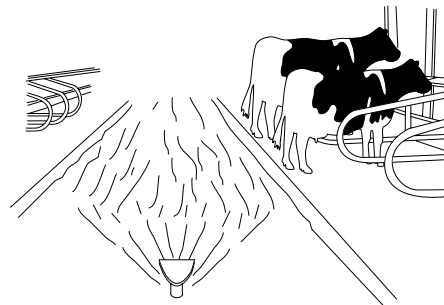
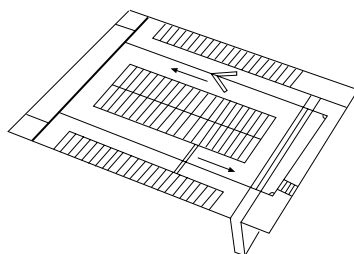
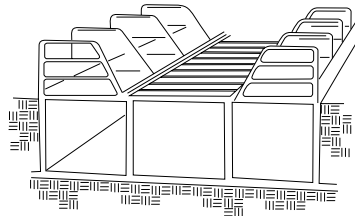
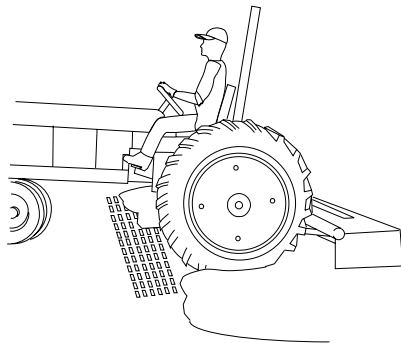




THE DAIRY PRACTICES COUNCIL

# Guideline for Dairy Manure Management from Barn to Storage



Natural Resource, Agriculture, and Engineering Service (NRAES)

Cooperative Extension

# About NRAES

NRAES, the Natural Resource, Agriculture, and Engineering Service, is a not-for-profit program dedicated to assisting land grant university faculty and others in increasing the public availability of research- and experience-based knowledge. NRAES is sponsored by fourteen land grant universities in the eastern United States (see map below). We receive administrative support from Cornell University, the host university.

When you buy books from NRAES, you are helping to improve the accessibility of land grant university knowledge. While 15% of NRAES' annual income is provided by member universities, the funds to publish new books and coordinate new conferences come from our customers through book sales, conference registrations, and occasional project-specific grants.

NRAES publishes practical books of interest to fruit and vegetable growers, landscapers, dairy and livestock producers, natural resource managers, SWCD (soil and water conservation district) staff, consumers, landowners, and professionals interested in agricultural waste management and composting. NRAES books are used in cooperative extension programs, in college courses, as management guides, and for self-directed learning.

NRAES publishes two types of books: peer-reviewed books and conference proceedings. Our peer-reviewed books are evaluated prior to publication for technical accuracy and usefulness to the intended audience. The reviewers may include university faculty, extension educators, potential users, and interested persons from gov-

ernment and agribusiness. Conference proceedings are not peer-reviewed. However, the authors of papers presented at NRAES-sponsored conferences are chosen for their recognized expertise. NRAES also distributes some videos related to waste management and fruit and vegetable production.

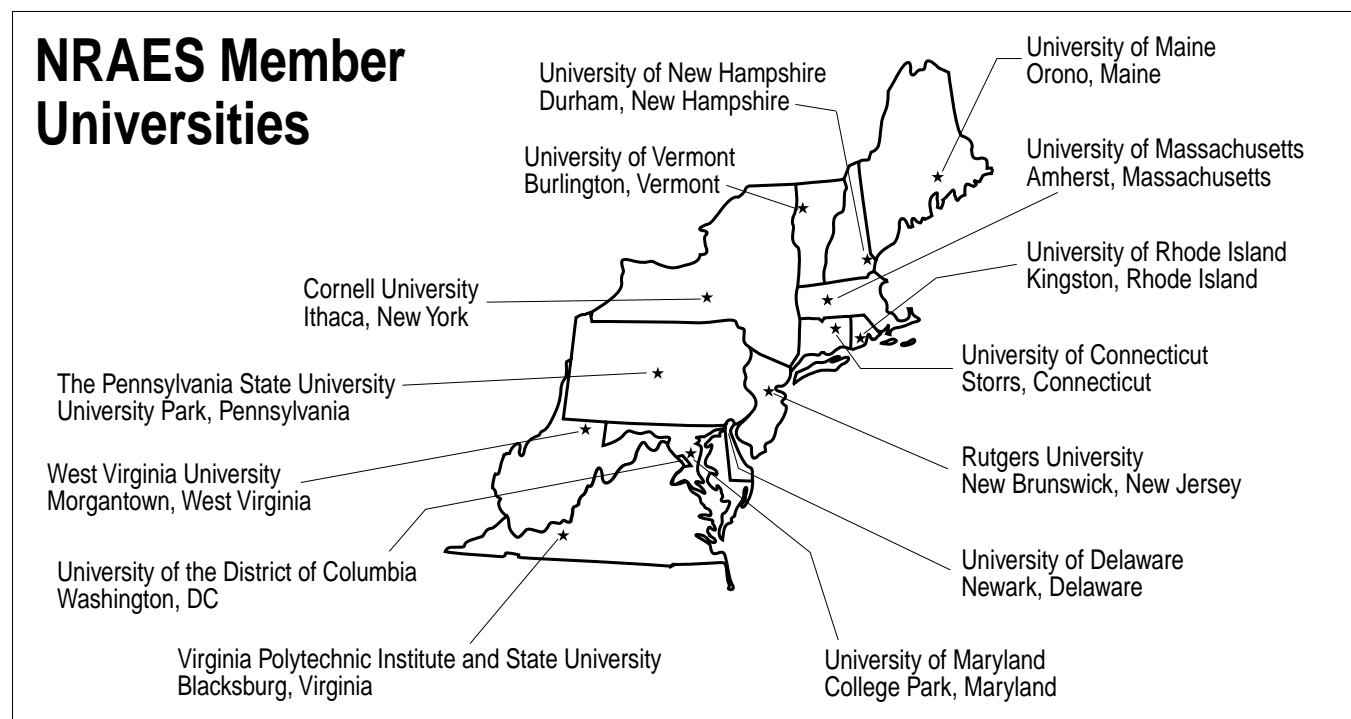
NRAES was started in 1974 and was originally known as the Northeast Regional Agricultural Engineering Service. In 1987, with encouragement from member university extension directors, NRAES began offering its services to faculty from all disciplines at member universities. In 1998, Virginia Polytechnic Institute and State University joined the original thirteen member universities. Our name was changed in 1998 to reflect the expansion of NRAES beyond the Northeast and the broadening scope of our books and conferences.

Contact us for more information or a free book catalog:

Natural Resource, Agriculture, and Engineering Service (NRAES)  
Cooperative Extension  
PO Box 4557  
Ithaca, New York 14852-4557

Phone: (607) 255-7654  
Fax: (607) 254-8770  
E-mail: [NRAES@CORNELL.EDU](mailto:NRAES@CORNELL.EDU)  
Web site: [WWW.NRAES.ORG](http://WWW.NRAES.ORG)

Marty Sailus, NRAES Director  
Jeffrey S. Popow, NRAES Managing Editor



# **Guideline for Dairy Manure Management from Barn to Storage**

## **Prepared by**

Stanley A. Weeks, Subcommittee Chair  
Farm Buildings and Equipment Task Force  
The Dairy Practices Council

## **With assistance from**

Michael F. Brugger, J. Robert Engle, Nancy Ferris, Robert E. Graves, William Graves,  
Richard Guest, Kirt Hartzell, Wilmot W. Irish, Joseph Moreau, John Porter,  
Marty Sailus, Peter Wright

Natural Resource, Agriculture, and Engineering Service (NRAES)  
Cooperative Extension  
PO Box 4557  
Ithaca, New York 14852-4557

**DPC 27**  
**NRAES-108**  
**June 1998**

ISBN-13: 978-0-935817-27-0

ISBN-10: 0-935817-27-1

Requests to reprint parts of this book should be sent to NRAES. In your request, please state which parts of the book you would like to reprint and describe how you intend to use the reprinted material. Contact NRAES if you have any questions.

Natural Resource, Agriculture, and Engineering Service (NRAES)  
Cooperative Extension  
PO Box 4557  
Ithaca, New York 14852-4557

Phone: (607) 255-7654  
Fax: (607) 254-8770  
E-mail: [NRAES@CORNELL.EDU](mailto:NRAES@CORNELL.EDU)  
Web site: [WWW.NRAES.ORG](http://WWW.NRAES.ORG)

# Authors

## Prepared by

Stanley A. Weeks  
Subcommittee Chair  
Farm Buildings and Equipment Task Force  
The Dairy Practices Council

## With assistance from

Michael F. Brugger  
Assistant to Director  
Ohio State University

J. Robert Engle  
Babson Brothers Co.

Nancy Ferris  
Albers Manufacturing Co.

Robert E. Graves  
Professor  
Agricultural and Biological Engineering  
The Pennsylvania State University

William Graves  
Extension Professor  
Veterinary and Animal Science  
University of Massachusetts Amherst

Richard Guest †  
Professor Emeritus  
Agricultural and Biological Engineering  
Cornell University

Kirt Hartzell  
Albers Manure Handling Systems, Inc.

Wilmot W. Irish  
Professor Emeritus  
Agricultural and Biological Engineering  
Cornell University

Joseph Moreau  
President  
NORBCO, Inc.  
Westmoreland, New York

John Porter  
Dairy Extension Specialist  
Merrimack County Cooperative Extension  
University of New Hampshire

Marty Sailus  
Director  
Natural Resource, Agriculture, and Engineering  
Service (NRAES)

Peter E. Wright  
Animal Waste Specialist  
Agricultural and Biological Engineering  
Cornell Cooperative Extension

† Deceased



# Table of Contents

<b>Section 1: Planning, Getting Help, and Meeting Regulations</b> .....	1
Planning .....	1
Getting Help .....	2
Meeting Regulations .....	2
Safety .....	2
<b>Section 2: Manure Characteristics and Production</b> .....	3
Manure Characteristics .....	3
Manure Production .....	3
Effects of Adding Bedding and Water .....	4
Solids Separation .....	5
Other Characteristics—Drying and Freezing .....	5
<b>Section 3: Manure Management Alternatives</b> .....	6
Moisture Content and Management Options .....	6
Manure Collection Systems .....	7
<b>Section 4: Transferring Manure from Barn to Storage</b> .....	9
Gravity Pipes for Transferring Manure .....	9
Manure Type .....	9
Collecting Hopper .....	9
Transfer Pipe .....	11
Gravity Channels .....	11
Equipment Options for Moving Manure to and from Storage .....	11
Pumping Manure to Storage .....	12
<b>Section 5: Manure Storage</b> .....	18
Evaluating Manure Storage Options .....	18
Daily Haul .....	18
Uncovered Storages .....	20
Stacks .....	20
Earthen Bank with Concrete Floor .....	20
Earthen Bank with Earthen Floor .....	20
Earthen Bank with Polyethylene Liner .....	21
Anaerobic Lagoon .....	21
In-Ground Tank .....	21
Aboveground Silo or Rectangular Tank .....	21
Picket Dam .....	21
Covered Storages .....	22
Underground Tank beneath Slotted Floor .....	22
Roofed Vertical-Wall Storage .....	22
Bedded Pack .....	22
Solid Manure Storage .....	22

Construction .....	23
Size .....	23
Runoff Control .....	23
Bedding .....	23
Semisolid Manure Storage .....	24
Covered Semisolid Manure Storages .....	25
Picket Dam Drains .....	25
Earthen Basin Storages .....	26
Vertical-Wall Storages .....	27
Sizing Manure Storage Units .....	27
Manure Volume .....	27
Volume of Bedding, Wastewater, and Runoff .....	27
Extra Depth for Precipitation, Dead Space, and Freeboard .....	27
Sample Situations and Solutions for Sizing Storages .....	31
Situation 1 .....	31
Situation 2 .....	31
Situation 3 .....	32
Management of Storages .....	33
Safety Concerns .....	33
Filling .....	33
Unloading .....	34
Fly Control .....	34
Odor Control .....	34
<b>Common Conversion Factors</b> .....	<b>35</b>
<b>References</b> .....	<b>36</b>



# List of Figures

1	Manure collection systems .....	7
2	Gravity-flow manure storage system .....	10
3	Reception pit and gravity pipe .....	10
4	Manure spreader or reception pit and gravity pipe .....	10
5	Collecting hoppers in freestall alleys .....	10
6	Cross section of a typical collecting hopper .....	11
7	Sump design to prevent storage backflow when pumping from a lower elevation .....	13
8	Centrifugal pump impellers .....	13
9	Open impeller chopper agitator pump .....	13
10	Flooded suction arrangement .....	16
11	Dairy manure storage and handling systems .....	19
12	Semisolid manure storages .....	24
13	Guidelines for picket dam construction .....	25
14.a	Rectangular storage, 6 feet working depth, sides sloped 2:1, bottom dimensions to hold a given volume. Example is given in situation 2. ....	30
14.b	Rectangular storage, 8 feet working depth, sides sloped 2:1, bottom dimensions to hold a given volume ..	30

# List of Tables

1	Manure production from all animals in a typical dairy herd with 80 milking cows plus dry cows and replacements .....	4
2	Equipment options for moving manure into the storage area .....	12
3	Equipment options for removing manure from the storage area .....	12
4	Liquid manure handling pumps .....	14
5	Suitability of storage systems for three types of manure .....	20
6	Typical floor area (square feet) of solid manure storages for a four-month storage .....	23
7	Runoff-collecting pond size for a six-month storage .....	23
8	Bedding material water absorbing capacity (bedding at 10% moisture) .....	23
9	Bedding material density .....	23
10	Bedding requirements .....	24
11	Volume of bedding in storage per cow per day .....	28
12	Estimated volume of wastewater from milking centers .....	28
13	Circular storage dimensions to hold a given volume .....	28
14	Rectangular storage with side slopes 2:1, top dimensions to hold a given volume .....	29