Swine Waste Management Education

Final Report

CWA Section 319(h) FY 1997
Nonpoint Source Pollution Program Task 220
Contract AG-95-EX-050
OSU Project Account 3-5-96150
Oklahoma Conservation Commission Task #100

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OSU
OKLAHOMA COOPERATIVE EXTENSION SERVICE

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Acknowledgements

The authors would like to express appreciation to all the Extension Educators in the Project region whose efforts helped make the field days and demonstration sites a success

The cooperation and support of NRCS personnel, especially Mike Barrick and Mark Moseley were instrumental in the Project's success.

The generosity of the many producers, kind enough to provide land for the demonstration sites, is much appreciated.

List of Commonly Used Abbreviations

BMP – Best Management Practice
Corp Comm – Oklahoma Corporation Commission
DEQ – Department of Environmental Quality
EQIP – Environmental Quality Incentives Program
FSA – Farm Service Agency
NPS – Non-Point Source
NRCS – Natural Resource Conservation Service
OCC – Oklahoma Conservation Commission
OCES – Oklahoma Cooperative Extension Service
ODA – Oklahoma Department of Agriculture
ODA-FD – Oklahoma Department of Agriculture-Forestry Division
ODWC – Oklahoma Department of Wildlife Conservation
OSE – Office of the Secretary of the Environment
OSU – Oklahoma State University
OWRB – Oklahoma Water Resources Board
PPP – Pollution Prevention Plan
TMDL – Total Maximum Daily Load
USFS – United States Forestry Service
USFWS – United States Fish and Wildlife Service
USGS – United States Geological Survey
WHIP – Wildlife Habitat Improvement Program

Table of Contents

Oklahoma Conservation Commission Task #100 ii
Acknowledgements iii
List of Commonly Used Abbreviations iv
Table of Contents v
Executive Summary vii
Task 1: Project Team Development vii
Task 2: Pollution Prevention Workshops vii
Task 3: Field Demonstrations vii
Task 4: Educational Materials Development vii
Task 5: Public Meetings viii
Task 6: Water Quality Monitoring viii
Final Report viii
Project Accomplishments viii
Project Evaluation and Impact viii
Final Project Report 1
Introduction 1
Project Area 1
Project Goals 2
Objectives for the Demonstration/Education Component 2
Project Management 2
Project Tasks 2
Task 1: Project Team Development 2
Task 2: Pollution Prevention Workshops 3
Task 3: Field Demonstrations 4
Task 4: Educational Materials Development 7
Task 5: Public Meetings 8
Task 6: Water Quality Monitoring 8
Project Accomplishments 8
Project Evaluation and Impact 9
Appendix A: Workplan 11
Appendix B: Arkansas Field Trip Agenda 17
Appendix C: In-Service Training May 1995 Agenda 23
Appendix D: In-Service Training Pre- and Post-Test 27
Appendix E: In-Service Training Phillips Farm Effluent Analysis 33
Appendix F: In-Service Training December 1998 Agenda 39
Appendix G: Kerr Center Field Day Agenda 43
Appendix H: 2G Farm Field Day Agenda 47
Appendix I: Fact Sheets 51
Appendix J: Record-Keeping Notebooks Table of Contents 73
Appendix K: Articles for 'Pork Pages' 77
Appendix L: Environmental Assurance Training Program Agenda 91
Appendix M: AWRA Conference Agenda 95
Appendix N: AWRA Conference Program 99

Executive Summary

This report details OCES activities from 1994 – 2000 in support of the education component for the FY 1997 CWA 319(h) Nonpoint Source Pollution Program grant, "Task 220: Swine Waste Management Education," (OCC Task #100, OSU Account No. 3-5-91650, Contract No. AG-95-EX-050.) The grant was administered by OCC. Key personnel at OSU included Project Director Michael D. Smolen (OCES Water Quality Programs Coordinator) and Project Manager Douglas W. Hamilton (OCES State Animal Waste Specialist).

This report details activities undertaken in support of five tasks defined to address the goal of the education component.

Task 1: Project Team Development

In-service training for project team and associated agency/industry personnel. (Includes travel to other states with established programs).

A team of OCES personnel and other natural resource professionals received background information on swine waste management and pollution prevention. This training enabled them to help contract swine producers understand and implement their waste management plans. Two in-service training sessions were held at the beginning and end of the project. The team also took a tour of swine waste handling facilities in Arkansas to see how a similar project was accomplished in an adjoining state.

Task 2: Pollution Prevention Workshops

Conduct producer workshops to write pollution prevention plans and develop record keeping systems.

Workshops were held on three different occasions in Shawnee, Holdenville, and Poteau, Oklahoma to train 12 contract hog operations (15 individuals) to use a pollution prevention record keeping system developed under Task 4. Four Tyson Company farm managers were also trained to use the system at a separate meeting in Holdenville.

Task 3: Field Demonstrations

Install field demonstrations for use in field days and self-directed tours and conduct field tours to demonstrate appropriate practices for management of wastes and recycling of nutrients.

Field demonstrations were developed at five different sites in southeastern Oklahoma to show how swine waste management can be an integral part of farm nutrient management planning. At least five field days and tours have been conducted using these facilities and the facilities of record book cooperators.

Task 4: Educational Materials Development

Develop fact sheets on waste management and nutrient recycling.

A series of fact sheets on animal waste management was initiated. The initial work plan also called for development of a video and newsletter. The Project Team transformed the video effort into development of a record system to make the records required by the EPA Region 6 CAFO permit more useful to operators. It was also determined that it

would be more effective to use the Oklahoma Pork Council's Newsletter (Pork Pages) as a vehicle to deliver educational content, than to create a second newsletter. In addition, project personnel gave input for a display panel at the 1997 Oklahoma Pork Congress that demonstrated swine waste contribution to non-point source pollution.

Task 5: Public Meetings

Hold public meetings to educate producers, potential producers, public officials, and news media.

Seven meetings were held for pork producers across the state of Oklahoma (three in southeastern Oklahoma) as a part of the National Pork Producers Council Environmental Assurance Training Program. The environmental assurance meetings emphasized awareness of environmental hazards. Producers in southeastern Oklahoma were made aware of the 319 swine waste education project and potential cooperators were recruited to participate in pollution prevention workshops covered in Task 2. Public officials and news media were educated in a conference held in conjunction with the Oklahoma section of the American Water Resources Association. The conference featured a workshop entitled, "Hog farming for the non-farmer", presentations on state of the art technology progress, and a field trip.

Task 6: Water Quality Monitoring

Monitor water quality and biology of receiving water bodies.

This task was the responsibility of the Oklahoma Conservation Commission. Their report is included in the appendices.

Final Report

This document, including appendices, is the final report.

Project Accomplishments

The original intent of this project was to educate pork producers in the Holdenville, OK area on swine waste management. This goal was accomplished and expanded to include all pork producers in southeastern Oklahoma. As a result of this project, Pork Producers, Extension Educators, Natural Resources Agency Personnel, Policy Makers, and the News Media received a greater appreciation of the environmental hazards associated with modern swine production and pollution prevention techniques available to lessen the hazards. A fact sheet series was initiated. A record-keeping system was developed to monitor pollution prevention. The record-keeping system was evaluated on sixteen contract and company swine production facilities. Five on-farm demonstrations of swine waste nutrient recycling were initiated. A monthly column in the state pork producers' newsletter was established.

Project Evaluation and Impact

Perhaps more important than the accomplishments of the stated goals of this project is the impact it has had on further educational and research efforts. The record-keeping system established in this project was further refined for dairy and poultry farms in another 319 project, "Small Farms Livestock Pollution Prevention". The poultry records are now standard records established by the Oklahoma Licensed Poultry Operations Act. Through this project, Oklahoma State University established links with the

Oklahoma Pork Council that have resulted in many cooperative educational programs. Farms of demonstrators and record book cooperators have been used for many tours by the pork production companies and others, including a stop on a tour conducted by the Oklahoma Governor's Task Force on Animal Waste Management. Cooperators have been involved in a number of continuing projects including: a water balance model for anaerobic lagoons developed by OSU, a study of sludge growth in lagoons by OSU, The National Pork Producers Council On-farm Odor Assessment and Odors Solutions Programs, OSU student design projects to develop odor assessment systems and lagoon close-out procedures, and a farm environmental assessment tool developed by the University of Missouri. We anticipate that the impacts of this project will continue to multiply in the future.

Final Project Report

This report details OCES activities from 1994 – 2000 in support of the education component for the FY 1997 CWA 319(h) Nonpoint Source Pollution Program grant, "Task 220: Swine Waste Management Education," (OCC Task #100, OSU Account No. 3-5-91650, Contract No. AG-95-EX-050.) The grant was administered by OCC. Key personnel at OSU included Project Director Michael D. Smolen (OCES Water Quality Programs Coordinator) and Project Manager Douglas W. Hamilton (OCES State Animal Waste Specialist).

Introduction

In 1994, southeastern Oklahoma was rapidly developing an intensive swine production industry. A major pork producing company (Tyson Foods), with headquarters in Arkansas, located a corporate office at Holdenville, Oklahoma. Tyson contracted with private farmers to produce pigs in McCurtain County near Idabel and in the vicinity of Holdenville. A small expansion from 21 to 28 growers was expected to occur in McCurtain County and a ten-fold expansion of swine production was expected within a 60-mile radius of Holdenville in a four-year period. At the same time, a second company, Cargill Pork, was also expanding in the vicinity of Poteau, Oklahoma. Although industry growth did occur, the overall expansion was more modest than originally expected. Only 54 contract operations were constructed in the Holdenville vicinity, as opposed to the expected 100.

Contract growers were provided with a loan package to cover costs of installing waste retention facilities, irrigation systems and other components of their waste management systems. Individual growers retained responsibility for managing the utilization or disposal of the swine wastes. There was little experience in proper management and utilization of these wastes in a pollution control system. Contract growers and their neighbors needed education about the environmental concerns associated with manure production and management and the concept of recycling nutrients through crops such as forage and livestock. Tyson Foods Pork Division (later changed to Pork Group, Inc), as well as Cargill, supported the program fully.

In this project, Oklahoma Cooperative Extension Service and Conservation District personnel worked together with small groups of producers to teach waste management and nutrient recycling concepts and to help them develop pollution prevention plans. By 1999, all of the 54 contract producers in the Holdenville area implemented animal waste management through their local conservation district. Producers utilize Extension resources and personnel extensively to implement their pollution prevention plans.

Project Area

The project focused on three areas of Oklahoma; the Holdenville area, which includes Hughes, Seminole, Pontotoc, and Okfuskee counties, the Idabel area in McCurtain County, and the Poteau area, which includes LeFlore and Haskell counties. The Holdenville area drains primarily into the Canadian River and Lake Eufaula. The Idabel

and Poteau areas drain into the Red and Arkansas Rivers, respectively. Each of these areas is sensitive to nutrients from animal waste.

Project Goals

The objective of this activity was to control potential pollution from concentrated swine production facilities and swine waste disposal areas by educating swine producers about pollution prevention, helping them develop pollution prevention plans, and demonstrating appropriate technology for waste management and waste nutrient recycling. Producers learned about record keeping, proper use of animal waste nutrients in their cropping/grazing systems, and the value of the waste in alternative management systems. Public officials learned what environmental concerns exist and what practices and regulations are in place or needed to assure protection of the environment. The news media and the public learned what swine producers are doing to protect the environment from pollution.

Objectives for the Demonstration/Education Component

The Cooperative Extension Service, with assistance from the Conservation Commission, Conservation Districts, and the State Department of Agriculture, conducted educational programs for agency staff and agricultural producers. Educational programs included in-service training for staff, workshops and field demonstrations for small groups of producers, and general educational programs for agricultural producers, public officials and news media.

Project Management

OCC supervised the overall project. OCES was enlisted to develop and implement the education component. OCES Water Quality Coordinator Mike Smolen served as Project Director and OCES State Animal Waste Specialist, Douglas W. Hamilton, was Project Manager.

Project Tasks

The objectives of the education component included five different tasks. A copy of the workplan is provided as Appendix A. A listing of the five tasks with a discussion of the education/demonstration activities undertaken follows.

Task 1: Project Team Development

In-service training for project team and associated agency/industry personnel. (Includes travel to other states with established programs).

Under this task, a group of OCES personnel and other natural resource professionals received background information on swine waste management and pollution prevention to enable them to help contract swine producers understand and implement their waste management plans.

On April 5-6, 1995, 9 members of the team took a tour of swine waste handling facilities near Mineral Springs and Nashville, Arkansas. Agenda and map for the trip are included as Appendix B. The state of Arkansas had undertaken a similar 319 project on swine waste management, beginning in 1992. This trip provided a valuable opportunity

to explore the benefits and pitfalls of conducting such an education project. During the tour, team members attended a field day that included demonstrations of holding pond agitation equipment and a big gun irrigation calibration. The team also reviewed the results of an intensive grazing study using swine effluent. After the field day, team members visited a dead hog composting facility.

Two in-service training sessions were held at the beginning and end of the project. The first in-service lasted two days (May 11-12, 1995). Agenda is included as Appendix C. The first day included classroom instruction on waste management systems, a review of the parts of an NRCS Animal Waste Management Plan, presentation of waste nutrient recycling concepts, and an in-depth look at lagoons and lagoon water balance. Pre- and Post-Testing was conducted on participants after the first day of in-class training. Test Sheets and results are given in Appendix D. The second day was spent in the field on the LeRoy Phillips farm. Here the team saw how an Animal Waste Management Plan was implemented for a specific farm. The difference between lagoons, holding ponds, and settling basins was also demonstrated by observing the technology first-hand. Samples were taken of material irrigated from a settling basin and from a lagoon. A follow-up explanation of the analysis was mailed to team members (Appendix E).

A second in-service was held at the conclusion of the project on December 18, 1998. Agenda is included in Appendix F. Team members were given information gathered from the on-farm demonstrations (Task 3), record keeping notebooks (Task 4), and a tutorial on how pork producers could use the notebooks to follow their pollution prevention plans.

Task 2: Pollution Prevention Workshops

Conduct producer workshops to write pollution prevention plans and develop record keeping systems.

The local conservation districts assisted producers in developing pollution prevention plans. Fifty-four plans were completed in the Holdenville area for Tyson contract growers. This is less than the 75 plans anticipated, but expansion did not occur as projected. All of the Tyson contract growers developed plans.

Under Task 4, a record-keeping notebook was developed to supplement the records required through the CAFO general permit. Records were written so that producers could track the flow of liquids and nutrients through a cropping year and potentially assign a dollar value to nutrient recycling. Operators were taught to use the notebooks in small group workshops. Workshops were held on three different occasions in Shawnee (December 17, 1996), Holdenville (December 19, 1996), and Poteau (May 13, 1997), Oklahoma, to train 12 contract hog operations (15 individuals). Four Tyson Company farm managers were also trained to use the system at a separate meeting in Holdenville (March 13, 1997). Name of farm, location of farm, and number of notebooks distributed are listed in Table 1.

Table 1. Synopsis of Farms Represented at Pollution Prevention Workshops.

Farm Name	Type	County Located	Meeting Site	Notebook #
Stabel	Tyson Contract	Pottawatomie	Shawnee 12-17-96	5
Rickey	Tyson Contract	Pottawatomie	Shawnee 12-17-96	4
Werner	Tyson Contract	Pottawatomie	Shawnee 12-17-96	6
Hardin	Tyson Contract	Hughes	Shawnee 12-17-96	9
2G	Tyson Contract	Hughes	Shawnee 12-17-96	8
Baker	Tyson Contract	Hughes	Holdenville 12-19-96	14
Bishop	Tyson Contract	Hughes	Holdenville 12-19-96	10
Allen	Tyson Contract	Hughes	Holdenville 12-19-96	15
Home	Tyson Company	Hughes	Holdenville 3-13-97	27
AI	Tyson Company	Hughes	Holdenville 3-13-97	28
Nursery	Tyson Company	Hughes	Holdenville 3-13-97	12
Tree	Tyson Company	Hughes	Holdenville 3-13-97	13
Brewer	Cargill Contract	LeFlore	Poteau 5-13-97	25
Treadway	Cargill Contract	LeFlore	Poteau 5-13-97	26
Oeschlager	Cargill Contract	LeFlore	Poteau 5-13-97	29
Wright	Cargill Contract	LeFlore	Poteau 5-13-97	30

The project manager followed up with cooperators to determine use and improve the records. As of 1999, four contract producers were using the records exactly as trained with only minor modifications. The remaining eight used a portion of the record sheets with their existing CAFO records. Record books developed with this project were used in further refinements of books developed for dairy and poultry farms under the related 319 Project, “Small Farms Livestock Pollution Prevention”.

Task 3: Field Demonstrations

Install field demonstrations for use in field days and self-directed tours and conduct field tours to demonstrate appropriate practices for management of wastes and recycling of nutrients.

Field demonstrations were developed at five different sites in southeastern Oklahoma. Three of the five demonstrators (identified in parentheses) also helped in the development of record books.

Extension Personnel working on demonstrations in the eastern half of the district were Steve Smith (Area Livestock Specialist), Jim Enis (Area Agronomist), Joe Bullard (LeFlore County Water Quality Agent), Marty Green (Haskell County Agriculture Agent), and Dennis Bailey (McCurtain County Extension Director). Four potential

demonstrations were identified, three of which developed into on-going projects. The sites varied according to location, topography, type of waste handling system, and land application equipment. All demonstrations focused on nutrient management of swine waste in grazing systems.

Haskell County (Treadway)
This site was a new 500-sow facility operated under contract with Cargill. The producer uses a two-stage lagoon to treat and store waste. Swine lagoon effluent is spread with a traveling gun on a field partitioned into four treatments: grass + effluent, grass + interseeded legumes + effluent, grass + commercial fertilizer, and grass + interseeded legumes + fertilizer. Initial soil samples were collected from the application site. Effluent application rates were calculated from soil samples and results of effluent samples. Grazing exclosures were constructed to monitor forage production and quality. Forage nutrient content, along with continuing soil and manure testing, was used to monitor nutrient status of the application site.

LeFlore County (Oeschlager)
This is a 500-sow Cargill facility identical to the Haskell County site. However, the producer uses a single stage lagoon and stationary gun. Application is less frequent than at the Haskell County site. Emphasis was on management of system to maintain liquid balance in the lagoon and nutrient recovery on the application site. Preliminary soil and effluent samples were collected.

McCurtain County
The site is a Tyson finisher operation using a debris basin/lagoon system. The producer makes efficient use of the debris basin slurry, irrigating with a big gun on the average of every three weeks during the growing season. Bermuda grass is used for both grazing and hay. Forage production (quantity and quality), as well as soil nutrient balance, in the existing system was monitored.

Extension Personnel working with demonstrators in the western half of the district were Jack Wallace (Area Animal Science Specialist), Jim Enis (Area Agronomist), Don Britton (Pottawatomie County Extension Director), Joe Benton (Seminole County Extension Director), and Monroe Sumter (Hughes County Extension Director). Two demonstrators were identified. Both facilities demonstrated use of anaerobic lagoon effluent in grazing systems.

Pottawatomie County (Rickey)
The site is a Tyson contracted finisher unit. Although a finisher unit in name, the facility is equipped to either finish hogs for market or to produce replacement gilts. Feed rations for finishers and replacement gilts are similar, so waste characteristics were not expected to vary considerably with time. Three thousand six hundred hogs can be housed on the farm at any given time. Manure is flushed into a single-cell anaerobic lagoon. The producer was interested in optimizing a cow-calf grazing operation using lagoon effluent. One hundred twenty to one hundred sixty acres are available for grazing. The total acreage is divided into two, equal 60-acre areas. One 60-acre plot received no effluent. The second 60-acre plot received effluent and was further subdivided into two 30-acre plots to include a weed control component. So, a total of three treatments, no effluent, effluent alone, and effluent + 2.4 D, were tested. Cattle

were separated into treatment and control groups and weighed July 5, 1995. The control group averaged 703 lbs per head and the treatment group averaged 722 lbs per head. In October, cattle were weighed again and total gain and average daily gain calculated. Clippings were taken from excluded areas to determine forage quantity and quality. Cattle performance testing continued throughout the life of the demonstration. Soil samples were removed from both control and treatment areas. These results, combined with effluent monitoring and financial records, will be used to determine the optimum grazing area to recycle nutrients.

Seminole/Hughes

This demonstration is located on the Seminole/Hughes county line. The demonstrator does not raise hogs, but allows his acreage to be used as an application site for a Tyson company-owned facility. This producer is in the business of buying and grazing stocker calves. The demonstration is designed to evaluate the grazing performance of stocker steers on a combination warm season/cool season pasture receiving lagoon effluent. The demonstration area was broken into three treatments: no effluent or commercial fertilizer, commercial fertilizer, and effluent. Fertilizer applied with effluent was matched to commercial fertilizer rates using effluent sampling. Soil samples were taken from treatment and control areas to provide nutrient accumulation data.

At least five field days and/or tours were held on the farms of demonstrators and record book cooperators between 1995 and 1998.

Kerr Center for Sustainable Agriculture: August 7, 1996

This field day was held as part of another 319 Project to demonstrate the use of a rainfall simulator on runoff plots. Effluent from the Oeschlager farm was used to compare runoff from plots irrigated with swine lagoon effluent to plots with various loading rates of poultry litter and commercial fertilizer. Agenda is found in Appendix G.

Baker Farm: August 28, 1997

The Baker farm was a stop on a tour of swine facilities in Hughes County for the Oklahoma Governor's Task Force on Animal Waste. The operator demonstrated her use of records to maintain water and nutrient balance. The task force and media entourage also visited an aeration project underway in the Baker Lagoon.

2G Farm: October 10, 1997

This was a major field day for the Tyson Pork Group. All of the contract growers and company farm managers, as well as company service personnel, were required to attend. Agenda is attached as Appendix H.

Rickey-Stabel Farms: February 10,1998

Douglas Hamilton gave a tour of these two farms to a group of Environmental Science Seniors from Oklahoma State University working on a design project for odor control.

Stabel Farm: November 9, 1998

Douglas Hamilton and Ronald Elliott conducted a tour of the Stabel farm for a group of Biosystems Engineering Seniors working on a project to optimize design of swine waste handling facilities.

Task 4: Educational Materials Development

Develop fact sheets on waste management and nutrient recycling.

A series of fact sheets on animal waste management was initiated. Fact sheets are provided in Appendix I. Factsheets developed during this project included:

F-1734-What is a waste management system?

F-1735-Production and Characteristics of Swine Manure

F-1736-Lagoons for Livestock Waste Treatment

F-2245-Using Lagoon Effluent as Fertilizer

F-2248-How to Get a Good Manure Sample

The initial work plan also called for development of a video and newsletter. The Project Team transformed the video effort into development of a record system to make the records required by the EPA Region 6 CAFO permit more useful to operators. The Table of Contents for the notebook is given in Appendix J. The idea of the records was to allow producers to track the movement of nutrients through the farm. A worksheet is provided to estimate volume of liquids and mass of nutrients produced on the farm each year. The worksheet also allows the producer to calculate potential value of nutrients produced on the farm each year. The storage record, along with a stage-storage curve, allows the operator to determine the volume of effluent potentially available for irrigation at any point in time. Field sheets allow the operator to keep a running total of nutrients added to the field each year. Finally, the nutrients utilized on the entire farm can be determined using the summary sheet. This allows the producer to calculate the potential dollar value of the fertilizer elements and to determine the consequent fertilizer savings.

It was also decided that using the Oklahoma Pork Council's Newsletter, Pork Pages, as a vehicle to deliver educational content would be more effective than creating another newsletter for the producers in the region. Every pork producer who sells or contracts to sell hogs in the state of Oklahoma receives a copy of Pork Pages. A sampling of articles, beginning in November 1998, is given in Appendix K. As can be seen in Appendix K, the message given in the articles is proper management of swine manure. At the time the articles were written, pork producers' greatest concern was reduction of odors; therefore, the bent of the articles was management to control odors. However, management to preserve air quality is also management to preserve water quality. Producers' concerns have now returned to water quality -- compliance with the unified AFO strategy and comprehensive nutrient management plans -- future Pork Pages articles will be more oriented towards water quality protection.

In addition, input was given to build a display panel that demonstrated swine waste contribution to non-point source pollution. Southeast Area Extension Aquaculture Specialist Marley Beem presented the display at the 1997 Oklahoma Pork Congress.

Task 5: Public Meetings

Hold public meetings to educate producers, potential producers, public officials, and news media.

Seven meetings were held for pork producers across the state of Oklahoma (three in southeastern Oklahoma) as a part of the National Pork Producers Council Environmental Assurance Training Program (Table 3). The environmental assurance meetings emphasized awareness of environmental hazards. Agenda of the meeting is included as Appendix L. Producers in southeastern Oklahoma were made aware of the 319 swine waste education project and potential cooperators were recruited to participate in pollution prevention workshops covered in Task 2.

Table 3. Public Meetings for Pork Producers.

Location	Date	Attendance
McAlester, OK*	April 4, 1996	80
El Reno, OK	April 9, 1996	10
Guymon, OK	April 16, 1996	40
Enid, OK	August 13, 1996	20
Broken Bow, OK*	August 26, 1996	40
Poteau, OK*	November 19, 1996	40
Oklahoma City, OK	February 22, 1997	20

*Located within project boundaries

Public officials and news media were educated in a conference held in conjunction with the Oklahoma section of the American Water Resources Association on March 2-4, 1998 (Agenda included as Appendix M). The conference began with a workshop entitled, “Hog Farms for the Non-farmer” and contained a series of lecture and poster sessions on the environmental aspects of animal waste. The conference had a lunchtime panel discussion lead by members of the Oklahoma Legislature. Several faculty members from Oklahoma State University gave state of the technology papers on animal waste (Program included as Appendix N). The conference concluded with a tour of a Land of Lakes swine production facility.

Policy makers and media toured a demonstration cooperating with this project when the Governors Task Force on Animal Waste chose to visit the Baker farm in Hughes County on August 28, 1997.

Task 6: Water Quality Monitoring

Monitor water quality and biology of receiving water bodies.

This task was the responsibility of the Oklahoma Conservation Commission. Their report is included in the appendices.

Project Accomplishments

The original intent of this project was to educate pork producers in the Holdenville, OK area on swine waste management. This goal was accomplished and expanded to

include all pork producers in southeastern Oklahoma. As a result of this project, Pork Producers, Extension Educators, Natural Resources Agency Personnel, Policy Makers, and the News Media received a greater appreciation of the environmental hazards associated with modern swine production and pollution prevention techniques available to lessen the hazards. A fact sheet series was initiated. A record-keeping system was developed to monitor pollution prevention. The record-keeping system was evaluated on sixteen contract and company swine production facilities. Five on-farm demonstrations of swine waste nutrient recycling were initiated. A monthly column in the state pork producers' newsletter was established.

Project Evaluation and Impact

Perhaps more important than the accomplishments of the stated goals of this project is the impact it has had on further educational and research efforts. The record-keeping system established in this project was further refined for dairy and poultry farms in another 319 project, "Small Farms Livestock Pollution Prevention". The poultry records are now standard records established by the Oklahoma Licensed Poultry Operations Act. Through this project, Oklahoma State University established links with the Oklahoma Pork Council that have resulted in many cooperative educational programs. Farms of demonstrators and record book cooperators have been used for many tours by the pork production companies and others, including a stop on a tour conducted by the Oklahoma Governor's Task Force on Animal Waste Management. Cooperators have been involved in a number of continuing projects including: a water balance model for anaerobic lagoons developed by OSU, a study of sludge growth in lagoons by OSU, The National Pork Producers Council On-farm Odor Assessment and Odors Solutions Programs, OSU student design projects to develop odor assessment systems and lagoon close-out procedures, and a farm environmental assessment tool developed by the University of Missouri. We anticipate that the impacts of this project will continue to multiply in the future.

Appendix A: Workplan

Agency:

Oklahoma Conservation Commission and Oklahoma Cooperative Extension Service

Title:

Swine Waste Management Education

Project Number:

Project Statement:

Southeastem Oklahoma is rapidly developing an intensive swine production industry. A major pork producing company (Tyson Foods), with headquarters in Arkansas, has located a corporate office at Holdenville, Oklahoma. Tyson contracts with private farmers to produce pigs in McCurtain County near Idabel and in the vicinity of Holdenville. A small expansion from 21 to 28 growers is expected to occur in McCurtain County, and a ten-fold expansion of swine production is expected within a 60-mile radius of Holdenville in the next four years.

When expansion is complete in the Holdenville area the company expects to have 100 contract growers feeding more than 3500 tons of feed per week to 60,000 sows and more than 115,000 pigs. Total production will be more than I million pigs per year. Although contract growers will be provided with a loan package to cover costs of installing waste retention facilities, irrigation systems and other components of their waste management systems, the individual growers retain responsibility for managing the utilization or disposal of the swine wastes.

A tremendous amount of swine wastes will be produced by contract growing facilities in the Holdenville and McCurtain County areas, but there is little experience in proper management and utilization of these wastes in a pollution control system. Contract growers and their neighbors need education about the environmental concerns associated with manure production and management and the concept of recycling nutrients through crops such as forage and livestock.

Tyson Foods supports this program fully. They routinely offer waste testing as a service to their contract growers and encourage them to use proper handling and disposal practices. However they have no direct authority over the management practices of individual contract growers, and they feel they may lack credibility in the area of waste management and crop production. Extension Service programs can fill this need directly. Extension with support from local Conservation Districts will help individual producers develop and implement their pollution prevention plans.

In this project, Oklahoma Cooperative Extension Service and Conservation District personnel will work with small groups of producers to teach them waste management and nutrient recycling concepts and to help them develop pollution prevention plans. Sites will be developed on cooperating farms to demonstrate the replacement of fertilizer with waste liquids and solids, management and selection of vegetation to recycle waste nutrients efficiently, and grazing systems for conversion of waste nutrients.

Project Area Description:

The project will focus in two areas of Oklahoma, the Holdenville area, which includes Hughes, Seminole, Pontotoc, and Okfuskee counties, and the Idabel area in McCurtain County. The Holdenville area drains primarily into the Canadian River and Lake Eufaula, and the Idabel area drains into the Red River. Each of these areas is sensitive to nutrients from animal waste.

Activity I.D.: III-9

Activity Description

Cooperative Extension Service with assistance from the Conservation Commission, Conservation Districts, and the State Department of Agriculture will conduct educational programs for agency staff and agricultural producers. Educational programs will include: in-service g for staffs, workshops and field demonstrations for small groups of producers, and general educational programs for agricultural producers, public officials and news media.

Participants and Target Audience:

Agency field staff from Extension, Conservation Districts, the State Department of Agriculture, and the Swine industry, as well as agricultural equipment suppliers will be trained in management of waste retention and handling facilities and reuse of waste nutrients in cropping and grazing systems. This activity will also seek to educate nearby producers who are considering animal waste as a source of nutrients and organic matter for their crop and for media and public officials who are concerned about environmental protection.

Activity Objectives:

The objective of this activity is to control potential pollution from concentrated swine production facilities and swine waste disposal areas by educating swine producers about pollution prevention, helping them develop their own pollution prevention plans, and demonstrating appropriate technology for waste management and waste nutrient recycling. Producers should learn about record keeping, proper use of animal waste nutrients in their cropping/grazing systems, and the value of the waste in alternative management systems. Public officials should learn what environmental concerns exist and what practices and regulations are in place or needed to assure protection of the environment, and news media and the public should learn what swine producers are doing to protect the environment from pollution.

Milestones:

Activity	Target Date
Establish coordinating committee of county Extension specialists and district conservationists (Project Team)	Monthly beginning agents, July 1994
Establish oversight committee consisting of Extension Service, Conservation Commission, Department of Agriculture, Industry representatives	Quarterly beginning Sept 1994
Select field sites for demonstrations	July – Sept., 1995

Quarterly report to Conservation Commission	Begin Sept 30, 1994
In-service training for project team (includes travel to Arkansas or Missouri)	March – May 1995
Conduct Pollution Prevention Planning Workshops with small groups of producers.	Sept 1995 – Sept 1997
Producer meetings	Sept l995 – Feb 1996
Field Days for producers	Nov 1995, April 1996, July 1996
Annual Report to Conservation Commission	Sept 1995, Sept 1996
Public meeting and tours	July 1996
Final Report	Sept 30, 1998

Activity I.D.: III-11

Activity Description

Animal waste problem evaluation; specific problem evaluation and selective monitoring to assess animal waste management effectiveness to protect surface and ground water as well as wetland areas and endangered species critical habitat areas.

Participants and Target Audience:

Coordinate with the local conservation districts, the Department of Environmental Quality, the State Department of Agriculture, and the Soil Conservation Service to identify where pollution occurs in surface or ground waters. Monitor reference streams to document existing conditions and changes that result from expanding animal industry or improvements due to BNV implementation.

Activity Objectives:

Conduct a monitoring program to characterize the water quality and stream ecology to measure project effectiveness.

Milestones:

Activity	Target Date
1. Develop Q/A plan.	July 1994
2. Select monitoring sites.	July 1'994
3. Begin quarterly monitoring	August 1994
4. Prepare annual monitoring report	July 1995, 1996, 1997
5. Final Monitoring Report	July 1998

Project Management:

Oversight for this project will be provided by the Oklahoma Conservation Commission and the Extension Water Quality Coordinator. The project coordinator is aware that any operations which fall under the requirements of the CAFO permit are not eligible for Section 319(h) funded activities associated with this projects Funding can be used to provide assistance to small operators only if those operations have not been sl2ecificallv designated by EPA as causing significant water pollution problems.

Measures of Success:

The project will be evaluated on the number of producers who develop pollution prevention plans for swine waste, the level of understanding improvement resulting from

workshops, attendance at field days and other educational programs, and water quality indicators showing no significant deterioration from expansion of the swine industry.

Project Outputs:

1. Seventy-five pollution prevention plans developed by swine producers.
2. Six field days to demonstrate proper use of swine waste liquids and solids in agricultural management systems to recycle nutrients without pollution of water resources.
3. Thirty-five agency personnel trained on pollution prevention planning for animal waste.
4. Fact sheets: "Environmental Impact of Swine Waste Utilization," Recycling Swine Waste Nutrients through Agricultural Systems," "Management of Waste Retention Systems to Prevent Discharge to the Environment," and reports to producers on what is shown in demonstration plots.
5. Training video for producers considering swine production.
6. Public education program for news media, legislators, and environmentalists.
7. Monthly newsletter to swine growers and users of swine waste liquids and solids.

Project Duration:

July 1, 1994 through September 30, 1997

Project Tasks:

Description	Allocation
TASK 1. In-service training for project team and associated agency/industry personnel. (Includes travel to other states with established programs).	$5,000
TASK 2. Conduct producer workshops to write pollution prevention plans and develop record keeping systems.	$8,000
TASK 3. Install field demonstrations for use in field days and self-directed tours and conduct field tours to demonstrate appropriate practices for management of wastes and recycling of nutrients	$24,000
TASK 4. Develop videos and fact sheets on waste management and nutrient recycling.	$6,000
TASK 5. Hold public meetings to educate producers, potential producers, public officials, and news media.	$2,000
TASK 6. Monitor water quality and biology of receiving water bodies.	$15,000

Resource Support:

Federal	$36,000
State	$24,000
Total	$60,000
Remaining Balance:	**$25,341.57**

Appendix B: Arkansas Field Trip Agenda

Oklahoma Cooperative Extension Service

Division of Agricultural Sciences and Natural Resources
Oklahoma State University

DATE: March 30, 1995

Extension Agents Participating in Swine Waste Management Tour

FROM: Jack Dale Wallace, Area Ext. Livestock Specialist,
S.E. District

Agenda for Tour

Gentlemen,

Please find enclosed a detailed agenda for the upcoming Swine Waste Management tour to Arkansas. For those of you that wish to catch the bus here at Ada, you will need to be here at the extension office located on the fairgrounds before 1:00 p.m. We will most likely take Highway 3 to Broken Bow and could possibly pick up one or two of you along the way if that would be more convenient for you. If so, let me know in advance (when and where to meet you) so no one will be left behind.

We should return to Ada between 7:00 and 8:00 p.m. on Thursday, April 6, 1995. If you have any questions, just give me a call.

Steve Smith	Doug Hamilton
Jim Ennis	Mike Smolen
Marley Beem	Claude Bess
Monroe Sumter	Dennis Bailey
Bill Luce	Gerald Claywell
John Thomas (Tyson Foods)	

Oklahoma State University, U. S. Department of Agriculture, State and Local Governments cooperating. Oklahoma Cooperative Extension Service offers its programs to all eligible persons regardless of race, color, national origin, religion, sex, age or disability and is an Equal Opportunity Employer.

24

Cooperative Extension Service

University of Arkansas, United States Department of Agriculture, and County Governments Cooperating

MAR 28 1995

421 North Main Street
Nashville, Arkansas 71852
March 22, 1995

Dear Pork Producer:

The University of Arkansas Cooperative Extension Service will conduct an irrigation calibration clinic on April 6 at Ken Sights' farm, south of Mineral Springs, Arkansas. The clinic will begin at 10 a.m. and will conclude by noon.

The clinic will include demonstrations of irrigation calibration and lagoon agitation. It will also include a discussion of phosphorous management through forage production. This program will be valuable in helping pork producers stay in compliance with liquid waste regulations.

There is a map on the back of this letter to help you locate the Sights farm. If you need further information, call me at 845-7517.

Sincerely,

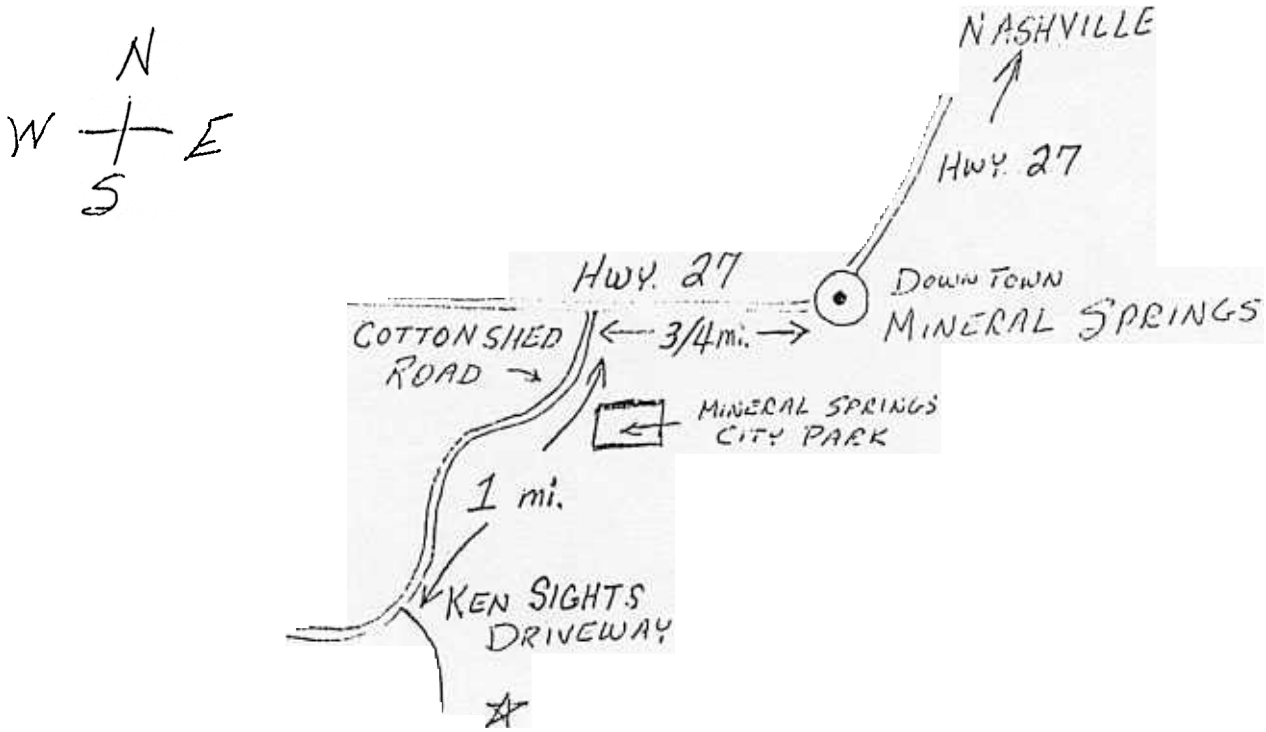
Marc Neathery
County Extension Agent
Agriculture/Comm. Dev.

MN:ss

The Arkansas Cooperative Extension Service offers its programs to all eligible persons regardless of race, color, national origin, sex, or handicap, and is an Equal Opportunity Employer.

25

Irrigation Calibration Clinic
Ken Sights Farm
Mineral Springs, Arkansas
April 8, 10 a.m.



Going west out of Mineral Springs on Highway 27, look for signs to Cottonshed Landing and Mineral Springs City Park. Follow those signs, stay on black-top road through several curves. Look for Ken Sights Poultry and Swine Farm signs on the left after going one mile off Highway 27.

27

ARKANSAS WASTE MANAGEMENT
EDUCATIONAL TOUR AGENDA

April 5, 1995

10:00 a.m.	Leave Stillwater – OSU Parking Lot, northeast corner of intersection of Monroe and Farm Road.
1:00 p.m.	Leave Ada – County Extension office, Fairgrounds.
6:00 p.m.	Arrive Nashville, AR – Spend night at Southern Belle Motel, phone 501-845-2353.

April 6, 1995

10:00 a.m.	Field Day – Ken Sight Farm, Mineral Springs, AR.
12:30 p.m.	Lunch with Mike Phillips, Superintendent, Arkansas Research and Extension Center, Hope, AR.
2:00 p.m.	Return to Oklahoma

Appendix C: In-Service Training May 1995 Agenda

Proposed Agenda for
Swine Waste Education InService

Objectives: After this inservice, an agent will be able to:

1. Sit down with a producer and explain the components and functions of a manure handling system.
2. Work through calculations and assumptions necessary to prepare a CAFO pollution prevention plan.
3. Teach a producer how to use CAFO record books to stay in compliance with the terms of the general permit.

Day One - Classroom (5 or 6 Hours)

I. Introduction. (Jack Wallace) 15 Min.
II. Systematic Approach. (Doug Hamilton) 45 Min.
   A. Overview of Animal Waste Handling Systems
   B. Manure Production, Spreadsheet Introduction
   C. Building Systems and Transport
III. Storage and Treatment. (Doug Hamilton) 45 Min.
   A. Current Options
   B. Use of Spreadsheet to Size Options
   C. Other Treatment Issues
   D. Equipment for Land Application
IV. Land Application. (Mark Moseley - NRCS Range Conservation, Grazing Lands Specialist located at State Office in Stillwater) 45 Min
   A. Nutrient transformations
   B. Animal Waste Management Plans
   C. Waste Management Plans Tied into Overall Conservation Planning
V. Catch-Up and Work Time for Waster Management Plans. 45 Min
VI. Pollution Prevention Plans. (Mike Smolen or Doug Hamilton) 45 Min.
   1. What CAFO/FYA require
   2. CAFO record books

Day 2 - in the Field (4 Hours)

I. Walk Through of Overall Hog Facilities (Producer)
II. Walk through of Specific Waste Management Plan (Mike Barrick, NRCS Soil Conservationist, Holdenville Field Office)
III. Manure sampling, application depth (Doug Hamilton)

Resource Materials:

1. Agricultural Waste Management Field Handbook. USDA- NRCS.
2. Livestock Waste Facilities Handbook. Midwest Plan Service.
3. CAFO Record Book. OSU Cooperative Extension Service.
4. Other materials identified by presenters.

Scope of Course:

The nature of the inservice will be as "hands on" as possible.

Although the first day's outline is written in a lecture format, agents will be broken into groups and work on specific problems. Doug Hamilton has developed a spreadsheet that takes animal numbers and assists the design of storage facilities. Starting with the animal numbers typical of three or four Tyson facilities, groups of agents will develop both a lagoon and storage ponds for those farms. Mark Moseley will discuss how waste management plans are developed. Agents will then create a basic waste management plan for one of their storage/treatment scenarios. Finally, Mike Smolen will use the CAFO books to show how record keeping, employee training, manure testing, soil testing, discharge sampling, and maintenance tie into pollution prevention plans.

On the second day, agents will visit a swine facility. The farm will be one of the waste management plans worked on during the previous day. The landowner will walk agents through the swine production process. Mike Barrick will show how NRCS fit the waste management plan to reality. Doug Hamilton will discuss the whys and wherefores about manure testing and sample taking.

Appendix D: In-Service Training Pre- and Post-Test

Pre-Test

1. How often should a producer clean the solids out of his lagoon ? _____

2. How often should a producer clean the solids out of his storage pond ? _____

3. In an average year, a Hughes County Tyson contractor with a 600 sow unit and a facultative lagoon will irrigate about _____ inches over a 30 acre application site.

4. A producer should try to maintain lagoon liquid level between which of the following limits:

   a. freeboard and maximum operating level.
   b. maximum operating level and maximum drawdown level.
   c. freeboard and 10 year sludge level.
   d. c. maximum drawdown level and 10 year sludge level.

5. Approximately how much of the phosphorus removed with forage is recycled back to pasture in cattle manure?
   a. 10 - 20 %
   b. 40 - 50%
   c. 60 - 70%
   d. 80 - 90%

6. Stacy Q. Sowbelly contracts with Tyson to produce nursery pigs in Pontotoc County. She has a single-stage anaerobic lagoon. During the winter, she recycles lagoon liquids back into her buildings for flushwater. Come spring, she irrigates liquids on an adjoining pasture with a stationary gun. If she applies one inch of liquids, what is the approximate fertilizer value of the irrigation water?

   a. 100 lbs N, 50 lbs P_20_5, and 50 lbs K_20 per acre.
   b. 50 lbs N, 100 lbs P_20_5, and 50 lbs K_20 per acre.
   c. 50 lbs N, 50 lbs P_20_5, and 100 lbs K_20 per acre.

7. Stacey should send a sample of her irrigation water to _____ to have it analyzed for nutrients. Cost to have the sample analyzed for Solids Content, Total-N, Ammonia-N, Total-P, Total-K, pH, Ca and soluble salts is _____ dollars.

8. The terms of Stacy's CAFO permit require her to analyze manure applied to a field for:

   a. Fecal coliform bacteria
   b. Total-N, Ammonia-N, Total-P, Total-K
   c. BOD_5 and Suspended Solids
   d. All of the above
   e. None of the above

Post-Test

1. Ernest T. Porcine contacts with Tyson to produce finishers in Pottawatomie County. He has a single stage facultative lagoon. During the winter, he recycles lagoon liquids back to his buildings for flushwater. In the spring he irrigates liquids on Bermuda grass pasture with a big traveling gun. If he applies one inch of liquids, what is the approximate fertilizer value of the irrigation water.

a. 100 lbs N, 50 lbs P_20_5, 50 lbs K_20
b. 50 lbs N, 100 lbs P_20_5, 50 lbs K_20
c. 50 lbs N, 50 lbs P_20_5, 100 lbs K_20

2. Approximately how much of the applied phosphorus do Ernest's Brangus cattle recycle back to the pasture?

a. 90 to 80% b. 70 to 60% c. 40 to 50% d. 20 to 30%

3. If Ernest continues to irrigate 3 inches of liquids on his pasture every year for the next twenty years, he can expect soil nitrogen levels to:

a. steadily increase from year to year.
b. stay the same
c. fluctuate from year to year
d. steadily decline

4. Ernest's CAFO permit requires him to keep records of.

Weekly water levels of the lagoon	T	F
Depth of liquids applied on each field of his farm	T	F
Daily rainfall	T	F
Quarterly Inspection Reports	T	F
Annual Facility Inspection Report	T	F
Results of manure testing	T	F
List of pesticides kept on the farm	T	F
Record of employee training	T	F
Log of preventative maintenance	T	F

5. For some strange reason Ernest got fed up with operating his lagoon. His neighbor, Monroe S. Busybody, persuaded him to convert his lagoon to a holding pond.

How many months can Ernest go without emptying his pond? _____
Can he still use his irrigation pump to spread waste? _____
Are his neighbors more or less likely to complain about odors? _____
Can he still recycle liquids back into his buildings? _____

Results of In-Service Testing. Ada. May 11, 1995

	Pre-Test			
Category	***Question***	***Correct***	***Incorrect***	***NA***
	(#)	***(%)***	***(%)***	***(%)***
Storage/Treatment Systems	1	62	15	23
	2	62	15	23
	3	38	38	23
	4	77	15	8
Land Application	5	30	47	23
	6	33	50	27
	7	38	35	27
CAFO	8	15	69	15

	Post-Test			
Category	***Question***	***Correct***	***Incorrect***	***NA***
	(#)	***(%)***	***(%)***	***(%)***
Storage/Treatment Systems	5a	82	0	18
	5b	27	55	18
	5c	82	9	9
	5d	55	45	9
Land Application	1	27	73	0
	2	60	40	0
	3	91	9	0
CAFO	4	73	17	0

Appendix E: In-Service Training Phillips Farm Effluent Analysis

Department of Biosystems & Agricultural Engineering
218 Agriculture Hall•Oklahoma State University
Stillwater, Oklahoma 74078-0469
405/744-7089•FAX 405/744-6059

Memorandum

DATE: February 26, 2001

TO: Agents and Specialists attending Swine Waste In-Service

FROM: Doug Hamilton, Extension Animal Waste Management Specialist

RE: Results of LeRoy Phillip's Analyses

The results of the samples we took at LeRoy Phillip's ponds are back from the lab. The sample labeled LROYB was taken from the settling basin using the "bucket chunk" method. The sample LROYF was settling basin liquid collected in buckets in the field. The last sample, LROYL, was taken from the lagoon using the "bucket chunk" method.

Despite Monroe's fears to the contrary, liquid taken directly from the settling basin looks very similar to liquid collected in the field. The fact that solids are slightly higher in sample LROYB gives me confidence that the bucket chunk method gave a representative sample.

Some nitrogen was lost between the settling basin and the field. You can see this in two sets of numbers. First, total nitrogen decreased 11% between LROYB and LROYF. We can assume that ammonia was stripped from the liquid as it sailed through the air. Notice the 15% decrease in ammonia-N concentration between LROYB and LROYF. This brings up why I recommend sampling from the lagoon or storage pond, not in the field. You can lose up to 50% of the nitrogen in top dressed liquid due to ammonia volatilization. Some volatilization occurs during irrigation (as our samples demonstrate), but losses also occur as the liquid sits on the soil and grass surface. Applying a 50% loss factor to sample LROYF, would underestimate the amount of fertilizer available to forage, because a large part of the estimated loss has already occurred during irrigation.

All three samples have similar nutrient concentrations. I do not have a real good explanation why the lagoon has higher than expected nitrogen and potash concentrations. Perhaps the lagoon has not had time to mature into steady state conditions. At any rate, let's look at the amount of nutrients LeRoy was delivering with a one inch application on May 12:

$$\frac{8.1\ lbs\ N}{1000\ gal}\ X\ \frac{27,000\ gal}{Acre\ in}\ X\ 0.5\ loss = \frac{110\ lbs\ N}{Acre}$$

$$\frac{3.2\ lbs\ P_2O_5}{1000\ gal}\ X\ \frac{27,000\ gal}{Acre\ in} = \frac{90\ lbs\ P_2O_5}{Acre}$$

$$\frac{7.0\ lbs\ K_2O}{1000\ gal}\ X\ \frac{27,000\ gal}{Acre\ in} = \frac{190\ lbs\ K_2O}{Acre}$$

This brings up another point. Perhaps we hammered a little too hard on phosphorus during the in-service. Your answers on the post test show that many of you came away thinking P_2O_5 is the most abundant nutrient in lagoon and pond liquids. Well, LeRoy's results turned out in the expected proportion: 1-1-2 availableN-P_2O_5-K_2O. Fertilizer Phosphorus is out of proportion with other nutrients because plants use less P_2O_5, not because P_2O_5 is more abundant in manure.

DWH:bkf

Copies distribution: M. Smolen (BIOEN), M. Fram (74401), M. Beem (74820), S. Smith (74501), R. Vick (74859), G. Claywell (74538), J. Wallace (74820), C. Bess (74820), J. Benton (74884), J. Dennis (73460), D. Britton (74953)

AGRICULTURAL SERVICES LABORATORY
UNIVERSITY OF ARKANSAS- FAYETTEVILLE

LIQUID MANURE FOR FERTILIZER ANALYSIS (report for CES-429)

Name:	DOUG HAMILTON	County:	HUGHES-OK
Address:	226 AG HALL OSU-COOP EXT	Date:	5-24-95
City:	STILLWATER	State:	AR
		Zip:	74078

Lab. No.	M5768	M5769	M5770
Sample No.	LROYB		LROYL
pH	7.5	7.7	7.7
Ec(umhos)			
% Solids			0.42
	mg/L on "as-is"basis		
Total N	972	869	926
Total P	164	141	83
Total K	696	696	722
Total Ca	204	172	81
Ammonia-N	801	681	811
Nitrate-N			
	lbs/1000 gal on "as-is" basis		
Total N	8.1	7.2	7.7
P2O5	3.2	2.7	1.6
K20	7.0	7.0	7.2
Total Ca	1.7	1.4	0.7
Ammonia-N	6.6	5.7	6.7
Nitrate-N			

36

Appendix F: In-Service Training December 1998 Agenda

Swine Waste Education Project
Wrap Up In-Service

Agenda

10:00	Introduction, Goals of the Project	-	Jack Wallace
10:10	Review of Last In-Service	-	Doug Hamilton
	1. Typical Swine Waste System in SE OK		
	2. Operating under Feed Yards Act		
10:30	Changes since 1995	-	Doug Hamilton
	1. CAFO Act of 1997		
	2. Governor's Task Force Recommendations		
	3. Possible Certification Training Program		
11:00	Hay Quality in Hughes County	-	Monroe Sumter
11:30	Forage Improvement in Pott. County	-	Jack Wallace
12:00	Lunch on own		
1:00	Swine Facts and Farm Records	-	Doug Hamilton
	1. Fact Sheet Series		
	2. Record Sheets		
2:00	Bread		
2:14	"Lagoonarama": Program	-	Doug Hamilton
3:30	Adjourn		

Appendix G: Kerr Center Field Day Agenda

Waste Management

Summer Field Day Pre-View
June 19, 1996
Kerr Center for Sustainable Agriculture

Rain Will Commence at 1:00 pm

See demonstration of Rainfall Simulator plots illustrating Best Management Practices for Poultry Litter and Livestock Manure Application.

Later this summer, farmers will have an opportunity to view these same techniques along with manure spreader calibration, hay and pasture equipment demonstration, manure management equipment display, riparian zone protection demonstration, and a full, extension program on application rate determination.

Producer Field Days

July 10	**Poultry/Dairy**	**Hudson Foods, Adair Co.**
Aug 7	**Poultry/Swine**	**Kerr Center, LeFlore Co**

.

Appendix H: 2G Farm Field Day Agenda

Swine Waste Management Field Day
Gavin Brothers Farm
Hughes County, OK

October 10, 1997

2:00	Demonstration of Agitator, Tank Wagon Application
3:00	Hay and Forage Quality (Monroe Sumter)
3:20	Results of Nutrient Management Demonstrations (Jack Wallace)
3:40	Nutrient Value of Swine Waste, Application Rates (Doug Hamilton)
4:00	Demonstration of Big Gun
5:00	Meal Provided by Pork Group, Inc

Appendix I: Fact Sheets

What Is A Waste Management System?

Oklahoma Cooperative Extension Service • Division of Agricultural Sciences and Natural Resources

F-1734

Douglas W. Hamilton
Waste Management Specialist

A farm manure handling facility is a system for managing animal waste. In other words, it is a set of interdependent components working together to perform a task. The components are interdependent because you can't change one part of the system without affecting all the other parts. We deal with systems every day. Your automobile is a mechanical system. Its task is to get you where you need to go. The transmission is a component (or a subsystem) of the automobile system. The engine will still run without the transmission, but the car will not move. The manure handling facility, like the automobile, is also a set of interdependent components.

The Waste Management System's Task

The animal waste management system's task is to satisfy three "clients." The first client is the environment. The manure handling facility prevents your farm from contaminating air, soil, or water. The second client is the public. A well-managed system means your neighbor shouldn't have a reason to complain about odor, noise, or the appearance of your farm. The third client is the producer. The waste management system should make your job easier, not more difficult.

If all three clients are satisfied, you will increase economic return, which means more money in your pocketbook.

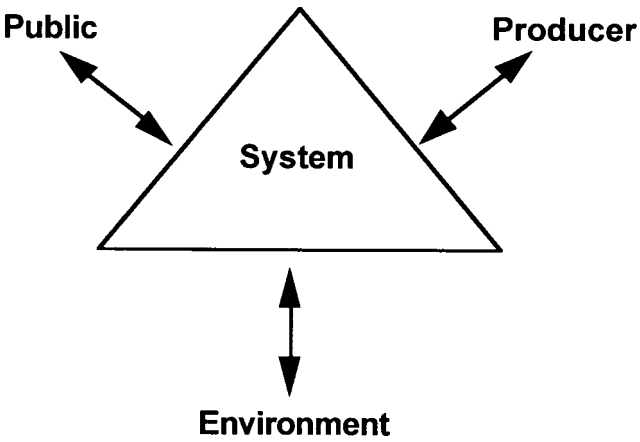


Figure 1. Three "clients" of a waste management system.

Figure 1 shows the relationship among the three "clients." The double-headed arrows illustrate how the clients and the system influence each other. For example, the system can impact the environment and the environment can impact the system. Temperature, rainfall, and wind all affect how the system operates. Remember, you, the producer, have the largest responsibility and impact on the system.

How The Waste Management System Performs Its Task

Figure 2 is a general schematic diagram for manure handling facilities. The boxes represent components where various actions take place. The arrows represent compo-

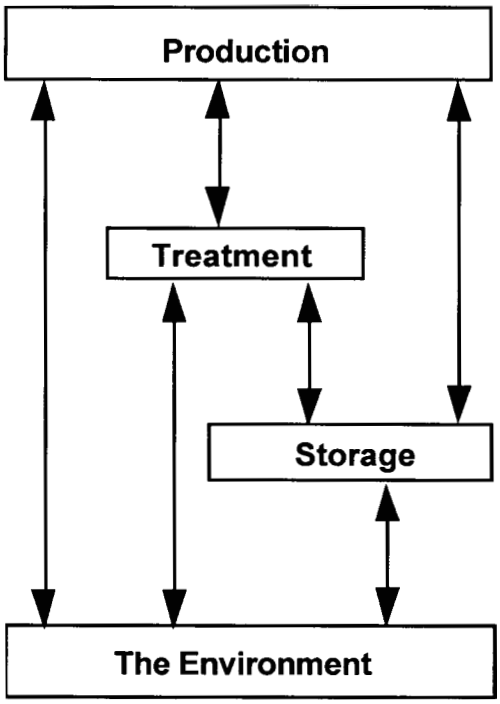


Figure 2. Components of an animal waste management system.

nents that transport material from one place to another. Notice that, as in Figure 1, the arrows are double-headed. This means material can flow in both directions. Using well-designed action components with properly sized transport components makes a waste management system extremely flexible. Let's look at the five components in more detail.

Production

Animals convert feed to feces and urine. This isn't the only source of waste when animals are confined. Other sources of waste include: flush water, spilled feed, bedding, leaking waterers, and captured rainfall. The non-animal sources of waste can be controlled by careful management and regular equipment maintenance.

Storage

Storage is like a shock absorber. It makes the whole operation more flexible. For instance, storage allows you to temporarily hold material until weather and field conditions are acceptable for land application. The storage structure must also prevent waste from seeping into the soil and groundwater. Type of storage is determined by waste consistency and the intended use of the waste.

Treatment

Treatment components alter manure characteristics using physical, chemical or biological methods. The main function of waste treatment is to reduce pollution potential. Treatment components include lagoons, composters, oxidation ditches, solid separators and chemical additives.

The Environment

Animal manure is a resource that is too valuable to throw away. Instead, think of recycling manure nutrients and organic matter back to the environment. Land application is the primary method of recycling. Spreading manure may improve the soil's water holding capacity and may help control erosion. It also greatly reduces the amount of commercial fertilizer required to grow a crop.

Transportation

Material is transported from one system component to another. For example, a flushing system moves manure from under a slatted floor to a lagoon. An irrigation system applies the lagoon effluent to a field. Waste consistency determines what equipment you use to move material.

How Waste Consistency Affects The System

The consistency of the manure is described as liquid, slurry, semi-solid, or solid. Figure 3 illustrates these consistencies. Figure 4 shows how animal type and solids content determine manure consistency. Consistency of manure may change as it moves through the system. Feces are excreted from a pig as a slurry (10% TS). Adding water creates a thinner slurry (2% TS). A solid separator divides the flushed manure into a semi-solid (20% TS) and a liquid (0.1% TS).

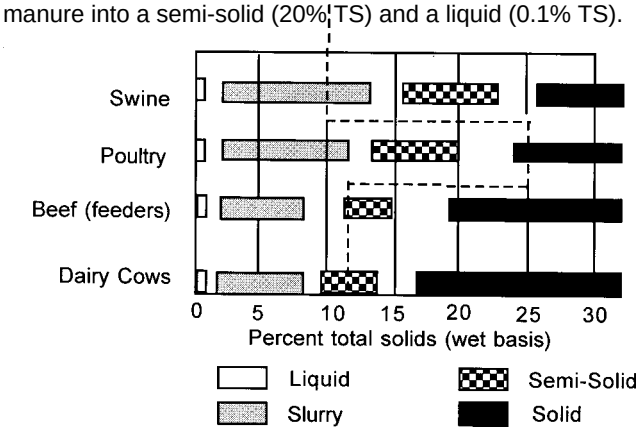


Figure 4. Manure consistency is dependent on animal type and solids content.

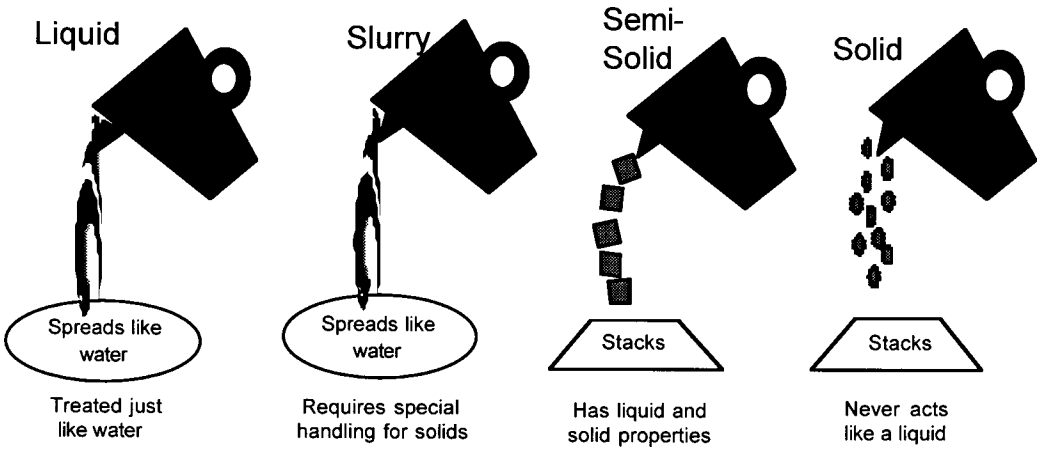


Figure 3. Manure consistency.

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Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Samuel E. Curl, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of $234.00 for 2,500 copies. #7688 0497

1734 / 2

Production and Characteristics of Swine Manure

Oklahoma Cooperative Extension Service • Division of Agricultural Sciences and Natural Resources

F-1735

Douglas W. Hamilton
Extension Waste Management Specialist

William G. Luce
Extension Swine Specialist

Aimee D. Heald
Agricultural Education Graduate Student

Digestive System

To understand the makeup of swine manure, you must have a basic knowledge of the hog's digestive system. Figure 1 shows the digestive tract of a mature hog. The body of the pig is more or less built around its digestive system. Like humans, pigs are monogastric, meaning they have a simple stomach. One of the stomach's main functions is to break down complex proteins. Broken down proteins are converted to amino acids and absorbed in the small intestine. The small intestine also absorbs fats, starches, sugars, and some water. The large intestine, or colon, however, absorbs the largest percent of water. Much of the final processing of feed takes place in the colon, where it is converted into a bacterial mass called feces. Although the kidneys are not considered a part of the digestive system, they are very important. Kidneys filter waste material from nutritive material in the blood stream and send the wastes to the bladder to be excreted as urine. Manure is the combination of feces and urine. Manure is approximately 60 percent feces and 40 percent urine.

From the perspective of the manure manager, the digestive system is a long hollow tube. Feed goes in one end; manure comes out the other end.

Basic Swine Diet

The make up of a hog ration is determined by the hog's age, sex, and weight. The diet of mature animals depends on reproduction stage. The five components of hog rations are energy, protein, minerals, vitamins, and water. Carbohydrates and fats supply energy to the pig. Carbohydrates are supplied as plant sugars or starches. Corn and sorghum are the primary sources of carbohydrates in swine diets. Soybean meal is a common protein source.

The major distinguishing characteristic of hog diets is the relationship of protein to energy in the diet. Energy level is similar in all diets (1,400 to 1,500 kcal/lb), but protein level changes as the pig grows. Starter pig rations contain 18 to 20 percent crude protein. The crude protein decreases to 14 to 15 percent by the time a finished hog reaches 250 pounds. Crude protein content of breeding stock is approximately 14 percent. Lactating sows are fed up to 16 percent crude protein. These percentages are important since protein is the major source of nitrogen and sulfur in manure. Nitrogen and sulfur compounds contribute the lion's share of manure odor.

Manure Production

Table 1 shows the daily production of manure as it is excreted by the animal. This table was calculated using a corn-based ration. Notice how the manure characteristics change as the diet changes for different animals in different stages of life. Manure characteristics are broken down into four broad categories: quantity, organic matter, plant nutrients, and salts.

Quantity

The largest single factor in determining manure quantity is the amount of feed the animal receives. Manure quantity increases as pigs grow from nursery pigs to slaughter weight. There is also a large jump in quantity between gestating and lactating sows, largely due to the increase in feed the lactating sow and her litter receive.

Organic Matter

The total amount of organic matter excreted by hogs also is largely determined by the amount of feed they receive. The energy content of manure, as measured by oxygen demand, increases slightly as finisher hogs reach maturity. The bulk of manure organic matter is contained in feces.

Plant Nutrients

The percent concentration of plant nutrients in manure does not change considerably throughout the hog's life. Phosphorus content is a nearly constant 2.5 percent of total solids for all hog types. Nitrogen concentration in nursery pig manure (5.7 percent of total solids, C:N ratio = 8) is actually lower than for breeding stock (7.5 percent of total solids, C:N ratio = 6), even though the younger pigs receive a higher protein diet. This shows the amazing ability of modern hog breeds to convert feed to body mass. Urine contains soluble nutrients such as ammonia. Feces contain more organic nutrients.

Table 1. Daily Manure Production As Excreted.

Component	*Units*	*Nursery*	*Grower Pigs 50-125 lb.*	*Finisher 125-175 lb.*	*Finisher 175-250 lb.*	*Replacement Gilt*	*Boar*	*Gestating Sow*	*Sow + Litter*
Quantity									
Weight	lbs/day	3.7	6.0	8.0	9.4	8.2	8.2	8.2	26
Volume	ft^3/day	0.056	0.095	0.13	0.15	0.13	0.13	0.13	0.41
Total Solids	lbs/day	0.37	0.60	0.80	0.94	0.82	0.76	0.75	2.6
Organic Matter									
Volatile Solids	lbs/day	0.31	0.54	0.72	0.85	0.73	0.68	0.65	2.3
COD	lbs/day	0.34	0.60	0.82	0.96	0.78	0.55	0.72	2.5
C:N Ratio		8	7	7	7	7	6	6	7
Plant Nutrients									
N	lbs/day	0.021	0.040	0.053	0.062	0.060	0.060	0.058	0.18
P	lbs/day	0.0087	0.015	0.020	0.024	0.020	0.020	0.019	0.064
K	lbs/day	0.012	0.021	0.028	0.033	0.033	0.040	0.037	0.12

*Average daily production for weight range noted. Increase solids and nutrients by 4% for each 1% feed waste more than 5%.

Salt

When thinking about salt in the hog ration, it is interesting to note that all the salt that goes into the hog will eventually be excreted in some form or another. Seventy-five percent of salt is excreted in urine and 25 percent in feces.

Altering Manure Characteristics through Diet Manipulation

Quantity

Since the values in Table 1 are calculated from a corn-based ration, they will be different if you change the ration. The digestibility of a sorghum ration is not as high as corn, so it will take slightly more feed to satisfy the hog's nutrition requirements. This also means the quantity of manure will increase slightly.

Nitrogen

Increasing nitrogen in the ration will increase nitrogen excreted. One way to reduce dietary nitrogen is to feed the essential amino acids as a diet supplement and reduce feed protein sources such as soybean meal. This is not very practical because the cost of soybean meal is relatively low compared to amino acid supplements. Besides, one of the problems with land application of manure is that the ratio of phosphorous to nitrogen in manure is higher than what most crops remove from the soil. It makes more sense to preserve nitrogen in the handling system. We can reduce nitrogen handling losses by feeding additives which tie up nitrogen. A few feed additives that have been investigated for nitrogen binding are yucca plant extracts, zeolites and activated carbon. Tentative results show that some nitrogen binding agents can be effective in reducing ammonia losses in storage.

Phosphorus

Hogs cannot absorb 100 percent of the phosphorus they are fed, primarily because 60 to 70 percent of plant phosphorus is organically bound in the form of phytate. Feeding a commercial product called Phytase improves plant phosphorous digestion. You can greatly reduce supplemental phosphorus by using Phytase. Reduction in price may eventually make feeding Phytase more cost effective than adding inorganic phosphorous to the diet.

Sulfur

Sulfur is a large contributor to the odors associated with hog production. One way to increase the digestibility of sulfur and reduce odors is to feed only one of the three sulfur-containing amino acids — methionine, cysteine, and cystine. In practice, this means selecting protein sources with lower sulfur contents. Reducing the sulfur content of common feedstuffs is an area of active research.

Table 2. Farm Manure Production Values - as excreted.

Farm Type	*Unit*	*Manure Volume (gal/unit/day)*	*Organic Matter (lbs VS/unit-day)*	*Nutrients in Fresh Manure*		*Nitrogen Available to Plants after Handling (lb/unit-year)*	
				N (lb/unit-year)	*P_2O_5 (lb/unit-year)*	*Lagoon + Irrigation*	*Waste Storage Structure + Injection*
Sow	Sow	1.4	1.0	29	23	4.4	12
Sow + Onsite Nursery	Sow	2.1	1.5	43	36	6.5	17
Offsite Nursery	Pig	0.42	0.31	7.7	7.3	1.2	3.1
Finisher	Hog	0.90*	0.70*	18	16	2.7	7.3
Farrow to Finish	Sow	7.1	5.3	150	130	22	58

* These are average values for a farm containing a mixture of different aged hogs. Many company farms use "all in-all out" finishing. Under "all in-all out" conditions, volume increases from a minimum of 0.5 gal/unit-day when hogs arrive at 50 lbs. to a maximum of 1.2 gal/unit-day when reach 220 lbs. Similarly, organic matter increases from 0.36 lbs. VS/unit-day to 0.9 lbs. VS/unit-day as the hogs mature.

Salt

Another ration component to watch closely is salt. Salt is a major factor in the amount and quality of urine produced. Salt should not be fed in excess of the pig's dietary requirement. Any attempt to manage salt intake will benefit the waste handling system through improved treatment performance and better quality manure for land application.

Manure Characteristics from a Farm Scale Perspective

Hog farms are made up of a combination of all different types of animals. Table 2 gives total farm manure characteristics for farms commonly found in Oklahoma. Values are given on the basis of the animal number that distinguishes the farm unit. For instance, a 600-sow farrowing and gestation farm contains 11 boars, 500 gestating sows, and 100 lactating sows with litters. The distinguishing animals on the farm are the 600 sows. To find the daily volume of manure produced, multiply 1.4 gallons/day times 600 for an 840 gallons/day farm total.

Conclusion

The values in this fact sheet are only an example of how a certain ration affects the production and characteristics of swine manure. Keep accurate records of water and manure use on your own farm. Get in the practice of testing waste materials at different points in the manure handling process. A little time spent becoming familiar with manure production on your farm will save feed, labor, and money in the long run.

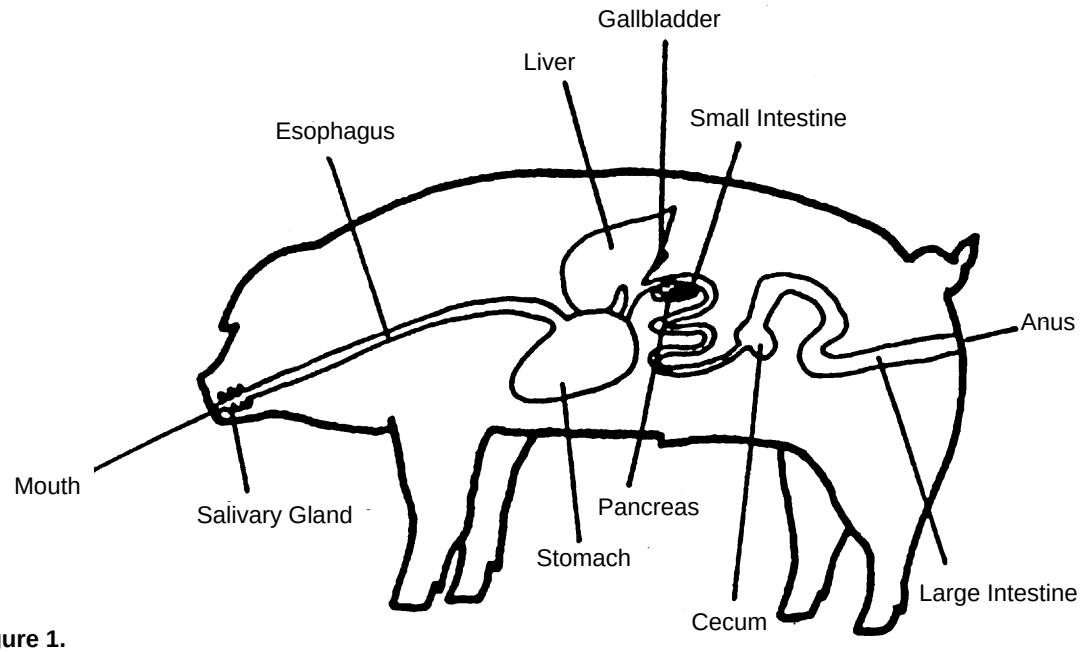

Figure 1.

Definition of Manure Production Terms

Quantity

Quantity terms define the amount of manure produced. Manure quantity determines storage and equipment sizes and plays a great role in the time and labor required to handle manure.

Weight: The daily mass of feces and urine excreted by the animal.

Volume: The space taken up by the daily production of manure.

Total Solids (TS): The daily mass of manure — minus water.

% Total Solids The mass percentage of feces and urine taken up by solids. This value determines the consistency of manure. When it is excreted at 9 to 10 percent total solids, swine manure is a thick slurry. Dried to 30 percent, manure acts more like a solid. Diluted to less than one percent, manure becomes a liquid.

Organic Matter

Organic matter determines how we handle manure to reduce odors and nuisance conditions. Undigested feed energy shows up in manure as organic matter. Because of these factors, we use organic matter content to design waste treatment systems.

Volatile Solids (VS): The mass of solids that will ignite when heated to 550° C. Approximately 85 to 90 percent of fresh manure solids are volatile; therefore, nearly 90 percent of all manure solids are organic matter.

Chemical Oxygen Demand (COD) A measure of the pollutant strength of manure. This is the mass of oxygen required to break down the organic matter in manure. It is measured by digesting a manure sample with a strong chemical oxidant.

C:N Ratio The ratio of carbon to nitrogen in manure. It is a rough measure of the biological stability of organic matter. Stability is defined two ways. Unstable organic matter has a high energy content as denoted by large amounts of carbon. When dried to an optimum moisture content for bacterial growth, high C:N materials give off heat. Organic matter with C:N above 30 removes nitrogen from the environment; whereas, materials with C:N less than 20 release nitorgen to the environment.

Plant Nutrients

The values given in Tables 1 and 2 are the masses of total nutrients excreted by the animal. These values determine area required to spread material when it is applied to cropland and pasture. Nutrient content changes greatly as manure moves through the handling system.

"As Excreted" versus "As Used"

The values given in Tables 1 and 2 are excreted values. Once manure is excreted from the animal, it undergoes a multitude of changes. For example, water is added to flush material out of buildings, and volatile solids are digested in lagoons. Waste production and characteristics for your farm is unique to your system. Keep accurate records of farm water and manure use. Get in the practice of testing waste materials at different points in the manure handling system. A little time spent becoming familar with manure production on your farm will save lots of feed, labor, and money in the long run.

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1735 / 4

Lagoons for Livestock Waste Treatment

Oklahoma Cooperative Extension Service • Division of Agricultural Sciences and Natural Resources

F-1736

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What is a Lagoon?

A lagoon is a lined earthen basin used to ***treat*** raw organic waste, and ***store*** treated solids and liquids. Treated solids are called ***sludge***. Treated liquids are called ***supernatant*** or ***effluent***. In addition to their treatment and storage functions, lagoons are designed with extra storage capacity, or ***freeboard,*** to prevent them from overflowing due to unexpected rainfall. In Oklahoma, lagoons are required to contain runoff from a 25 year, 24 hour storm. A lagoon performs these functions in five zones stacked one on top of the other as shown in Figure 1. Two liquid levels, the ***minimum drawdown*** and ***maximum operating*** levels, define the zones. The lagoon operator does not allow liquid levels to drop below the minimum drawdown to preserve treatment and sludge storage functions. He also keeps liquids below the maximum operating level to prevent overflow and to protect the embankment from waves. The volume sandwiched between the minimum drawdown and maximum operation levels is effluent storage.

Treatment

Treatment follows four steps.

1. Manure solids settle to the bottom of the lagoon.
2. Bacteria convert settled solids into sludge and organic acids and other byproducts.
3. Bacteria convert organic acids to methane (CH_4) and carbon dioxide (CO_2).
4. Odorous byproducts, such as Hydrogen sulfide (H_2S), Ammonia (NH_3) and volatile organic compounds (VOC), produced during conversion to organic acids are oxidized to less odorous compounds.

Microscopic organisms (bacteria, protozoa, and algae) join together to form microbial communities. The communities are named according to their function in the lagoon: acid formers and methane formers, for example. Figure 2 illustrates how microbial communities interact to complete the four treatment steps. Since all the treatment steps rely on the growth of living creatures, we say that lagoons use ***biological treatment*** processes. Biological processes depend on temperature, light, and availability of proper food. Another important factor is oxygen. ***Aerobic*** organisms require oxygen in order to survive. ***Anaerobic*** organisms only function in the absence of oxygen. ***Facultative*** organisms can go both ways; they can live in very low oxygen environments and in environments that cycle between aerobic and anaerobic conditions. Cooperation between microbial communities makes a lagoon a highly effective biological treatment system. Because each community flourishes in its own special conditions, the lagoon's treatment volume is divided or stratified into three layers (Figure 3). The layers do not always exist in every lagoon. If the facultative layer exists only rarely (or not at all), a lagoon is said to be anaerobic. Facultative lagoons, on the other hand, almost always have a facultative layer.

Engineers design lagoons to be either anaerobic or facultative using a factor called the ***organic loading rate***. The organic loading rate is the amount of manure organic matter added to the lagoon each day, divided by the size of the lagoon. The most common method of measuring organic matter is to use the parameter volatile solids (VS). Volatile solids are the amount of manure solids lost when a sample is heated to 550° C.

There are two ways to define organic loading rate. First, is the volumetric loading rate:

$$\text{Volumetric Loading Rate} = \frac{\text{Daily Mass of Volatile Solids}}{\text{Treatment Volume}}$$

Natural Resources Conservation Service (NRCS) design standards for volumetric loading rates for anaerobic and "reduced odor" or facultative lagoons are shown in Figure 4. In general, facultative lagoons are loaded at one half the rate of anaerobic lagoons. Also note how climate affects lagoon design. Lagoons work very well in southern regions where the winters are warm enough for bacteria to stay active. Lagoons become less effective as you move north. Even though lagoons in the north have a lower treatment efficiency, they can still be made effective by lowering the organic loading rate. Eventually, lagoon size becomes impractical. This is why you see few lagoons north of southern Nebraska.

A second way to define organic loading rate is the surface loading rate:

$$\text{Surface Loading Rate} = \frac{\text{Daily Mass of Volatile Solids}}{\text{Surface Area}}$$

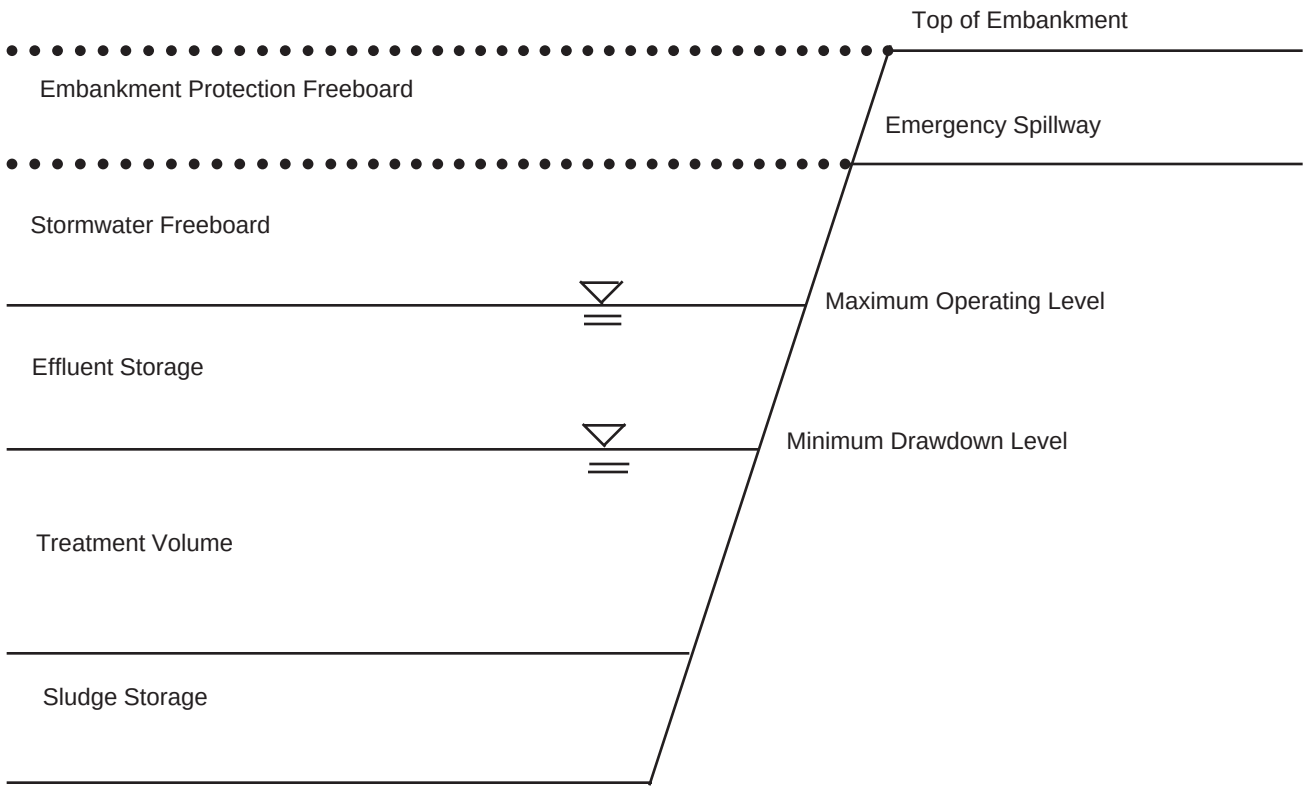


Figure 1. Lagoon zones and operating levels

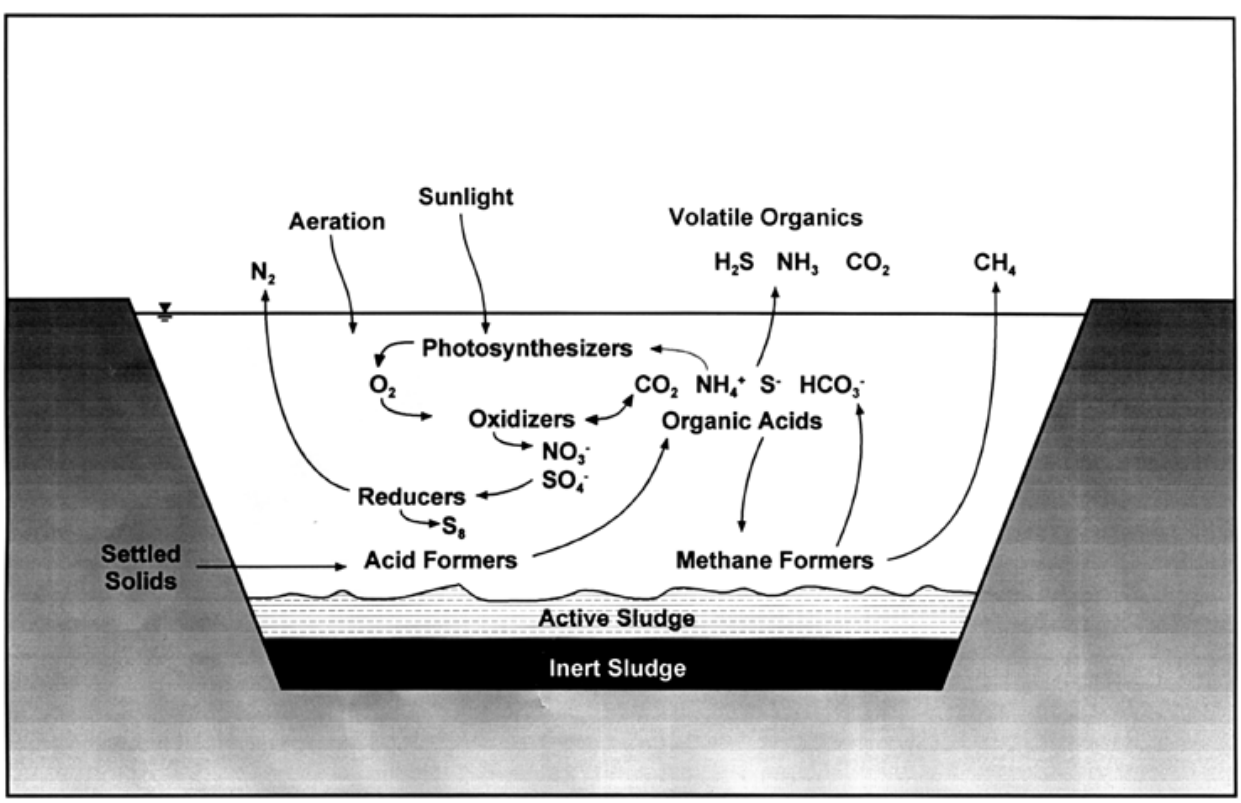


Figure 2. Biological treatment in a lagoon

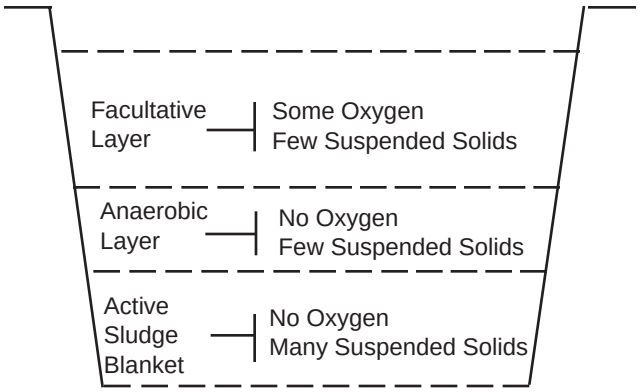


Figure 3. Treatment volume layers

Determining the proper surface loading rate for anaerobic and facultative lagoons is an area of active research. Studies in Tennessee, which has a climate similar to east central Oklahoma, indicate that a break between facultative and anaerobic treatment may occur at a surface loading rate of 700 lbs. VS/Acre per day. If you assume that the same factors affect surface loading rate as volumetric loading rate, surface loading for a facultative lagoon in the Oklahoma panhandle would be close to 650 lbs. VS/Acre per day. Likewise, the facultative loading rate in extreme southeastern Oklahoma may be 730 lbs. VS/Acre per day.

Storage

Sludge Storage

Sludge builds up slowly in a lagoon. Lagoons are designed to store sludge for at least 10 years, but there is definitely a limit to how much sludge a lagoon will tolerate. At some point, the growing sludge blanket will squeeze the treatment volume from the bottom. The smaller the treatment volume becomes, the larger the volumetric loading rate becomes. Sludge grows fairly rapidly in the early years of a lagoon's life. Table 1 shows the estimated sludge growth in lagoons for typical dairy, swine, and laying hen operations during the first two to five years after start-up. Grit chambers are used with layer farms to reduce the amount of heavy material settling to the bottom of the lagoon. Dairies use solid separators to reduce the amount of crust forming on top of the lagoon. In both cases, sludge growth rate increases approximately 25 percent on farms that do not use these pretreatment practices. After a few years, the lagoon's microbial communities mature, and sludge growth slows down. This is because the mature communities are better adapted to digest manure solids. Research in Iowa indicates that sludge growth in mature swine lagoons may be a function of lagoon depth. Sludge blankets grew approximately half an inch per year in mature, deep lagoons, and up to two inches per year in mature, shallow lagoons. One explanation of these findings is that the deep lagoons have more persistent anaerobic conditions in their active sludge layers than shallow lagoons.

Effluent Storage

Effluent is stored for much shorter periods than sludge. Lagoons are designed to store effluent for six months to a year. Liquid storage is a balance between what enters the lagoon and what leaves the lagoon (Table 2). The idea is to provide enough effluent so farmers can irrigate their crops when plant nutrient requirements are greatest. The storage volume should be large enough to keep liquid below the maximum operating level throughout the storage period.

Lagoons are defined as either single-stage or two-stage depending on how they store effluent (Figure 5). A single

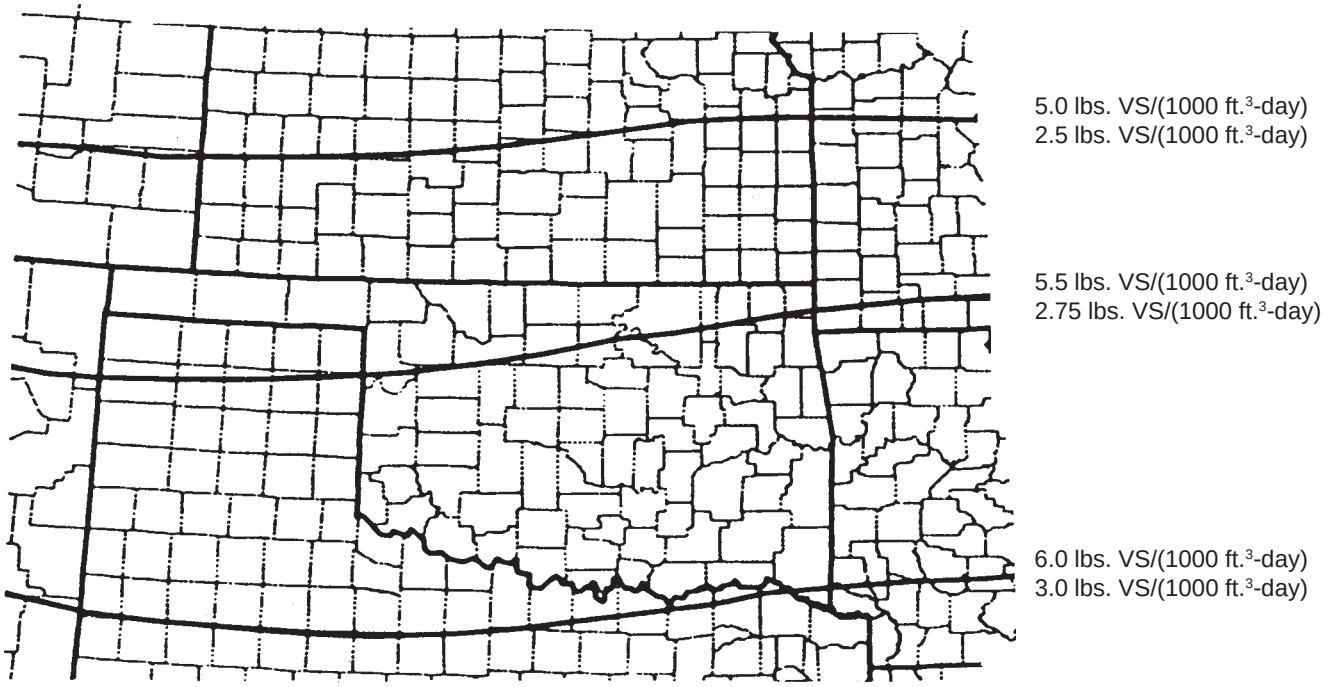


Figure 4. NRCS design standards for volumetric loading ratess for anaerobic and "reduced odor" or facultative lagoons. Top number is Anaerobic loading rate, bottom number is Faculative rate.

Table 1. Estimated Sludge Accumulation in Lagoons.

	ASAE Design Factor for Sludge Storage *(ft^3/lb TS added)*	*Estimated Growth of Sludge Blanket for Typically Sized Lagoons in the First 2 to 5 Years After Start-up*
Swine without pre-treatment	0.0486	3 to 6 inches/yr*
Laying Hens with Grit Chamber for pre-treatment	0.0295	~4 inches/yr**
Dairy with Solid Separator for pre-treatment	0.0729	~8 inches/yr**

* Based on measurements in Iowa and South Carolina
** Based on ASAE design factor

Table 2. Lagoon Liquid Balance.

Lagoon Input	*Lagoon Output*
Manure	Effluent removed for irrigation
Flushwater	Effluent recycled as flushwater
Washwater	Evaporation from the lagoon surface
Rain falling on the lagoon surface	
Runoff draining into the lagoon	

stage lagoon performs all treatment and storage functions in one pond or cell. A two-stage lagoon treats incoming waste and stores sludge in it's first cell; effluent and storm runoff is stored in a second cell. Sometimes, people mistake a system using a settling basin ahead of a single-stage lagoon for a two-stage lagoon. The difference is biological treatment does not take place in the settling basin as it does in the first cell of a two-stage lagoon.

Management

There are eight keys to proper lagoon management.

1. Get off to a good start. It is best to start a lagoon in late spring or early summer. The bacteria will have a long, warm period to begin their growth.

2. Fill at least half of the treatment volume with water before flushing any manure into a lagoon. This will ensure that the bacteria will have the proper growth environment from the beginning. You can "jump start" biological treatment by seeding the new lagoon with sludge from an existing livestock treatment lagoon, or sludge from a sewage treatment plant using an anaerobic digester. Some live cultures of bacteria are also commercially available for seeding.

3. Keep the effluent between the minimum drawdown and the maximum operating levels. Falling below the minimum drawdown reduces treatment efficiency. Rising above the maximum operating level means you could discharge effluent in a rain less than the 25-year, 24-hour storm. Check your lagoon design. It tells you how long you can store liquids and rainwater. With experience, you will learn to balance inputs and outputs to stay within the limits. The single greatest tool you have in the water balance is the ability to use both recycled and fresh flushwater.

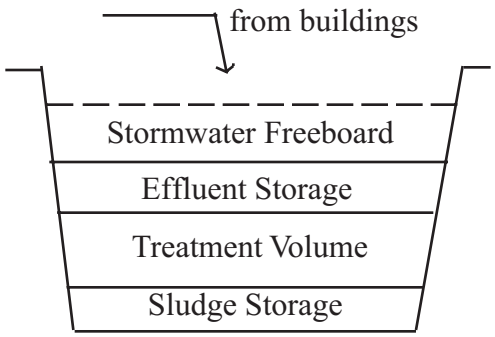
4. In the rare occasions that effluent level rises above the maximum operating level, irrigate effluent to return liquid level to the effluent storage zone, as soon as weather permits.

5. Plan to irrigate effluent at least once per year. Not only will you recycle valuable plant nutrients to your crops, you will prevent salts and other toxins from building up in the lagoon.

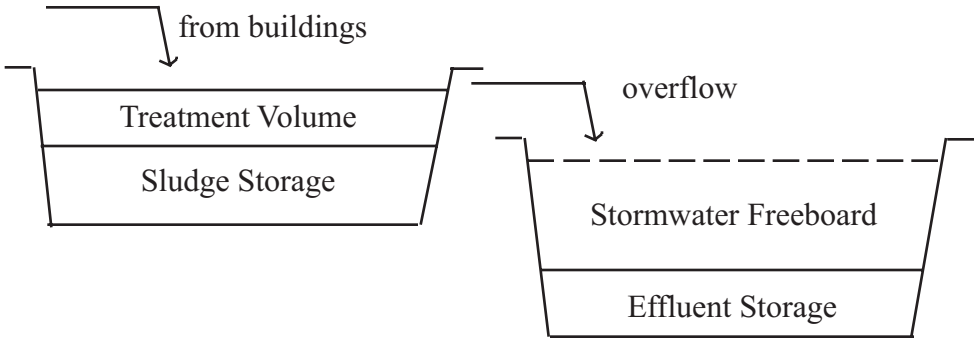
6. Periodically check growth of sludge. Sludge storage volume should be included in the lagoon's design calculations. When sludge approaches the design volume, remove half of the accumulated solids.

7. Protect the lagoon embankments. The roots of woody vegetation destroy the earthwork of a lagoon. Likewise, the hooves of grazing animals accelerate erosion of the embankment. Tall weeds entice burrowing animals such as muskrats to call your lagoon home. Take care of all these problems by keeping the earthwork fenced and mowed.

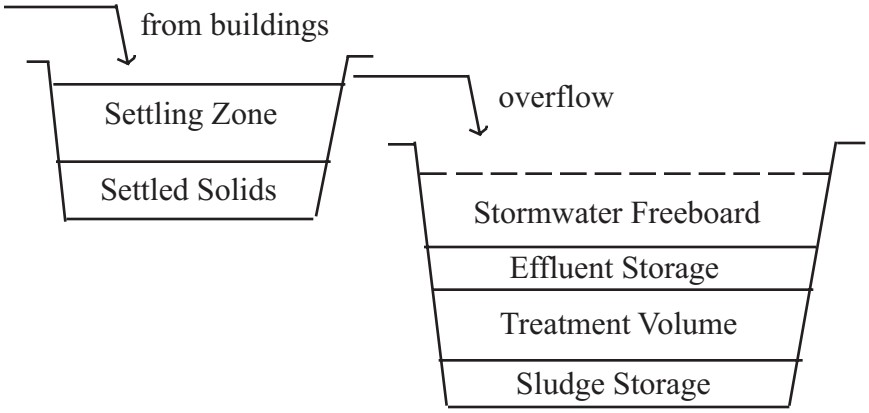
8. Keep foreign materials (dead animals, gloves, cinder blocks, 2 X 4's, AI supplies, rags, bottles, small automobiles, etc.) out of the lagoon. Lagoons are designed to treat manure. Non degradable objects in the lagoon reduce treatment volume, play havoc with pumping, and leave a poorly managed appearance.



Single-Stage Lagoon



Two-Stage Lagoon



Settling Basin + Single Stage Lagoon

Figure 5. Types of lagoons based on effluent storage

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The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; home economics; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

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- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and based on factual information.
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1736 / 6

Using Lagoon Effluent as Fertilizer

Oklahoma Cooperative Extension Service • Division of Agricultural Sciences and Natural Resources

F-2245

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Waste Management Specialist

Lagoon effluent can be a good source of nutrients for crop production if it is managed properly. Effluent contains soluble elements required to grow plants. Although nutrient concentrations in lagoon effluent tend to be low, large volumes of effluent are often available to producers. Therefore, the total potential nutrient for crop production is quite high. The steps to proper effluent management are:

1. Determine the nutrient requirements of the crop based on a realistic yield goal.
2. Determine the nutrient content of the effluent.
3. Determine the fraction of effluent nutrients available to the crop in the first year of application.
4. Calculate the total depth of irrigation for the growing season.
5. Determine approximate number of applications to achieve total irrigation depth.
6. Determine supplemental nutrients needed for maximum crop growth.

These steps will assure the proper amount of effluent is applied. Avoiding excess effluent application protects soil and water quality.

Crop Nutrient Requirement

Lagoon effluent should not be applied to soil beyond the limits of the growing crop's nitrogen needs due to potential nitrate leaching. Applications of effluent at agronomic rates generally will not create salinity problems. Any soils scheduled for effluent application should first be tested to determine its fertility level. Periodic soil testing is recommended to monitor nutrient supplying capability of the soil. The soil test results and subsequent fertilizer recommendations for the crop to be grown are the only reliable way to obtain crop nutrient requirement.

Soil testing is available through OSU Soil, Water and Forage Analytical Laboratory in Stillwater, as well as a number of commercial laboratories. Crop nutrient needs are given in the interpretations and requirements section of the soil test report. You also can determine crop nutrient needs using Extension Facts #2225, OSU Soil Test Interpretations. Contact the local extension office for instructions and supplies for taking and submitting soil samples.

Effluent Nutrient Content

It is difficult to give an average nutrient content for lagoon effluent. A lagoon is a living system; therefore, nutrient concentrations in the effluent depend on how living organisms digest manure solids. The major factors influencing nutrient content include type of livestock supplying manure, time of year, and the balance of water into and out of the lagoon.

See Extension Facts F-2248, Sampling Animial Manure for Analyses, for details on sampling. Sample lagoon effluent at the same time of year you plan to irrigate effluent. After a number of years, you may see a predictable pattern of nutrient concentration emerge. Table 1 gives some typical analyses

Table 1. Nutrient Analyses of Swine Lagoon Effluent Sampled in Oklahoma.

Analysis	*LeFlore County*	*Pottawatomie County*	*Texas County*	*Texas County (nursery)*
Total-N (lbs/1000 gal)	4.5	5.6	2.1	4.4
NH_4-N (lbs/1000 gal)	4.5	4.9	1.8	3.7
Total P_2O_5 (lbs/1000 gal)	1.2	1.3	0.8	0.7
Total K_2O (lbs/1000 gal)	5.9	6.4	2.3	5.3
EC (mmho/cm)	5.9	7.3	3.0	5.6

of swine lagoon effluent at different locations in Oklahoma. We can make a number of general statements about the results in Table 1:

1. A large portion of the nutrients in lagoon effluent is dissolved and highly available to plants. Notice in all the samples, 80% or more of the total nitrogen appears as ammonium (NH_4-N). Plants can use ammonium directly from soil solution and soil exchange sites.
2. Nutrients fall into fairly predictable ratios. In this table, the ratio of Total-N to P_2O_5 to K_2O in units of lbs/1000 gallons is approximately 4:1:5. These ratios are a reflection of the living nature of a lagoon and the water balance. Bacteria release a fairly fixed proportion of the nutrients into the liquid. Nutrients are then concentrated or diluted according to lagoon operation. Since evaporation exceeds rainfall in most parts of Oklahoma, effluent tends to become more concentrated.
3. Nutrient concentration is roughly proportional to salt content or electrical conductivity (EC). The same operational factors concentrating nutrients also concentrate soluble salts. Lagoon effluent should be analyzed for EC and sodium content, as well as major nutrients. The detrimental effect of irrigating high salt effluent must be taken into account when planning a waste management system.

Availability of Effluent Nutrients to Crops

Nutrients in lagoon effluent cannot be substituted for those in commercial fertilizers on a pound-for-pound basis because not all the nutrients reported on a manure analysis report are readily available to a crop in the year of application. Some elements are released when organic matter is decomposed by microorganisms. Other elements can combine with soil constituents and become unavailable. Nitrogen may also be lost to the atmosphere through ammonia volatilization or denitrification depending on application methods, soil pH and soil moisture level.

Organic nitrogen in effluent must be converted (mineralized) into plant available inorganic forms (ammonium and nitrate) before it can be absorbed by roots. Although very little of the effluent N is organic, about 25% to 50% of the organic N may become available the year of application. Most effluent N is in ammonium form (NH_4-N). Potentially, all of the NH_4-N can be utilized by the plants in the first year of application. However, if manure is applied on the soil surface and not quickly incorporated, considerable NH_4-N can be lost to the air as ammonia (NH_3) gas. This decreases nitrogen available for plant growth. Ammonium worked into the soil is subject to nitrification (rapid conversion to NO_3-N). Nitrate-N is readily available to plants, but if excess water is present, it can be lost through leaching or denitrification (conversion of NO_3-N to N_2 gas). Combining inorganic N after ammonia volatilization losses, and N available from organic N, gives the total N available to crops. This is sometimes called plant available nitrogen, PAN. If ammonia volatilization was eliminated, almost all of the Total N in effluent is PAN. However, a rule of thumb is 50% of the Total N is available after volatilization losses. However, recent studies have shown that ammonia losses may be as high as 80% of total N.

Some studies have shown that the availability of effluent P is equal or superior to that of commercial phosphorus fertilizers; others have shown lower responses from manure than from fertilizer P. In general 90% availability has been commonly used for P calculation. Most manure K is soluble and readily available for plant use in the year of application. Ninety to 100% availability has been commonly used for K calculation.

Total Depth of Irrigation

Producers should develop a nutrient management plan that maximizes the use of manure nutrients available. In many cases the producer may need to supplement effluent with commercial fertilizers if total crop nutrient needs are not met. Land application rates should be based on the nutrient requirements of the crop being grown to ensure efficient use of manure nutrients and minimize the chances of nitrogen volatilization and leaching. Soil testing, effluent analysis, and proper estimation of yield goal are necessary to calculate proper agronomic application rates of lagoon effluent and additional fertilizers. Follow the first four steps in the attached worksheet to calculate the seasonal application rate.

When using many irrigation systems, it is more convenient to use application depth rather than application rate. There are approximately 27,000 gallons per acre-in of application. Divide application rate in 1000 gal/acre by 27 to determine irrigation depth in inches..

Irrigation Scheduling

You may not apply all the effluent at one time because of the limited water holding capacity and infiltration rate of your soil. A sandy loam soil, for example, can hold 0.8 to 1.4 inches of water per foot of soil when it is completely dry. It is reasonable to assume that the soil will be at half field capacity before irrigation. To bring one foot of soil up to field capacity, the most effluent you could apply would be between 0.4 to 0.7 inches. One half inch would be a reasonable irrigation depth under these conditions. So, if the total effluent irrigation needed to provide nitrogen through the growing season is three inches, you would apply six separate irrigations of 0.5 inch each.

Lagoon effluent has a high concentration of available nitrogen. Crops take up most nitrogen during the vegetative growth phase of plant development. Space irrigations throughout the vegetative growth period in order to get the most use out of the effluent nitrogen. Using the example in the last paragraph, if the vegetative growth period of the crop lasts six weeks, you will get the most use of nitrogen by irrigating 0.5 inch of effluent, once per week, for six weeks. Consult the agricultural extension educator or crop consultant in your area to find active growth periods for crops.

If applied pre-plant, effluent should be added as near to the planting dates as possible to provide starter nutrients. Effluent can also be applied post harvest to supply nutrients for winter cover crops. Lagoon effluent should not be applied to already stressed plants because the salt and ammonium in the liquid may further stress the crop. The water added with lagoon effluent will rarely be sufficient to provide the total moisture needs of a crop throughout the growing season. Use effluent to meet crop nutrient needs and irrigate with additional clean water to provide moisture needs.

Effluent Irrigation Work Sheet

		Example:	*Your Number:*
1.	**Nutrient needs of crop (lbs/acre)** Recommendations based on soil test results and a realistic yield goal.	N= 180 P_2O_5= *95* K_2O= *40*	N= ____ P_2O_5= ____ K_2O= ____
2.	**Total nutrient value of effluent (lbs/1000gal)** Based on manure analysis of a representative sample collected close to time of application.	N= *5.2* P_2O_5= *1.3* K_2O= *5.9*	N= ____ P_2O_5= ____ K_2O= ____
3.	**Determine available nutrients (lbs/1000gal)** Multiply the value from Step 2 by nutrient availability, 50% for N and 90% for P and K	N= *2.6* P_2O_5= *1.2* K_2O= *5.3*	N= ____ P_2O_5= ____ K_2O= ____
4a.	**Calculate application rates to supply N and, P_20_5 needs. (1000gal/acre)** Divide values from Step 1 by values from Step 3.	N= *69* P_2O_5= *79*	N= ____ P_2O_5= ____
4b.	**Choose between N or P_2O_5 application rate (1000gal/acre)** Select the highest rate calculated in Step 4a for using effluent as a complete fertilizer. Select the lowest rate for maximizing nutrient use.	Rate = *69* *(based on N for this example)*	Rate = ____
4c	**Determine total depth of irrigation (inch)** Divide application rate in 1000 gal/acre from Step 4b by 27 to get irrigation depth in inches.	Depth = *2.6*	Depth = ____
5.	**Determine numbers of application needed to apply total irrigation depth.** Most soils cannot accept the total irrigation depth in one application. Divide total irrigation depth in 4c by acceptable application depth for average soil conditions	*5* (*based on 1/2 inch per application)*	____
6a.	**Determine amount of nutrients applied at chosen rate (lbs/acre)** Multiply the rate chosen in Step 4b, by available nutrients, Step 3.	N= *180* P_2O_5= *83* K_2O= *366*	N= ____ P_2O_5= ____ K_2O= ____
6b.	**Determine supplemental nutrients (lbs/acre)** Subtract the nutrients applied, Step 4e, from nutrients needed, Step 1. If the difference is negative, enter 0.	N= 0 P_2O_5= 12 K_2O= *0*	N= ____ P_2O_5= ____ K_2O= ____

Preventing Salt Buildup

Soil salinity testing will help you use lagoon effluent more effectively. It is recommended to include EC and ESP (exchangeable sodium percentage) in your annual soil testing program to monitor the effects of effluent salts. See OSU Extension Facts F-2401 for details on irrigation water quality and F-2226 for salt tolerance of different crops.

Salt buildup is possible with excessive effluent application. The amount of salt added before detrimental conditions occur depends on soil texture, irrigation depth, and rainfall depth. Almost all of the potassium present in lagoon effluent is in K^+ ion in the form of a salt. Applying effluent to meet crop nitrogen needs often exceeds potassium recommendations. Monitoring both EC and Soil K index may provide and indication of potential salt problems.

Excess sodium in relation to calcium and magnesium may cause soil aggregates to disperse into individual particles. The resulting crust will make it difficult for rainfall to infiltrate into soil. It is important to consider the sodium concentration, as well as, the total salt content of lagoon effluent.

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Sampling Animal Manure

Oklahoma Cooperative Extension Service • Division of Agricultural Sciences and Natural Resources

F-2248

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The accuracy of a chemical analysis is only as good as the sample sent to the lab. The sample collected should closely represent the material used as a fertilizer. Manure collected at one point in the system may be completely different from manure collected at another point. Manure characteristics can also change with the seasons. Sample and analyze manure close to the time when it will be used. If you only use it during a certain time of the year, sample during that time. Take samples at least once per year and whenever manure handling procedures change. If manure is used throughout the year, sample more frequently. Many laboratories supply sampling kits on request. Always consult with the lab before collecting samples. The representative sample collected may become useless, if the proper shipping and preservation procedure is not used.

Sampling Techniques

Litter Inside a Broiler or Pullet House

Dry litter varies across the width of the house—material near the curtains is different from that under feeders and waterers. There are also differences between brood and growout areas and even the north and south sides of a house. These differences must be considered to get a representative sample. The following techniques allow samples to be taken with birds in the house.

Trench Method

Using a shovel (a narrow spade works well), dig a trench as wide as the shovel across half of the broiler house (Figure 1). Start at the center line of the house and dig a trench in the litter to the sidewall. If there is cake, cut the caked litter to the width of the shovel and collect it too. Place the entire contents of the trench on a tarp or drop cloth. Thoroughly mix the litter using a hoe. Place a portion of this well-mixed litter into a zipper-closing plastic bag. Place it in a second bag. Use the litter remaining on the tarp to backfill the trench.

Zigzag Method

Walk the entire house in a zigzag pattern (Figure 1) and grab 15 to 20 subsamples with a shovel or coffee can. Collect the entire depth of the litter, but be careful not to remove soil beneath the litter. Place subsamples in a plastic bucket, and mix thoroughly. Take a small sample from the bucket and place in a zipper-closing plastic bag. Place in a second plastic bag.

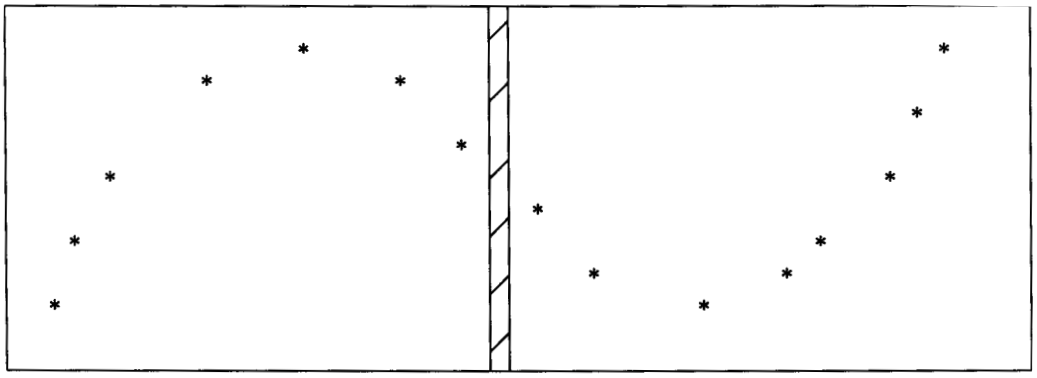

Figure 1. Taking poultry litter samples in the house using trench and zigzag methods.

Litter Inside a Breeder House (partially slatted)

A composite sample from a partially slatted breeder house can be sampled by collecting sub-samples from both slatted and litter areas. In all collect at least 20 sub-samples to get a representative sample of the building. Since 2/3 of the house is under slats, and 1/3 is litter area, collect 14 cores from under the slats and 7 samples from the litter area. Sample through the slats using a soil probe or section of pipe. Collect litter samples similar to the zigzag method above. Place slat and litter samples in a plastic bucket and mix thoroughly. Take a small sample from the bucket and place in a zipper-closing plastic bag. Place in a second plastic bag.

Lagoon Effluent

If you only pump effluent from the top of a lagoon, you only need to take a sample from the upper two feet. Samples taken from the upper layer of the lagoon should represent the contents of the layer for several weeks, although lagoons do change from month to month. It is a good idea to sample lagoon effluent during the season of year you intend to irrigate. For instance, if you plan to irrigate bermudagrass in May and wheat in August, then take two effluent samples—April-May for the bermudagrass, and July-August for the wheat.

Bucket-Toss Method

A simple effluent sampler is a rope attached to a small plastic bucket. Throw the bucket out into the lagoon and let it sink. Slowly pull the bucket back to shore, being careful not to collect scum or solids with the sample. Then swirl the bucket and pour a subsample into a plastic container.

Dipper Method

Dipping is less accurate than the bucket-toss method. But if you object to handling an effluent covered rope, use a plastic bottle securely taped to a long pole. Make sure the pole is long enough to reach over any scum collected at the edge of the lagoon. Dip out a number of samples at different depths and locations, then mix the samples together in a bucket. Swirl the bucket and pour a subsample into a plastic container.

Entire Lagoon Contents

Sometimes, producers need to analyze the entire contents of a lagoon, or they need to measure chemicals deeper than two feet in the lagoon. Lagoons separate into layers (Figure 2). The bottom of the lagoon contains sludge. A scum or crust may form at the top of the lagoon. Between the sludge and scum is a large volume of liquid. To determine the total contents of a lagoon for diagnostic purposes, you must put together a sample from all the layers. You have two choices—collect a complete column of the lagoon profile or collect material from each layer and mix it into a composite sample based on the mass of each layer. Either way means getting out on the lagoon in a boat.

Column Sampler

A number of column samplers are commercially available. All are basically a long hollow tube (Figure 2) that is slowly lowered into the lagoon. Once the sampler reaches the bottom, the tube is closed off, so you can raise the entire column from the lagoon. Be sure the sampler is long enough to reach the bottom of the lagoon and wide enough to collect an undisturbed sludge sample.

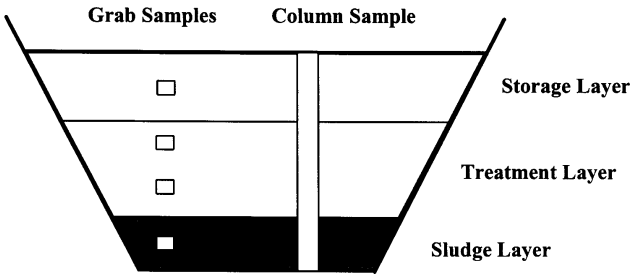

Figure 2. Sampling entire lagoon contents.

Grab Sampler

A discrete or grab sample is a small sample taken from one layer (Figure 2). The idea is to grab the sample without disturbing layers above or below it. Discrete samplers use water pressure to force sludge or liquid into the sampler. The "Sidewinder" sampler is an easy to build grab sampler for lagoons. (Plans are available. Contact your county Extension educator). Once collected, discrete samples may be analyzed separately or combined into a composite sample for the whole lagoon.

Slurry From a Waste Storage Pond or Settling Basin

Layers form in a waste storage pond just as they do in a lagoon. Sampling the entire contents of the pond requires the same techniques as a lagoon. Storage ponds are mixed before slurry is spread on the field as fertilizer. You can use the bucket-toss or dipper methods to collect samples from ponds. But the pond must be agitated first! Solids contents change as the pond is pumped. Take small samples over the entire pumping period and mix into a larger sample. Remove a small subsample from the well mixed sample and place in a plastic container.

Slurry From Pre-fabricated Storage Structures

Above ground storage structures are agitated before spreading. The return line on a pump agitator should have a valve to allow you to take samples. Take a number of small samples while emptying the storage structure. To collect samples from a propeller-agitated pit, use the bucket-throw or dipping method. Remove a small subsample from the well-mixed sample and place in a plastic container.

Slurry or Semi-Solid From Pits Beneath Slotted Floors

Column samplers that are used to sample lagoons work in storage pits as well. Homemade column samplers work just as effectively, though. Take a section of plastic pipe narrow enough to slip through the floor slots, but wide enough to collect undisturbed solids. Lower the pipe through the slots until you feel the bottom of the pit. Cap the upper end, trapping a column of manure. Empty the entire contents of the pipe into a plastic bucket. Take samples from a number of locations

throughout the pit. Swirl or mix the contents of the bucket and pour a subsample into a plastic container.

Solid and Semi-Solid Manure Off Feedlot Surfaces

Using soil probe, take a minimum of 20 cores randomly from the pen surface. Walk the entire area of the pen in a zigzag pattern to make sure you remove cores from all areas. Be careful to remove only manure and not the hardened soil beneath. Collect cores in a plastic bucket and mix them thoroughly. Take a small sample from the bucket and place it in a zipper-closing plastic bag. Place the bag in a second plastic bag. Manure characteristics change with the age of cattle and other management differences, so you should sample representative pens of the same age and similar management practices.

Solid Manure From Stockpiles and Dry Stacks

Using a shovel, remove samples from several locations of at least 18 inches into the pile. Place subsamples in a plastic bucket. Mix, but do not allow the material to dry. Place a portion of the sample in a plastic bag. For added safety, place the bag in a second plastic bag.

Liquid and Slurry During Land Application

Sometimes it is easier to get a representative sample by collecting samples during application. However, the total N concentration of samples collected in the field may be lower than samples taken from storage because some ammonia is lost during application. Contact your local Extension educator or crop consultant before using samples collected in the field for fertilizer recommendations.

Catch Cans in the Field

This technique is especially useful if slurry is spread from a honey wagon or tank truck. Randomly place a number of cans in the field. Collect waste from the cans and mix in a large bucket immediately after spreading. Swirl the bucket to mix the contents and pour a subsample into a plastic container.

Slurry or Liquid From a Big Gun Sprayer

Some big gun sprayers have a valve at the spray riser used to drain the hose. Place a bucket under the valve and open while the gun is running. Open the valve slowly! Big guns operate at high pressures. Collect a number of samples while pumping, and mix together. Take a subsample from the well mixed material and place in a plastic container.

Sample Liquids From a Sprinkler Nozzle

Impact sprinklers and LEPA spray nozzles work at lower pressures than big guns, so it is safe to collect a sample directly from the spray stream. Place a bucket or cylinder directly in the stream. In large irrigation systems, collect a number of samples at different locations. Mix samples into a composite. Take a subsample of the well mixed liquid and place it in a plastic container.

After Collecting Samples

Ship liquid and slurry samples in a quart-sized plastic bottle with a screw top lid. Only fill the bottle half full to allow for gas expansion. Squeeze flexible bottles slightly before screwing on the lid. Place solid and semi-solid samples in zipper-closing plastic bags. Place a second plastic bag over both liquid and solid samples for extra safety. Use cardboard boxes to ship sample bottles and bags. Pack the box tightly with expanded styrofoam peanuts or shredded paper and seal with strapping tape.

Preservatives are generally not needed for manure samples used for fertilizer recommendations. Other analyses may require special shipping and preservation. This is especially true when collecting samples for biological or bacteriological analysis.

The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; home economics; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective and based on factual information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
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2248 / 4

Appendix J: Record-Keeping Notebooks Table of Contents

Waste Management Notebooks

I. Fact Sheets

II. Management Plan
   1. Drawings of Structures
   2. Operation and Maintenance
   3. Stage-Storage Curve
   4. Land Application Plan

III. Manure and Soil Analysis Records

IV. Core Records
   1. Expected Production Worksheet
   2. Rainfall
   3. Storage/Lagoon Volume
   4. Land Application
   5. Year End Fertilizer Value

V. CAFO Information and Records

Appendix K: Articles for 'Pork Pages'

OKLAHOMA PORK COUNCIL

PORK PAGES

Volume 1999, Issue 5 November 1999

Richard Castle — A Dedicated Leader of Oklahoma's Pork Industry

by Bill Luce

Jet's Richard Castle holds the record on the number of years served on the board of directors of the Oklahoma Pork Council. He was a director for 28 years, serving from 1971 to 1998. He also holds the record of the longest tenure as president, a total of eight years.

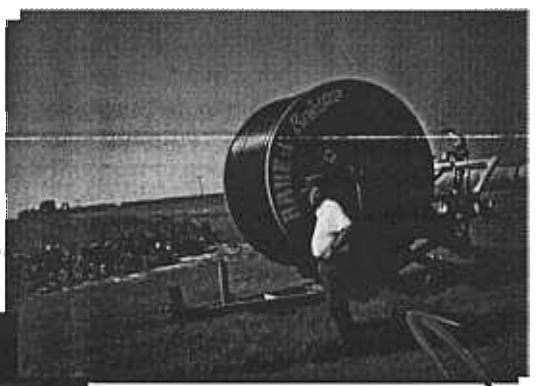
Castle held many other offices in the organization as well. He also served a six-year term on the National Pork Producers Council Federation Council. Castle was highly regarded for his superb diplomacy and outstanding leadership. He served during periods of inadequate funding, yet he would lead the organization to accomplish its goals in ways that did not take a lot of dollars.

Castle was also a director of the Oklahoma Swine Breeders Association for several years. He currently serves as state chairman of the swine committee for the Oklahoma Farm Bureau and is on the board of directors of the Alfalfa County Farm Bureau. Castle has served on the Alfalfa County Extension Advisory Board, and has been a great supporter of 4-H and FFA programs. He is a dedicated community leader and is a member and former president of the Jet Lions Club.

The 250-sow farrow-to-finish operation at the Castle farm is one of the oldest continuous swine operations in the state, starting in the 1960s.

Castle said, "that it has been as large as 620 sows, but the competition of other farm enterprises has resulted in a decrease in sow numbers."

The Castle farming operation also includes his brother, L.E., and son, Kent. All three are graduates of the OSU College of Agriculture.



Castle uses a traveling irrigation gun to apply effluent to Bermuda grass and other crops.

Castle said he believes productive sows are a key to his farm's success.

The Castle operation is truly a diversified family farm. It includes 2,700 acres of wheat, 700 acres of milo, 200 acres of "Jose" wheat grass for seed harvesting, 100 acres of alfalfa, 100 acres of Bermuda grass for hay and additional Bermuda grass for grazing.

Each year, Castle purchases 1,200 to 1,500 calves directly from ranches in eastern Oklahoma for grazing the wheat and other pastures. He said he prefers buying calves directly from ranches and has bought calves from some ranches for more than 25 years.

The Castle operation markets their hogs through Walt Hackney and Associates. Castle said he is pleased with this arrangement. A neighboring similar-sized swine operation that belongs to the Campbell brothers and families also markets through the same organization.

Purchase of superior breeding stock has always been a high priority with the Castle operation. Castle has a SPF Hampshire boar, purchased from the Penner herd of Plymouth, Neb., that he is using to produce some of his own herd boars.

Liquid swine manure from the Castle operation is used to fertilize and irrigate crops such as the Bermuda. Nutrient analyses are performed on a routine basis on both the lagoon effluent and soil samples to help determine the amount of effluent to apply to each field.

Castle and his wife, Cecelia, have two grown, married daughters in addition to Kent and his wife.

Odor Notes: The Electronic Nose

by Doug Hamilton, OSU extension waste management specialist

If you watch TV or read magazines, you've probably seen a story about one exciting odor measurement devices to come out — the electronic nose. These devices measure odors by reproducing a computerized version of nature's best detector ... the sense of smell.

The olfactory organ does most of our smelling. Special receptor nerve cells in the nose capture odorous chemicals from the air. The receptors give off a signal when an odorant lands on them. Signals from several receptors are combined in the olfactory bulb. The olfactory bulb sorts through all the chaotic receptor signals and passes them on to the brain, which does the actual smelling.

Electronic noses use metal oxide or polymer sensors in place of receptor cells. Electronic wiring and a computer do the work of the olfactory bulb and brain. Each sensor has a slightly different chemical make-up, so they give a unique response when confronted by an odorant. The computer notes the arrangement of responses and stores it as an odor profile. If the nose smells a second odor with the same profile, the computer remembers it and says the two odors are the same.

Electronic noses best compare an unknown odor to a known odor. The food industry has used electronic noses effectively for this purpose. If the nose knows what a product's odor profile is supposed to smell like, and it detects something different, it's time to investigate what's wrong. Electronic noses have also shown limited ability to measure odor concentrations and to differentiate between groups of odorants.

Because of their tireless ability to compare odors, electronic noses have the potential to monitor agricultural odors. Imagine setting the nose up in a hazardous area such as a manure pit and letting it run, faithfully recording subtle changes in odor profiles.

Limitations exist, however. An electronic nose will determine an odor change. It can't tell if the odor is better or worse, stronger or less intense. You must take samples and present them to an odor panel to determine that.

Humidity and moisture interfere with performance. Sensors respond to water vapor, as well as organic chemicals.

Electronic noses can only distinguish odors at fairly high concentrations. Scientists estimate that the average human olfactory organ is 10,000 times more sensitive than the best electronic nose.

Electronic nose technology will undoubtedly improve. Improvements will likely result in two types of noses: custom made sniffers with a limited number of sensors chosen to respond to specific odorants, and devices with a large number of sensors made from different materials selected to respond to a variety of odors.

An article in *BioSystems* chided electronic nose developers for not keeping up with science. The author claims amazing discoveries have been made about animal olfactory organs in the past 10 years, but sensor arrangements have not changed. Once recent breakthroughs are implemented, we may see new electronic noses that closer match the performance of the sensor on your face. Meanwhile, the electronic nose remains a reliable addition to sensory panels.

Oklahoma State Fair's Golden Pork Chop Contest Produces Outstanding Carcasses

OPC sponsored the recent Oklahoma State Fair Golden Pork Chop Contest. A total of 48 market hogs were entered in the swine carcass contest.

After display at the State Fair, they were slaughtered and processed at Ralph's Packing Company, Perkins. The result was an exceptional set of market hogs.

The winner was Jamie Liston, Moore, who placed second last year. Liston or other family members also placed fourth, fifth, seventh and thirteenth. The carcass cut-out values of the top ten market hogs are shown below.

Place	Exhibitor				Adj. Live Wt.	Carcass Weight	Adjusted to 230 lbs. Length	BF	LEA	10th Rib Fat	% Lean
1	Jamie Liston, Moore	G	Y	21	247.62	182	33.26	0.73	8.76	0.20	65.72
2	Craig Perry, Moore	G	X	18	234.33	172	31.69	0.75	8.74	0.30	64.35
3	Trevor Thomasson, Davis	G	X	5	262.59	193	32.89	0.64	8.71	0.40	63.70
4	Jamie Liston	G	X	30	253.06	186	32.22	0.67	8.65	0.40	63.40
5	Jamie Liston	G	H	26	254.42	187	31.69	0.70	8.63	0.40	63.38
6	Alisha Rockenbach, Byron	G	H	9	235.69	173	31.16	0.81	8.21	0.30	63.23
7	Larry Liston, Moore	G	X	43	231.61	170	31.76	0.99	8.68	0.40	63.08
8	Kelly Graham, Byron	G	H	8	253.06	186	30.52	0.81	8.45	0.40	62.97
9	Jessica Penner, Shawnee	G	H	42	269.39	198	31.42	0.94	8.41	0.50	62.06
10	James Hoel, Guthrie	G	X	19	243.54	179	31.66	0.98	7.90	0.40	61.58

OKLAHOMA PORK COUNCIL

PORK PAGES

Volume 1999, Issue 4 August 1999

High Tech Pork Production Alive in Oklahoma

by Bill Luce

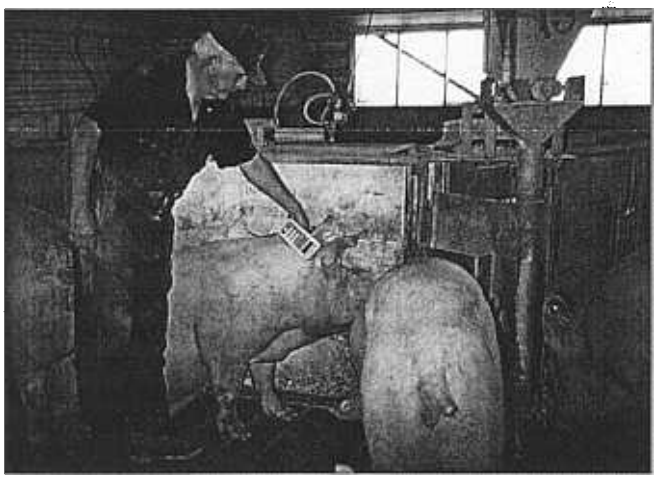
High-tech pork production is certainly evident at David Richardson's farm near Pocasset. Richardson, a 1999 Oklahoma Pork Hall of Fame Winner, manages and owns a 2,400-sow farrow-to-wean operation with his brother, Phil. The duo produce pigs for Purina Mills. Richardson has been in pork production for more than 30 years, beginning as a finisher of feeder pigs. Other farming operations have included beef cattle and wheat.

Richardson uses the latest technology available in the swine industry as evidenced by an electronic individual sow feeding system in his gestation barn. It is the only system of its kind in Oklahoma, and one of only a few in the nation. It is the the largest sow herd in the nation using an electronic individual sow system.

The gestation building houses 60 bred sows per pen. Each pen contains an electronic individual sow feeder, and each sow has a transponder tag fastened to her ear that allows her to eat a pre-set amount of feed during a 24 hour period.

"It only takes about a week for incoming gilts to become adapted to the system," Richardson said. "After that the sows are contented and seldom fight." Using the Osborne Industries system makes it possible to feed according to need and condition of each bred sow. Feed waste is essentially eliminated. Richardson estimates that the feed savings is one pound per sow per day, or approximately a ton of feed daily.

Richardson and his employees use hand held computers in the gestation and farrowing buildings to record pertinent data such as breeding dates, farrowing dates and number born. The information is downloaded daily to the office computers using the Pig Champ system. Richardson's son Wynn who is in the University of Minnesota agricultural economics department, helped set up the system.



David Richardson, Pocasset, records information on a sow using a hand held computer.

All sows in the herd are artificially inseminated with fresh semen shipped from the Pipestone Boar Stud in Pipestone, Minn. Richardson said, "The sows of PIC breeding currently average 11.9 pigs born alive and wean 24 pigs per sow per year."

The operation employees six full time and three part-time local residents. Richardson's wife, Donna, a retired school teacher, also helps part-time with computer records.

Richardson's farrow-to-wean sow operation has allowed five other Oklahoma farm families to become involved in pork production. The weaned pigs go to a nursery, owned by Kevin and Tracey Chiles and Darrell and Beverley Bortell, only four miles away. The nursery pigs go to finishing farms owned by the Darrell Mosburg family, Custer, and to finishing operations owned by the Bernard Pavlu and Walter Hodges families of Okeene.

Richardson also has a part interest in another 2,400-sow farrow-to-wean operation near Minco, producing pigs for Farmland Industries. This operation is managed by his brother, who is a veterinarian by training.

Richardson has been a truly outstanding leader of the Oklahoma pork industry, serving on the OPC board of directors for 12 years. He also served as president for two years and treasurer for one year. He also served on the National Pork Producers Council (NPPC) board of directors for six years. He is a past director of the Oklahoma Swine Breeders Association and has been a member of the OSU Extension Advisory Council.

He stays current in state and national pork producer programs. Richardson discussed the upcoming national referendum for pork producers to determine if they will keep the checkoff to the national pork board.

continued on page 10 ...

69

Odor Notes: Odor Control with Pull Plug Systems

by Doug Hamilton, OSU extension waste management specialist

Hog farmers often ask what they can do to reduce odors in buildings. I usually reply, "Pull your pits one at a time, pull them everyday and never let a pit go longer than a week without pulling."

Pit recharge is the most common manure removal system found in Oklahoma hog buildings. Pit recharge is a compromise between flushing and deep pits. Flush systems remove manure from buildings almost as fast as it is produced. Manure is allowed to rot in deep pits, but gases are removed by mechanical ventilation.

In pit recharge, or pull plug systems, manure drops into a shallow liquid-filled pit. The pit is cleaned out and recharged with liquid before the manure begins to decompose. Manure starts to decompose after about three to seven days in the pit, depending on temperature.

So, my advice is straightforward. If you pull the plugs weekly, bacteria never gets a chance to start working on the manure.

Pit recharge systems rely on fresh water or high quality lagoon effluent to fill the pits. Recharging with poor quality effluent allows manure gases to rise out of the pits and contaminate the building. The best way to keep a lagoon operating smoothly is to feed it a constant stream of fresh manure. Pulling three pits a day — one in the morning, one at noon, and one at dusk — is about as constant as feeding gets with a pull plug system.

What causes pit recharge systems to go bad?

First, there are lagoon problems. A number of problems will result in poor quality effluent entering the buildings. The lagoon was too small for effective treatment. The lagoon was not allowed to start-up properly. The operator has not maintained liquid level above the minimum drawdown level. Recharge water is removed too close to inflow pipes.

Second, farmers wait too long between pulling plugs. The building smells because manure is rotting in the pits. Some operators pull all their overflowing pits at the same time, which makes the situation worse. The lagoon may take a week to recover from the shock load.

Here's a common situation combining all of the problems mentioned into one tragic mess. The effluent recirculation system is clogged with salt. The farmer gets impatient with how long it takes the pits to fill, so he uses his irrigation pump to recharge. And, since it's such a pain to set up the big pump, a month passes before he pulls the pits. Of course, he pulls all the pits at the same time, then drops the pump's suction line into the lagoon near the inflow pipes as soon as the pits are empty.

What has he done? He's refilled the pits with the same stuff that came out, and his lagoon crashes from the heavy manure load.

Let's back up. To avoid falling into the same escalating catastrophe, go to your county extension office for advice on solving the problem with the recirculation system. Buy a good, properly sized, submersible pump and hang it as far away from the inflow pipes as possible. Remove effluent from the upper two feet of the lagoon. Pull one plug at a time. Pull a few plugs daily. And, never let a pit go more than one week without pulling.

One Size Doesn't Fit All in Providing Effective Checkoff-Funded Programs.

During the World Pork Expo, the programs finished by the national pork producer checkoff during its first decade of existence were outlined. "Our goal from the start has been to help all producers regardless of size or type," said John McNutt, National Pork Producer Council (NPPC) president.

NPPC carries out most of the checkoff programs for the National Pork Board. "We can't accomplish our goal with a "one size fits all" approach," he said. "NPPC has more than 30 checkoff-funded committees made up primarily of producers who put together programs that help producers. Some of these programs are geared primarily to the smaller size producer to allow them economies of scale and the ability to compete."

He cited the Pork Quality Assurance and the Environmental Assurance Programs, along with A.I., genetics information and networking concepts, as programs that allowed smaller independent producers to increase efficiency in their operations.

"Our goal is to give pork producers of all sizes access to the same knowledge so they can make decisions and take advantage of changing opportunities," said Arnie Stuthman, Platte Center, Neb., pork producer who is president of the National Pork Board.

"We are not using checkoff dollars to build one single program," McNutt said. "Not everyone reads the same book, but everyone has access to all the information in the library.

"If that library was gone, where would all the information be found? If the checkoff suddenly disappeared where would producers turn for information? It would all be proprietary, meaning that only an elite few who could afford to pay for it would have access to it," he concluded. "As it now stands, the vast amount of information financed through the checkoff is available to all pork producers any day of the year. That's what the checkoff buys for pork producers."

Stuthman said the pork board will invest more than $40 million in national checkoff programs this year. "The Pork Board and NPPC will be depleting their reserves this year in an effort to maintain the present level of national checkoff program funding," he said. Funding is down from last year's $44 million level. The decrease results from dramatically lower hog prices the past six months.

OKLAHOMA PORK COUNCIL

PORK PAGES

Volume 1999, Issue 3 June 1999

Trail of Devastation

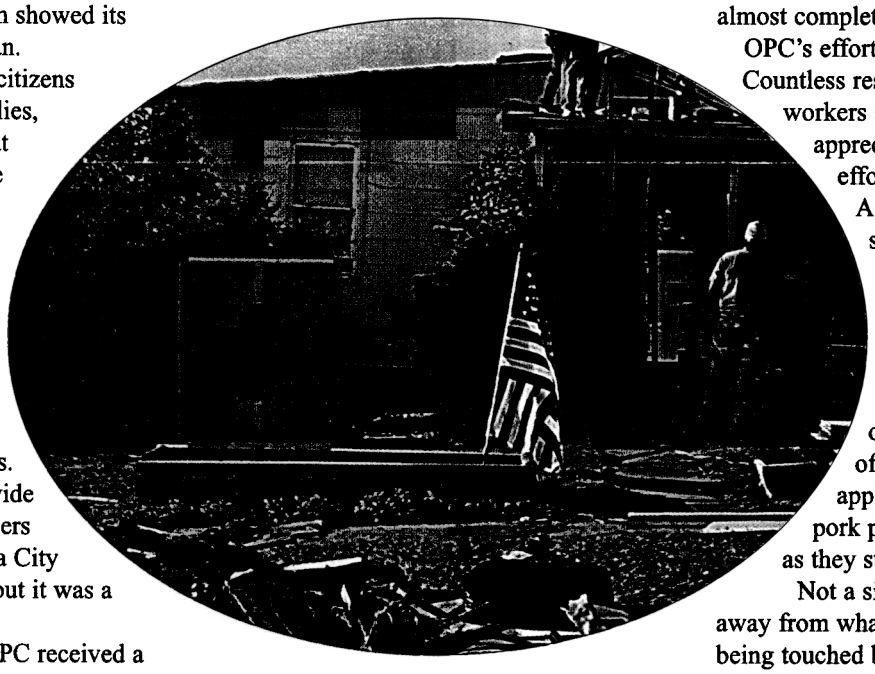
In the early evening hours of May 3, a series of deadly and devastating tornadoes swept across Oklahoma, leaving unbelievable destruction in their wake. Hundreds of Oklahomans lost loved ones and thousands of Oklahomans were left without homes or sustained significant property damage. In the aftermath of the storms, Oklahoma once again showed its compassion for its fellow man.

Countless businesses and citizens donated food, clothing, supplies, shelter, and anything else that might help the suffering. The Oklahoma Pork Council and Oklahoma's pork producers were proud to contribute to the relief effort.

Early on Tuesday, May 4, a contribution was arranged through the Oklahoma Restaurant Association to donate 700 lbs. of sausage to be used to provide hot meals to victims, volunteers and workers in the Oklahoma City metro area. It wasn't much, but it was a start.

Later on Friday, May 7, OPC received a call from the community of Mulhall. "Was there any way we could help provide hot meals over the weekend," they asked. We volunteered on the spot to be in Mulhall on Saturday and Sunday to do our part. We didn't have any meat or volunteers, but we knew we would be there somehow.

Phone calls were made across the state and meat was found. At 4:30 p.m. on a Friday afternoon, Seaboard Farms started grinding pork to make burgers. By 8:30 that evening, 2,000 burgers were in the cooler waiting to be picked up.



OPC board member Dale Cook, Elmwood, met Seaboard staff early Saturday morning to load those burgers and bring them to Mulhall — some four and a half hours away.

Approximately 1,000 lbs. of pork loins were also purchased in Oklahoma City and delivered to Mulhall on Saturday. For the better part of two days, OPC members, staff and volunteers cooked and served hot pork items to a community that had been almost completely destroyed.

OPC's efforts did not go unnoticed. Countless residents, volunteers and workers stopped by to show their appreciation of the Pork Council's efforts. Oklahoma Secretary of Agriculture Dennis Howard sent a letter thanking us for lending a hand.

"It is heartwarming to see agricultural organizations such as the Pork Council rise to the occasion during this period of disaster," wrote Howard. "I applaud the willingness of our pork producers to offer help even as they struggle to survive."

Not a single person could walk away from what we saw in Mulhall without being touched by it. All OPC members can be proud of the way they responded to great need within our state.

See photos of the scenes in Mulhall on the back cover.

Most Hogs Sold on Carcass Basis

More than 85% of hogs sold today are purchased on a carcass basis according to the USDA. Because of this, USDA has shifted almost totally to reporting carcass prices. USDA also reports that only a third of hogs sold are negotiated sales at the marketing time. A University of Missouri study reveals that 64.2% of market hogs are sold under some prearranged marketing agreement.

71

Youth For Pork 4-H and FFA Speech Contest

Sponsored by the Oklahoma Pork Council

Your speech may be over any pork related topic.
Contest will be held in conjunction with the Swine Field Day
held at Oklahoma State University, Stillwater
Thursday, July 15)()()()()(1:30 p.m.
Room 125, Animal Science Building

Categories:
Sr. FFA – 11th and 12th grades
Sr. 4-H – 14 or older as of Jan. 1, 1999
Jr. FFA – 8th through 10th grades
Jr. 4-H – Under 14 as of Jan. 1, 1999

Speech Length:
5-7 minutes – 4-H
6-8 minutes – FFA

Prizes:
Plaques and $75 will be given to first place winners.
Plaques and $50 will be given to second place winners.
A trophy and $100 will be given to the overall winner.

For more information, call Joe Hughes, Oklahoma State University, at (405) 744-6060
or Bill Luce at (405) 377-3339.

Odor Detection and Recognition

by Dr. Doug Hamilton, OSU extension waste management specialist

When the tornadoes tore up Oklahoma City in May, people all over town reported natural gas leaks. This was curious because folks smelled gas everywhere, even in Edmond, which is 10-12 miles away from where a tornado could have torn up an exposed gas line.

The next day, Oklahoma Natural Gas (ONG) reported several barrels containing the chemical Mercaptan were ruptured by the tornado at a trucking terminal in south Oklahoma City. Mercaptan is a harmless, but strong smelling, chemical added to odorless natural gas so people can detect leaks in gas lines.

Weldon Watson, ONG spokesman, stated, "(Mercaptan) creates a powerful stench that is easy to detect."

This great Mercaptan outbreak helps explain an interesting quirk of our sense of smell. People detect and recognize odors at different concentrations.

Detection means you can smell an odor, but you are not sure what it is. Recognition means you smell the odor and are able to identify it.

Mercaptan is used by ONG because it is recognized at low doses. You can smell Mercaptan at 0.5 parts per billion (one molecule of Mercaptan in two billion molecules of air). You recognize the smell of a gas leak at 2.1 parts per billion. Edmond citizens smelled two or three molecules of Mercaptan in a billion air molecules. A little bit goes a long way.

Most farm odors are not like Mercaptan. We detect farm odors at low levels, but don't recognize them until they become concentrated. You can detect ammonia at 17 parts per billion, but you will not recognize the smell as ammonia until the concentration reaches 37,000 parts per billion. When you smell ammonia in hog buildings, there's a lot of it in the air.

The wide gap between detection and recognition is largely responsible for the ambivalent feelings people have about odors. Add the uncertainty over recognizing odors to the fact that smell is processed in the same part of the brain that holds memories, and you have a powerful base to form an opinion.

I visited Central America for the first time four years ago. My visit came in the middle of a two-year drought. Stepping off the plane, I detected two odors. One was smoke from burning sugar cane fields. The other I was not sure of, but I knew I didn't like it. The smell kept coming and going as we drove into the countryside, but I could not pinpoint the scent. Finally, it hit me: human feces.

Let's back up and tell the story scientifically. I stepped off the plane and detected the chemical Skatole at around 1.2 parts per billion. Skatole is responsible for making manure smell like manure.

Water was scarce, so sewage lagoons were low and overloaded. Overloaded lagoons do not remove Skatole from human waste as well as healthy ones.

Our van passed close to the lagoon I smelled at the airport. When this happened, my nose crossed a pocket where the concentration of Skatole in the air was above its recognition level: 470 parts per billion.

The time between detecting Skatole and recognizing its fecal scent was about half an hour. I formed a few opinions about what I smelled in that half hour. Now, to be fair, I have visited Central America three times, and this is the only time I detected Skatole. It is an impression the tourist board just as soon I forgot.

What does tornado-spread Mercaptan and a Central American drought have to do with your hog farm? First impressions are strong impressions. If someone smells your lagoon once, they may remember it forever. You will have a hard time changing their opinion.

Some material used in this column was originally reported by the Tulsa World *in an article by Russell Ray.*

OKLAHOMA PORK COUNCIL

PORK PAGES

Volume 1999, Issue 2 May 1999

OPC supports OKC Spring Fair Jr. Livestock Show

The Oklahoma Pork Council commends the 4-H and FFA exhibitors for the outstanding set of barrows (over 2500) shown at the recent Oklahoma City Junior Livestock Show. The carcass data on the 55 pigs in the premium sale reflects the quality of the pigs in this year's show. The data on the top 10 is shown on page 8.

The Oklahoma Pork Council is a general sponsor of the carcass contest in addition to donating $3350 to be divided among the exhibitors of animals in the premium sale that have pigs that were bred and sold in Oklahoma. Of the 55 pigs in the sale, 36 were bred and sold in Oklahoma. The exhibitors of these pigs received an additional $93.05 from the Oklahoma Pork Council.

The Oklahoma Pork Council also invested an additional $1000 in the premium sale and $188 as a general sponsor of the carcass contest.

OPC was the buyer of the third-place Berkshire barrow during the Oklahoma City Junior Livestock Show Premium Sale. The barrow was exhibited by Ashley Kennemer, Canute FFA. Pictured with Ashley is Dr. Bill Luce, representing OPC.

Pork Group Names John Thomas President

Rogers, Arkansas - The Pork Group, a subsidiary of Tyson Foods, Inc., has named John Thomas to succeed outgoing President Bill Moeller, who will retire from the company as of May 1.

OPC Member John Thomas has recently been named President of Tyson Foods' Pork Group.

Thomas, a native of Nashville, Arkansas, has been the Pork Group's Western Operations Manager, based in Holdenville, Oklahoma. He has been with the company for 14 years. Thomas is a graduate of Oklahoma State University. He is married, with two children. Thomas will be relocating to the Pork Group's headquarters in Rogers, Arkansas.

"I'm looking forward to the challenges and opportunities offered by this role," said Thomas. "The Pork Group has a great group of people, well-run operations, and one of the most solid independent contract grower bases in the country. I'm committed to maximizing all of our resources and strengthening the solid foundation that has sustained us through more than a quarter of a century of live swine operations."

It's been a long time coming... $38 hogs

As of press time for this issue of *Pork Pages* live market price for hogs was $38 in Omaha. Prices across the Midwest ranged from $35 to $38/cwt. Analysts are still predicting prices around $40 for June of 1999. There is still work to do, but we have come a long way since $9 hogs in December.

Lagoon Effluent or Perfume with Negative Hedonic Tone?

by Dr. Doug Hamilton, OSU Extension Waste Management Specialist

Reading about farmstead odors can be unpleasant, so let's change the subject to perfume. Perfume and manure odors have a lot in common. They are both mixtures of many different odors that leave a lasting impression on the smeller. The blending of different odors creates a complex fragrance constantly changing in time.

Perfumers have worked out a method to mix their potions using a system of odor notes. A note is a distinct scent. Notes are mind-boggling mixtures of odor causing chemicals called odorants. There are over 2,000 notes identified and cataloged by the perfume industry. A bottle of perfume may contain as many as 400 or 500 notes.

Notes are named from the natural sources they are made of and are often described using the language of music or painting. If a single scent is a note, then a perfume is a chord of odors. The following passage from *Perfumery Technology* by Billot and Wells (1959) describes the perfume component Oil of Rose de Grasse:

"The odor of this oil of rose is characterized by a honey note, resembling very slightly a delicate peppery note shading off into a light tonality of natural carnation. Sometimes it is possible to perceive a slightly green odor, depending on the ripeness of the flower ..."

The wording may seem a little weird, but it makes perfect sense to a perfumer. The first scent you smell after applying oil of rose is a sweet, peppery smell. This is the top note – the least tenacious and most volatile note in the perfume. Oil of rose also contains middle and base notes, rounding off the chord and giving the oil a fuller, floral scent. If the flowers are not fully ripe when picked, you might even catch a scent of stems and leaves.

What has this got to do with swine odors?

Farm odors are complex chords of odor notes just like perfume. Five main groups of odorants are responsible for the notes we smell in manure odors: Organic Acids, Phenols, Alcohols-Aldehydes-Ketones, Nitrogen Compounds, and Sulfur Compounds. The chemical names are not really important. Organic acids have sour, greasy, and sweaty smells. Phenols can smell medicinal or tar-like. Alcohols, aldehydes and ketones give off plant-like odors, and ketones often smell sweet and fruity. Nitrogen compounds range from the sharp smell of ammonia, to the fishy smell of the amines, to the distinctive 'manure' odor of skatole. Sulfur compounds lend 'rotten' odors to the farmstead. When the notes are mixed together they lose their individual smells and blend together to smell like something altogether different.

A keen sense of smell can tell you a lot about a farm.

"Irrigated lagoon effluent is characterized by a sharp ammonia note, resembling very slightly a delicate sour scent of greasy chicken shading into earth tones. Sometimes it is possible to perceive a slightly rotten and fishy odor, depending on the time of year and performance of the lagoon."

What did I say? Lagoons treat manure. They convert the heavy, base notes of raw manure into lighter, sharper top notes like ammonia and hydrogen sulfide. While these top notes may smell strong right after application, an application site irrigated with effluent from a well managed lagoon will not have strong, lingering odors. If the lagoon is not functioning properly, effluent may contain larger sulfur and nitrogen compounds, giving it a more offensive and persistent odor.

If you would like to learn more about how perfumes are made, read the article "Perfume, the Essence of Illusion" in the October 1998 issue of *National Geographic*. To learn more about how the notes in hog odors are measured and detected, pick up a copy of the factsheet *Measuring Farmstead Odors* at your local Extension office.

If you have questions or comments on swine odor issues, please mail them to:

Dr. Doug Hamilton
Ext. Waste Mgmt. Specialist
226 Ag Hall
Stillwater, OK 74078

Or e-mail: dhamilt@okstate.edu.

Your comments and questions will appear in future additions to Odor Notes.

In 1999, about 25% of the meat America eats is pork. Beefs accounts for 27%; chicken, 33%; fish, 7%; and 8% is other (veal, lamb, turkey). The gap between pork and beef is closing.

Pork as a new menu item increased by 40% during the first six months of 1998, according to a recent survey of the top 200 restaurant chains.

OKLAHOMA PORK COUNCIL

PORK PAGES

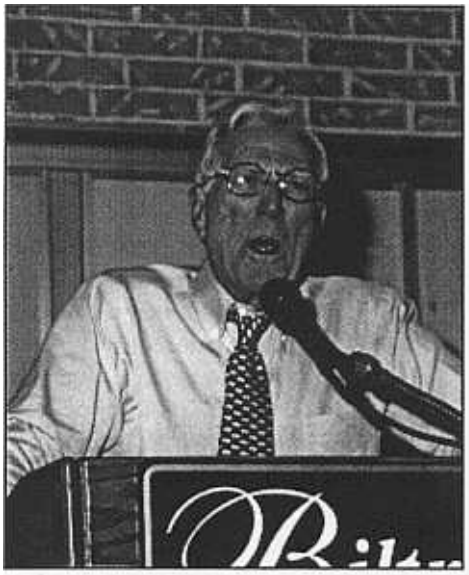
Volume 1999, Issue 1 March 1999

Oklahoma Pork Congress a tremendous success

The 1999 Oklahoma Pork Congress was a tremendous success. More than 250 people joined us throughout the weekend's activities at the Biltmore Hotel in Oklahoma City.

Highlights of the Congress included a special presentation by Al Tank, CEO of the National Pork Producers Council, educational presentations from OSU and Texas Tech Faculty, the election of board members, the annual awards luncheon, Friday night's entertainment, and much, much more. Throughout this issue of *Pork Pages* you will find pictures and more information about the Congress.

Here's just a few of the 1999 OPC award recipients and honorees recognized at the Oklahoma Pork Congress. *(Clockwise from above)*
1. Brent Bolen, Idabel, accepts the 1999 Pork All-American Award from Robin Friedrichs, 1999 OPC President.
2. Representative Elmer Maddux,Mooreland, accepts his Distinguished Service Award from outgoing OPC President Shane Boothe.
3. Senator Bruce Price, Hinton, makes a few remarks after accepting his Distinguished Service Award.
4. Hall of Fame Inductee David Richardson, Pocasset, accepts his award from Roy Lee Lindsey, OPC State Executive.
5. Past State Executive Gene Parsons addresses the crowd after receiving his Hall of Fame Award.
6. Amy Higdon, Fletcher, Pork Leadership Scholarship winner, and Travis Bradshaw, Sterling, OPC Speech Contest winner, were recognized and made comments during the OPC Awards Luncheon.



Odor Control Basics

Second in a Series:

By: Dr. Doug Hamilton, OSU

There must be a million ideas and products claiming to cure hog odors. What's a farmer to do with so many choices? It never hurts to go back to the basics. These are the basics of odor control: locate the source of odors, reduce the odor at the source, and take advantage of atmospheric dispersion to dilute odors once they leave the farm.

The first step may be the most difficult. Rarely will you find just one source giving off all the odors on the farm. Farmstead odors are a combination of smells coming from many sources. Odors arise in three general locations: buildings or pens, lagoons or outdoor manure storage structures, and land application areas. Your nose and experience are your best guides. Having an outside nose visit the farm is also helpful. Participating in NPPC's On-Farm Odor Assessment Program is a good way to get a second opinion.

Once you have located the likely sources of odors, it's time to start thinking about a cure. All odor reduction schemes are variations of three strategies.

Prevent the creation of odors. Rotting manure is the number one source of farmstead odors. Manure is food to bacteria. Bacteria give off odors as they digest manure. You can reduce odors by preventing bacteria from growing, but completely stopping bacteria from growing is harder than it seems. Manure is just too good a meal to pass up. So, instead of trying to stop all growth, simply move waste away from trouble spots. Flushing raw manure to a lagoon means fewer odors are released into the building.

Alter strong odors to less intense odors. This is the tactic used by most treatment schemes and manure additives. For instance, counteractants are chemicals added to the air above manure pits to counteract the smell given off by bacteria. Lagoons alter heavy manure odors to lighter, less tenacious odors.

Capture odors so they do not escape to the surroundings. Trap and hold odors before they leave the source. Filters for ventilation systems and covers on storage ponds capture odors. Incorporating manure into the soil after spreading is another way to capture odors. Smells cannot escape the application site if they are trapped underground.

After sniffing out the sources and nipping the worst smells at the bud, the final step in odor control is to use atmospheric ***dispersion*** to your advantage.

The simplest way to visualize odors moving off the farm is to think of a smoke plume. Smoke and odors rise in the air and move downwind. The plume rolls and tumbles on itself as it moves downwind. The tumbling motion is the result of turbulence in the atmosphere. Atmospheric turbulence causes outside air to mix with the plume. Another term for the mixing created by turbulence is dispersion. Separation distances between farms and residences rely on dispersion to dilute farmstead odors before they reach the neighbor's nose. Trees strategically placed on the farm help the wind mix and dilute odors. You cannot always count on the wind to disperse odors, though. On calm nights, heavy farmstead odors are carried to low spots in the landscape by gravity. Your neighbors may wake up to odors undiluted by dispersion.

OSU has developed a system to forecast atmospheric dispersion. You can access maps showing current and forecasted dispersion conditions at the following site on the worldwide web: http://radar.metr.ou.edu/agwx/models/. Once you reach the site, click on the link to the Oklahoma Dispersion Model.

There's one last point to consider when trying to control odors on the farm. A change made on one part of the farm affects every other part of the farm. Let's say you add disinfectant to keep bacteria from growing in your pits. What happens when you flush the disinfected manure to the lagoon? It might kill the good bacteria you are counting on to reduce odors from the lagoon.

By now, you may have reached the conclusion that there is not one single cure for odors. Odor control is a combination of many efforts, large and small. To sum things up, basic odor control is good, conscientious management. Odor control is like losing weight. You can spend time and money chasing the perfect diet, but in the end, getting more exercise and eating fewer calories is what does the trick.

If you have questions or comments on swine odor issues, please mail them to:

Doug Hamilton
Extension Waste Management Specialist
226 Ag Hall
Stillwater, OK 74078

Or e-mail: dhamilt@okstate.edu.

Your comments and questions will appear in future additions to Odor Notes.

We couldn't do it without you!!

The Oklahoma Pork Council greatly appreciates the help of the following volunteers at the 1998 Tulsa State Fair Pork Chop Shop:

Doug Foran, Holdenville
Jay McLemore, Holdenville
Billy Hufford, Holdenville
Craig Brown, Holdenville
Anthony Williams, Holdenville
Gwenda Williams, Holdenville
Sidney Mordin, Holdenville
Chris Wall, Wetumka
Amy Higdon, Stillwater

OKLAHOMA PORK COUNCIL

PORK PAGES

Volume 1 • Issue 6 November, 1998

Chef Mark Acheson of Oak Tree Golf and Country Club (winner of the 1998 Taste of Elegance) visits with Matt Alig, a pork producer from Okarche.

FOOD BANK GETS A TASTE OF ELEGANCE FROM OKLAHOMA'S TOP CHEFS

The Oklahoma Pork Council presented the 1998 Taste of Elegance Friday, October 9 at the National Cowboy Hall of Fame where eleven of Oklahoma's most talented chefs created their tastiest dishes. Over 300 guests were in attendance raising a total of $8,000 for the Oklahoma City Food Bank and those faced with hunger. The premier pork-tasting event included appetizers, salads, side dishes, samples from all chef dishes and musical entertainment by One Time.

Chefs from across Oklahoma gathered at the competition to prepare their best pork entrées with each chef anticipating first place honors and the chance to represent Oklahoma at the National Pork Competition scheduled for the spring. Preparing black bean roasted tenderloin with trio sauces and smoke shitake salsa, Chef Mark Acheson of Oak Tree Golf and Country Club was awarded first place for his culinary talents and also received a prize of $1,000. A close second, Chef Peter Seay of Oak Tree Golf Club received $500 for his pork and ginger potstickers in a roasted corn broth. Third place and $250 went to Ouida and Robert Merrifield of The Polo Grill in Tulsa who were the top winners at last year's competition and then placed second at the 1997 National Taste of Elegance in Chicago.

The burden of choosing the top three participants was that of the distinguished judges: Sharon Dowell - The Daily Oklahoma Food & Restaurant Editor; Joan Gilmore - Journal Record "Around Town" Columnist; Meghan Maddux - R.C. Stephens & Associates; Jay Porter - The Oklahoma Gazette Food & Restaurant Critic; Guests were also allowed in on the fun with the result of a People's Choice ballot revealing David Ortiz of Hilton Inn Northwest the favorite among those in attendance.

The Oklahoma City Food Bank is able to distribute $16 worth of Food for every one dollar received in donations, meaning the $8,000 from Taste of Elegance will ultimately provide $128,000 for Oklahoma's hungry. Over 600,000 people in the state are at risk of going hungry and the childhood poverty level is at 25 percent. There is a need and it is the Oklahoma City Food Bank's mission to help the charitable community effectively feed those who are hungry. For more information about hunger-relief, please call the Food Bank at 236-8349.

ATTENTION EVERYONE!!!

THE OKLAHOMA PORK COUNCIL'S QUARTERLY BOARD MEETING HAS BEEN CANCELED FOR NOVEMBER 13, 1998 AT 1:00 PM. IT IS RESCHEDULED FOR NOVMEBER 20, 1998 AT 1:00 P.M. IN OKLAHOMA CITY.

ODOR NOTES

Introductory Article

"Why do people take odors personally?"

By Dr. Doug Hamilton, OSU

Want to start a heated discussion?

Just bring up odors from swine farms.

We are adding "Odor Notes" to Pork Pages in hopes of cooling the talk down a few degrees.

In the coming weeks, this column will explain how odors are created, how odors are measured, how to control odors, and how to begin odor abatement planning.

We will also use "Odor Notes" to keep pork producers up to date on OSU Extension and NPPC odor programs.

Why do people get so emotional about odors?

Part of the reason is because we are made that way.

Odors are really just chemical compounds floating in the air.

We smell an odor when special nerve cells located behind the nose latch on to an odorous chemical.

These odor receptors are connected directly to the brain, which makes the sense of smell different that sight and hearing.

Our eyes and ears transmit messages to the brain in a much more round about way.

Because smell in "hardwired" to the brain, message are sent directly into the limbic system -- the seat of emotion and memory.

That's why I sometimes get hungry smelling lagoons.

Back when I was a graduate student, I would ride by bike out to the Iowa State Beef Nutrition Farm every afternoon and load an anaerobic digester.

By the time I was through loading, it was time for dinner.

To this day, the smell of certain digester and lagoon gases conjures up the hunger response.

I doubt many people get hungry at the smell of a lagoon.

Needless to say, smell is a highly individual sense.

No two people perceive an odor exactly the same way, nor do they react in the same manner once they've smelled it.

This makes it really hard to talk about odors -- even harder to describe them scientifically.

Languages lack a precise vocabulary to describe odors.

Sight, sound, and touch are physical senses.

They depend on very tangible phenomena -- things you can put your finger on.

Almost everyone who has seen a cow can describe a cow.

We can even differentiate between a Holstein and an Ayrshire.

"Its a large animal with four legs; It has short hair; It is covered with big, black and white spots; makes a noise that sounds like 'moo'."

Smell and taste are chemical senses.

Try to describe the taste of steak to a vegetarian, or the smell of hay to a city dweller.

Descriptions of unpleasant odors seldom rise above "bad" or "awful" or "stinky", and this leads to conflict.

Not only are odors hard to describe, but hog farmers have one more peculiarity of human anatomy working against them.

Those receptors in the back of your nose are made of living tissue, and frequent exposure to an odor dampens their ability to detect it.

This is a phenomenon known as "odor fatigue".

Your neighbor may find it hard to believe you cannot smell your hogs, but working around hogs every day makes you less sensitive to hog odors.

So, here are four reasons odors cause heated discussions:

- Our brains are constructed so that odors are closely tied to emotions and memories.
- No two people perceive odors the same way.
- Smell is a chemical rather that a physical sense.
- Frequent exposure to an odor dampens the ability to smell it.

I have a fifth reason.

Scientists and engineers make the subject more complicated than it needs to be.

Because smell is a chemical sense, the experts always fall back on chemistry to try to explain odors.

Which statement get the message across?

"Your perfume reminds me of soft dew on a rose petal."

Or, "Rose scent contain the primary odorants; 1-Citronello., Phenylacetic Acid, and Dimethyl octanol."

Wouldn't it be nice if experts used everyday language to describe farmstead odors?

Perfumers use four basic components to describe fragrance: quality, quantity, intensity, and volatility; and they do it without opening an organic chemistry book.

The second installment of "Odor Notes" will show how simple ideas borrowed from the perfume industry can describe farmstead odors.

If you have questions or comments on swine odor issues, please mail them to: **Doug Hamilton; Extension Waste Management Specialist • 226 Ag Hall • Stillwater, OK 74078 or E-mail him at dhamilt@okstate.edu.**

Your comments and questions will appear in future edditions of odor notes.

Many Winners from Oklahoma at the National Barrow Show

Oklahoma purebred swine breeders had another excellent year at the Annual National Barrow Show held at Austin, Minnesota in September, 1998. Winners from Oklahoma included:

Champion Spotted gilt-Hartman Farms, Weatherford, Oklahoma; **Champion Poland China gilt**-Jim Waits, Tahlequah, Oklahoma; **Chester White Hog College Boar**-Coy Farmer, Prague, Oklahoma; **Spotted Hog College gilt**-Pullan and Nation, Aline, Oklahoma; **Poland China Hog College gilt**-Jim Waits, Tahlequah, Oklahoma; **Poland China Premier Sire Award**-Jim Waits, Tahlequah, Oklahoma; **Landrace Premier Sire Award**-Triple B Hog Farm (Randal Buck), Eufaula, Oklahoma; **Duroc Reserve Premier Sire Award**-Leon and Kent McLemore, Ninnekah, Oklahoma; **Yorkshire Premier Sire Award**-Oklahoma State University, Stillwater, Oklahoma.

78

Appendix L: Environmental Assurance Training Program Agenda

Oklahoma Cooperative Extension Service

Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Animal Science Department • Animal Science Building
Stillwater, Oklahoma 74078-0425 • (405) 744-6060 • Fax (405) 744-7390

February 23, 1996

To: Field Extension Agents

Dear Co-Workers:

Three Environmental Assurance meetings have been scheduled for pork producers by the Oklahoma Pork Council and OSU. Date and locations are as follows.

Date	Location
April 4, 7:00 pm	McAlester - Kiamichi Vo-Technical School
April 9, 7:00 pm	El Reno - Fairgrounds
April 16, 7:00 pm	Guymon - Fairgrounds

These meetings are designed to educate pork producers on environmental issues and get pork producers involved in the National Pork Producers Council Environmental Assurance programs (a continuing education program). Specific items to be included are good waste management practices, conducting an on-farm environmental inventory to comply with state and federal environmental regulations and improving community relations. Instructors will be Doug Hamilton OSU Extension Waste Management Specialist and Bill Luce, OSU Extension Swine Specialist.

Please notify pork producers and other interested parties of these meetings.

Sincerely,

Doug Hamilt

Douglas W. Hamilton
Extension Waste Management
Specialist

Bill Luce

William G. Luce
Extension Swine Specialist

WGL:bb

Oklahoma State University, U. S. Department of Agriculture, State and Local Governments cooperating. Oklahoma Cooperative Extension Service offers its programs to all eligible persons regardless of race, color, national origin, religion, sex, age or disability and is an Equal Opportunity Employer.

Pork Environmental Assurance Meetings

I. Self Assessment – Luce
   A. Individual
   B. Small Groups
   C. Big Group

II. Water Quality
   A. Hydrologic Cycle - Matlock, Eddlemon, ?
      1. Big Picture
      2. How Hogs Might Pollute
   B. Negative Value of Manure – Hamilton

III. Manure Handling Systems – Hamilton
   A. What is a system?
   B. Lagoon, Settling Basin, Storage - what the heck?
      1. The difference between the three
      2. What have I got? (small group discussions)
      3. How do you manage?
   C. Positive Value of Manure

IV. Record Keeping- Luce, Fram, Lee, Schoenecke, tag team with Doug
   A. What can records do for you?
      1. Legal
      2. Management
      3. What do you want to know?
   B. Types of record keeping systems
      1. CAFO
      2. NPPC handouts
      3. Records OCES is developing

V. Where do you go from here? – Luce

Sections I through IV approximately 30 minutes each for a total of 2 hours.
Section V is a brief, 10 - 15 minute wrap up

Appendix M: AWRA Conference Agenda

Who should attend?

Anyone with interest in animal agriculture and the quality of water resources in Oklahoma

Conference Objectives:

- Provide a forum for exchange of scientific and technical expertise
- Present the very latest scientific and technical knowledge in water quality, water resources, and animal waste management
- Build common understanding and public support for water resources

Topics:

- Environmental impacts: water quality monitoring, watershed modeling
- The latest methods to reduce impacts on water resources
- Nonpoint Source Programs, manure marketing, watershed protection programs
- Education programs for producers
- Legislative and political considerations

OKLAHOMA Section

American Water Resources Association

The Oklahoma Section of the AWRA will provide a forum in which professionals from all water-related fields can share information, ideas, and concerns. The Section will conduct meetings, sponsor symposia, and provide a range of formal and informal networking opportunities for its members and others with similar interests. The Section will also develop work groups to educate the public and formulate position statements on issues of concern to the State and the Nation.

For more information, contact any of the OK-AWRA Board of Directors:

- Jayne Salisbury, President, 405-744-8433
- John Daniel, Vice President, 405-262-5291
- Ellen Stevens, Secretary, 405-372-7396
- Joanne Kurklin, Treasurer, 405-843-7570
- Mike Smolen, Past President, 405-744-8414

Oklahoma Section AWRA
c/o Jayne Salisbury
201 CITD
Stillwater, OK 74078

4351

Oklahoma Section *AWRA*

Water Quality & Animal Waste

Conference, Workshops, & Field Trip

Radisson Inn

Oklahoma City, OK

March 2-4, 1998

PROGRAM SCHEDULE

- Monday, March 2 Workshops

8:30 a.m. - 12:00 and 1:30 p.m. – 5:00 p.m.

- Tuesday, March 3 Conference

8:30 – 9:30	Registration
9:30 – 9:35	Welcome, Jayne Salisbury, President of the Oklahoma Section, AWRA
9:35- 10:25	KEYNOTE SPEAKER, Brian Griffin, Oklahoma Secretary of Environment, *Recommendations of the Governor's Animal Waste and Water Quality Protection Task Force*
10:45 – 12:00	Technical Session – Impact of Animal Agriculture on Water Quality
12:00 – 1:15	LUNCHEON & SPEAKER, Senator Paul Muegge, *Legislative Directions Regarding Animal Wastes*
1:30 – 3:00	Technical Session – What Oklahoma State University is doing to address animal waste issues
3:30 – 5:00	Technical Session – Technology of Waste Management
7:00 – 9:30	Water Resources Public Forum with poster session

- Wednesday March 4 Conference

7:00 – 8:00	Continental Breakfast
8:00 – 8:30	INVITED SPEAKER: Dave Mueller, USGS, NAWQA National Synthesis Project, *Sources & Fate of Nutrients in USA Water Resources*
8:30 –10:00	Technical Session – Marketing & Alternative Uses of Manure
10:30 – 12:00	Technical Session – Legislation/Regulation/Education
12:15 – 5:00	Field Trip to Land O'Lakes

- Workshops

1) **Swine Waste Management for the Non-farmer** 8:30 – 1:00
This workshop will cover: modern swine production, pollution control, recycling manure nutrients to crop and forage production, and more than you ever wanted to know about lagoons! Instructors: Doug Hamilton, Hailin Zhang, and Bill Luce – Oklahoma State University

2) **Composting – Degrading vs. Discarding** 1:30 – 5:00
This workshop will compare composting processes, techniques and methods. Special discussions of vermicomposting and a 4-H vermicompost project will be included along with instructions to start an indoor worm bin. Instructors – Mitch Fram and Billie Chambers, Oklahoma State University Cooperative Extension Service, and John Meadows, City of Ponca City.
★BONUS: worms for all participants! ★

Workshop registration covers the entire day. You may attend the morning or afternoon session or both. All workshop materials are included with registration. Class size is limited to 30. A workshop may be cancelled if registration is insufficient. Lunch is on your own.

Water Resources Public Forum

The public will be invited to join the conference on Tuesday evening to review posters and discuss animal waste issues. To inquire about participating as an exhibitor, contact Ellen Stevens at 405-372-7396 or Joanne Kurklin at 405-843-7570.

- Field Trip: Land O'Lakes

Following the conference on Wednesday will be a field trip to Land O' Lakes' swine operation located at Hinton, Oklahoma. The tour will spotlight their waste management facilities. Tour size is limited so register soon to hold your spot for what is sure to be an informative event.

- Conference Registration

Registration includes admittance to all conference sessions, a program with abstracts, Tuesday luncheon, Wednesday continental breakfast, and refreshments at breaks.

DEADLINE for registration is **February 24, 1998**. A small number of registrations may be accepted at the meeting, space permitting, but lunch may not be included.

CANCELLATION AND REFUNDS Notice of cancellation must be received by the Agricultural Conference Services by **February 24, 1998,** to insure a refund.

- **Location and Lodging**

The conference and workshops will be held in the North Conference Building at the Radisson Inn, West I-40 and Meridian, Oklahoma City, OK. Make lodging reservations directly with the Radisson Inn at (405)-947-7681. To secure a room, reservations must by made by **February 15th.** Mention the *AWRA Water Quality Conference* to ensure conference room rate. Room rate: $59 + tax per night for 1-4 person occupancy. Reservations after the 15th will still receive this rate but room availability cannot be guaranteed.

For the latest conference information visit our web site:
http://www.seic.okstate.edu/ok-awra

Registration Form
Water Quality and Animal Waste Conference
March 2-4, 1998

Name: _____
Title: _____
Affiliation: _____
Address: _____
City, State, Zip: _____
Telephone/FAX _____
Email: _____

American with Disabilities Act

❑ Check if you need additional information or accommodation. We will contact you to make arrangements to facilitate attendance.

Dietary Preference

❑ Check for special dietary needs (e.g. vegetarian) _____
_____

Registration Fees

Conference:	Members:	$35	_____
	Non-members	$45	_____
	Student:	$25	_____
Workshop: (check appropriate box)		$30	_____
❑ Swine Waste Management			
❑ Composting			
Field Trip		$25	_____
1998 Membership:		$10	_____
Oklahoma Section, AWRA (Not required for registration)			
	TOTAL	$	_____

Method of Payment:

❑ Check
❑ Please bill my registration fees to the following organization:
_____
Purchase Order # _____

Make checks and P.O. #'s payable to Oklahoma State University.

For questions about registration contact Agricultural Conference Services at: (405) 744-6489.

Send registration form and payment to:

Water Quality & Animal Waste Conference
Agricultural Conference Services
430 OSU Student Union
Stillwater, OK 74078

Appendix N: AWRA Conference Program

Program for the Conference on Water Quality and Animal Wastes

Oklahoma Section, American Water Resources Association
March 3-4, 1998, Radisson Inn, Oklahoma City

Tuesday, March 3

8:30 - 9:30 On-site Registration and Check-in

9:30 - 9:35 Welcome - Jayne Salisbury, President of the Oklahoma Section, AWRA

9:35-10:15 **KEYNOTE SPEAKER**, Brian Griffin, Oklahoma Secretary of the Environment, *Recommendations of the Governor's Animal Waste and Water Quality Protection Task Force*

10:15 - 10:30 BREAK

10:30 - 12:00 **Impact of Animal Agriculture on Water Quality**, Moderator: Richard Smith

Overview of Water Quality Impacts - Richard Smith

Field and Watershed Studies - Mike Smolen

Geochemical Perspective of Poultry Waste - Bert Fisher

Overview of Animal Waste Regulations - Tina Gunter

12:00 - 1:15 **LUNCHEON AND SPEAKER**, Senator Paul Muegge, *Legislative Directions Regarding Animal Wastes*

1:30 - 3:00 **What OSU Is Doing to Address Animal Waste Issues,** Moderator: D. C. Coston

Pollution Control in Hog Production - Doug Hamilton

Feeding for control of odor and water quality - Scott Carter

Animal Waste Application - Jeff Hattey

Impact of Hog Production on the State of Oklahoma - Joe Williams and Mike Woods

3:00 – 3:30 BREAK

3:30 - 5:00 **Technology and Education for Waste Management,**

Reducing Livestock Impacts on Surface Water Impoundments, Marley Beem and Jack Wallace

Land Applications of Drilling Mud in Conjunction with Pit Closure: A Conceptual Model for Agricultural Waste Management, G.A. Shirazi

Using Manure Characteristics to Determine Land-Based Utilization, David C. Moffitt and Charles Lander

Manure Nutrient Management Education on the Internet, Hailin Zhang and Jinquan Wu

DINNER ON YOUR OWN

7:00 - 9:30 **Public Forum on Water Resources in Oklahoma**

Water-related organizations and the general public are invited to join the Conference on Tuesday evening to continue discussions of the water quality impacts and management of animal waste on Oklahoma's waters and on water resources in general. Organizations will have exhibits of their water interests and activities. Conference speakers will be present with posters on research, technical, and educational programs.

Some of the posters that will be on display:

Livestock Watering Options to Protect Surface Water Impoundments, Don Britton

Water Quality Best Management Practices, Marley Beem

Fecal Bacteria Occurrences in Surface Water Runoff from Grazed Watershed, Rhiannon England, Clifton Valley, and John A. Daniel

GIS of Oklahoma's Water Body ID System for Water Quality Studies, W. Shad Meldrum

Examination and Development of Soil Sampling Strategies for Estimating Basin-Scale Soil Phosphorous, William R. Marshall, Daniel E. Storm, Michael D. Smolen, C. Tom Haan

The Impact of Environmental Regulation on the Growth of the Hog Industry, Simeon Kaitbie and Larry Sanders

Animal Waste Planning and Application: A Water Quality Management Program, Wayne E. Fjseth

Wednesday, March 4

8:00-8:30 **INVITED SPEAKER**, David Mueller, U. S. Geological Survey, *Sources and Fate of Nurtients in USA Water Resources*

8:30 - 10:00 **Marketing and Alternative Uses of Manure,** Moderator: Mike Thralls

Concentration of Nutrients, a Mass Balance Study - Dan Storm .

History of Marketing Litter and the Marketing Work Group - Paul Brown

Alternate uses of poultry litter, G. L. Bullard

Litter Marketing, Comparison with Wheat and Cattle Marketing, Darrell Peel

10:00 – 10:30 BREAK

10:30 - 12:00 **Watershed Water Quality Studies**, Moderator: Marty Matlock

Development and Application of a Lotic Ecosystem Trophic Status Index, Marty D. Matlock, Daniel E. Storm, Michael D. Smolen, Monty E. Matlock, Anne M. S. McFarland, and Larry Hauck

Methods to assess nutrient limitation in streams, DaleToetz

The OU-OSU Water and Watershed Study of the Illinois River Basin, Mark Meo

Point and Nonpoint Source Impact on the Illinois River, David Gade

Outdoor Classroom Development/Water Quality Awareness, Wayne E. Fjseth

Wednesday, March 4 Field Trip

12:30-5:00 Join the bus trip to Land O'Lakes swine operation near Hinton, OK. The tour will spotlight their waste management facilities, including lagoon operation and the myriad of record keeping associated with animal agriculture.

Monday, March 2 Workshops at OSU Extension Center

830-12:00 *Swine Waste Management for the Non-Farmer*. Non-technical presentation on modern practices of swine production and pollution control, including lagoons and recycling to crops and forage

1:30-5:00 *Composting – Degrading or Discarding*. Compare composting processes and methods, including vermicomposting