5.9
	Boyer-Oshtemo	7.8		2.1		0.2
	Rodman-Casco	11.5		39.3		4.5
	Hochheim-Theresa	15.9		10.4		1.7
					Watershed Soil Index	18.8
Middle Fox	Houghton-Palms-Adrian	9.1		50.0		4.6
	Fox-Casco	2.8		11.4		0.3
	Warsaw-Lorenzo	1.5		4.2		0.1
	Ozaukee-Morley-Mequon	16.9		23.0		3.9
	Montgomery-Martinton-Hebron-Saylesville	13.7		8.9		1.2
	Hochheim-Theresa	56.0		10.4		5.8
					Watershed Soil Index	15.9
Mukwonago	Houghton-Palms-Adrian	7.5		50.0		3.8
	Fox-Casco	15.8		11.4		1.8
	Warsaw-Lorenzo	31.3		4.2		1.3
	Rodman-Casco	27.2		39.3		10.7
	Montgomery-Martinton-Hebron-Saylesville	1.4		8.9		0.1
	Hochheim-Theresa	16.8		10.4		1.7
					Watershed Soil Index	19.4
Scuppernong	Houghton-Palms-Adrian	15.4		50.0		7.7
	Fox-Casco	3.6		11.4		0.4
	Warsaw-Lorenzo	8.3		4.2		0.3
	Boyer-Oshtemo	13.0		2.1		0.3
	Rodman-Casco	33.2		39.3		13.0
	Montgomery-Martinton-Hebron-Saylesville	17.4		8.9		1.5
	Hochheim-Theresa	9.1		10.4		0.9
					Watershed Soil Index	24.1
Upper Fox	Houghton-Palms-Adrian	6.3		50.0		3.2
	Warsaw-Lorenzo	2.5		4.2		0.1
	Rodman-Casco	0.3		39.3		0.1
	Ozaukee-Morley-Mequon	11.0		23.0		2.5
	Montgomery-Martinton-Hebron-Saylesville	2.1		8.9		0.2
	Hochheim-Theresa	72.3		10.4		7.5
	Pella, moderately shallow variant-Knowles	5.5		3.2		0.2
					Watershed Soil Index	13.8

Source: U. S. Soil Conservation Service; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Appendix B

CALCULATION OF SOIL ASSOCIATION SCORE FOR SOIL ASSOCIATIONS IN WAUKESHA COUNTY

Association	Series	Percent of Series in Association	× Series Hydrologic Soil Group Factor	× Series Slope Factor	× Series Erodibility Factor	=	Series Score
Houghton-Palms-Adrian	Houghton	68	50	--	--		34.0
	Palms	16	50	--	--		8.0
	Adrian	16	50	--	--		8.0
						Association Score	50.0
Fox-Casco	Fox	67	1	15	.37		3.7
	Casco	33	1	73	.32		7.7
						Association Score	11.4
Warsaw-Lorenzo	Warsaw	78	1	11	.28		2.4
	Lorenzo	22	1	30	.28		1.8
						Association Score	4.2
Boyer-Oshtemo	Boyer	78	1	12	.17		1.6
	Oshtemo	22	1	10	.24		0.5
						Association Score	2.1
Rodman-Casco	Rodman	60	50	--	--		30.0
	Casco	40	1	73	.32		9.3
						Association Score	39.3
Ozaukee-Morley-Mequon	Ozaukee	41	3	21	.37		9.6
	Morley	37	3	23	.43		11.0
	Mequon	22	3	10	.37		2.4
						Association Score	23.0
Montgomery-Martinton-Hebron-Saylesville	Montgomery	31	2	10	.37		2.3
	Martinton	24	3	10	.32		2.3
	Hebron	15	1	16	.32		0.8
	Saylesville	15	3	16	.37		2.7
	Navan	15	2	10	.28		0.8
						Association Score	8.9
Hochheim-Theresa	Hochheim	58	1	45	.32		8.4
	Theresa	17	1	12	.37		0.8
	Pella	17	1	10	.28		0.5
	Miami (Kidder)	8	1	38	.24		0.7
						Association Score	10.4
Pella, moderately shallow variant-Knowles	Pella, moderately shallow variant	56	1	10	.28		1.6
	Knowles	44	1	10	.37		1.6
						Association Score	3.2

Source: U. S. Soil Conservation Service; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Appendix C

CALCULATION OF WATER QUALITY-USE INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	[Watershed Stream Index (from Appendix D)	+ Watershed Lake Index (from Appendix E)]	- [Number of Stream Segments in Watershed	+ Number of Lakes in Watershed]	= Water Quality-Use Index
Ashippun.....	11.0	18.0	1	1	14.5
Bark.....	44.8	249.7	4	16	14.7
Middle Fox.....	109.2	62.4	8	4	14.3
Mukwonago.....	34.4	53.6	3	4	12.6
Scuppernong.....	51.5	17.0	3	1	17.1
Upper Fox.....	74.8	17.0	7	1	11.5

Source: SEWRPC.

Appendix D

CALCULATION OF STREAM INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

Watershed	Stream[a]	[Fishery Status + Public Use] ×	Stream Length as Percent of Total Length of Streams in Watershed	× Number of Stream Segments in Watershed	= Weighted Stream Score
Ashippun	Ashippun River.....	10 1	100.0	1	11.0
				Watershed Stream Index	11.0
Bark	Bark River				
	Segment 1.....	10 1	39.6	4	17.4
	Segment 2.....	10 4	7.1	4	4.0
	Segment 3.....	10 1	25.1	4	11.0
	Scuppernong Creek.....	10 1	28.2	4	12.4
				Watershed Stream Index	44.8
Middle Fox	Fox River.....	10 4	46.7	8	52.3
	Genesee Creek				
	Segment 1.....	15 1	12.0	8	15.4
	Segment 2.....	10 1	7.3	8	6.4
	Mill Brook.....	10 3	6.3	8	6.6
	Mill Creek.....	10 1	5.4	8	4.8
	Muskego Creek Canal....	10 1	5.4	8	4.8
	Pebble Brook.....	10 3	11.7	8	12.2
	Spring Creek.....	15 1	5.2	8	6.7
				Watershed Stream Index	109.2
Mukwonago	Jericho Creek.....	10 1	41.5	3	13.7
	Mukwonago River				
	Segment 1.....	10 4	16.3	3	6.8
	Segment 2.....	10 1	42.2	3	13.9
				Watershed Stream Index	34.4
Scuppernong	Scuppernong River				
	Segment 1.....	15 4	44.1	3	25.1
	Segment 2.....	15 4	19.5	3	11.1
	Segment 3.....	10 4	36.4	3	15.3
				Watershed Stream Index	51.5
Upper Fox	Brandy Brook.....	10 1	5.3	7	4.1
	Deer Creek.....	5 1	13.7	7	5.8
	Fox River.....	10 3	40.2	7	36.6
	Pebble Creek.....	10 1	6.8	7	5.2
	Pewaukee River.....	10 3	11.2	7	10.2
	Poplar Creek.....	5 1	13.2	7	5.5
	Sussex Creek.....	10 1	9.6	7	7.4
				Watershed Stream Index	74.8

[a] Location of streams is shown on map included as Appendix F.

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Appendix E

CALCULATION OF LAKE INDEX FOR SELECTED WATERSHEDS IN WAUKESHA COUNTY

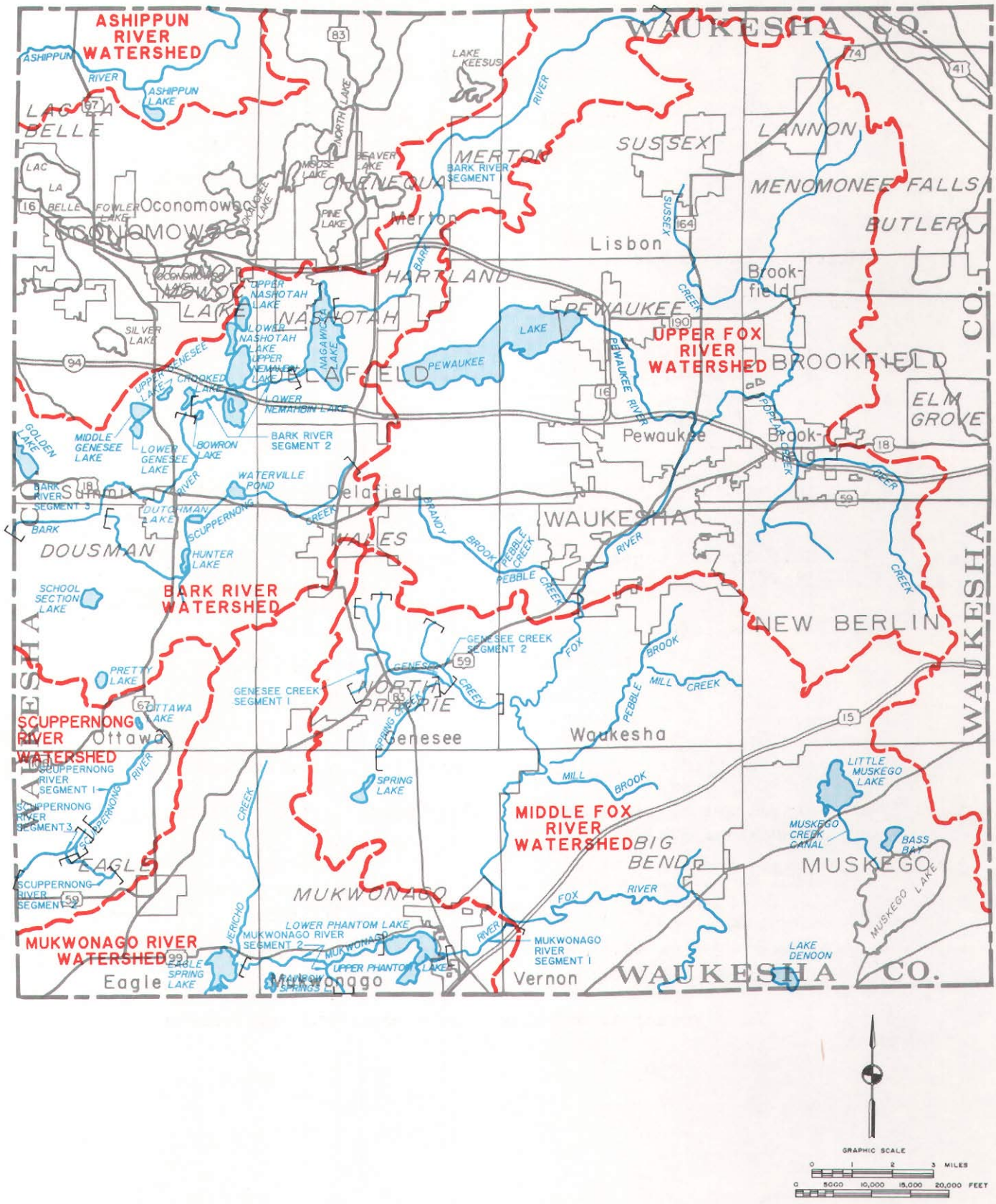
Watershed	Lake[a]	[Trophic Status + Stratification Potential + Public Use] ×	Lake Area as Percent of Total Area of Lakes in Watershed ×	Number of Lakes in Watershed =	Weighted Lake Score
Ashippun	Ashippun	10 + 5 + 3 ×	100.0 ×	1 =	18.0
			Watershed Lake Index		18.0
Bark	Crooked	7 + 0 + 1 ×	2.2 ×	16 =	2.8
	Dutchman	7 + 5 + 1 ×	1.3 ×	16 =	2.7
	Genesee (Lower)	5 + 5 + 1 ×	2.5 ×	16 =	4.4
	Genesee (Middle)	5 + 5 + 1 ×	3.9 ×	16 =	6.9
	Genesee (Upper)	5 + 5 + 2 ×	1.3 ×	16 =	2.5
	Golden	10 + 5 + 3 ×	9.5 ×	16 =	27.4
	Hunter	10 + 5 + 1 ×	2.5 ×	16 =	6.4
	Nagawicka	7 + 5 + 5 ×	36.5 ×	16 =	99.3
	Nashotah (Lower)	5 + 5 + 1 ×	3.4 ×	16 =	6.0
	Nashotah (Upper)	5 + 5 + 1 ×	5.1 ×	16 =	9.0
	Nemahbin (Lower)	10 + 5 + 3 ×	10.3 ×	16 =	29.7
	Nemahbin (Upper)	10 + 5 + 3 ×	10.8 ×	16 =	31.1
	Pretty	7 + 5 + 1 ×	2.4 ×	16 =	5.0
	School Section	10 + 0 + 3 ×	4.8 ×	16 =	10.0
	Waterville	10 + 0 + 1 ×	2.6 ×	16 =	4.6
	Widgeon (Bowron)	7 + 5 + 1 ×	0.9 ×	16 =	1.9
			Watershed Lake Index		249.7
Middle Fox	Bass Bay	7 + 5 + 1 ×	12.1 ×	4 =	6.3
	Denoon	10 + 5 + 4 ×	18.4 ×	4 =	14.0
	Little Muskego	7 + 5 + 4 ×	57.6 ×	4 =	36.9
	Spring	5 + 5 + 1 ×	11.9 ×	4 =	5.2
			Watershed Lake Index		62.4
Mukwonago	Eagle Spring	10 + 0 + 3 ×	35.1 ×	4 =	18.3
	Phantom (Lower)	10 + 0 + 3 ×	48.9 ×	4 =	25.4
	Phantom (Upper)	10 + 5 + 3 ×	12.1 ×	4 =	8.7
	Rainbow Springs	7 + 0 + 1 ×	3.9 ×	4 =	1.2
			Watershed Lake Index		53.6
Scuppernong	Ottawa	7 + 5 + 5 ×	100.0 ×	1 =	17.0
			Watershed Lake Index		17.0
Upper Fox	Pewaukee	7 + 5 + 5 ×	100.0 ×	1 =	17.0
			Watershed Lake Index		17.0

[a]Location of lakes is shown on map included as Appendix F.

Source: Wisconsin Department of Natural Resources; Wisconsin Department of Agriculture, Trade and Consumer Protection; and SEWRPC.

Appendix F

LAKES AND STREAMS CONSIDERED IN CALCULATING THE WATER QUALITY-USE INDEX FOR THE ASHIPPUN, BARK, MIDDLE FOX, MUKWONAGO, SCUPPERNONG, AND UPPER FOX RIVER WATERSHEDS



Source: SEWRPC.

Appendix G

NOTICE OF MEETING AND AGENDA

NOTICE OF MEETING AND AGENDA

PUBLIC INFORMATIONAL MEETING ON THE
WAUKESHA COUNTY SOIL EROSION CONTROL PLAN AND
ANIMAL WASTE MANAGEMENT PLAN

Date: June 19, 1986

Time: 8:00 p.m.

Place: Brookfield Room
Waukesha County Office Building
500 Riverview Avenue
Waukesha, Wisconsin

1. Introductory Remarks (George L. Oncken, Natural Resource Agent, University of Wisconsin-Extension)

2. Soil Erosion Control Planning Program (Regional Planning Commission Staff)

    a. Program Origin and Objectives

        - State Soil Erosion Control Program
        - Waukesha County Soil Erosion Control Planning Program

    b. County Soil Erosion Control Planning Process

3. Animal Waste Management Planning Program (Regional Planning Commission Staff)

    a. Program Origin and Objectives

        - State Animal Waste Water Pollution Grant Program
        - Waukesha County Animal Waste Management Planning Program

    b. County Animal Waste Management Planning Process

Appendix H

LETTER OF INVITATION TO PUBLIC INFORMATIONAL MEETING

WAUKESHA COUNTY LAND CONSERVATION COMMITTEE
Waukesha County Office Bldg.
500 Riverview Ave - Waukesha, WI 53188 - Phone (414) 548-7767

October 8, 1986

Dear :

Would you like to improve the management of your barnyard, manure handling, and herd health, as well as to improve water quality in Waukesha County, while receiving 70 percent cost-sharing to make the necessary improvements? You may be eligible for such cost-sharing under the Wisconsin Farmers Fund Program. The Farmers Fund is a cost-sharing fund set aside by the State Legislature and administered by the Wisconsin Department of Agriculture, for the purpose of improving livestock operations which may pose pollution hazards to surface and groundwater.

Your farm is located in a priority area and may be eligible for cost-share grants at a 70 percent rate, up to $10,000. Technical assistance is available through the County Land Conservation Committee Office.

The following management options are eligible for cost-sharing grants under the Wisconsin Farmers Fund:

Barnyard runoff systems:
- Diversions
- Gutters and downspouts
- Filter strips, grassed waterways
- Settling basins
- Underground outlets
- Filter walls

Animal waste storage systems:
- Stacking facilities
- Earthen pits
- Concrete and steel tanks

In order to become eligible for cost-sharing, you must be willing to have an onsite evaluation of your farm done by the County staff. A public meeting to further explain the program will be held October 20, 1986, at 8:00 p.m. in the Oconomowoc City Hall.

We hope you are able to attend the meeting on October 20. This program offers an excellent opportunity for farmers to receive financial and technical assistance to enhance herd productivity and soil fertility and improve water quality as well. If you are unable to attend the October 20 meeting but would like more information about the program, please contact the Land Conservation Committee Office at (414) 548-7767.

Sincerely,

Tom Littwin Waukesha County
Conservationist

TL/aa

Appendix I

BARNYARD RUNOFF CONTROLS AND RELATED IMPROVEMENTS RECOMMENDED UNDER THE WAUKESHA COUNTY ANIMAL WASTE MANAGEMENT PLAN

Improvement Category	Operation 1		Operation 2		Operation 3		Operation 4		Operation 5	
	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost
Roof Runoff System.....	--	$ 4,890	--	$ 760	--	$ --	--	$ --	--	$ 1,000
Diversion.....	--	--	120 feet	2,160	--	--	--	--	--	--
Concrete Slab.....	--	--	170 cubic yards	13,600	30 cubic yards	2,400	100 cubic yards	8,000	20 cubic yards	1,600
Concrete Curb.....	--	--	120 feet	780	200 feet	1,300	90 feet	585	--	--
Concrete Wall.....	--	--	40 feet	340	20 feet	170	40 feet	340	--	--
Picket Wall.....	--	--	--	--	--	--	60 feet	420	--	--
Outlet Box.....	--	--	1	300	1	300	--	--	--	--
Weir (spreader box)....	--	--	1	250	1	250	--	--	1	250
Filter Strip.....	--	--	3,600 square feet	900	3,600 square feet	900	3,600 square feet	900	3,600 square feet	900
Pump.....	--	--	--	--	--	--	1	5,000	--	--
Transfer Pipe.....	--	--	--	--	--	--	200 feet	2,400	--	--
Concrete Settling Pad..	--	--	--	--	--	--	33 cubic yards	2,640	--	--
Concrete Storage Structure.....	--	--	--	--	--	--	--	--	--	--
Fill.....	--	--	60 cubic yards	360	20 cubic yards	120	--	--	310 cubic yards	1,860
Grading.....	--	5,000	--	1,200	--	900	--	1,500	--	900
Fencing.....	--	--	--	--	400 feet	500	--	--	--	--
Seed and Mulch.....	2 acres	240	3 acres	360	3 acres	360	2 acres	240	1 acre	120
Miscellaneous.....	--	--	--	--	--	--	--	720[a]	--	3,300[b]
Engineering.....	--	1,010	--	2,100	--	720	--	2,270	--	990
Total	--	$11,140	--	$23,110	--	$ 7,920	--	$25,015	--	$10,920

Improvement Category	Operation 6		Operation 7		Operation 8		Operation 9		Operation 10	
	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost
Roof Runoff System.....	--	$ 1,675	--	$ --	--	$ --	--	$ 800	--	$ 1,650
Diversion.....	100 feet	900	--	--	100 feet	300	--	--	--	--
Concrete Slab.....	83 cubic yards	6,640	--	--	40 cubic yards	3,200	110 cubic yards	8,800	70 cubic yards	5,600
Concrete Curb.....	50 feet	325	--	--	60 feet	390	160 feet	1,040	140 feet	910
Concrete Wall.....	90 feet	765	--	--	20 feet	170	40 feet	340	60 feet	510
Picket Wall.....	--	--	--	--	--	--	--	--	--	--
Outlet Box.....	1	300	--	--	1	300	1	300	--	--
Weir (spreader box)....	1	250	--	--	1	250	1	250	--	--
Filter Strip.....	3,600 square feet	900	--	--	3,600 square feet	900	3,600 square feet	900	--	--
Pump.....	--	--	--	--	--	--	--	--	1	5,000
Transfer Pipe.....	--	--	--	--	--	--	--	--	300 feet	3,600
Concrete Settling Pad..	--	--	--	--	--	--	--	--	--	--
Concrete Storage Structure.....	--	--	--	--	--	--	--	--	1	14,740
Fill.....	40 cubic yards	240	--	--	--	--	600 cubic yards	3,600	--	--
Grading.....	--	1,060	--	1,200	--	1,220	--	950	--	1,300
Fencing.....	800 feet	1,000	200 feet	250	3,000 feet	3,750	--	--	600 feet	750
Seed and Mulch.....	4 acres	480	--	--	1 acre	120	3 acres	360	2 acres	240
Miscellaneous.....	--	--	--	710[c]	--	130[d]	--	800[e]	--	1,080[a]
Engineering.....	--	1,450	--	220	--	1,070	--	1,810	--	3,540
Total	--	$15,985	--	$ 2,380	--	$11,800	--	$19,950	--	$38,920

Appendix I (continued)

Improvement Category	Operation 11		Operation 12		Operation 13		Operation 14		Operation 15	
	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost
Roof Runoff System	--	$ 1,760	--	$ 1,100	--	$ 800	--	$ 700	--	$ --
Diversion	500 feet	4,500	--	--	--	--	50 feet	850	500 feet	5,000
Concrete Slab	--	--	--	--	37 cubic yards	2,960	--	--	25 cubic yards	2,000
Concrete Curb	--	--	70 feet	455	--	--	--	--	--	--
Concrete Wall	--	--	--	--	--	--	--	--	--	--
Picket Wall	--	--	225 feet	3,600	--	--	--	--	--	--
Outlet Box	--	--	--	--	1	300	--	--	1	300
Weir (spreader box)	--	--	--	--	1	250	--	--	1	250
Filter Strip	--	--	--	--	3,600 square feet	900	--	--	3,600 square feet	900
Pump	--	--	--	--	--	--	--	--	--	--
Transfer Pipe	--	--	--	--	--	--	--	--	--	--
Concrete Settling Pad	--	--	70 cubic yards	5,600	--	--	--	--	--	--
Concrete Storage Structure	--	--	--	--	--	--	--	--	--	--
Fill	--	--	--	--	20 cubic yards	120	--	--	--	--
Grading	--	--	--	2,200	--	1,300	--	--	--	700
Fencing	2,000 feet	2,500	--	--	200 feet	250	--	--	--	--
Seed and Mulch	2 acres	240	1 acre	120	3 acres	360	--	--	5 acres	600
Miscellaneous	--	--	--	--	--	--	--	--	--	400[f]
Engineering	--	900	--	1,310	--	720	--	160	--	1,020
Total	--	$ 9,900	--	$14,385	--	$ 7,960	--	$ 1,710	--	$11,170

Improvement Category	Operation 16		Operation 17		Operation 18		Total	
	Units	Cost	Units	Cost	Units	Cost	Units	Cost
Roof Runoff System	--	$ --	--	$ --	--	$ 2,170	--	$17,305
Diversion	--	--	--	--	500 feet	5,000	1,870 feet	18,710
Concrete Slab	8 cubic yards	640	--	--	120 cubic yards	9,600	813 cubic yards	65,040
Concrete Curb	--	--	--	--	--	--	890 feet	5,785
Concrete Wall	--	--	--	--	--	--	310 feet	2,635
Picket Wall	--	--	--	--	215 feet	3,440	500 feet	7,460
Outlet Box	--	--	--	--	--	--	7	2,100
Weir (spreader box)	--	--	--	--	--	--	8	2,000
Filter Strip	--	--	--	--	--	--	32,400 square feet	8,100
Pump	--	--	--	--	--	--	2	10,000
Transfer Pipe	--	--	--	--	--	--	500 feet	6,000
Concrete Settling Pad	--	--	--	--	--	--	103 cubic yards	8,240
Concrete Storage Structure	--	--	--	--	--	--	1	14,740
Fill	--	--	--	--	--	--	1,050 cubic yards	6,300
Grading	--	500	--	900	--	5,300	--	26,130
Fencing	900 feet	1,125	700 feet	875	1,200 feet	1,500	10,000 feet	12,500
Seed and Mulch	4 acres	480	2 acres	240	5 acres	600	43 acres	5,160
Miscellaneous	--	480[g]	--	370[d]	--	--	--	7,990
Engineering	--	320	--	240	--	2,760	--	22,610
Total	--	$ 3,545	--	$ 2,625	--	$30,370	--	$248,805

[a] Concrete reception pit.

[b] Drain tile and outlets--$1,800; sediment box--$300; earth removal--$1,200.

[c] Cattle watering ramp: base and sub-base materials--$350; finishing--$360.

[d] Stone for cattle crossing.

[e] Earth removal.

[f] PVC pipe.

[g] Wood wall.

Source: Waukesha County Land Conservation Department and SEWRPC.