



GRETCHEN WHITMER  
GOVERNOR

STATE OF MICHIGAN  
DEPARTMENT OF AGRICULTURE  
AND RURAL DEVELOPMENT

DR. TIM BORING  
DIRECTOR

**NOTICE OF MEETING**

**MICHIGAN COMMISSION OF AGRICULTURE  
AND RURAL DEVELOPMENT**

**November 6, 2024**

The regular meeting of the Michigan Commission of Agriculture and Rural Development will be held on Wednesday, November 6, 2024. The business session is scheduled to begin at 9:00 a.m. The meeting is open to the public and this notice is provided under the Open Meetings Act, 1976 PA 267, MCL 15.261 to 15.275. The Commissioners will be meeting at Constitution Hall – Atrium Level, Con-Con Conference Room, 525 West Allegan Street, Lansing, Michigan. This meeting is also being conducted electronically to allow for greater remote public attendance and participation. To join the meeting via Microsoft Teams: by telephone dial: **1-248-509-0316** and enter the **Conference ID 172 999 0#** or by video conference visit [www.michigan.gov/mdard/about/boards/agcommission](http://www.michigan.gov/mdard/about/boards/agcommission) to join the day of the meeting.

In accordance with the Commission's Public Appearance Guidelines, individuals wishing to address the Commission may pre-register to do so during the Public Comment period as noted below and will be allowed up to three minutes for their presentation. Documents distributed in conjunction with the meeting will be considered public documents and are subject to provisions of the Freedom of Information Act. The public comment time provides the public an opportunity to speak; the Commission will not necessarily respond to the public comment.

To pre-register to speak virtually during this meeting, individuals should contact the Commission Assistant **no later than Fri. November 1, 2024**, via email at [MDA-Ag-Commission@michigan.gov](mailto:MDA-Ag-Commission@michigan.gov) and provide their name, organization they represent, address, and telephone number, as well as indicate if they wish to speak to an agenda item. You may also contact the Commission Assistant at that email address to provide input or ask questions on any business that will come before the Commission at the meeting. The Commission Chair will call upon each person by name and telephone number when it is time for them to speak and there will be a meeting moderator facilitating participation. All others wishing to speak will be provided two minutes to do so. Instructions on how to be recognized will be provided at the beginning of the meeting.

Those needing accommodations for effective participation in the meeting should contact the Commission Assistant at 800-292-3939 one week in advance or may use the Michigan Relay Center by calling 711 for deaf, hard of hearing, or speech-impaired persons.

  
Tim Boring  
Director

## MICHIGAN COMMISSION OF AGRICULTURE AND RURAL DEVELOPMENT

Constitution Hall – Atrium Level  
Con-Con Conference Room  
525 West Allegan Street  
Lansing, Michigan

Option to Join via Remote Technology  
Dial: 1-248-509-0316; Conf. ID: 172 999 0#

### **November 6, 2024** TENTATIVE AGENDA

- 9:00 a.m.
1. **Call to Order and Roll Call**
  2. **Approval of Agenda (action item)**
  3. **Approval of Minutes** from the September 11, 2024, Commission of Agriculture and Rural Development Meeting (**action item**)
  4. **Commissioner Comments and Travel (action item)**
  5. **Director's Report**
  6. **Public Comment on Agenda Items**  
In accordance with the Public Appearance Guidelines in the Commission Policy Manual, individuals wishing to address the Commission must complete a Public Appearance Card and will be allowed up to three minutes for their presentation. Documents distributed at the meeting will be considered public documents and are subject to provisions of the Freedom of Information Act. The public comment time provides the public an opportunity to speak; the Commission will not necessarily respond to the public comment.
  7. **Proposed 2024 Meeting Schedule (action item)**
  8. **Intertribal Agriculture Council Presentation:** Abby Buraglio, Great Lakes Region Technical Assistance Specialist Intertribal Agriculture Council (**information only**)
  9. **Food and Agriculture Investment Fund Request Amendment:** Jamie Zmitko-Somers, Bureau Director, Agriculture Development Bureau (**action item**)
  10. **Generally Accepted Agricultural Management Practices (GAAMPs) – Process and Introduction of Draft 2025 GAAMPs:** Michael Philip, Bureau of Environment and Sustainability Director and Kyle McCarty, Right to Farm, Conservation Stewardship Division (**action item**)

11. **MDARD Regenerative Agriculture Program:** Michael Philip, Bureau of Environment and Sustainability Director, and Megan DeLeeuw, Soil, Water, and Climate Section Manager **(information only)**
12. **Nursery and Related Inspection Fees:** Molly Mott, Plant Health Section Manager, and Michael Philip, Bureau of Environment and Sustainability Director **(action item)**
13. **Public Comment**  
In accordance with the Public Appearance Guidelines in the Commission Policy Manual, individuals wishing to address the Commission will be allowed up to three minutes for their presentation. Documents distributed at the meeting will be considered public documents and are subject to provisions of the Freedom of Information Act. The public comment time provides the public an opportunity to speak; the Commission will not necessarily respond to the public comment.
14. **Adjourn (action item)**

# **MICHIGAN COMMISSION OF AGRICULTURE AND RURAL DEVELOPMENT**

Con-Con Conference Room  
525 West Allegan Street  
Lansing, Michigan

Option to Join via Remote Technology  
Dial: 1-248-509-0316; Conf. ID: 653 238 181#

## **MEETING MINUTES SEPTEMBER 11, 2024**

### **PRESENT:**

Monica Wyant, Chair, Michigan Commission of Agriculture and Rural Development  
Dr. Felicia Wu, Michigan Commission of Agriculture and Rural Development  
Kathrine Garthe, Michigan Commission of Agriculture and Rural Development  
Dr. Tim Boring, Director, Michigan Department of Agriculture and Rural Development

### **ABSENT**

Andy Chae, Vice Chair, Michigan Commission of Agriculture and Rural Development, absent.  
David Williams, Michigan Commission of Agriculture and Rural Development joined the meeting remotely.

### **CALL TO ORDER AND ROLL CALL**

Chair Wyant called the meeting of the Commission of Agriculture and Rural Development to order at 9:00 a.m. on September 11, 2024. Chair Wyant called the roll with Commissioners Wyant, Wu, Garthe, and Director Boring present. Commissioner Williams joined the meeting via TEAMS. Commissioner Chae was absent.

### **APPROVAL OF AGENDA**

**COMMISSIONER GARTHE MOVED TO APPROVE THE AGENDA FOR SEPTEMBER 11, 2024. COMMISSIONER WU SECONDED. MOTION CARRIED.**

### **APPROVAL OF JULY 24, 2024, MEETING MINUTES**

**MOTION: COMMISSIONER WU MOVED TO APPROVE THE JULY 24, 2024, MEETING MINUTES. COMMISSIONER GARTHE SECONDED. MOTION CARRIED.**

### **NEXT SCHEDULED MEETING**

The next scheduled commission meeting is November 6, 2024.

### **COMMISSIONER COMMENTS AND TRAVEL**

Commissioner Wu had recently traveled to Taiwan in her role as the President of the Society of Risk Analysis (SRA) where she was a keynote speaker at the SRA Asia Meeting. In the upcoming week, she will be hosting a visiting professor from Harvard University, who is a leading nutritional epidemiologist, who will be speaking on diets and human health and how they are affected by the environment. Afterwards, she will be traveling on to Ethiopia to study impacts of milk consumption on children's growth and health.



Commissioner Garthe's farm is currently picking apples and pears. Their cherry harvest lasted 3 weeks due to fungal growth, typically the season lasts 6 weeks.

Commissioner Wyant's produce team from Meijer visited watermelon, blueberries and sweet corn farms this summer around the state. She highlighted the new Fresh from Meijer brand that will focus on Michigan agriculture in the store.

**MOTION: COMMISSIONER WU MOVED TO APPROVE THE COMMISSIONERS' TRAVEL. COMMISSIONER GARTHE SECONDED. MOTION CARRIED.**

### **DIRECTOR'S REPORT**

Director Boring stated the department continues to be in a growth period after the realignment. He highlighted the Regenerative Agriculture Program. The Strategic Plan is close to completion, and they continue to make hires, including, on-the-ground employees that will be able to visit farms and directly work with farmers around the state. The department is also a recipient of a USDA Working Climate Grant which establishes a demonstration regenerative ag farm at the National VFW Home in Eaton Rapids. Another program the department continues to build is the Farm to Family Program. This program is to be more inclusive in the food system, including broader effort of healthiness, in communities, in people and in the economy.

The Director highlighted work with the cherry industry and some of the challenges they have faced this year due to weather and quality concerns. The department is working with USDA on requesting disaster assistance. Two weeks ago, MDARD hosted the U.S. Trade Representative, Doug McKalip. Together they visited with commodity groups, then Port of Monroe, a meat manufacturer in Ferndale, and food agriculture businesses in the Dearborn area. The tour highlighted how imports and exports in the state are vital to agriculture.

The director invited the commissioners to the department's upcoming all staff meeting and employee awards ceremony at the end of October. Both events are in person in downtown Lansing and will highlight the department's accomplishments and focus on training, networking and team building.

Commissioner Garthe asked about what the department is hearing at the Farm to Family listening sessions throughout the state. The Director shared there is a lot of interest of on farm for diversification but barriers exist throughout the supply chain. Commissioner Garthe explained their current farm co-op expands in northern Michigan and helps producers process and distribute across multiple counties.

Commissioner Wu asked the director to expand more about Regenerative Agriculture in the department and the plans in the future. The director explained the program plans to focus initially on conservation outcomes, increasing the value of products grown and environmental service achieved are seen as future opportunities.

### **PUBLIC COMMENT ON AGENDA ITEMS**

Chris Patterson, representing Peninsula Township, testified before the commission.

### **MICHIGAN AGRICULTURE ENVIRONMENTAL ASSURANCE PROGRAM (MAEAP) STANDARDS – ADOPTION OF 2025 STANDARDS**

Michael Philip, Bureau of Environment and Sustainability Director, and Joe Kelpinski, MAEAP Manager recapped the introduction of the MAEAP Standards from the prior

meeting. Mr. Kelpinski reminded the commission there were no major changes to the 2025 standards, but revisions are planned for the 2026 standards. The MAEAP program has started to discuss those changes and will focus on climate and regenerative agriculture practices.

**MOTION: CHAIR WYANT MOVED TO APPROVE THE 2025 MICHIGAN AGRICULTURE ENVIRONMENTAL ASSURANCE PROGRAM (MAEAP) STANDARDS. COMMISSIONER GARTHE SECONDED. MOTION CARRIED.**

#### **GENERALLY ACCEPTED PROCESSING PRACTICES (GAPPS) – ADOPTION OF PROPOSED REVISIONS**

Michael Philip, Bureau of Environment and Sustainability Director, informed the commission that Laura Doud, who previously led the department effort on the GAPPS has departed for a promotion at the Michigan Department of Transportation. Mr. Philip introduced Mollie Woods, Director of the MSU Product Center and the recently appointed GAPPS Committee Chair. Mollie informed the commission she is currently recruiting members for the committee and plans to provide revisions by next year. Commissioner Wyant asked Ms. Woods to reach out to all industries of focus for suggestions on upcoming revisions. Ms. Woods assured the commission Ms. Doud had expressed the same concern and had already been reaching out to industry representatives to join the committee.

**MOTION: CHAIR WYANT MOVED TO APPROVE THE 2025 REVISIONS TO THE GENERALLY ACCEPTED PROCESSING PRACTICES. COMMISSIONER GARTHE SECONDED. MOTION CARRIED.**

#### **FOOD AND AGRICULTURE INVESTMENT FUND AMENDMENT**

Jamie Zmitko-Somers, Agriculture Development Bureau Director, informed the commission that the request before the commission is an amendment to a past approved grant for La Colombe from May 2022. Ms. Zmitko-Somers explained at times grants need to be amended due to time constraints, equipment adjustments, or location changes.

The original grant was approved in May 2022 for La Colombe in Allendale, Michigan. Due to unavailability of long-term lease options, La Colombe decided to expand their current facility in Norton Shores to include the bottling line that was approved in the grant.

Bill Cooper, Vice President of Operations at La Colombe, joined Ms. Zmitko-Somers to explain the work and expansion the company plans to grow in the Michigan economy. They currently purchase 1.6 million gallons of milk from Michigan dairy farmers annually and plan to increase to 2.1 million gallons by 2025.

**MOTION: COMMISSIONER WU MOVED TO APPROVE A FOOD AND AGRICULTURE INVESTMENT FUND PRIOR GRANT AGREEMENT AMENDMENT FOR LA COLOMBE FOR THE LOCATION CHANGE. COMMISSIONER GARTHE SECONDED. MOTION CARRIED.**

#### **GENERALLY ACCEPTED AGRICULTURAL MANAGEMENT PRACTICES (GAAMPS) – PROCESS AND INTRODUCTION OF DRAFT 2025 GAAMPS:**

Michael Philip, Bureau of Environment and Sustainability Director and Kyle McCarty, Right to Farm, Conservation Stewardship Division, introduced the 2025 Draft GAAMPS to the commission. The commission packet included all updated GAAMPS, highlights of the

changes and all public comment received on the proposed changes. Mr. McCarty highlighted that the 2025 Site Selection GAAMPS have been updated to include site review and verification processes, specifically identifying application requirements. In the Farm Market GAAMP, Mr. McCarty highlighted the physical characteristics of a farm market definition had been updated and clarified, especially related to parking and driveways. Mr. McCarty also noted that the Manure Management and Utilization GAAMP chair has retired and MDARD is working with MSU College of Agriculture and Natural Resources on appointing a new chair. Mr. McCarty also pointed out that the chairs of the Pest Utilization and Pest Control GAAMP and the Nutrient Utilization GAAMP have also retired, but with new chairs appointed by MSU.

Commissioner Garthe inquired about developing science on PFAS might be incorporated in future Irrigation GAAMPs. Director Boring responded that PFAS is an emerging issue and an important topic in the department. MDARD continues to implement protective measures.

### **PUBLIC COMMENT**

Bee Friedlander, President of Attorneys for Animals, inc., tried to connect virtually to testify and due to technical issues was unable to.

### **ADJOURN**

**MOTION: COMMISSIONER WU MOVED TO ADJOURN THE MEETING.  
COMMISSIONER GARTHE SECONDED. MOTION CARRIED.**

There being no further business, the meeting adjourned at 10:00 A.M.

### **Attachments:**

- A) *Agenda*
- B) *Agriculture and Rural Development Commission Meeting Minutes July 24, 2024*
- C) *Food and Agriculture Investment Fund Amendment –La Colombe*
- D) *Generally Accepted Agricultural Management Practices (GAAMPS) 2025 Drafts*



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## Michigan Commission of Agriculture and Rural Development 2025 Meeting Schedule

<b>Wed., Jan. 22, 2025</b> 9:00 a.m.	Constitution Hall Atrium Level, Con-Con Conference Room. (525 West Allegan Street, Lansing, Michigan) <b>Option to join via remote technology:</b> <b>Dial by telephone: 1-248-509-0316, Conf. ID: 878 418 624#</b>
<b>Wed., March 12, 2025</b> 9:00 a.m.	Constitution Hall Atrium Level, Con-Con Conference Room. (525 West Allegan Street, Lansing, Michigan) <b>Option to join via remote technology:</b> <b>Dial by telephone: 1-248-509-0316, Conf. ID: 493 475 543#</b>
<b>Wed., May 14, 2025</b> 9:00 a.m.	Constitution Hall Atrium Level, Lee Walker Conference Room. (525 West Allegan Street, Lansing, Michigan) <b>Option to join via remote technology:</b> <b>Dial by telephone: 1-248-509-0316, Conf. ID: 706 355 858#</b>
<b>Wed., July 23, 2025</b> 9:00 a.m.	Constitution Hall Atrium Level, Con-Con Conference Room. (525 West Allegan Street, Lansing, Michigan) <b>Option to join via remote technology:</b> <b>Dial by telephone: 1-248-509-0316, Conf. ID: 811 341 993#</b>
<b>Wed. September 24, 2025</b> 9:00 a.m.	Constitution Hall Atrium Level, Con-Con Conference Room. (525 West Allegan Street, Lansing, Michigan) <b>Option to join via remote technology:</b> <b>Dial by telephone: 1-248-509-0316, Conf. ID: 415 978 460#</b>
<b>Wed., Nov. 5, 2025</b> 9:00 a.m.	Constitution Hall Atrium Level, Con-Con Conference Room. (525 West Allegan Street, Lansing, Michigan) <b>Option to join via remote technology:</b> <b>Dial by telephone: 1-248-509-0316, Conf. ID: 702 217 188#</b>

Approved November 6, 2024

## WHAT WE DO

### POLICY & GOVERNMENT RELATIONS

The Policy and Government Relations team formulates and implements strategies to address Tribal producers' needs through national and local education and advocacy. The team ensures that Tribal producers across Indian Country have the opportunity to participate in policymaking that impacts Tribal agriculture, including economic development, racial equity, and more. Further, IAC advances many of its policy priorities through our joint stewardship of the Native Farm Bill Coalition, which advocates for, and alongside, tribal communities for the betterment of Indian Country through the Farm Bill.

### TECHNICAL ASSISTANCE (TA) NETWORK

The TA Network provides direct on-the-ground assistance with USDA program access and supplemental resource identification through conducting outreach, assessing program applicability and eligibility, supporting interface with USDA and partners, advising on contract implementation, and growing tailored support networks. IAC's Technical Assistance Specialists serve Tribes and Tribal producers across Indian Country while enhancing government-to-government relations, partnerships, project management, and capacity to realize goals related to agriculture, land management, and community wellness.

### NATURAL RESOURCES

Our Natural Resources Department recognizes our Tribal producers as the descendants of this continent's original land stewards. Working in tandem with youth, producers, and tribal land offices, we promote natural resources conservation and land regeneration through indigenous systems approaches.

### AMERICAN INDIAN FOODS (AIF)

The American Indian Foods program revitalizes food economies in Indian Country through tailored branding support and the creation of diversified market options for all products made and produced by American Indians. Elevating awareness of Indian Country's food products on both the domestic and international scale, producers engaged in the AIF program redirect the narrative of our vibrant, resilient food economies of Indian Country.



### REGENERATIVE ECONOMIES

Our Regenerative Economies Programming promotes and highlights the benefits of investing in Indian Agriculture, while providing individual assistance on business and finance solutions that will promote healthy & regenerative economic growth rooted in the principles and value systems of Indian Country.

### YOUTH & PROFESSIONAL DEVELOPMENT

The IAC prioritizes direct engagement with our youngest generation of leaders in all aspects of our work. Tailoring outreach and toolkit development to reach the next generation is a vital aspect of ensuring long-term economic development efforts in Indian Agriculture. Youth & Professional Development programming offers leadership development opportunities such as internships, fellowships, and apprenticeships. Additionally, we provide higher education resources, immersive learning experiences, and virtual engagement opportunities that equip Indian country's youth with a highly employable skillset.

# INTERTRIBAL AGRICULTURE COUNCIL



[WWW.INDIANAG.ORG](http://WWW.INDIANAG.ORG)



## ORGANIZATIONAL BACKGROUND

Following the 1980's Farm Crisis, a panel of 12 Indian leaders and 6 BIA personnel were appointed by the Secretary of Interior to address Indian Country's agricultural challenges. Over the course of a year, the panel offered recommendations to improve agricultural conditions that supported Tribal goals across the nation. As a result of their efforts, 87 Tribes came together in 1987 to officially form the Intertribal Agriculture Council (IAC). Today, IAC serves as the nation's primary voice on Native agricultural policies and programs. The IAC strives to benefit Indian people by tackling systemic inequities and ensuring that agricultural resources are available to better serve Native producers. The IAC's distinct leadership structure enables Tribal leaders to maintain direct representation with agricultural policy development and implementation, while also reconstructing our self-determined Tribal food systems. Our program areas include: policy and government relations, USDA technical assistance, natural resource management, domestic and international marketing support, regenerative economies, and Native youth and professional development.



Traditional corn event, Ganondagan Seneca Nation

## IAC MISSION AREAS

### LEGAL POLICY

IAC **elevates** the concerns of Tribal agriculture producers through education and advocacy in Washington, D.C., aimed at developing responsive and equitable federal agriculture laws and policies for Indian Country. IAC promotes stronger Tribal engagement and development of useful resources among federal agencies to ensure greater food system resiliency for all Tribal Nations.

### PROFESSIONAL DEVELOPMENT

IAC **inspires** and empowers current and future leadership within Indian Country's food and agriculture sectors. Through comprehensive and transformative programming, IAC directly contributes to addressing issues concerning aging demographics in agriculture to support the perpetuation of our foodways.

### FOOD SYSTEMS

IAC **grows** Tribal Food Systems by equipping production systems, expanding market access through increasing awareness of Indian Country food products, and leveraging resources to ensure healthy, sustainable, and culturally aligned foods regain their proper positions within our communities.

### CONSERVATION AND PRODUCTION INNOVATION

IAC **regenerates** landscapes through producer training, networking, and leveraging strategic resources to address persistent land management concerns throughout Indian Country. IAC promotes culturally-aligned and holistic production strategies to uphold the wellbeing of Tribal lands.

### ECONOMICS

IAC **leverages** Tribal producer expertise in the design of equitable agriculture financing solutions. Through strategic networking and resource identification, IAC seeks to increase financial literacy, improve access to capital, maximize profitability, and meaningfully contribute to rural economies.

### COMMUNICATION

IAC **connects** diverse Tribal and non-Tribal stakeholders to further individual and collective goals. IAC draws upon extensive local, regional, national, and international networks to maximize impacts and contribute to agriculture resiliency within our communities.



Working cattle, Cheyenne River Sioux Reservation



# Intertribal Agriculture Council



[WWW.INDIANAG.ORG](http://WWW.INDIANAG.ORG)





# Our Story

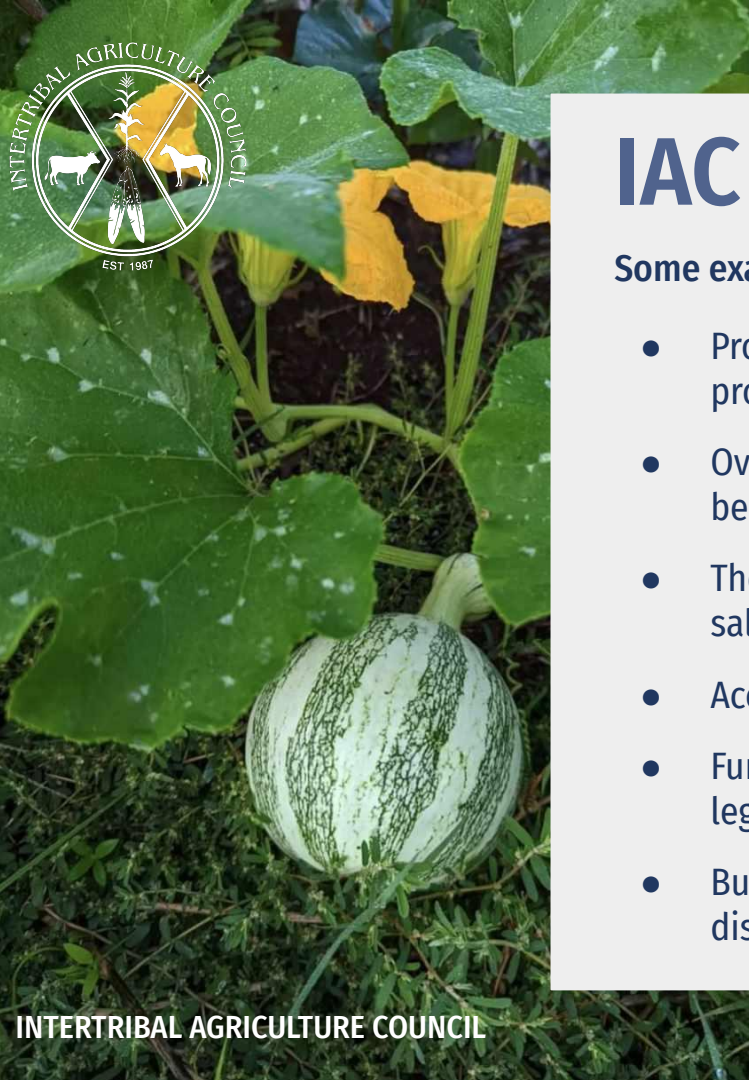
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IAC was established to pursue and promote the conservation, development, and use of our agricultural resources for Native producers and the 574+ diverse American Indian and Alaska Native Tribes. To achieve this, IAC's programmatic offerings have expanded over nearly four decades to include the following:

- USDA technical assistance
- Natural resources management
- Legal and policy development
- Domestic and international marketing support
- Regenerative financing assistance
- Native youth in food and agriculture leadership development

**IAC serves as the nation's leading voice on Native agricultural policies and programs that revitalize and advance Native food systems and economic development throughout Indian Country.**





# IAC Impact

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Some examples of IAC's programmatic efficacy include (annually):

- Provision of direct outreach and assistance to between **12,000-15,000** producers and Tribal contacts annually.
- Over **80,000** producers and the community members they serve directly benefit from IAC Programming.
- The generation of over **30 million of dollars** in domestic and international sales for Tribal producers.
- Accomplishing conservation goals over **millions of acres** of land.
- Fundamentally shaping federal policy through the Farm Bill and other major legislation to include underrepresented producers.
- Building badly needed infrastructure in Indian Country for processing and distributing food.



# Policy & Government Relations Department

IAC has been involved in Federal Policy since its inception, shaping Farm Bills starting as early as 1980s:

- American Indian Ag Resource Management Act of 1993/ARMPs
- Federally Recognized Tribal Extension Program (FRTEP)
- Creation of a permanent Office of Tribal Relations at USDA

Our Policy Team works closely with Key Congressional Offices, Elected Officials, partners and others to elevate TRIBAL priorities, holding the U.S. Government to their trust responsibility

Native Farm Bill Coalition efforts beginning in 2017



# IAC Stakeholder Services Programming

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- American Indian Foods
- Regenerative Economies
- Natural Resources and Regenerative Ag
- Youth and Professional Development
- Technical Assistance Network





# American Indian Foods

The American Indian Foods program is designed to work with American Indian and Alaskan Native owned businesses to provide export education and technical assistance in order to facilitate access into domestic and international markets.

Visit: [www.indianagfoods.org](http://www.indianagfoods.org) for more information on the:

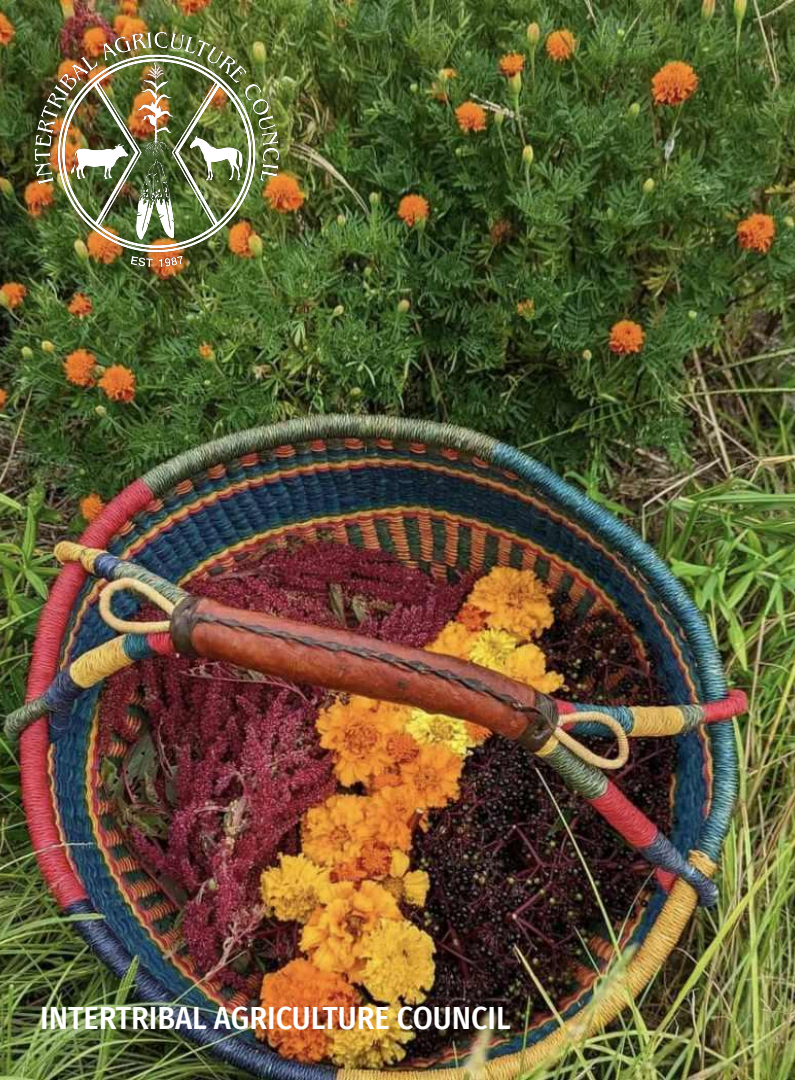
- Export Program
- Native Food Connection
- 'Made/Produced by American Indians' Trademark



# Regenerative Economies

- One-on-one consultation with:
  - Tribal producers
  - Food and agriculture businesses
  - Industry stakeholders
- Understanding details of operations, current barriers & issues, and furthering economically viable end goals.
- Specialized services include financial analyses, identifying credit solutions, financial literacy training, balance sheet support, building operating cost tables, domestic and international marketing cost-benefit analyses for planning purposes, creating Agri-Business Financial Toolkits, individualized economic research and market analysis (domestic and international markets), USDA intermediacy and mediation support, and general business planning and wellness analysis.





# Natural Resources and Regenerative Agriculture

- Coordination with USDA-Natural Resources Conservation Service to improve access to conservation planning, management resources, and other useful land stewardship tools.
- Empower producers through trainings, resources, and direct and tailored assistance to improve the sustainability, health and profitability of their operation's resources.

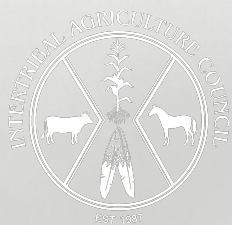


# Youth And Professional Development

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- Direct support from high school through career placement
- Youth programming available at IAC:
  - Bob Miller Memorial Scholarship
  - LEAP Program (formerly Food 4 Families)
  - IAC Annual Conference Essay Contest and Youth Track
  - Youth Soil Health Days
- Youth Internships



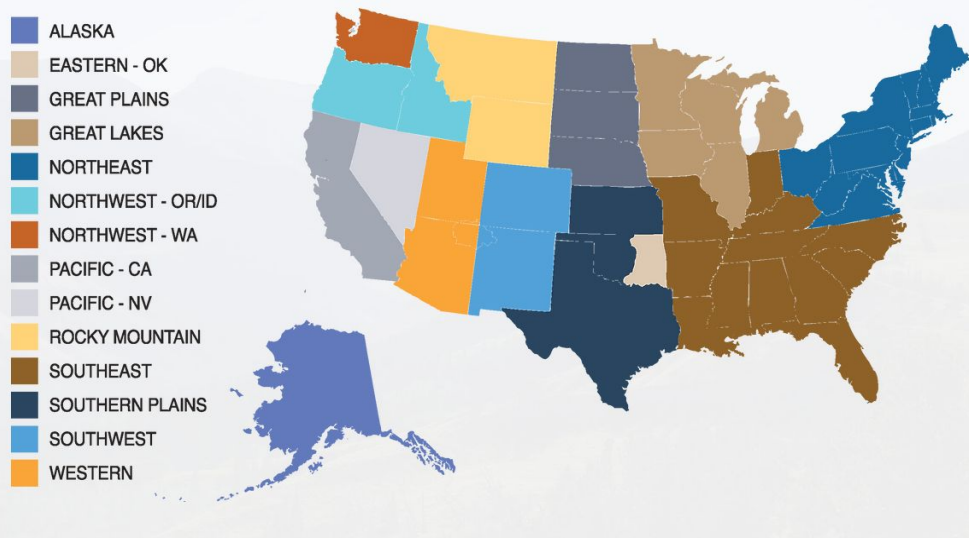


## Youth Internships

- IAC, in partnership with NRCS, is recruiting undergraduate, junior college, and community college students or Native individuals seeking experience in Tribal agriculture and natural resources.
- This is an excellent opportunity for those who are passionate about promoting the regeneration of natural resources and addressing food scarcity within their communities.



# Technical Assistance Network



- Resource identification for individual Tribal producers
- Tribal food sovereignty
- Tribal representation on state and national level
- On-the-ground coordination
- Native youth in mentoring and leadership development
- Regional summits



# IAC TA Initiative: Meat and Poultry Processing Technical Assistance

In March 2022, AMS identified IAC as one of six organizations to provide technical support focusing on four key areas.

- Federal Grant Application Management
- Business Development and Financial Planning
- Meat and Poultry Processing Technical and Operational Support
- Supply Chain Development

## Note:

The MPPTA Program *does not* offer or provide contractor services or financial capital. It does not offer grant writing or project management services, nor does the voluntary use of MPPTA guarantee the success of a grant application or the grant-funded project.

# Overview

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**Providing  
technical  
assistance and  
capacity-building  
opportunities for  
Native food  
producers**





# 2024 IAC ANNUAL CONFERENCE

✦ ✦ ✦ ✦ DECEMBER 10 - 12 ✦ ✦ ✦ ✦

**PALMS CASINO RESORT • LAS VEGAS, NV**

Register by December 6th at  
[www.indianag.org/annual-conference](http://www.indianag.org/annual-conference)

**Abby Buraglio**

*Technical Assistance Specialist  
Great Lakes Region*  
abby@indianag.org  
(218) 591-8722



# Thank you!

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AND RURAL DEVELOPMENT

DR. TIM BORING  
DIRECTOR

**DATE:** November 6, 2024

**TO:** Michigan Commission of Agriculture and Rural Development

**FROM:** Jamie Zmitko-Somers, Agriculture Development Bureau Director

**SUBJECT:** Peterson Brands LLC

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### **Background**

Peterson Farms, Inc. was founded in 1984 by Earl and Linda Peterson, with a modest tart cherry tonnage of 250,000 lbs. The business quickly expanded, and in 1985, they began processing tart cherries for neighboring farms in addition to their own. Responding to customer demand for pit-free cherries, the Petersons established Cherry Technologies in 1989, which holds the patent rights for electronic detection of pits in processed cherries. Over the years, the company's focus on quality and customer satisfaction led to rapid growth. They expanded their processing to include other commodities such as asparagus, apples, sweet cherries, blueberries, and peaches. Today, Peterson Farms is a leading marketer of frozen fruits in the United States, selling over 150 million pounds of frozen fruits and 7 million gallons of single-strength apple juice/cider and juice concentrates. In 2004, Peterson Farms Fresh, Inc. was established as a state-of-the-art fresh-cut fruit processing company, specializing in fresh-cut apples. Today, they are one of the top processors of fresh-cut apples in the United States.

In August of 2024, Peterson Farms acquired King Brands, LLC. King Brands supplies shelf-stable juices in aseptic liter boxes and in cups or pouches. The products, which require no refrigeration and are ready to serve, are distributed to food service sectors that include healthcare, schools, military, airlines, cruise lines, and other food-service related industries with products marketed under the HC Plus brand. The acquisition of King Brands, renowned for its high-quality fruit products and strong distribution network, is a significant step towards expanding Peterson Farms' product portfolio and reaching new markets. This synergy is expected to drive innovation, improve operational efficiencies, and enhance customer satisfaction. The King Brands production will be moved to Peterson Farms' main campus in Shelby, MI and work is underway to have the products listed by the USDA nationally.

### **Project Description**

The project will relocate juice production from Florida to Michigan with the building of a storage room and renovations to the existing facility to create the juice line. The project will include the installation of new juice line equipment, which will include storage tanks, blending tanks, cooling equipment, cup fillers, and other equipment necessary for the juice production. The finished line will produce 430 million juice cups and 101 million juice pouches annually with a focus on procuring Michigan fruit. The total project investment is \$29,121,323 and will create 82 jobs.

### **Impact on Michigan's Agriculture Industry**

Moving King Brands juice production to Peterson Farms' main campus in Shelby, Michigan from Fort Meyers, Florida will increase apple usage by approximately 40 million pounds annually, an increase of apples which are currently not picked or do not have a market outlet. This move will

allow a third pick or even fourth pick of Honeycrisp apples which does not occur today. The ability for growers to yield more dollars per acre for additional pickings of apples increases their overall profitability by depreciating their yearly fixed costs. The company is also working on research and development of an additional flavor of cherry flavor juice cups which will open additional cherry market for growers. Peterson Farms currently works with 285 apple and 129 cherry growers in Michigan.

### **Additional Impact**

Moving the facility to Michigan will create job opportunities for the residents, stimulate economic growth, and provide steady employment. The move is expected to lead to a reduction in transportation-related emissions and costs due to the decreased distance between the production site and the market. Furthermore, Peterson Farms has implemented more sustainable and energy-efficient practices at their main campus, which positively impacts the overall environmental footprint of juice production. Sustainability is a key focus at the campus, with a dedicated team assigned to monitor and audit for continuous improvement.

All new employees are provided extensive training for their positions. Additionally, certificates may be earned for specific training such as HACCP, FSMA Preventive Controls, and electrical/refrigerant/welding certifications. All training is company-paid.

### **MDARD Staff Recommendation**

Michigan Department of Agriculture and Rural Development staff recommend the Michigan Commission of Agriculture and Rural Development approve a Food and Agriculture Investment Fund performance-based grant of \$250,000 for Peterson Brands LLC.



GRETCHEN WHITMER  
GOVERNOR

STATE OF MICHIGAN  
DEPARTMENT OF AGRICULTURE  
AND RURAL DEVELOPMENT

DR. TIM BORING  
DIRECTOR

July 26, 2024

## RE: Changes to the 2024 GAAMPs for approval and use in 2025

Below is a summary of changes that the corresponding Advisory Committees are proposing to the Michigan Commission of Agriculture and Rural Development for adoption in the 2025 Generally Accepted Agricultural Management Practices.

### General Updates Across ALL GAAMPs include:

- Annual review of applicable references to ensure up to date links, formatting for readability.

### Summary of *Care of Farm Animals GAAMPs* proposed changes:

Minor reference updating and removal of ambiguity for clarity.

Under Sheep and Goats, addition of Animal Identification requirements (pg. 66)

**Animal Identification:** Sheep and goats are required to follow federal and state regulations for officially identifying their animals as part of the national scrapie eradication program ([https://www.aphis.usda.gov/sites/default/files/umr\\_scrapie.pdf](https://www.aphis.usda.gov/sites/default/files/umr_scrapie.pdf)).

### Summary of *Site Selection for New and Expanding Livestock Facilities GAAMPs* proposed changes:

The Site Selection GAAMPs were reorganized for readability, clarity.

High Public Use Areas language was moved to under definitions (pg. 6):

**High Public Use Areas** - Are locations with high density of individuals during certain periods of time, either time of day or time of year. High public use areas are hospitals; churches; licensed commercial elder care facilities; licensed commercial childcare facilities; school, government, commercial, professional, office or retail buildings; publicly accessible parks or campgrounds (excluding terrestrial and aquatic trails).

Clarity was added to the "Site Review and Verification Process" identifying application requirements (pg. 10):



### Site Review and Verification Process

A livestock facility with less than 50 Animal Unit(s) (AUs) is not required to complete the entire site review and verification process described in **Appendix A**. Instead, the livestock facility must submit a complete [GAAMPs Review Application](#) form for determination of conformance. **This application must complete Sections 1, 2 and 3 at a minimum.**

### Summary of *Farm Market GAAMPs* proposed changes:

Added clarification under Farm Market definition (pg2):

At least 50 percent of the farm products offered must be produced on and by the affiliated farm measured by retail floor space during peak production season, or 50 percent of the average gross sales for up to the previous five years or as outlined in a business plan.

Added clarification to PHYSICAL CHARACTERISTICS OF FARM MARKET: Parking and Driveways, Signage sections (pg. 3):

#### **Parking and Driveways**

Parking and driveway surfaces may be paved, vegetative, ground, gravel, ~~pavement~~, or other unpaved suitable material. ~~However, other parking and driveway requirements must comply with all applicable regulations.~~

#### **Signage**

~~The operator of the farm market must comply with all applicable state and federal regulations for signs.~~ A minimum of one roadside sign is allowed. ~~pursuant to local sign ordinance setbacks, lighting, height, and size requirements.~~

Added APPENDICES, Appendix A: Considerations for Farm Markets. The intention is to provide reference and education regarding topics surrounding Farm Markets, but the language is not intended to be utilized for determination of conformance. (pg. 4, 5)

### **Appendix A: Considerations for Farm Markets**

#### **Statement of Intent**

Appendix A is explicitly intended as a reference for informational and educational purposes only. Information contained in Appendix A is not intended to be utilized by Michigan Department of Agriculture and Rural Development (MDARD) Right to Farm Program as part of any Generally Accepted Agricultural and Management Practices (GAAMPs) conformance determination process.

#### **GAAMPs Conformance and Other Regulatory Permits**

Depending on the nature and location of a GAAMPs conformant farm market operation, other local, state and/or federal regulations may still apply. It is the responsibility of the farm market owner or their representative acting on the owner's behalf to contact the appropriate regulatory authorities to determine if additional permits for compliance are required prior to beginning any activity or construction.

MDARD Right to Farm Program does not have authority to determine applicability of, or compliance with, any regulation other than conformance to the management practices described within the GAAMPs.

## **Non-Farm Product Sales, Processing and Miscellaneous Activities**

Michigan Right to Farm Act provides nuisance protection for farms and farm operations in conformance with GAAMPs including the production of farm products and the marketing and sales of farm products at farm markets. This protection may not extend to sales of non-farm products (e.g., hats, t-shirts, jewelry, etc.), on-site processing of farm products (e.g., baking pies, brewing hard cider, etc.) or other on-farm activities (e.g., wedding/event barns, bed & breakfast/lodging, restaurants, glamping, etc.). A GAAMPs-conformant farm market operation may still be subject to other local, state and/or federal regulations (see *GAAMPs Conformance and Other Regulatory Permits* above).

## **Signage**

Farm Markets GAAMPs allows for a minimum of one roadside sign; however, this sign (and any additional signs, if permitted) may be subject to other local ordinance requirements (e.g., setbacks, lighting, height, and size)

## **Agritourism**

'Agritourism' currently has no legal definition or recognition in Michigan law. Activities commonly identified as, and/or associated with, agritourism may or may not comply with GAAMPs. These activities must be assessed on a case-by-case basis and may be subject to additional local, state and/or federal regulations (see *GAAMPs Conformance and Other Regulatory Permits* above).

## **Resources**

There are many professional resources available to assist farmers, government officials and others navigating Right to Farm and GAAMPs-related issues. Resources include, but are not limited to, MDARD Right to Farm Program, Michigan State University Extension, Michigan Townships Association, Michigan Farm Bureau, and Michigan Agritourism Association.

## **Summary of *Manure Management and Utilization* and GAAMPs proposed changes**

The chair retired, still working on identifying a new chair. Reviewed references and weblinks.

## **Summary of *Pest Utilization and Pest Control* GAAMPs proposed changes:**

The chair retired, a new chair was identified, appointed. Reviewed references and weblinks.

## **Summary of *Irrigation Water Use* GAAMPs proposed changes:**

No changes.

## **Summary of *Nutrient Utilization* and GAAMPs proposed changes**

The chair retired, and a new chair was identified, appointed. Reviewed references and weblinks.

## **Summary of *Cranberry Production* GAAMPs proposed changes:**

No changes.

**From:** [Suzanne Reamer](#)  
**To:** [MDARD-rtf](#)  
**Cc:** [Wozniak, Michael \(MDARD\)](#); [Doud, Laura \(MDARD\)](#)  
**Subject:** 2025 - Public Comments - Siting GAAMPS Draft  
**Date:** Monday, August 5, 2024 11:40:49 AM

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MDARD,

NRCS is providing Public Input on the 2025 Draft Siting GAAMPS to address a few concerns that need correction before publication of the final 2025 GAAMPS.

**Page 18-** References the “[Michigan](#) Natural Resources Conservation Service Waste Storage Facility Standard 313<sup>18</sup>.” The link provided in NOT the link to the Michigan NRCS 313 practice standard but the National NRCS Practice standard. The correct link should be [Michigan | Field Office Technical Guide | NRCS - USDA](#)

- There is a difference between the two documents. Michigan’s 313 practice standard includes the Michigan well isolation distance criteria and required setbacks from Michigan’s water wells per 1976 PA 399, Michigan Safe Drinking Water Act.
- Michigan’s 313 practice standard is consistent with EGLE’s CAFO freeboard requirements and acknowledges EGLE’s CAFO permit requirements may be more restrictive.
- To reference the National 313 practice standard in the Siting GAAMPS would be contradictory to the wording in the sentence that specifically calls out “Michigan”.

**Page 20 – Section IV: Manure Storage Structure Change or Installation at Existing Livestock Facilities**

“Property Line Setbacks” --- This paragraph NEEDS to go back to committee. Comments were submitted during the Site Selection review process in June and July and this paragraph still needs work before it is finalized for 2025.

**Concern 1:**

“Property line setbacks must be determined by measuring from the **nearest point of the livestock facility** to the nearest point of the livestock facilities owner’s property line.”

The definition of a Livestock Facility is “Any place where livestock are kept and/or the associated manure storage structures are located regardless of the number of animals. Sites such as loafing areas, confinement areas, or feedlots, which have livestock densities that preclude a predominance of desired forage species as vegetation, are considered part of a livestock facility. This does not include pastureland. Any livestock facility within 1,000 feet of another livestock facility, and under common ownership, constitutes a single livestock facility.”

The sentence identified above in red text, the use of the wording “nearest point of the livestock facility”. NEEDS to be changed. As a member of the original committee that developed this section into the Siting GAAMPs in 2021, this section was specifically to measure from the manure storage facility. The use of the words “nearest point of the livestock facility” creates confusion as to what part of the “livestock facility” are you supposed to measure from and could be misinterpreted and measure from any place where livestock are kept instead of the intended purpose of measuring from the manure storage facility which is in many situations the primary source of odor.

It is recommended and has been in the Siting GAAMPs committee meetings (May, June, and July) by NRCS-MI to change the wording “nearest point of the livestock facility” to “nearest point of the manure storage facility” This section of the Siting GAAMPs is specifically about setbacks from manure storages not other places where livestock are kept as identified in the definition of a “Livestock Facility”.

#### **Concern 2:**

“ All variances from minimum property line setbacks must be proposed in advance of Site Suitability Approval.” This sentence at the last Siting GAAMPs committee meeting (July 22, 2024) was agreed to be removed. The first part of this section states, “A manure storage structure change or installation at an existing livestock facility is not required to complete the site review and verification process found in Appendix A” Yet this sentence conflicts stating that “Site Suitability Approval” ? How can this sentence identify Site Suitability Approval when the above paragraph states it is NOT REQUIRED.

Please note that on page 9 it states in **BOLD**, “Existing livestock facilities installing new, altering, or adding manure storage that is not related to an increase in animal unit capacity are not required to go through the site review and verification process, but must meet the applicable setback criteria under Section VI for Manure Storage Change or Installation at Existing Livestock facilities to conform to the provisions of Siting GAAMPs.” --- This bold sentence in the GAAMPs plainly states, that meeting the identified setbacks in Section IV, will be in conformance and NO site view and verification is REQUIRED.

The sentence stated in Concern 2 with red text above is conflicting and needs to go back to committee or removed from the 2025 Site GAAAMPs document.

**Page 30** – Existing Manure/Waste Storage Structure. Last paragraph refers to NRCS-MI CNMP Guidance for Evaluation of Existing Components. It is recommended to include the weblink to this document for the user. The weblink is; [NRCS\\_CEMA-227\\_EEC\\_Guidance\\_2024\\_January.docx \(live.com\)](#)

NRCS recognizes all the hard work by the Site Selection and Odor Control for New and Expanding

Livestock Facilities in 2024. The reorganization of this document is a great improvement and will be of value to users going forward.

Respectfully Submitted,

Suzanne Reamer  
USDA NRCS-MI  
State Environmental Engineer  
517-290-6145

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**From:** [Alex Lagina](#)  
**To:** [MDARD-rtf](#)  
**Subject:** 2025 Draft GAAMPs feedback  
**Date:** Friday, August 30, 2024 12:56:03 PM

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To whom it may concern,

We vigorously object to the proposed changes to the Michigan Farm Market Generally Accepted Agricultural Management Practices (“GAAMPs”) because they remove all protections previous versions of the GAAMPs provided to Michigan farmers and threaten the viability of our businesses. Further, there is no demonstrated need for these changes to be made, and the addition of Appendix A is in direct contradiction with the provisions of the actual GAAMPs, which, far from being ‘educational’ actually creates more vagueness and conveys contradictory information to Michigan citizens, which will do nothing but invite conflict.

Marketing and promotional activities that draw customers to a farm market are fundamental to the successful operation of an agricultural business. In an industry where margins are thin and consumers are extremely price sensitive, small family farms that by definition cannot compete on economies of scale must instead compete on customer experience and brand awareness. On-farm activities such as weddings/events, lodging, restaurants, etc. are precisely the mechanisms by which small family farms can continue to survive in the presence of larger farms with more resources and the ability to spread costs over more land. To strip small farms of these protections is to strip them of their only means of competing with larger farms - their produce is necessarily more expensive due to their smaller scale. This is not a recipe for success, and does nothing to protect smaller farms, nor to encourage them to follow the GAAMPs.

Further, in order to qualify as a farm market, at least 50% of a business’s products by sales area or gross sales must be produced on or by the affiliated farm. This provision alone is enough to address the fear that promotional activities or sales of apparel (which, please remember, can be made out of cotton produced on a family farm) would overshadow bona fide farming. Nobody is going to start and operate a commercial farm for the opportunity to sell hats. These activities are by definition ancillary to the primary goal: selling farm products. They are a necessary part of marketing and operating a modern agricultural business, and they cannot and should not be separated from it.

Perhaps most baffling is the passage about GAAMPs protections not extending to “on-site processing of farm products.” Is this not the essence of farming? What logic drives the idea that a product produced on a farm cannot be further processed by that farm? Many farm products that people may consider “unprocessed” actually require a great deal of processing before they are sold. Who decides when a product has been processed enough? Will this change require the courts to make that decision for each and every variant of a farm product? And is this passage not in direct contradiction to an earlier portion of the draft GAAMPs, which states that “Fresh products as well as processed products may be sold at the farm

market” and that a processed product is “a farm product or commodity that has been converted into a product for direct sales. Processing may include, but is not limited to, packing, washing, cleaning, grading, sorting, pitting, pressing, fermenting, distilling, packaging, cutting, cooling, storage, canning, drying, freezing, or otherwise preparing the product for sale.” This attempt to winnow down the definition of a farm product until it includes only items that are pleasing to the nebulous and undefined standards of each and every local government might be a decent pun, but it’s not good policy.

The Right to Farm Act was originally enacted because local governments were overregulating Michigan farms and threatening the viability of Michigan’s agricultural industry. It is well known that over the past several years, local governments have caved to the demands of residents who have moved to rural areas desiring a bucolic lifestyle but not wanting to see, hear, or smell farms. In short, these residents want farmers to be their landscapers and provide them with pretty views and nothing more. But farmers need more, and value-added agriculture is more necessary than ever. We need the ability to draw customers to our farms to buy our products. Simply having a farm stand is no longer enough to draw in customers. Customers want an experience. This might include offering processed items like cider, pies, jams, wine, etc. It might be selling merchandise containing the farm’s logo. It might include events, birthday parties, school trips, music, or any host of other activities intended to draw in customers to buy our farm products while also entertaining those customers. But the proposed 2025 GAAMPs gut the prior protections we enjoyed and return authority to local governments to regulate farmers not based on state-wide standards but based on complaints from residents who do not understand what it takes to keep a family farm viable. The Right to Farm Act was passed to avoid that exact problem.

In addition to the concerns stated above, we take specific issue with the appendices attached to the proposed GAAMPs for the following reasons. The draft states: “This protection may not extend to sales of non-farm products (e.g., hats, t-shirts, jewelry, etc.), on-site processing of farm products (e.g., baking pies, brewing hard cider, etc.) or other on-farm activities (e.g., wedding/event barns, bed & breakfast/lodging, restaurants, glamping, etc.). A GAAMPs-conformant farm market operation may still be subject to other local, state and/or federal regulations (see GAAMPs Conformance and Other Regulatory Permits above).” This sentence is vague and does not provide clarity to family farms. By using the term “may,” the GAAMPs leave room for local governments to try to regulate our activities and there is no clear line between local authority and MDARD authority. The appendices also state: “‘Agritourism’ currently has no legal definition or recognition in Michigan law. Activities commonly identified as, and/or associated with, agritourism may or may not comply with GAAMPs. These activities must be assessed on a case-by-case basis and may be subject to additional local, state and/or federal regulations (see GAAMPs Conformance and Other Regulatory Permits above).” Again, this sentence is ambiguous and invites local government overreach. It could reasonably be interpreted to give local governments the authority to determine what is and is not agritourism. This would result in a patchwork of regulations throughout the state. If agritourism needs a definition, then it is the duty of the State of Michigan, or MDARD, to define it. It cannot be left to local governments.

The proposed changes to the Farm Market GAAMPs will inevitably lead to local government overreach and, ultimately, litigation. Given this concern and the concerns noted above, these paragraphs should be removed altogether to make clear that the intent of the Right to Farm Act and GAAMPs to protect and promote Michigan farms remains intact in the 2025 GAAMPs. With these changes, MDARD will return Michigan to the days of local government

overregulation and threaten the viability of Michigan's agricultural industry. We hope you will reconsider these changes and protect our farms.

Sincerely,

--

Alex Lagina

General Manager

**MARI VINEYARDS**

8175 Center Rd.

Traverse City, MI 49686

[\(231\) 938-6116](tel:(231)938-6116) x 102

[marivineyards.com](http://marivineyards.com)



**From:** [louis santucci](#)  
**To:** [MDARD-rtf](#)  
**Subject:** Comments on 2025 amendments to Right To Farm GAAMP For Farm Markets  
**Date:** Thursday, August 15, 2024 7:01:31 PM

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I am a small farmer on Old Mission Peninsula growing grapes, apples, raspberries, black raspberries blackberries and peaches.

I sell these products on my farm stand except for the grapes.

The proposed GAAMP for farm markets would give rise to confusing interpretations by local enforcement officials due to the inclusion of the appendix. The introduction on the one hand says it is not to be interpreted as binding, the text of the appendix goes on to give specific examples of things that are not allowed under the proposed GAAMP.

I would recommend that the appendix be deleted. The GAAMP is quite clear and needs no further explanation.

Louis Santucci  
12602 Center Rd  
Traverse City MI 4986

**From:** [Ayers, Cheri \(MDARD\)](#)  
**To:** [Wozniak, Michael \(MDARD\)](#)  
**Cc:** [Reynero, Olivia \(MDARD\)](#)  
**Subject:** FW: Right to farm request.  
**Date:** Wednesday, August 21, 2024 7:53:04 AM

---

Hi Mike,  
Would you please handle this inquiry on behalf of the Director.  
Thx!  
Cheri

---

**From:** M S <[sirokyindustriesllc@gmail.com](mailto:sirokyindustriesllc@gmail.com)>  
**Sent:** Tuesday, August 20, 2024 1:37 PM  
**To:** Boring, Tim (MDARD) <[BoringT1@michigan.gov](mailto:BoringT1@michigan.gov)>  
**Subject:** Right to farm request.

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[abuse@michigan.gov](mailto:abuse@michigan.gov)

Hello Tim,

I was wondering if we can set up a noise limit on air / propane cannons at farm edge to coincide with local Township rules for ALL OTHER RESIDENTS please!

How is it fair for ALL RESIDENTS other than farmers to have to abide by township rules and let farmers do whatever and whenever they want?! This country does not abide by rules for thee but not for me!

--

Best Regards,  
Milan

Siroky Industries LLC  
586-246-5192

**From:** [charles.r.rhines@gmail.com](mailto:charles.r.rhines@gmail.com)  
**To:** [Wozniak, Michael \(MDARD\)](#)  
**Subject:** Formula for target elevation updated  
**Date:** Tuesday, February 27, 2024 3:42:36 PM

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Michael

There is too many interpretations of Matsuzawa and GAAMPs leaving to much confusion and improper use to achieve the desired goals. Example what if the bee hive location is much lower than the elevation of the adjacent property by slope or by terracing of the land scape. Then too is the situation of a down slope or elevated hives such as land terracing, roof tops or on a balcony leaving from the hives toward the property line. In this case the desired 6-foot height of bee flight is greatly reduced or eliminated.

I would like to propose a change to GAAMPs in the following manner, which would eliminate these unnecessary challenges and errant measures to seek the target elevation sought. It is a simple formula,  $XY=Z$ .

Wherein;

X = Distance from the Property line.

Y= Matsuzawa established glide slope of 60%.

Z= Property line elevation +6 feet above hive entrance.

This simple equation would improve accuracy of achieving the target goal and to mitigate challenges in neighbor relations. Added to this I agree that a setback minimum of 3 feet is a good idea as expressed in illustration from the City of Portland Oregon. And as to sidewalks and other public high intensity use should also have a minimum distance requirement.

Examples of how this would work;

1, Property is sloped upwards to the property line from the hives. Hive entrance is 3 feet AGL. The property line is 1 foot above the hive entrance for a net elevation of -1 foot. Using the equation  $X = -1 \text{ divided by } 60\% (.60)$  the hives would need to be Z or 11.67 feet between the property line and the hive.

2, Property is sloped downwards to the property line. Hive entrance is 2 feet AGL. The property line is 4 feet below the hive entrance for a net elevation of +6 foot. Using the equation  $X = +6 \text{ divided by } 60\% (.60)$  the hives would need to be Z or 0 feet from property line. In this case the established minimum distance from property line would apply, hive location would be 3 feet from property line.

3, Property is level to the property line. Hive entrance is 2.5 feet AGL. The entrance is a net elevation of 2.5 foot. Using the equation  $X = 2.5 \text{ divided by } 60\% (.60)$  the hives would need to be Z or 4.17 feet from the property line.

4, In the case of baloneys and roof operations, If the hive entrance is at or above 6 feet, the target elevation has already been met.

If the target cannot be met of 6 feet at property line for various reasons, then a structure is needed to achieved 6 feet flight elevation and shall be implemented.

Michael, If this formula and established minimums are implemented, there would be greater understanding by the bee keepers, MDARD agents and the public. Not all property is equal. Not all property is level. And as you see in the examples even if the current principals are used it does not solve all issues. This makes it much easier and opens up more possibilities for home pollinators to be placed.

I updated this email to make it more clear and remove typos.

Charles



# Generally Accepted Agricultural and Management Practices for the Care of Farm Animals

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**DRAFT 2025**

Michigan Commission of  
Agriculture & Rural Development  
PO BOX 30017  
Lansing, MI 48909

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**In the event of an agricultural pollution emergency such as a chemical/fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture and Rural Development and/or the Michigan Department of Environment, Great Lakes, and Energy (EGLE) should be contacted at the following emergency telephone numbers:**

**Michigan Department of Agriculture and Rural Development: 800-405-0101**  
**Michigan Department of Environment, Great Lakes, and Energy's Pollution**  
**Emergency Alerting System (PEAS): 800-292-4706**

**If there is not an emergency, but you have questions on the Michigan Right to Farm Act or items concerning a farm operation, please contact the:**

**Michigan Department of Agriculture and Rural Development**  
**Right to Farm Program**  
**P.O. Box 30017**  
**Lansing, Michigan 48909**  
**517-284-5619**  
**517-335-3329 FAX**  
**877-632-1783**



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## PREFACE

The Michigan legislature passed into law the Michigan Right to Farm Act, (Act 93 of 1981, as amended), which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). These practices are written to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require revision of the practices. The GAAMPs are reviewed annually and revised as considered necessary.

The GAAMPs that have been developed are as follows:

- 1) 1988 - Manure Management and Utilization
- 2) 1991 - Pesticide Utilization and Pest Control
- 3) 1993 - Nutrient Utilization
- 4) 1995 - Care of Farm Animals
- 5) 1996 - Cranberry Production
- 6) 2000 - Site Selection and Odor Control for New and Expanding Livestock Facilities
- 7) 2003 - Irrigation Water Use
- 8) 2010 - Farm Markets

These practices were developed with industry, university and multi-governmental agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices are provided protection from public or private nuisance litigation under the Right to Farm Act.

This GAAMP does not apply in municipalities with a population of 100,000 or more in which a zoning ordinance has been enacted to allow for agriculture, provided the ordinance designates existing agricultural operations present prior to the ordinance's adoption as legal non-conforming uses as identified by the Right to Farm Act for purposes of scale and type of agricultural use.

The website for the GAAMPs is at <http://www.michigan.gov/righttofarm>

## OVERVIEW

These voluntary Generally Accepted Agricultural and Management Practices (GAAMPs) are intended to be used by the livestock industry and other groups concerned with animal welfare as an educational tool in the promotion of animal husbandry and care practices. The recommendations do not claim to be comprehensive for all circumstances; but attempt to define general standards for livestock production and well-being on farm operations.

Scientifically derived guidelines and handbooks for species care are referenced in each section of the GAAMPs for the purpose of providing more detailed guidance when required. Certain references used within this document must also be carefully considered based on production objectives. The National Research Council (NRC) publishes various documents containing the nutrient requirements of domestic animals. These documents are referenced frequently herein. In general, NRC requirements are for growing and reproducing animals experiencing different levels of productivity or performance. That level of productivity or performance may not be sought or required in all situations. Thus, referral to NRC herein is meant to serve as a guideline or resource, and not intended to be used as the minimum acceptable practice. In all cases, the animal's nutritional needs for health and well-being must be met. The assistance of a nutrition consultant in recognizing these needs in each production situation and subsequently in establishing a feeding program for that situation, is recommended.

These GAAMPs can serve producers in the various sectors of the livestock industry to compare or improve their own managerial routines. It should be understood, new scientific discoveries, legislation, and changing economic conditions may make necessary revision of the GAAMPs. In addition, farm operations may be engaged in producing animals to certain specifications that are audited and certified such as the National Organic Program, animal welfare or natural programs. Farmers producing honey, meat, milk, eggs, and other products should reference the program standards to adhere to animal care specifications. The GAAMPs herein are written to address animal care across the board spectrum of farm operations in the state of Michigan.

Proper animal management is essential to the well-being of animals and the financial success of livestock operations. A sound animal husbandry program provides a system of care that permits the animals to grow, mature, reproduce and maintain health. Specific operating procedures depend on many objective and subjective factors unique to individual farm operations and the local environment.

In addition to husbandry, animal well-being is also a function of many environmental variables, including physical surroundings, nutrient intake, and social and biological interactions. Environmental conditions should minimize disease, death loss and behavioral problems and enhance performance. Components of the environment that should be managed include housing, space concentrations, pests, nutritional factors and water. Domestic animals readily adapt to a wide range of environments.

Sometimes procedures that result in temporary stress and even some pain are necessary to sustain the long-term welfare of the animals. Some of these procedures reduce aggressive behavior and injuries among animals. These practices have developed over generations of animal care and husbandry and include, but are not limited to: beak-trimming, dehorning, tail docking and castration of males. Various humane techniques are available, but at present, no technique can be recommended as ideal under all circumstances for any species.

The livestock industry is involved in many activities that require the movement of animals. The handling of livestock in shows, exhibitions, fairs, and races should always be done with primary concern for handler, public, and animal safety. Animals need to be humanely trained, shown, and exhibited using safe and non-harmful devices and procedures. Animal care under exhibition conditions can differ from farm conditions; but, the basic needs of animals remain the same.

Transportation by road, boat, rail and air requires careful planning to reduce adverse effects on animals. Animal should be fit and able to withstand transport. Any preconditioning of the animals to the conditions they will face will ease their stress during transportation. Vehicles should be of adequate size and strength for the animals carried. Floors, in particular, should be in good repair and sufficiently solid to prevent animals from breaking through. The inside walls and lining should have no sharp edges or protrusions likely to cause injury. Vehicles should be constructed of materials that are easily cleaned and kept as clean as possible. Enclosed vehicles must have adequate ventilation, especially when stationary.

A complete manure management plan is suggested when caring for farm animals. The goals of this plan should be to:

- Maintain acceptable levels of animal health and production through clean facilities;
- prevent pollution of water, soil, and air;
- minimize generation of odors and dust;
- minimize vermin and parasites; and,
- compliance with local, state, and federal laws, regulations, and policies.

A farm or farm operation that conforms to these and other applicable GAAMPs adopted under the Michigan Right to Farm Act according to the Michigan Right to Farm Law (Act 93 of 1981, as amended), shall not be found to be a public or private nuisance. This protection also covers farm operations that existed before a change in the land use or occupancy of land within one mile of the boundaries of the farmland, if before that change, the farm would not have been a nuisance. Likewise, this conditional protection applies to any of the following circumstances (Section 3):

- (a) A change in ownership or size.
- (b) Temporary cessation, or interruption, of farming.
- (c) Enrollment in governmental programs.
- (d) Adoption of innovative technology.
- (e) A change in type of farm product being produced.

Domestication of livestock has made farm animals dependent on humans. Consequently, humans have accepted this dependence as a commitment to practice humane conduct towards domestic animals and to prevent avoidable suffering at all stages of their lives. These voluntary GAAMPs represent a step toward meeting that commitment. These GAAMPs include care for the major farm animals raised in Michigan.

Owners of calves raised for veal, gestating sows, or egg-laying hens need to be aware of Act No. 117, Public Acts of 2009. This law identifies some specific care standards for these types of animals on farms. Requirements for veal calves became effective October 1, 2012. Requirements for gestating sows and egg-laying hens became effective in 2020 (10 years after the law was enacted).

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## BEEF CATTLE AND BISON

### MANAGEMENT OVERVIEW

Because of similarities among production practices between beef cattle and bison, GAAMPs for care of these animals will be similar in many cases. Unless specified otherwise, the term “cattle” used throughout this section will refer to both beef cattle and bison. Genetic variation among cattle species, breeds and individuals makes it possible for them to thrive in a wide range of natural conditions and artificial environments. When behavioral and physiological characteristics of cattle are matched to local conditions, cattle thrive in virtually any natural environment in Michigan without artificial shelter. Protection, however, may be beneficial, especially for newborns, during adverse weather conditions. Cattle reside on pastures and woodlots, in small dry lot facilities, in a variety of diverse types of feedlots, and in confinement. Programs and manuals covering the proper care and management of beef cattle can be found at the websites listed for Beef Quality Assurance and for bison at the website for the National Bison Association (see references).

### MANAGEMENT PRACTICES

**Nutrition:** Feed and water should be presented to cattle in ways that minimize contamination by urine, feces, and other materials. Feed bunks, where used, should be monitored, and kept clean. Animals should be fed and watered in a manner consistent with one of the following publications: Nutrient Requirements of Beef Cattle (National Academies of Sciences, Engineering, and Medicine, 2016) or for bison, the Bison Producers Handbook (National Bison Association); or Buffalo Producer’s Guide to Management and Marketing (Dowling, 1990). Avoid feed and water interruption that lasts longer than 24 hours.

Cattle may vary considerably in body weight during grazing and reproductive cycles. Feeding programs should make it possible for animals to regain the body weight lost during the normal periods of negative energy balance. Cattle should have frequent or free access to a source of clean water. When continuous access to water is not possible, individual animals should have access to water for a minimum of 30 minutes daily. Warmer weather conditions, greater amounts of feed consumed, and higher levels of animal production may increase this suggested minimum access time. Snow has been shown to be an acceptable source of water for a short period of time if it is loose and clean (Degen and Young, 1990<sup>a</sup>; Degen and Young, 1990<sup>b</sup>; Schmid K. and Bergen R. 2012).

**Manure Management and Sanitation:** Manure management should conform to the recommendations presented in the current Manure Management and Utilization GAAMPs (Michigan Agriculture Commission). Midwest Plan Service (1993) has a publication on recommended waste handling facilities. For the pasture-based systems, manure management and sanitation are generally less of a concern, but care should be taken to

protect surface waters and prevent erosion. When surface waters are used as a water source, it is recommended that cattle have controlled crossing and drinking access to lakes, streams, and wetlands (Rector and Powers. 2008; O'Callaghan et al 2019). Cattle crossings and watering sites should be constructed to minimize erosion and water pollution.

Cattle may be managed indoors on a bedded pack, which combines manure storage with a permeable and/or moisture-absorbing bedding material. Materials used for bedding vary, but often consist of crop straws, crop residues, grain hulls, wood shavings, or sawdust. Maintenance of a firm, relatively dry environment that maintains cattle health and comfort, depends on management of cattle stocking rate, adequate air ventilation, bedding addition frequency, and periodic manure removal (Pastoor, et al., 2012; Endres and Schwartzkopf-Genswein, 2018). An array of different housing types (e.g. open lot, partially covered, fully covered), flooring types (e.g. flat concrete, slatted concrete, slatted rubber mats) and manure management systems (e.g. bedded pack, partial scrape, fully scrape, slatted-floor/pit) are commonly used. See Park et al. (2020) for advantages and disadvantages on the welfare of beef cattle of some specific housing features.

**Animal Handling and Restraint:** Some aggressive behaviors of larger farm animals risk the health and well-being of herd mates as well as the humans handling these animals. Such behaviors may be modified, and their impact reduced by a number of acceptable restraint devices (e.g., hobbles, squeeze chutes, and stanchions) and practices. Restraint should be the minimum necessary to control the animal and still ensure the safety of attendants. Restraints and chutes should be free of sharp edges and ramps should have solid sides and non-slip flooring (e.g. cleats spaced every 8 inches) to reduce slips and falls. Cattle should be moved at a normal and comfortable pace. Proper design of the handling facility will facilitate safe animal movement (Grandin, 2014; National Cattleman's Beef Association, 2019, Midwest Plan Service, 1987). Roping of cattle is necessary under certain conditions (e.g., in pastures when an animal needs treatment and no restraining facility is readily available). It is strongly encouraged to apply the principles of low stress handling when moving cattle and bison (Bartlett and Swanson, n.d., and Grandin et al., 2015).

Bison are less domesticated than cattle and require special handling facilities. Specific practices can be obtained from the Bison Producers Handbook (National Bison Association. 2016) and Buffalo Producer's Guide to Management and Marketing (Dowling, 1990). Bison are much more nervous and excitable in close quarters. Work bison slower and calmer than you would other stock. Handling facilities will need to be stronger and taller than pasture fences. Facilities for capturing, sorting, treating, testing, loading out, or confining bison should be strong, long lasting, cost efficient, and most importantly, safe for animals and the operator (National Bison Association).

**Transportation:** Safety and comfort should be the primary concerns in the transportation of any animal. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, exhausted, unable to stand, and unfit to withstand travel (AABP, 2019). When animals are transported, they should be provided with proper

ventilation and a floor surface that minimizes slipping. Animal injuries, bruises, and carcass damage can result from improper handling of animals during transport. Recommendations on facility design for loading and unloading trucks and restraint of animals have been published (Grandin, 2000; Grandin 2019).

Additional information is available on the Beef Quality Assurance section of the National Cattlemen's Beef Association website (<http://www.bqa.org/resources/manuals>). Transport and handling stresses can be aggravated greatly by adverse weather conditions, especially when the weather is changing rapidly. Water and feed must be readily available for long trips ~~as described in Federal Regulations (Transportation of Animals statute 49 USC Sec. 80502)~~. The maximum transportation duration is based on the 28-hour rule as described in Federal Regulations (Transportation of Animals statute 49 USC Sec. 80502). Briefly, this law requires interstate livestock transporters to unload, feed, water, and rest the animals after 28 consecutive hours in transit. Stocking density and bedding should be adjusted for extreme weather conditions. More information on handling cattle can be found at Beef Quality Assurance website (see references). All Michigan cattle moving to show, sale or exhibition on or after March 1, 2007, are required to have an official (Michigan Animal Industry Act. Act 466 of 1988. MCL section 287.711b) Radio Frequency Identification (RFID) ear tag. This includes all out-of-state cattle exhibited in Michigan.

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

Cattle on pasture and woodlots are often monitored less directly and less frequently than cattle raised in other indoor systems. Cattle in woodlot and pasture systems are more likely to be affected by weather, predators, insects, internal and external parasites, poisonous plants, and variation in feed supply. Hot or extremely cold weather is stressful and special accommodations may be needed (National Research Council, 1981). In extreme heat, cattle will be more comfortable with provision of shade (Edwards-Callaway, 2021) and free access to water. Air temperature, humidity, and movement should be considered to ensure animal comfort and dietary alterations to reduce heat stress. Likewise, cattle exposed to extreme cold and wind chill should be provided extra feed and shelter from the wind. A properly maintained perimeter fence is required for the safety of the animals and surrounding community (Michigan Fences and Fence Viewers. Act 34 of 1978. Cattle in backgrounding facilities or feed yards must be offered adequate space for comfort, socialization, and environmental management. Periodic pen maintenance and cleaning are strongly encouraged. When muddy conditions exist, realistic intervention, such as addition of bedding, should be employed.

The strength and height of fencing is more important for bison than beef cattle. Many producers recommend an exterior fence of six feet in height. If a bison can get its nose over the fence and wants to be out, it is likely the animal will try to jump or push over the fence. Grown bulls can make a standing six-foot jump, if so inclined (National Bison Association).

## **FACILITIES AND EQUIPMENT**

Cattle may be housed in intensive management systems, either indoors or in open lots, with or without overhead shelter. Proper airflow and ventilation are essential in confinement facilities to control for gas and particulate matter. For open lots, south-sloping exposure, mounds, and a windbreak are recommended so dry areas with low air velocities are available for the cattle to rest. Floors in housing facilities should be properly drained. Barns and handling alleys should provide adequate traction to prevent injuries to animals and handlers. Additionally, handling alleys and pens should be free of sharp edges and protrusions to prevent injuries. Handling facilities should be designed to encourage safe animal movement as much as possible. When handling the animals, excessive noise should be avoided. Hydraulic and mechanical equipment should be adjusted to the size of the animal to minimize injuries.

For additional information, see the Structures and Environment Handbook (Midwest Plan Service, 1987), Grandin, 2000, Boyles, et al. 2002, the Beef Housing and Equipment Handbook (Midwest Plan Service, 1987), and Effective Natural Ventilation Strategies (Gooch, 2003).

## HEALTH CARE AND MEDICAL PROCEDURES

Adequate health care is an essential part of a profitable cattle operation. A health care program should be planned to address potential problems as appropriate for local conditions. Appropriate health care involves: 1) methods to prevent, diagnose, control, and treat diseases and injuries; 2) training and guidance for animal caretakers on appropriate antibiotic therapy; 3) instruction on proper handling of pharmaceuticals and biologicals and withdrawal times, and, 4) adequate record keeping systems. Animals should be observed frequently for signs of illness or injury, needed emergency action, and ensuring adequate availability of feed and water. Observation should be daily in intensive housing facilities and should be frequently enough in extensive conditions, such as range or pasture, so that animal needs can be accomplished in a timely fashion.

Methods of prophylaxis, diagnosis, therapy, vaccination, and disease control should follow currently accepted practices. Assistance from a veterinarian in establishment of a health care program is recommended. Organic production programs should work with a veterinarian to ensure adequate protection and treatment for sick animals.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.



As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising cattle for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of cattle and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
3. the veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

**Euthanasia:** Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Farmers should consult with their veterinarian to determine the options and guidelines for euthanizing such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Euthanasia (American Veterinary Medical Association, 2020) and state law.

**Depopulation:** AVMA definition of the term depopulation refers to the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable. Farmers should consult with their veterinarian to determine the options and guidelines for depopulation such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Depopulation (American Veterinary Medical Association, 2019 Edition) and state law.

**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

**Non-Ambulatory (Downed) Cattle:** A prompt examination should be performed on non-ambulatory animals to determine whether extended care or euthanasia is recommended. If the animal is not in extreme distress and continues to eat and drink, it is recommended that the producer contact a veterinarian for assistance/advice and provide food, water, shelter, and appropriate nursing care to keep the animal comfortable. If the animal is in extreme distress and the condition is obviously irreversible, the animal should be euthanatized immediately. Downed animals should be moved carefully to avoid compromising animal welfare. Dragging downed animals is unacceptable. Non-ambulatory animals are not fit for transport and must not be sent to a livestock market or to a processing facility (AABP, 2019).

#### Beef Quality Assurance

Beef Quality Assurance (BQA) and Beef Quality Assurance Transportation (BQAT) are training and certification programs supported by Beef Checkoff funding to ensure cattle are properly cared for and a safe and nutritious product is presented to consumers. It is recommended all owners/managers of cattle receive training on the proper handling and care of livestock, antibiotic stewardship, and transportation of cattle. Certification in BQA and BQAT is mandatory for commercial truckers and owners/managers of cattle entering some cattle processing facilities.

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## DAIRY

### MANAGEMENT OVERVIEW

~~Michigan's female dairy cattle population is currently over 432,000 mature dairy cows and about 395,000 calves and heifers (USDA's National Agricultural Statistics Service). The remainder of the dairy population consists of calves used for veal, dairy steers raised for beef and approximately 4,000 bulls used for breeding purposes.~~ Proper care of dairy animals consists of providing a clean, comfortable environment, adequate access to quality feed and water while employing management techniques designed to limit injuries, stress, diseases, and disorders (Beef Quality Assurance, 2022). Proper care of animals can be maintained with either confinement or pasture management systems.

Dairy cows, because of milk production, have special needs that require proper management every day. Calves and heifers should be managed to minimize health problems and to provide for adequate growth and development. Application of sound management practices will result in healthy dairy cows, and healthy, properly grown calves and heifers.

### MANAGEMENT PRACTICES

Management practices on a dairy farm are specific for five classes of dairy cattle: calves, heifers, dry cows, lactating cows, and bulls. Calf mortality and morbidity from birth to weaning can be minimized by utilizing sound management practices (Calf Care Quality Assurance, 2022; ~~Raising Dairy Replacements, Midwest Plan Service, 2003~~).

**Newborn Calves:** Calves should be born in a clean, dry environment and receive an adequate amount (12-15% of body weight) of high-quality colostrum soon after birth. Hand feeding ensures that each calf receives an adequate amount of colostrum (~~Raising Dairy Replacements, 2003~~; Jones and Heinrichs, 2022). Calves are normally removed from their mothers to reduce risk of exposure to infectious pathogens (~~Raising Dairy Replacements, 2003~~). Newborn calves remain healthier when housed in a clean, properly ventilated environment (~~Raising Dairy Replacements, 2003~~; McFarland, 2012). Young calves are normally fed milk or milk replacer during the first 6-8 weeks of life. Calves should be observed several times a day. The amount of feed and times fed per day should increase as temperatures decrease in the winter.

Some farms use automated or robotic nursing machines during part of this stage of a calf's life which may involve group pens with adequate clean and dry bedding and proper ventilation. Stocking rates of no more than 25 calves per nipple are advised. Calves can be started on feeders by day 7 to day 14. Prior to moving calves, monitoring immune levels and individual housing help determine if calves are healthy and eating well (James et al, 2017). Increased calf density will impact air quality as well. Sick calves should be isolated to minimize disease spread.

**Calves and Heifers:** Calves are normally weaned when adequate intake of dry feed has been reached (National Research Council, 2021). All calves should have access to clean, fresh water and nutritionally adequate diets to support an appropriate growth rate. Proper heifer growth can be achieved with varied management systems (Raising Dairy Replacements, 2003). Heifer and intact male calves can be housed together from 2-6 months but bull calves should be separated after that to prevent early pregnancies. Heifers should be managed in groups to ensure adequate access to feed and water. The number of groups will depend on herd size. Each group of heifers should be fed a balanced ration (National Research Council, 2021) to maintain adequate growth.

Underfeeding delays normal heifer development. Overfeeding may result in overly fat heifers at higher risk of health problems at first calving.

Heifers may be bred upon reaching an adequate size and weight (~~Raising Dairy Replacements, 2003, Midwest Plan Service~~). Use of artificial insemination or natural service (bull) are acceptable practices to breed heifers and/or cows.

**Dry Cows:** Cows benefit from a dry period prior to a subsequent lactation. Restricting feed intake a few days prior to dry-off is an acceptable practice that will aid cessation of milk secretion ~~and improve udder health (Managing the Dry Cow for More Profit, 1996)~~. Nutrition must be adequate to allow mammary involution and ~~the~~ support the needs of the fetus.

Proper management of the lactating cow starts during the dry period. Since approximately 70 percent of health problems in a dairy herd are associated with calving, proper management of pre-calving, calving and post calving periods will improve the health of mother and calf. A clean and dry environment should be provided for pregnant heifers and dry cows. In addition, access to ~~good~~ appropriate nutritional diets that maintain appetite and feed intake should also be provided. Nutrition for the majority of dry cows should follow a maintenance program according to National Research Council requirements (National Research Council, 2001). Nutrition and housing needs will change 2-3 weeks prior to calving.

**Lactating Cows:** Nutrition programs for dairy cows should provide for adequate intake of the essential nutrients needed for maintenance, growth, milk production and proper development of the fetus (National Research Council, 2021). Grouping cows according to nutrient needs will help meet the nutrient requirements of any cow. Good quality, fresh water must be available at all times.

**Animal Handling:** Facilities designed specifically to handle dairy cattle for health checks or treatment, vaccinations, weighing, or hoof trimming and for handling bulls during hand-mating will decrease risk of injury to cattle and people as well as reducing the stress of handling. All traffic areas should have non-skid surfaces that avoid causing excessive hoof wear. Several restraint devices are acceptable, such as halters, hobbles, breeding chutes, squeeze chutes, headlocks, tables and stanchions. Restraint should be the

minimum necessary to control the animal and ensure the safety of the animal and attendants. Proper design of the handling facility will facilitate animal movement.

**Transportation:** Safety and comfort of dairy cattle should be the primary concerns in their transportation. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel (American Association of Bovine Practitioners, 2019). Animals should be provided with adequate ventilation and a floor surface to minimize slipping. Animal injuries, bruises, and carcass damage can result from improper handling of animals during transport.

Recommendations on facility designs for loading and unloading trucks and restraint of animals have been published (Grandin, 2014). Transport and handling stresses can be aggravated greatly by adverse weather conditions, especially when the weather is changing rapidly. Water and feed should be readily available for long trips as described in Federal Regulations (the Transportation of Animals statute from the U.S. Code (49 USC Sec. 80502 Reference). All Michigan cattle moving to show, sale or exhibition on or after March 1, 2007 are required to have an official RFID ear tag. This includes all out-of-state cattle exhibited in Michigan.

## **RECOMMENDATIONS FOR THE ENVIRONMENT<sup>1</sup>**

Proper management of the environment enhances animal production and minimizes animal disease, death loss, and behavioral problems. Dairy cattle are bred for growth, production, and reproduction in a variety of environments to which they can readily adapt. Cattle can be raised outdoors on pasture, dry lot, and in hutches, or indoors in stalls and pens.

Environmental temperature affects an animal's comfort that, in turn, affects an animal's behavior, metabolism, and performance. Even though cattle are adaptable and can thrive in almost any region of the world, they must be protected from heat and cold stress caused by extreme weather events. Access to shelter can be beneficial even in moderate climatic regions. Heat stress adversely affects animal comfort as does cold stress. Windbreaks, sunshades, or solid-roofed shelters are needed if trees or other landscape features do not provide adequate protection from winter storms and extremely cold or hot temperatures. Sunshades, sprinklers, misting, fans, and other methods of cooling, as well as dietary alterations, will reduce heat stress during hot weather. Air temperature, humidity, quality, and movement should be considered to ensure animal comfort and prevent diseases.

## **FACILITIES AND EQUIPMENT**

Housing for calves, heifers, and cows varies widely. However, each housing facility should provide adequate space per animal for eating, drinking, and resting (~~Bickert, and Stowell, 1994~~) and adequate ventilation (~~Gooch, 2003~~[Dairy Freestall Housing and](#)

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<sup>1</sup>Condensed from environment chapter in Caring for Dairy Animals Reference Guide, 1994.

Equipment – MWPS#7, 2013). Calf housing systems are varied. Cold housing ranges from calf hutches to larger naturally ventilated barns. Bedding should be kept clean and dry. Adequate housing for heifers can range from bedded packs to free stalls to pasture. Housing should be well ventilated and keep heifers clean and dry. Heifers should be protected from winter winds. Summer resting areas may need shade.

Feed bunks or feeding areas should be designed to allow animals to eat with a natural motion. Watering sites should be easily accessible to provide adequate water intake without risk of injury. Adequate feed space per animal should be provided (Dairy Freestall Housing and Equipment- MWPS #7. 2013).

Milking equipment should be designed, installed, and maintained correctly to provide for maximum comfort of the cow at milking (~~Milking Systems and Parlors, 2001, Building Freestall Barns and Milking Centers, 2003~~Dairy Freestall Housing and Equipment MWPS#7, 2013). To eliminate the potential of stray voltage at time of milking, feeding, or watering, guidelines for proper wiring of a farm should be followed. (Stray Voltage and Dairy Farms, 2003; Effects of Electrical Voltage/Current on Farm Animals. 1991).

## **HEALTH CARE AND MEDICAL PROCEDURES**

Proper care of dairy animals includes the establishment of a herd health program that covers all ages of cattle and emphasizes disease prevention. Dairy farmers should establish a valid veterinarian/client/patient relationship with a licensed veterinarian to assist them in providing proper health care to their herd. An ongoing preventive herd health program designed for each farm by the veterinarian and farmer will result in healthy animals. This includes a veterinarian designed vaccination program for cows, calves, and heifers. Appropriate health care involves: 1) methods to prevent, control, diagnose, and treat diseases and injuries; 2) training and guidance to animal caretakers on appropriate antibiotic therapy; 3) instruction on proper handling of pharmaceuticals and biologicals and withdrawal times; and 4) accurate record keeping systems with proper animal identification. All confined animals should be observed daily for signs of illness, injury, or unusual behavior. Management practices to reduce the risk of introduction and spread of infectious disease should be implemented. Health programs for heifers are designed to prevent disease and increase efficiency of growth. Organic production programs should work with a veterinarian to ensure adequate protection and treatment for sick animals.

External and internal parasites need to be controlled. Pasturing may increase risk of internal parasites and will increase exposure to diseases carried by wild animals.

Suggested husbandry procedures such as castration, dehorning, removal of extra teats, etc. should be carried out by skilled personnel. These procedures are best done when calves are less than 8 weeks of age. All procedures should follow the veterinarian's recommendations or accepted management practices.



**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
3. the veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

**Non-Ambulatory (Downed) Cattle:** A prompt examination should be performed on non-ambulatory animals to determine whether extended care or euthanasia is recommended. If the animal is not in extreme distress and continues to eat and drink, it is recommended

that the producer contact a veterinarian for assistance/advice and provide food, water, shelter, and appropriate nursing care to keep the animal comfortable. If the animal is in extreme distress and the condition is obviously irreversible, the animal should be euthanized immediately. Downed animals should be moved carefully to avoid compromising animal welfare. Dragging downed animals is unacceptable. Non-ambulatory animals must not be sent to a livestock market or to a processing facility.

**Euthanasia:** Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Farmers should consult with their veterinarian to determine the options and guidelines for euthanizing such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Euthanasia (American Veterinary Medical Association, 2020) and state law.

**Depopulation:** AVMA definition of the term depopulation refers to the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable. Farmers should consult with their veterinarian to determine the options and guidelines for depopulation such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Depopulation (American Veterinary Medical Association, 2019 Edition) and state law.

**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animals Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

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## VEAL

### MANAGEMENT OVERVIEW

Most veal comes from dairy calves. Formula-fed veal calves (also known as milk-fed or special-fed) are raised for about six months and marketed at 500 pounds or more. The calves consume milk, grain, and some supplemental fiber throughout the production process. Three types of veal in the United States include: Bob veal, which are fed a milk-based liquid diet and marketed at less than three weeks of age and at less than 150 lbs., grain-fed veal, which are fed a milk-based liquid diet and possibly hay, pasture or other feeds including grain; and formula-fed veal (also known as milk-fed or special-fed), which are fed a milk-based liquid diet throughout the feeding period (Schwartz, 1990). Formula-fed veal calves are raised for about six months to a market weight of 500 pounds or more. Formula-fed veal is the most common in Michigan and these recommendations will be specific to this type.

The term milk-fed veal—sometimes referred to as special-fed or formula-fed—is a USDA classification that describes veal calves derived from the dairy industry and fed a special milk formula or milk replacer that is rich in nutrients. This formula is typically made from whey and whey protein, both of which are by-products of cheese making. It's nutritionally designed to produce creamy white to pale pink meat. In addition to the milk, farmers also feed some grain and forages.

### MANAGEMENT PRACTICES

Veal calves should be handled with the same management practices afforded to dairy calves. Special care, gentleness, and patience are recommended management practices for all dairy calves. Until they are selected for veal production systems, they should receive the same husbandry practices as dairy replacement heifers. Young dairy animals not intended for dairy herd replacements or formula-fed veal should follow beef management recommendations.

A healthy calf is a priority at the farm. Veal calves have special animal health needs as young calves have not developed a strong defense system and are more prone to challenges associated with stress. Veal farmers have an ethical obligation to provide each animal with appropriate quality care through each stage of life. This can best be achieved by establishing on-farm protocols and training that seek to maximize animal health while minimizing stress, disease and pain. In conjunction with providing essential nutrition, access to water, and a clean, comfortable environment, timely and appropriate response to treating sickness or disease is important. By working directly with a veterinarian to establish a comprehensive herd-health program, veal farmers are able to provide quality animal care, prevent disease and determine the best option for addressing any animal health concern.

Initially, each calf can be housed in separate pens or individual hutches. This method may help to minimize the risk of disease, avoid competition for milk and feed, allow intake to be individually monitored, and prevent cross-sucking. As a best practice, the industry standard is to move calves to group pens of two or more by ten weeks of age. Disease transmission is complex and other farm management practices, in addition to grouping, influence the incidence of these diseases, such as method of milk-feeding, hygiene, ventilation, colostrum practices, diet and health monitoring. Group housed calves must be strategically grouped to ensure they are housed with calves that have a similar size, age, and drinking habits. Calves must always have access to clean, fresh water. Veal farmers should adopt a protocol for individual monitoring that ensures maximum health and comfort for each animal. Consult with your veterinarian to develop a robust herd-health program specifically designed for group-housed calves.

Best management practices include: Adequate space is provided for calves to easily stand, stretch, lie down, turn around, groom naturally, and have visual contact with other calves. Calves are in group pens of two or more calves, and no calf is individually penned after 10 weeks of age, unless it is for health purposes such as sickness, injury or disease. Calves should never be tethered (Veal Quality Assurance ~~2018~~2024).

Revision of the Michigan Animal Industry Act 446 of 1988, Sec 46(1) by Act 117, effective March 31, 2010 provides for the following regulations for calves raised for veal after October 1, 2012: 1) Calves should be able to fully extend all limbs without touching the side of an enclosure, and 2) turn around in a complete circle without any impediment, including a tether, and without touching the side of an enclosure or another animal. Size of groups and space per animal for group pens that calves are initially placed into should be considered as is done with weaned dairy calves to reduce stress caused by competition for food and space. Determination of area requirements should be based on body size, head height, stage of life cycle, behavior, health, and weather conditions. (Guide for the Care and Use of Agricultural Animals in Research and Teaching 2010). Draft control within a group pen should be accomplished by draft barriers (Raising Dairy Replacements, 2003).

Diets should be formulated to meet nutrient requirements for both maintenance and growth (National Research Council, 2021).

Veal farmers should work with a reputable nutrition expert to provide quality feed that meets the nutritional requirements of veal calves and contains the nutrition necessary to maintain health, growth and energy. Veal calves provided grain should be fed a high-quality starter that promotes rumen development. Feed should have proper protein and fat levels for the age and size of the calf. Feed mixing and distribution equipment should be designed to facilitate easy, thorough cleaning and sanitizing. Buckets, bottles and all equipment used for mixing or distributing feeds should be completely cleaned and sanitized daily between uses. Maximize water intake immediately upon arrival of the calves. All calves should have access to clean, fresh water to maintain proper hydration from the first day of life. All calves should have access to fresh water to maintain proper hydration from the first day of life. Feeding milk or replacer should not be a substitute for

water. Provide sufficient space for group-fed calves that allows all animals to feed at the same time or sufficient quantities of feed are available for all animals during a 24-hour period (Veal Quality Assurance, ~~2018~~2024).

**Transportation:** Safety and comfort should be the primary concerns in the transportation of any animal. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel (American Association of Bovine Practitioners, 2019). Animals should be provided with adequate ventilation and a floor surface to minimize slipping. Animal injuries, bruises, and carcass damage can result from improper handling of animals during transport. Recommendations on facility design for loading and unloading trucks and restraint of animals have been published (Grandin 2014,). Transport and handling stresses can be aggravated greatly by adverse weather conditions, especially when the weather is changing rapidly. Water and feed should be readily available for long trips as described in Federal Regulations (the Transportation of Animals statute from the U.S. Code 49 USC Sec. 80502 Reference).

## RECOMMENDATIONS FOR THE ENVIRONMENT

A clean, dry, draft-free building or outside surrounding is recommended for animal comfort and performance. For enclosed “warm” buildings, ventilation rates in winter should be sufficient to remove moisture produced in the building. Rates should be increased as the weather warms to provide temperature control. Recommendations for calculating ventilation rates are similar to those for dairy calves in warm housing ([Dairy Freestall Housing and Equipment- MWPS #7, 2013](#)~~Midwest Plan Service, 2000~~, Gooch, ~~C.~~ 2003). It is important that the building air inlets are properly positioned and can supply the airflow for the exhaust fans when veal calves are housed indoors.

Thermostats can be effectively used for automatic control of the fans and temperature. Heating and ventilation systems should be planned simultaneously. Control of temperature is important to the health of calves and is a factor in feed conversions. Michigan's climate can be erratic; therefore, producers should attempt to provide a comfortable temperature and level of relative humidity. Sudden fluctuation in temperature should be avoided.

During daylight periods, natural or artificial indoor lighting intensity should allow for every housed calf to be seen clearly for inspection.

## FACILITIES AND EQUIPMENT

The internal surfaces of barns and holding systems for veal calves should be made of materials that can be cleaned and disinfected effectively and routinely. Surfaces of barns, stalls, pens, and other equipment accessible to the calves should have no sharp edges or projections. All floor surfaces should be designed, constructed, and/or maintained to avoid injury or stress to the calves.

## HEALTH CARE AND MEDICAL PROCEDURES

Proper care of animals includes the establishment of a health program that emphasizes disease prevention. Veal farmers, including those participating in organic programs, should establish a valid veterinarian/client/patient relationship with a licensed veterinarian to assist them in providing proper health care to their animals. An ongoing preventive health program designed for each farm by the veterinarian and producer will result in healthy animals. This includes a veterinarian designed vaccination program. Appropriate health care involves: 1) methods to prevent, control, diagnose, and treat diseases and injuries; 2) training and guidance to animal caretakers on appropriate antibiotic therapy; 3) instruction on proper handling of pharmaceuticals and biologicals and withdrawal times; and, 4) accurate record keeping systems with proper animal identification. All confined animals should be observed daily for signs of illness, injury, or unusual behavior. Management practices to reduce the risk of introduction and spread of infectious disease should be implemented. Preventive and therapeutic health programs and medical procedures should follow a veterinarian's recommendation.

Castration and dehorning are not necessary practices in raising veal calves. Additionally, hormone implants are prohibited.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

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DRAFT

## SWINE

### MANAGEMENT OVERVIEW

In Michigan, swine can be raised humanely in a variety of production systems, provided they are given ample protection from extreme cold, excessive wind, solar radiation, and precipitation. Production systems used include: 1) environmentally controlled buildings in which the pigs remain inside; 2) open front buildings that permit the pigs to go outside; and 3) outside lot or pasture production with portable shelters. Well maintained facilities and sound management practices optimize animal comfort and well-being regardless of the type of production system. The swine care practices described herein are relative to domestic swine production. National Pork Board - Swine Care Handbook, Pork Quality Assurance Plus (PQA Plus), Youth Quality Assurance and Transport Quality Assurance programs are available to swine producers wanting additional information on swine management and production (<https://www.pork.org/production>).

### MANAGEMENT PRACTICES

**Observation:** Pigs must be observed daily, but more frequently during specific events such as farrowing or recovery from illness. Drinkers and feeders must be monitored to make sure pigs have access to fresh water and feed. Pigs should be examined for signs of health problems, physical discomfort, or injuries. Facilities need to be inspected regularly to be sure they are functioning properly. Producers need to be aware of these responsibilities during normal work hours, nights, holidays, and weekends. Caretakers are encouraged to adopt neutral or positive animal interactions to improve the well-being of the pigs.

**Managing Sick and Injured Animals:** With daily observations, caretakers can develop a method for tracking and identifying healthy and non-healthy pigs. A pig is considered non-ambulatory if it cannot get up or if unable to stand without support and unable to bear weight on two of its legs. Handling of non-ambulatory pigs should include equipment appropriate for size and age and condition of the animal. Dragging of conscious animals by any body part is unacceptable, except for the rare case whereby a pig must be moved from a life-threatening situation. In addition, a caretaker might have to reposition a pig to perform euthanasia safely and effectively.

**Identification and Records:** Pigs may have some form of identification that can be easily read. These identification methods may include ear notches, ear tattoos, electronic transponders, ear tags, body tattoos, or by temporary mark. Pigs not individually identified but kept in groups can be identified as a group by using group identification. Identification is important to maintain records and track pigs as they are moved through the various production phases. Several types of management records that may be kept include source of pigs, health programs, housing location, genetic lineage, and nutrition. The farm should have its own premise identification number (PIN) assigned for the

appropriate tracking of diagnostic submissions and other regulatory purposes such as a VFD. PIN assignment is also important for management of pig location and movement in the event of a Foreign Animal Disease outbreak.

**Piglet care:** After birth, any of the following procedures may be performed on piglets by a skilled individual as a part of routine husbandry or to help reduce the risk of disease and infections: disinfection of navel, clipping or grinding of needle teeth tips, supplementing iron by injection or orally, docking of tail, permanent identification, and castrating males.

**Herd Health Management Program:** The overall goals of a herd health program are to eliminate or minimize disease by reducing exposure or controlling existing disease. The management plan should include Standard Operating Procedures (SOP) and compliance for biosecurity, vaccination, daily observation, timely euthanasia, vector control, pig flow, entry and culling, management of compromised pigs, treatment and mortality records.

**Nutrition:** Livestock should have access to clean drinking water. Swine are raised on a variety of feeds. Feedstuffs should be free of unacceptable levels of harmful molds, mycotoxins, or other impurities. If the presence of any of these substances or organisms is suspected, samples should be submitted for laboratory testing. Feed with unrecognized nutritional value or lacking in wholesomeness should not be used. The diet should meet the nutritional needs to support the intended performance of swine in a given phase of production (i.e., age specific growth, pregnancy, lactation, active and inactive breeding males).

High intake of rations may cause excessive weight gain during gestation. Sows allowed ad libitum access to feed will become obese negatively impacting her ability to raise born piglets. Restriction of energy intake is suggested for gestating females. This may be done by decreasing daily feed intake, adding fiber to the diet, or feeding everyone to three days. This is also true for boars. Consult your specialist for suggestions on how to adjust feed intake for breeding animals. Pigs in other phases of production are generally given ad libitum access to feed and water.

**Manure Management and Sanitation:** Manure handling and utilization systems for swine facilities should conform to practices adopted by the Michigan Agriculture Commission in its document entitled *GAAMPs for Manure Management and Utilization*.

Pigs should be kept comfortable and healthy. Defecating and resting preferences should be considered in designing facilities and in the day-to-day operation of those swine facilities. The frequency of manure removal from swine facilities is dependent on several factors including: pen size, animal density, temporary manure storage capacity and flooring type. Building interiors, corridors, storage space, and other work and production areas should be kept clean and free of any sharp edges or protrusions which may cause injury to pigs passing by. Damage to floors that could cause injury should be repaired in a timely fashion.



**Animal Handling:** An understanding of the behavioral characteristics of pigs will aid in handling and moving of swine, as well as increase productivity, improve meat quality, and help reduce undesirable stress. At all stages, pigs should be handled with care, gentleness, time for acclimation, time for rest, and patience. Pigs have wide angle vision in excess of 330 degrees. Although this allows them to almost see behind themselves completely without turning their heads, it also causes them to be sensitive to sharp contrasts in light and dark. Pigs may balk if they encounter shadows, puddles, bright spots, a change in flooring type or texture, drains, metal grates, or flapping objects.

Pigs will stop when a solid barrier is placed in front of them. Small portable panels will allow efficient moving and sorting. A light aluminum, plastic or wood panel is useful in separating pigs from a pen.

For physical examination, collection of samples, and other clinical procedures, pigs can be restrained manually or with handling aids, such as snout snares, restraint stocks or stalls. It is important that these devices be the right size and designed for the pig being held and that they are operated properly to minimize injury.

**Zero Tolerance for pig abuse or purposeful neglect:** At all levels of production, training must emphasize that there will be zero tolerance for pig abuse or purposeful neglect. Egregious acts of abuse include, but are not limited to:

- Intentionally applying electric prods to sensitive parts of the animal such as the eyes, ears, nose, genitals, or rectum. Excessive prod use could qualify as a willful act of abuse.
- Malicious hitting/beating of an animal. This includes forcefully striking an animal with closed fist, foot, handling equipment (e.g., sorting board, rattle paddle, etc.), or other hard/solid objects that can cause pain, bruising or injury.
- Driving pigs off high ledges, platforms or steps while moving, loading, or unloading (animals are falling to the ground).
- Dragging of conscious animals by any part of their body except in the rare case where a non-ambulatory animal must be moved from a life-threatening situation. Non-ambulatory pigs may be moved by using a drag mat.
- Purposefully dropping or throwing animals.
- Causing physical damage to the snout or tusks of a boar as a means to reduce aggression (this excludes nose ringing and tusk trimming).
- Failure to provide food, water, and care that results in significant harm or death to animals. This includes the intentional failure to provide food, water or care that falls outside of normal husbandry practices and would reasonably be considered neglect.

**Transportation:** Recommendations of facility design for loading and unloading trucks have been published (Grandin, 1988 and 2000) and by the National Pork Board. Prior to loading all pigs should be assessed for fitness for transport. Weak, sick, or fatigued pigs should not be loaded or transported with healthy ones. Appropriate steps should be taken

immediately to segregate sick pigs and care for their special needs. Injuries and bruises can result when pigs are improperly managed during loading and transport. Lights inside a building or inside a truck will attract pigs because they have a tendency to move from a darker area to a more brightly lit area. Funnel shaped pens should not be used to load pigs because pigs have a tendency to continue to press forward. Loading ramps with solid sides are more efficient than "see through" sides because they decrease distractions.

Safety and comfort should be a primary concern when transporting pigs. When pigs are transported, ventilation should be adequate, and the floor should be slip-resistant. Animals should be shipped in groups of uniform weight and provided with adequate space (Grandin, 1988; Grandin, and Shultz-Kaster, 2001). Truck beds should be clean and equipped with a non-slip floor.

Transport stresses can be intensified by adverse weather and wide temperature fluctuations. Correct adjustment of panels, bedding and pig density are important factors to reduce stress and improve welfare (See National Pork Board – Transport Quality Assurance® (TQA®) recommendations).

Hot weather is a time for particular caution. While in transit in warm weather, pigs should be protected from heat stress by being shaded, wetted, and bedded with wet sand or shavings. Prompt unloading in hot weather is essential because heat builds up rapidly in a stationary vehicle.

During transportation in cold weather, pigs should be protected from cold stress. Wind protection should be provided when the air temperature drops below 32°F, but ventilation must always be adequate. When trucks are in transit in cold weather for more than a few minutes, pigs should be bedded with sufficient material that has high insulating properties. Water and feed should be readily available for long trips as described in the Transportation of Animals statute from the U.S. Code (49 USC Sec. 80502).

Truck beds should be clean and dry and equipped with a bedded, non-slip floor.

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

Production systems should be designed with consideration of the environment of the pigs, the protection of air and water, and the working environment of the producer and employees.

**Social:** All classes and groups of pigs form an order of social dominance. These orders are formed by competition soon after birth or when the pigs are first grouped together. Addition of new pigs or regrouping of pigs will usually lead to reestablishment of social order. Adult boars that have not been living together should not be regrouped.

Females can be bred to farrow at any time of the year. Three mating options are: 1) pen mating (placing a boar with a group of sows without observation of mating); 2) attended or hand mating; and, 3) artificial insemination (utilizing semen collected from boars).

During gestation sows may be housed individually or in groups (CAST, 2009). Resolution 3 of the American Association of Swine Veterinarians, and the American Veterinary Medical Association states: The American Veterinary Medical Association supports the use of sow housing configurations that: 1) minimize aggression and competition between sows; (2) protect sows from detrimental effects associated with environmental extremes, particularly temperature extremes; 3) reduce exposure to hazards that result in injuries; 4) provide every animal with daily access to appropriate food and water; 5) facilitate observation of individual sow appetite, respiratory rate, urination and defecation, and reproductive status by caretakers; and, 6) allow sows to express most normal patterns of behavior (Vet Med Today: Sow Housing Task Force, 2005). Public Act No. 117 of October 12, 2009, requires, by April 1, 2020, all gestating sows be housed so that they are able to fully extend their limbs and turn around freely. Sows may be housed in individual pens or stalls which are large enough to do so, until they are determined pregnant. For further information on this enactment and exemptions see Rozeboom et al. (2019). Housing in groups in pens may be most easily applied and affordable. When housed in pens and in groups, pregnant sows may be fed to meet all nutrient requirements by providing a variable number of meals per day using one or more of the following methods: clean solid flooring, a common trough, in individual feeders within individual feeding stalls, controlled access to a self-feeder, or an electronic sow feeder.

Sows can farrow in pens, farrowing stalls, or pasture huts. Pens and pasture huts allow the sow to move around freely but may result in higher newborn piglet death loss because the sow may accidentally crush her newborn piglets (McGlone and Blecha, 1987; Stevermer, 1991). Stalls allow the sow to stand, lie, eat, and drink, but not to turn around. Restricting the movement of the sow in some manner during lactation allows the piglets more opportunity to escape being crushed when the sow lies down.

Weaning most often takes place at 2 to 5 weeks of age. Weaned pigs should be provided a warm, dry, and draft free environment and proper nutrition. Growing pigs should be provided space as summarized by **Pork Quality Assurance® Plus (PQA Plus)** .

**Thermal:** With outdoor production, trees can provide adequate shade. Facilities to provide shade can be constructed to also serve as protection from wind and cold during winter. Adequate dry bedding must be maintained during cold weather.

Ventilation typically is the primary means of maintaining the desired air temperature and humidity and gas concentrations for pigs housed inside of buildings. The amount of ventilation depends on the size, number, type, age, and dietary regimen of the pigs, the manure management system, and atmospheric conditions.

Appropriate, effective temperatures ranges for pigs at each stage of development have been summarized by the National Pork Board (2018).

**Air quality:** Air quality refers to the effects that the air has on the health and well-being of animals. Gases, dusts, and microorganisms are present in pig facilities, and, to a lesser extent, in outdoor operations. Harmful amounts of gases and dust in the air should be avoided in or around buildings (Meyer et al., 1991). Acceptable air quality can usually be achieved with proper ventilation and air distribution, regular cleaning and sanitation, feed dust control, and manure gas control.

**Photoperiod:** Lighting should give enough illumination to permit practicing good husbandry, inspecting the pigs adequately, maintaining their well-being, and working safely (ASABE, 2005; Clarke and Chambers, 2006). Compared with some species, the domestic pig is less sensitive to its environmental lighting and no particular daily photoperiod regimen is necessary.

## **FACILITIES AND EQUIPMENT**

Swine housing systems may be as simple as a fenced pasture with man-made shelters, or they may be much more complex. Whatever the system, it should be appropriate for the age of the pigs and the local climate. In enclosed structures, the system should be capable of maintaining environmental conditions within an acceptable range of temperature, humidity, chemical emissions and particulates. Descriptions of cold and warm housing systems have been given by the National Pork Board (2018).

Swine facilities should conform to applicable building codes unless deviations and variances are justified and approved. Physical facilities should be well maintained and clean. Facilities and equipment should be inspected, repaired, and maintained regularly to provide a safe environment for animals and people. The MWPS publications and publications of other organizations provide guidance for planning, specifications, cost estimates, and construction of commercial agricultural swine facilities in different parts of the U.S.

**Feeders and waterers:** Feeders should provide adequate access to feed. Feeders should be cleaned regularly to prevent feed accumulation and spoilage, and be maintained with no rough edges to injure the pigs. Waterers should be positioned and checked routinely for proper flow rate to ensure pigs have adequate access.

## **HEALTH CARE AND MEDICAL PROCEDURES**

Adequate health care is an essential part of a pork production enterprise. Appropriate health care involves: methods to prevent, control, diagnose and treat diseases and injuries; training of and guidance to animal caretakers on antibiotic therapy; instruction on proper handling of pharmaceuticals and biologicals and withdrawal times; and adequate record keeping programs. Animals should be observed daily for signs of illness or injury.

Methods of prophylaxis, diagnosis, therapy, and disease control should follow a herd health monitoring program based on Good Production Practices outlined in the PQA Plus practices. Animals should receive appropriate treatment even if marketing must be delayed or forgone due to withdrawal time indicated by the product. Assistance of a veterinarian in establishment of a health care program is recommended. Organic production programs should work with a veterinarian to ensure adequate protection and treatment for sick animals.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics including cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals, i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
3. the veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted



with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

**Euthanasia:** Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Farmers should consult with their veterinarian to determine the options and guidelines for euthanizing such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Euthanasia (American Veterinary Medical Association, 2020) and state law.

**Depopulation:** AVMA definition of the term depopulation refers to the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable. Farmers should consult with their veterinarian to determine the options and guidelines for depopulation such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Depopulation (American Veterinary Medical Association, 2019 Edition) and state law.

**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

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# EQUINE

## MANAGEMENT OVERVIEW

The equine industry in Michigan is large and diversified. Management systems include breeding farms; training facilities; show, exhibition, and racing enterprises; mare and foal operations; transportation companies; horses used for work on farms or for transportation; boarding stables, pleasure horse operations and riding stables. Equine management systems include operations with only a few animals to those with several hundred on one premise. The industry has statewide distribution, and the various components are integrated to provide specialized services. The show and racing operations accommodate horses throughout the country; therefore, a large number of horses are transported into and out of this state on a regular basis.

The seasonal changes and climate extremes of this state present possible management and health problems which need to be considered and managed. Housing and pasture systems may vary and be modified to meet the needs of the enterprise, to use existing facilities, and to be economically feasible. Emphasis on safety and minimizing stress, are important factors when transporting one or several horses. Herd health, disease prevention and emergency care programs should be individually developed and implemented for each equine operation. These programs need to be reviewed and modified as disease potential and needs change. Since horses are athletes and perform different tasks, nutritional programs need to meet the growth and performance requirements of each horse.

Federal and state laws concerning horse protection, animal cruelty, riding stables, and sale barns need to be understood by the industry and individual horse owners, complied with, and enforced.

## MANAGEMENT PRACTICES

**Nutrition:** Proper nutrition is important in maintaining health. Nutritional demands vary depending on age, size, and use. The amount and composition of feed required is governed by body weight, individual metabolism, age, pregnancy, lactation, and the amount of work the animal does. Horses need to be adequately fed to maintain their body weight and health; however, idleness, overfeeding and obesity are undesirable and may lead to health issues including insulin dysregulation and laminitis. Horses are kept for a much longer time than most farm animals and feeding programs should support the development of sound feet and legs that will sustain a long and athletic life.

Nutritional demands are usually met with good quality, hay and pastures combined with grains and supplements as needed to balance the diet. To maintain optimum health, most mature horses should derive the majority of their nutrition from good quality roughage, typically 1.5-2.0% of their weight in roughage daily. There may be exceptions to this forage intake, however, based on individual and workload. Horses utilize pasture,

hay or other roughages more efficiently than do other non-ruminants; however, consistency and nutrient quality are essential for optimum productivity and health. Because horses are particularly sensitive to toxins found in spoiled or contaminated feeds, grains and roughages should be of good quality and free from visible mold and toxic plants or ionophores found in medicated feeds for other livestock species and poultry. Feeding of dusty feeds should be kept to a minimum because of their tendency to initiate or aggravate respiratory problems.

When horses are fed in groups, adequate feeding space should be provided so that dominant animals do not prevent others from eating. Horses should be fed regularly, and since they have a relatively limited capacity for roughage at any one time, they should have frequent access to it. A horse should be rested after eating large grain meals before strenuous work starts.

Availability of clean water is essential. Water requirements depend largely upon environment, amount of work being performed, the nature of the feed, and the physiological status of the horse. For example, a 500 kg (1100-pound) idle adult horse in a moderate climate fed a hay diet, will typically drink 40 liters (12 gallons) of water per day. Extreme water temperatures (very hot or cold) may reduce water intake and lead to dehydration. Horses should be offered water during long exercise bouts and immediately following exercise and several hours throughout the recovery period.

**Transportation:** Trailers and vans should be free of protruding objects on the sides and top and should be of adequate height for the animal. When appropriate, protective devices such as helmets, leg wraps, boots, blankets, and tail wraps can be used to further protect the animal from injury.

Available hay in the trailer will help prevent boredom during transit. Suitable non-slippery flooring, e.g., rubber mats, straw, shavings, or a combination of these, should be available for transits. The vehicle exhaust system should not pollute the air inside the trailer. When trips are over 24 hours, an ample rest stop, fresh feed and water should be given. On shorter trips, a walking rest stop with water may be appropriate depending on the length of the trip. The ability to lower their head during transit (especially long distance) may reduce the incidence of shipping fever. Seriously debilitated or non-ambulatory animals should not be transported unless they can be appropriately accommodated without further injury or distress and the purpose of transport is to obtain medical care. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand the travel.

For the safety of the equine and handlers, the tranquilization of horses during transit is acceptable. Products should be administered by a person knowledgeable about the product and in consultation with a veterinarian. Administration of mineral oil may be helpful in preventing intestinal stasis during long trips.

**Training:** Horses in training, exhibition, racing and work should be treated in a humane manner. The acceptable standards for training, exhibition, racing and work are those



which an informed and recognized equine association (e.g., United States Equestrian Federation Rule Book, 2021, and American Quarter Horse Association Official Handbook, 2021) has developed and shall be in compliance with the Federal Horse Protection Act and Michigan cruelty to animals laws.

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

Proper illumination in barns and indoor riding arenas are important for the convenience and safety of both the horse and the attendant.

As a rule, horse owners can obtain adequate housing for their horses with non-insulated buildings. In northern regions, insulated buildings and supplemental heat are more commonly used to protect the animals and attendants from severe winter weather. Healthy horses with adequate diet and good body condition only require protection from the wind. Heated barns may be used for show horses to keep them in show condition throughout the year. Overcrowding should be avoided to minimize injuries and parasite problems.

Pastures should have adequate shelter where horses can get out of the sun, wind, rain, and other inclement weather. These may include but are not limited to open barns, lean-tos, constructed windbreaks and woodlots. There should be enough space to accommodate all animals comfortably.

If horses are confined to small spaces, manure should be stored away from the horse housing to decrease fly and parasite exposure. The manure should be stored, transferred, and utilized in compliance to practices outlined by the GAAMP for Manure Management and Utilization.

## **FACILITIES AND EQUIPMENT**

The basic purpose of horse housing is to provide an environment that protects the horses from temperature extremes, keeps them dry and out of the wind, eliminates drafts through the stables, provides fresh air in both winter and summer and protects the horses from injury. See reference section for more information on general housing requirements.

In cold non-insulated or insulated barns, fresh air is usually provided by natural air movement through wall openings and ridge vents or devices. Examples of wall openings may be small windows, wall panels or slots under the eaves. In tight, warm barns, fans, and spaced air inlets may be necessary. Adequate air exchange and distribution should be provided to remove moisture generated within the barn. If using supplemental heat, adequate ventilation will be required. Adequate air exchange and air distribution systems to provide adequate cooling should be provided during hot weather.

In most horse barns, some box stall space is necessary for sick animals, mares at foaling time and foals. Stall walls should be tight, smooth, and free of loose wires, protruding objects such as bolts and nails, and anything else that might injure the horse as it moves

about and lies down. The walls should be flush with the floor, so a horse cannot get its feet under the partition. The walls should be constructed from material and in a manner that will withstand pushing and kicking from the horses and that, if damaged, will not become a potential hazard to the horse (e.g., a horse kicks a hole in sheet metal). Wooden kick boards should be placed at least up to 4 feet for the average 1000 pound horse. For riding horses (1000 pound average) a typical box stall would be 10 feet by 10 feet. Stalls of 16 feet by 20 feet, or larger, are useful for foaling mares. Box stalls for ponies and miniature horses may be smaller, depending on the size of the animal.

Tie stalls require about half the area, use less bedding, are easier to clean than box stalls, and can often be constructed in existing buildings suitable for box stalls. A possible example of a typical tie stall is 5 feet by 9 feet (3 feet by 6 feet for ponies and miniature horses), although stall lengths up to 12 feet are often used. For either box stalls or tie stalls, construction materials must be strong enough to contain the animal.

Packed rock-free clay on a well-drained base makes comfortable and practical floors for stables. However, they are difficult to keep clean and must be renewed from time to time. Packed, crushed limestone makes a good stall surface in that it drains readily, has reduced maintenance, and has a reduced odor. Wood plank stall floors or wood block floors on concrete are preferred by some, but such floors are difficult to keep dry and free of odors. Concrete floors are the least desirable; and if used, a considerable amount of bedding is needed. Many stall floors, regardless of the stall base, are covered with some type of stall mat to reduce stall maintenance, bedding requirements and/or provide a more desirable surface for the horse to stand on. Floor finishes that are slippery should be avoided.

Common fencing materials are wood, pipe, PVC, electrical wire or tape, smooth, non-electrical wire, rubber belt, barbed wire, and woven wire (the mesh should be small enough that a horse or foal cannot get their feet through). The perimeter fence should provide an adequate physical barrier that is not dependent on electricity for containment. Electric fencing can be used as a psychological barrier to keep horses from leaning on the fence, reduce fighting over the fence or provide an interior fence. The fence should be free of sharp projections, such as nails, bolts and latches. Single or double strand wire fences may lack visibility and have the potential for severe cuts to horses entangled in them. More visible products are available for wire fencing or large strips of plastic or cloth can be tied to wire to increase visibility. Fences should be approximately 5 feet in height for light horses with additional height necessary for stallions and draft horses. Overcrowding in pastures and lots should be avoided to minimize injuries due to kicking and fighting.

Bands of horses may be housed in open sheds. If halters are left on in the pasture, they should be of a material that will break if the halter becomes caught on an object. (i.e., breakaway or thin leather halters).

Where animals are housed for any lengthy period, clean bedding should be provided regularly. Animals should be provided with daily exercise to maintain healthy skeletal –

muscle system and reduce behavioral problems. Daily exercise could be in the form of free exercise provided by turnout or forced exercise like lunging or riding for at least 30 minutes per day.

## HEALTH CARE AND MEDICAL PROCEDURE

Disease and injury prevention can best be achieved through nutritional management, adequate housing, vaccination programs, parasite control, cleanliness, and general equine husbandry in consultation with a veterinarian.

A healthy horse is active, drinks readily, has clear eyes and nose, a clean skin, and a good general body condition, without being excessively fat. A moderate body condition score of 4.5 – 6.5 ensures adequate energy reserves without excessive weight that could predispose a horse to nutritional or skeletal problems. The health of the horses should be routinely assessed to recognize appropriate signs of illness, so that care may be instituted. Management plays a significant role in the prevention of disease and injury.

A proper preventive vaccination program should be developed for individual horse needs. Effective vaccines are available to protect horses from fatal diseases including Tetanus, Encephalomyelitis, West Nile Virus, and Rabies. The manufacturer's and/or veterinarian's recommendations should be followed for all vaccines.

Internal parasitism is one of the most serious of all equine diseases. Parasitism is associated with general un-thriftiness, poor hair coat, and a high incidence of colic. Stable and pasture management can be helpful in parasite control. A parasite control program should be developed and implemented for each individual horse to limit the risk of developing and subsequent health issues. If grazing, appropriate grazing management strategies should be employed to minimize parasitic infestation.

Horses' teeth should be examined periodically and floated when necessary. Elongated enamel points on the teeth can cause trauma and constant irritation and result in improper chewing. Excessive salivation or dropping of feed from the mouth indicate the mouth should be examined and may indicate that dental care is needed.

Proper foot care is essential to maintain normal health of the foot and to prevent lameness. The hooves should be examined regularly and trimmed or shod as needed. For stabled horses, clean, dry bedding should be maintained. Excessive dryness of the hoof should be avoided.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are

important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3) (<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
3. the practicing veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

**Euthanasia:** Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Farmers should consult with their veterinarian to determine the options and guidelines for euthanizing such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Euthanasia (American Veterinary Medical Association, 2020) and state law.

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Guidelines on Depopulation (American Veterinary Medical Association, 2019 Edition) and state law.

**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

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## ADDENDUM: CURRENT STATE AND FEDERAL LAWS

[The Michigan Penal Code, Act 328 of 1931, as amended, MCL 750.50](#)--A person who willfully, maliciously and without just cause or excuse kills, tortures, mutilates, maims, or disfigures an animal or who willfully and maliciously and without just cause or excuse administers poison to an animal, or exposes an animal to any poisonous substance, other than a substance that is used for therapeutic veterinary medical purposes, with the intent that the substance be taken or swallowed by the animal, is guilty of a felony, punishable by imprisonment for not more than 4 years, or by a fine of not more than \$5,000.00, or community service for not more than 500 hours or any combination of these penalties. [Michigan Legislature - Section 750.50](#) (Visited 7.28.2022).

[Michigan Public Act, Act 93 of 1974, as amended, MCL 287.112](#)--A person, firm, or corporation shall not own or operate a riding stable (any establishment in which, for business purposes, six or more horses or ponies are rented, hired, or loaned for riding) or sale barn (any establishment where horses or ponies owned by others are sold or offered for sale) without first having obtained a license. A person who violates this Act is guilty of a misdemeanor. **Effective August 1, 2009**, the department is suspending the horse riding stable program. Although MDARD will no longer be regulating riding stables, all riding stable operators are advised to use the laws and regulations concerning riding stables as guidelines for animal care in their facilities. Complainants wishing to file complaints against riding stables will be directed to local law enforcement agencies. [https://www.michigan.gov/mdard/0,4610,7-125-1569\\_16979\\_21262---,00.html](https://www.michigan.gov/mdard/0,4610,7-125-1569_16979_21262---,00.html) (Visited 7.28.2022).

[Michigan Animal Industry Act, Act 466 of 1988, as amended, MCL 287.739](#)--A facility for exhibition of livestock shall be constructed to allow sufficient separation of each exhibitor's livestock. The facility shall be constructed of a material that can be adequately cleaned and disinfected. An exhibition building or yarding facility shall be cleaned and disinfected with USDA-approved disinfectant used in accordance with label instructions before livestock are admitted by removing from the premises all manure, litter, hay, straw, and forage from pens, runways and show rings, and thoroughly disinfecting walls, partitions, floors, mangers, yarding facilities, and runways in a manner approved by the director. [Michigan Legislature - Act 466 of 1988](#) (Visited 7.28.2022).

[Michigan Penal Code, Act 328 of 1931, as amended, MCL 750.60](#) Docking Horses Tails--Any person who shall cut the bone of the tail of any horse for the purpose of docking the tail, or any person who shall cause or knowingly permit it to be done upon the premises of which he is the owner, lessee, proprietor or user, or any person who shall assist in or be present at such cutting, shall be guilty of a misdemeanor, punishable by imprisonment in the county jail of not more than one year or by a fine of not more than \$500.00. Provided, that such cutting of the bone of the tail of any horse for the purpose of docking the tail shall be lawful when a certificate of a regularly qualified veterinary surgeon shall first be obtained certifying that such cutting is necessary for the health or safety of such horse. [Michigan Legislature - Section 750.60](#) (Visited 7.28.2022).

The [Federal Horse Protection Act](#) was passed in 1970 and amended in 1976. The legislation is aimed at stopping the cruel and inhumane practice of having horses take part in a horse show or sale while they are "sore". A horse is deemed to be sore if it suffers abnormal pain, distress, inflammation, or lameness when it walks, trots, or otherwise moves. Generally, soring refers to any application, infliction, injection, or practice which makes a horse sore in a way that exaggerates its gait, producing a flourish prized by show judges and viewers. The law forbids the entering of sore horses in shows, exhibitions, sales, or auctions; permitting such an entry to occur; and transporting horses for such an entry. Regulations further forbid acts that may cause horses to become sore at regulated events. Criminal offenses are prosecuted in federal courts. [https://www.aphis.usda.gov/aphis/ourfocus/animalwelfare/SA\\_HPA](https://www.aphis.usda.gov/aphis/ourfocus/animalwelfare/SA_HPA) (Visited 7.28.2022).

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The Horse Protection Act, Code of Federal Regulations, Title 9, Chapter I, Subchapter A, Part II. [https://www.aphis.usda.gov/aphis/ourfocus/animalwelfare/SA\\_HPA](https://www.aphis.usda.gov/aphis/ourfocus/animalwelfare/SA_HPA) (Visited 7.28.2022).

## PRIVATELY OWNED CERVIDAE

### MANAGEMENT OVERVIEW

The Michigan Animal Industry Act, Act 466 of 1988, as amended, describes farmed cervidae (hence known as privately owned cervidae, or cervids) as members of the cervidae family including, but not limited to, deer, elk, moose, reindeer and caribou living under the husbandry of humans. Because of their unique behavioral characteristics, a high degree of skill and sensitivity needs to be exercised when raising cervidae as livestock (Coon et al. 2001). Cervids require greater efforts to tame than other domestic species and, therefore, have special management, environmental, facility and health care requirements. Though exact husbandry systems may vary by species, facility layout, and/or location, all farmed deer require adequate nutrition, shelter, holding/handling facilities, and health management. Recommended husbandry and handling procedures for cervids can be found at: [http://www.nfacc.ca/pdfs/codes/deer\\_code\\_of\\_practice.pdf](http://www.nfacc.ca/pdfs/codes/deer_code_of_practice.pdf).

### MANAGEMENT PRACTICES

**Handling:** Handling cervidae requires care and caution to minimize stress, undue noise, and/or commotion, thereby avoiding over-excitement of the animals. Familiarization with routine management and facilities from an early age helps to reduce animal apprehension and reduce stress levels. Routine management procedures such as weighing, identification, vaccination, and anthelmintic (dewormer) administration should be carefully scheduled and performed simultaneously when feasible. To decrease the chances of animal or human injury antlers may be removed before the onset of rut. Handling equipment designed specifically for use with privately owned captive cervidae should be used if possible. Tranquilization may be required if proper handling facilities are not available or to minimize stress. A veterinary/client relationship is needed to handle these medications without direct veterinary supervision. Working cervidae with dogs is not recommended. If used, dogs must be well-trained on cervidae and used under the direction of experienced handlers.

**Nutrition:** Adequate feed and water are vital to all animals and farmed cervidae are no exception. Access to clean, fresh drinking water is essential for all cervidae. Nutritional requirements vary both between and within species. There are differences between those species that are primarily grazers and those that prefer to browse. Within species, nutritional requirements differ among adult males, adult females, and growing animals. In addition, seasonal variation exists within each of these animal classifications and must be taken into consideration to meet their nutritional requirements throughout the year.

**Reproduction:** Reproductive characteristics vary somewhat between cervidae species, but all are highly seasonal. Important management considerations to achieve good reproductive performance include: Paddock size and female: male ratio during breeding; aggressive behavior by males in the rut; normal parturition (birthing) behavior;



environmental needs of newborns; and specific requirements at weaning. Information from veterinarians, experienced individuals and/or reliable published sources can be valuable (see references).

**Transportation:** Transporting cervidae successfully requires specific attention to several key details. Cervids should be separated according to species, age, and sex when handling or transporting. Quiet handling and darkened transport crates or trailers tend to enhance outcomes.

Adequate ventilation is required, and confinement during transport for over 12 hours necessitates provision of feed and water. Extra caution should be exercised in transporting the following cervidae: males with antlers in velvet; females due to give birth within two months; and lactating females and offspring when those fawns/calves are less than one month of age. Bucks and bulls in hard antler should be transported individually or in separate compartments. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel. Finally, transportation of cervidae should be avoided in extremely hot weather to minimize associated stress.

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

Farmed cervidae can be successfully raised under a wide variety of systems. Their environmental needs vary from those of major livestock species based mainly on their behavioral differences. Accordingly, requirements often differ among individual cervidae species. For example, paddock size and stocking density should be determined by species preference toward social and gregarious behavior, and the relative proportions of open pasture and forested land should be based on species preference for browsing versus grazing. Cervidae must become habituated to their environment, and disruptions by people, other animals, or machines should be minimized. Newborn cervidae in particular require cover for hiding and shelter from inclement weather in some situations. Though most cervidae are quite tolerant of climatic fluctuations, provision of shelter to temper climatic extremes is extremely beneficial and should be provided if possible. Structures, windbreaks, natural cover and other shelters will optimize animal health. As with other aspects of cervidae farming, environmental design should utilize expert input. In addition, expert input should be sought to aid in the design of handling facilities, pasture and pen layout, and alleyway configuration to ensure ease of handling and animal movement.

## **FACILITIES AND EQUIPMENT**

For the most part, the facilities and equipment needed for cervidae farming are dictated by the requirements in handling, nutrition, reproduction, transportation, environment, and state regulations. Fences should be tall enough to avert jumping by the species of interest (and must meet state regulations), and sharp protrusions in the confined areas should be strictly eliminated. Recommendations and specifications for fencing and other facility requirements for privately owned cervidae can be found on the Michigan

Department of Natural Resources website: [Privately Owned Cervidae Facility Registration \(michigan.gov\)](#)

## HEALTH CARE AND MEDICAL PROCEDURES

In managing the health of farmed cervidae, aggressive prevention of disease and injury is much preferred to treatment. Reliable success with both prevention and treatment is more likely if a veterinarian skilled in cervidae management is involved. Adherence to regulatory requirements must be observed in the transport and transfer of cervidae. Development of a herd-specific health management program in consultation with a local veterinarian is recommended. This program should incorporate routine herd health evaluations appropriate for the particular management, environment, and facilities involved. Vaccination, anthelmintic administration, antler removal, and other health management practices can then be appropriately executed in a timely manner. Organic production programs should work with a veterinarian to ensure adequate protection and treatment for sick animals.

**Pharmaceutical Use:** To ensure continued human and animal [food safety](#), the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

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## SHEEP AND GOATS

### MANAGEMENT OVERVIEW

The sheep industry in Michigan is comprised of several components that include flocks focused on: commodity meat sales, market lamb finishing, production of breeding stock, production of exhibition animals, special fiber, dairy products and grazing services for vegetation management. is segmented into four major groups. Commercial flocks produce market lambs and wool, the lamb feeding industry specializes in market lamb production, the registered flocks produce breeding stock and exhibition animals, and the small, special interest flocks are involved in specialty fiber production, rare breeds, etc. In addition, the dairy sheep industry, still in its infancy, has begun in Michigan to produce specialty cheeses and other milk products.

The goat industry is smaller than the sheep industry and is divided differently. There are a very small number of Grade A dairy farms that may also produce dairy products, and with the rest of the dairy goats are kept in small herds for home milk production, 4-H youth projects, and exhibition. Angora goats are kept for mohair production. The meat goat industry is currently in a state of growth. The meat goat industry had been a by-product of the Angora and dairy goat herds but has evolved to utilize breeds selected specifically for carcass quality. References are provided for more specific guidance on the care of sheep and goats. Goats are produced for meat either as a byproduct of the dairy industry or with breeds or their crosses bred specifically for this purpose. Like sheep, there are many goats raised mainly for exhibition purposes.

### MANAGEMENT PRACTICES

Most sheep and goats in Michigan are seasonal breeders, breeding in the fall and giving birth in the spring each year. The marketing period is extended however by different production systems and lamb/kid feeding strategies. Indoor birth is to lamb/kid indoors typically early in the calendar year. Drop lot birth which comprises the majority of Michigan production generally occurs March-June and involves outdoor birth near a barn or similar facility followed by brief individual housing of mother and offspring to facilitate bonding and subsequent release on pasture. Pasture birth system involves birth on actively growing pasture during warm periods (commonly May-June) without individual housing and is the least laborious system. Accelerated lambing, currently in minor adoption in Michigan, may use a combination of the above systems and utilizes breeds that are less seasonal aseasonal in breeding and can reduce the birth interval to 6-8 months. Layered on top on these production systems are different rearing strategies that vary the rate of lamb/kid growth to effectively extend the marketing season and take advantage of seasonal feeding opportunities. The major system involves early growth on pasture followed by finishing in confinement. Other strategies include complete confinement or pasture rearing.



**Nutrition:** The nutritional program is of paramount importance in the production of sheep and goats and largely determines animal well-being and closely associated profitability of animal production. Sheep and goats at all stages of production should be fed and watered in a consistent manner to supply requirements as established by the National Research Council publication *Nutrition of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids* (National Research Council, 2007). These guidelines detail nutritional requirements according to physiological state and emphasize the importance of matching nutrition to physiological state. Sheep and goats are commonly litter bearing species and require a higher plane of nutrition in proportion to litter size during the last month of pregnancy. This requires a more concentrated diet due to this increased demand coupled with constraints on voluntary intake imposed by the pregnant uterus. Proper feeding during late pregnancy also sets the stage for subsequent lactation performance. The requirements of lactation are dependent on litter size and require a much higher plane of nutrition than other states of production. Special attention must be given to animals that are still in their growth phase during pregnancy and lactation. These animals should be fed to meet the nutritional requirements for their continued growth plus pregnancy. In addition to the ensuring adequate macronutrient supply as outlined above, micronutrient supply is also an important consideration given their potential inadequacy in feedstuffs. Iodine and selenium are deficient in Michigan soils and supplementation must be provided to small ruminants. This can be done most effectively in the form of mineral or grain supplement. Copper toxicity can be a problem for sheep. They have a much lower copper requirement than other livestock species and care should be taken to avoid feeding feeds formulated for other species to prevent toxic accumulation.

Water requirements of sheep and goats can be met from various sources including access to fluid water, surface water (fresh snow and dew), as well as via forage water content. Water consumption in its various forms must be sufficient to allow appropriate dry matter intake for each stage of production and to prevent dehydration. In practice, sheep and goats fed dry diets (dry hay and grain) will have higher needs for fluid water than those grazing fresh forage on pasture. The environmental temperature and physiological state of animals also have a large impact on water requirements. Animals in late pregnancy, lactation and in active growth states generally require continuous access to fluid water. During periods of cool weather, adult animals that are not lactating nor in late pregnancy with access to grazing forage with adequate water content may have their water requirements met via forage water content alone.

**Transportation:** Transportation of sheep and goats should be handled with regard to climatic conditions and productive stage of the animals. Temperature extremes should be avoided and transport of late pregnant animals or debilitated and non-ambulatory animals should be done with caution. Sheep in short fleece should be transported in trailers designed to minimize drafts during sub-freezing weather. Proper hydration of animals is especially important before and after shipment during hot, humid conditions. During hot, humid conditions, transport periods should be minimized, and consideration given to night travel to reduce animal stress. Animals should be handled carefully and quietly during loading and unloading. A ramp is advised for animal and human safety when animals need to make large changes in elevation. A delay or cancellation of transport

should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel. Interstate movement of sheep and goats may require a certificate of veterinary inspection as defined by USDA APHIS 9 CRF 79.3

## RECOMMENDATIONS FOR THE ENVIRONMENT

Nutrition, air quality and in the case of sheep, length of fleece, are primary considerations in the housing of animals during cold weather. Adult sheep, in particular, can be housed outdoors all year round if certain conditions are met. During winter, sheep housed outdoors need sufficient wool cover and improved quality and or quantity of feed to maintain body weight and condition depending upon temperature, precipitation, and wind speed. Wind breaks, either man made or natural, are effective in reducing heat loss and thereby reduce nutrient requirements for heat production and are advised under extreme winter conditions. If adult animals are housed indoors during winter, adequate ventilation should be provided to prevent humid conditions which promote the spread of respiratory disease. Buildings should be designed to allow adjustment of air turnover by natural or mechanical means depending on climatic conditions and animal density.

During the summer, housed animals require a more frequent rate of air change to prevent excessive temperature, humidity, and gas exposure that can lead to respiratory disease. This increased ventilation can be met by natural ventilation in properly designed buildings or facilitated with the aid of mechanical ventilation in other buildings.

Shearing should be performed by skilled personnel using techniques designed to minimize animal stress. There are shearing schools available in Michigan that provide quality training in this skill. Sheep and angora goats should be shorn at least annually but care should be taken to avoid the release of freshly shorn animals during cold, wet weather. The stress of such climatic conditions can be minimized by adjusting shearing combs to leave extra wool/hair stubble. The practice of providing extra stubble is also advised for prebirth shearing during indoor winter periods. Shearing pregnant ewes in this manner prior to lambing reduces humidity in the barn at animal level and provides adequate fleece to protect from the cold while also improving maternal feed intake.

Newborn lambs and kids are very susceptible to hypothermia, and therefore outdoor birth periods need to be chosen to coincide with favorable conditions for newborn survival. Newborns vary in their ability to mount an adequate heat response. Soil temperature above 50° F provides a reasonable lower limit for outdoor birth. Outdoor birth is also possible when soil temperature is less than 50°F but the option of shelter should be available nearby under these conditions. Indoor birth offers the opportunity for lambing/kidding year-round but facilities should be designed to minimize drafts at animal level while maintaining adequate air turnover to prevent humid conditions. In the case of newborns especially susceptible to hypothermia under extreme conditions (cold and/or wet), the birth environment may need to be controlled via housing to provide supplemental heat and/or insulated, draft-free areas to prevent hypothermia.

## FACILITIES AND EQUIPMENT

Pastures should be fenced to minimize predator entry and reduce escapes and entrapment of horned or heavily fleeced animals in the fence itself. Innovations in fencing have made this task easier. Portable electric fencing allows great flexibility in secure fencing options. Dry lots should be ~~of sufficient size~~large enough and well drained to prevent excessive mud during ~~times of~~ prolonged rainfall.

Minimum space recommendations for sheep in confinement can be found in the Midwest Plan Service, Sheep Housing and Equipment Handbook (MWPS, 1994).

Recommendations for goats can be found in the National Goat Handbook (1992).

Feeders should be designed to avoid waste and minimize fecal contamination of feed.

Feeder designs for sheep are often inappropriate for goats. For this reason, sheep and goats are not usually housed together in close confinement. Additionally, horned goats tend to dominate polled goats and sheep. Extra space must be allowed when horned animals are kept.

Well designed, well-lit facilities can aid in minimizing stress to the animals and the livestock attendants. Sheep and goats have a strong flocking/herding instinct and handling systems take advantage of this. Possible causes of accident or trauma to the animals or handlers should be eliminated. Gates and feed room doors should be securely fastened with livestock-proof latches to avoid illness and/or deaths that occur when animals suddenly have access to ~~large~~substantial amounts of feed without adequate fermentable fiber. Shearing facilities should be kept clean and dry and shearing equipment disinfected between flocks.

## HEALTH CARE AND MEDICAL PROCEDURES

A health care program should be devised for the ~~particular~~ farm based on its production system and goals. A health care program should emphasize preventative procedures and be thoroughly integrated with the farm's nutritional program. Assistance of nutrition and veterinary consultants (MSU Extension or private) are advised in developing such a program. A parasite control program will be an important part of such a program and should emphasize strategic de-worming along with control measures that prevent the development of anthelmintic resistant parasite populations (example grazing management).

Husbandry procedures, such as disbudding, castrating and tail docking of sheep, should be carried out by skilled personnel, while the animals are still small, preferably during the first two weeks of life. If lambs are to be tail docked the dock should be performed no shorter than the distal end of the caudal fold where the fold meets the tail to prevent rectal prolapse (Thomas, et al. 2003).

Animals that are lame should be treated promptly to minimize pain or distress. Foot rot is a contagious disease that is endemic in much of the United States. There are sound economic and welfare reasons why foot rot eradication should be carried out.

Recognition should be given to the fact that certain sheep and goat diseases are

potentially transmissible to people, and appropriate precautions should be taken (USDA APHIS, 2020). Animals that are suffering and/or dying should be treated or euthanized. All carcasses should be disposed of promptly and in accordance with state and local regulations. Organic production programs should work with a veterinarian to ensure adequate protection and treatment for sick animals.

### Pharmaceutical Use:

To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. There is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and
3. The veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the

animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

**Euthanasia:** Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Farmers should consult with their veterinarian to determine the options and guidelines for euthanizing such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Euthanasia (American Veterinary Medical Association, 2020) and state law.

**Depopulation:** AVMA definition of the term depopulation refers to the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable. Farmers should consult with their veterinarian to determine the options and guidelines for depopulation such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Depopulation (American Veterinary Medical Association, 2019 Edition) and state law.

**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

**Animal Identification:** Sheep and goats are required to follow federal and state regulations for officially identifying their animals as part of the national scrapie eradication program ([https://www.aphis.usda.gov/sites/default/files/umr\\_scrapie.pdf](https://www.aphis.usda.gov/sites/default/files/umr_scrapie.pdf)).



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DRAFT

## LAYING CHICKENS

### MANAGEMENT OVERVIEW

Nearly all commercial egg-laying hens are kept in indoor housing with light control, power ventilation and mechanical feeding and watering systems. Indoor housing systems vary from a few birds per house to more than 100,000 birds per house.

There are different types of laying hen housing systems used in the U.S. Conventional cage systems consist of a cage of 6-7 hens outfitted with water and feed resources, allow limited walking, and room for hens to stand, sit, rest, and turnaround. Enriched cage systems are larger cages housing on average 60 hens, offer more room for hen movement, and in addition to water and feed, provide nest, perch, and scratch areas to accommodate hen behavior. Commercial flocks may also utilize a variety of cage free (indoor), free range (indoor with access to the outside range area), or pasture-based housing systems (fully outdoor on pasture with shelter).

By the end of 2022, 34.1% of the U.S. commercial layer flock were dedicated to cage-free egg production (USDA NASS, 2022). Cage free housing can be of different design configurations including 1) multi-tiered aviaries with litter floors, 2) slatted floor platforms positioned over manure removal belts, 3) partially slatted systems with a litter floor area and raised slatted platform where manure drops through to a pit below, and 4) single level all litter floor systems (see description of housing types in United Egg Producers (UEP) Cage Free Guidelines, 2024). Smaller commercial flocks may use free range housing that provide small areas of fenced open ground or pasture that is coupled with indoor housing containing nests, perching areas, food and water, and a bedded floor. The flock is typically shut into the housing during the night to avoid predation. Pasture based systems provide full outdoor access on forage covered ground coupled with fencing and sheds to provide shelter during inclement weather and protection from predators. The housing systems for raising pullets (immature laying hens) will vary depending on the type of adult layer housing system the bird will be placed at maturity.

Using sound practices for managing egg laying flocks within the housing systems in which they are raised can reduce the probability of generating complaints from neighbors and result in a healthy and productive flock.

### MANAGEMENT PRACTICES

**Nutrition:** Meeting bird nutritional requirements for their stage of physical development and production is an important aspect of keeping birds healthy and avoiding unwanted mortality. Feed and clean water shall be available to the birds and when new birds are placed in the system, care must be taken to ensure that the birds find the feed and water resources. Knowing that all birds do not feed or drink at the same time, an average of 2.2 inches of feeder space and 1 inch of trough watering space per bird is acceptable for

most systems but may vary based on bird type. A maximum of 20 hens per mechanical water cup or nipple drinker is recommended (UEP 2017; 2024). During periods of high environmental temperatures, fewer birds per cup or nipple drinker is recommended.

Laying hens normally enter a natural molt period after 8 -12 months of producing eggs, and therefore, it is considered sound management for commercial flocks to induce or synchronize this molt so that all the birds molt at the same time (Glatz and Tilbrook, 2020). Benefits of molting for individual hens are improved feather cover and the loss of excess body weight, the latter of which is a health issue, and a return to egg production (Glatz and Tilbrook, 2020; Akbari et al.2018; Nicol et al. 2017; McGowan et al. 2006 ). Not all commercial egg producers or small flock managers conduct an induced molt on their flocks. For producers who do induce molts, a recommended molt induction program typically places the hens on a specialized dietary regime for a period of time allowing the birds a rest from egg production and physiological rejuvenation (Koch et al. 2007; Mazzuco and Hester 2005). As a result of this molting program, the birds' productive life will be prolonged for at least another flock cycle. Induced molting programs that engage feed and/or water withdrawal or use highly unpalatable feed causing birds not to eat are prohibited by animal welfare certifying organizations including the UEP and not scientifically justified (Glatz and Tilbrook 2020; UEP 2017, 2024). Poorly conducted induced molting can cause a substantial increase in bird culling, mortality and creates the need for excess carcass disposal.

**Stocking Density:** Regardless of the type of housing or system of management used, all birds should have sufficient freedom of movement. Depending on the type of bird minimum space allowance in a conventional cage system (until January 1, 2025) should be in the range of 67 to 86 square inches of usable space per bird or 1.0 to 1.5 square ft of useable floor space per bird in cage free housing systems, for white leghorn type and brown strains respectively (see United Egg Producers 2024). Commercially labeled organic egg producers are required to follow the USDA National Organic Program standards (see <https://www.ams.usda.gov/rules-regulations/organic>) which sets feeding, care and housing standards for livestock and poultry. At this time proposed rules for the stocking density for organic egg production have not been finalized. The status of these rules can be checked at <https://www.ams.usda.gov/rules-regulations/proposed-rules?page=3>.

**Rooster Management:** Small commercial flocks may employ the use of roosters for the purpose of fertilized egg production, hen protection (pasture or free-range) from predation, and mitigating the social dynamic of the hen flock. When these flocks are located close to neighbors or in close proximity to a populated area, rooster crowing can present a sound nuisance to neighbors. Roosters crow for a variety of reasons including claiming and protecting territory, asserting dominance, and emitting alarm calls for predators from the ground and air (Jacob 2023). Implementing proper management practices may assist in minimizing but not eliminating crowing. Excessive crowing can be precipitated by stocking the incorrect ratio of roosters to hens. One recommended ratio is 1 rooster to 4 -10 hens depending on the breed of chicken. Devices have been developed to restrict a rooster's ability to crow such as a crow collar or rooster box. Crow

collars reduce the ability of roosters to fully fill their air sacs and dampens but does not extinguish the crow. Crow collars require an abundance of caution when used. They must be properly fitted, observed, and managed or they can result in the death of the rooster. A rooster box is a small, darkened box or cage with a low ceiling that prohibits a rooster from fully extending its head and neck upward to emit a crow. Roosters are placed into the box for the night and let out well after sunrise so as not to wake neighbors. Both methods are considered an impingement of the rooster's welfare and discouraged from use. Egg production can be successfully accomplished using lighting strategies (artificial or natural) that stimulate egg production in hens without the introduction of roosters into the flock (Jacob 2023).

**Beak Trimming and Comb Dubbing:** Due to the predisposition of chickens toward feather picking, the tip of the beaks of domestic birds can be trimmed to prevent outbreaks of cannibalism and aggressive forms of pecking that cause increased mortality within a flock. Beaks may be trimmed using a hot blade knife or by rounding the end of the beak using infra-red technology. . No more than 1/3 of the upper beak should be removed and less than 1/3 is more desirable. Removing more than 1/3 is painful and interferes with a bird's ability to eat. Trimming or conditioning of the beak tip must be conducted by properly trained workers and should be done at prescribed times, usually in young chicks prior to 10 days of age. More detailed guidelines on acceptable methods of beak trimming and beak tip conditioning are available in the United Egg Producers Guidelines for caged and cage-free laying hens (UEP 2017; UEP 2024). Depending on strain or breed of poultry, smaller flock managers may choose to forgo beak trimming or conditioning. If well-managed and observant of flock behavior, injurious pecking and cannibalism can be minimized.

Partial removal of the comb at one day of age is called dubbing and has been widely practiced especially for breeds or strains of hens with large combs. Dubbing is conducted at the hatchery before the shipment of the chicks. Similar to molting practices, some commercial producers and small flock managers may choose not to comb dub depending on the breed or strain of hen. In laying hen strains that develop large combs, dubbing can reduce injury and bleeding caused by social contact with their flock mates, as well as cuts and abrasions sustained from contact with housing equipment during feeding and drinking. However, combs and wattles on laying hens have an important thermoregulatory function to assist in dissipating heat during periods of hot weather (AL-Ramaneh et al. 2016). Heat stress is a leading cause of poultry mortality during periods of extreme heat. If comb dubbing or wattle removal is a routine flock management practice, then attention to providing hens with water, cooling ventilation, and other heat mitigation strategies during periods of high heat must be considered.

**Transportation to Slaughter:** Safety and comfort of the birds are of prime importance when transporting culled or spent hens (end of production life). Poultry in transit should be provided with proper ventilation according to the prevailing environmental conditions. Clean, sanitized vehicles and equipment are important to avoiding the transfer of disease. A floor surface area within the transport container that allows all birds to rest

comfortably on the floor at the same time minimizes hens piling on top of each other and smothering.. A delay or cancellation of transport should occur for birds that are unhealthy, dehydrated, or exhausted and unfit to withstand travel. Detailed guidelines for the handling and transport of laying hens are available in the United Egg Producers Guidelines (2024).

**Chick delivery:** The day-old chick delivery vehicle should have the capability of maintaining a uniform temperature of 75°F (24°C) to 80°F (27°C) regardless of ambient temperature (Yerpes et al. 2021). Air circulation must always be maintained around all chick boxes regardless of their location in the vehicle. The vehicle should not stop from the time it is loaded until it reaches its destination. Provisions for maintenance of proper ventilation and temperature control should be provided in case of vehicle's mechanical failure or any other unforeseen vehicle stop(s). The transportation vehicle should be properly cleaned and sanitized between deliveries to avoid the spread of disease. These conditions are applicable to commercial and noncommercial delivery of chicks.

**Adult poultry delivery:** The recommendations for transporting culled hens (see above) also apply to the transport of pullets to new housing to begin egg production. When adult poultry are transported, adequate ventilation, space and flooring should be provided. Laying hens have been found to return to be resilient to transport stress if provided with adequate transport conditions and fit for travel (Lalonde et al. 2021).

Extreme weather conditions and microclimatic conditions within the transport vehicle have been determined as a common cause of transportation death in poultry (Vercekova et al. 2019). Hot weather is a time for particular caution. The birds should be protected from heat stress by being shaded and/or moved during the dark hours. Prompt unloading and/or auxiliary ventilation is essential when the birds reach their destination. During transportation in cold weather, birds should be protected by use of windbreaks, partial covering, etc. taking care that ventilation must always be adequate.

## **RECOMMENDATIONS FOR ENVIRONMENT**

**Ventilation and Lighting:** Ventilation in the layer house should provide a healthy level of moisture, gases and temperature maintained without drafts or dead air pockets.

Lighting has been found to affect bird development and ability to maneuver in cage-free housing conditions (Chew et al. 2021). Inability to navigate house conditions can result in injury and increased culling and mortality. Lighting should also be provided to allow effective inspection of all the birds and sufficient light for the birds to locate where to eat and drink. Light intensity within the house should be no less than 0.5 foot candles during the daily light period of at least 8 hours and no more than 18 hours of continuous light. And natural daylight and length for birds living in open houses (open sided barns or barns using skylights/windows) or pastured birds.

## **FACILITIES AND EQUIPMENT**

**Housing:** The design, construction and management of a poultry housing system must meet the birds' need for shelter against undesirable environmental conditions such as extreme cold, excessive heat, rain and wind and modify these climatic conditions to conform to an adequate environment for laying hens. They shall be constructed to minimize transmission of disease, parasites and other vermin infestation and optimize the principles of disease prevention. And protect birds from predation from land or aerial predators. The housing should allow for daily visual inspection and care. Michigan Public Act No. 117 of October 12, 2009 requires all commercial egg laying hens be housed so that they are able to fully extend their limbs and turn around freely and eggs may no longer be sold from conventional caged systems by January 1, 2025 according to Michigan Public Act No. 132 (<http://www.legislature.mi.gov/documents/2019-2020/publicact/htm/2019-PA-0132.htm>). Hens may be housed in a variety of housing arrangements such as aviary, single tier systems or decked systems with a minimum of 1 square foot of useable floor space per hen (see description of cage-free, free-range and pasture housing provided in the introduction).

**Housing in cages:** Cages shall be designed, constructed, and maintained to avoid injury to the birds and allow bird comfort and health. The cages must be so constructed as to allow the safe placement and removal of birds. Cage height shall allow a minimum of 14 inches with a floor slope not to exceed 8.5 degrees (UEP 2017). Conventional battery cage systems will be eliminated as a housing option in Michigan by January 12025 (<http://www.legislature.mi.gov/documents/2019-2020/publicact/htm/2019-PA-0132.htm>).

**Housing on floors:** All flooring shall be designed, constructed, and maintained to avoid injury and allow comfort and health to the birds. More complete guidelines for design of floor space, nesting area, perches, placement of feed and water, and litter management are available in the United Egg Producers Guidelines (UEP 2017; 2024) or other standards set by certification bodies for special label marketing purposes and meet the requirements of MI PA117 and 132. Litter on the floor is used as a bedding substrate (wood shavings, grain hulls, etc.) to absorb excreta, provides soft landing for hens in multi-tiered systems, and serves as an area to perform behavior including dustbathing and foraging. It is important to periodically check the litter to ensure it's in a friable dry condition. Wet caked litter fosters ammonia production and gas emissions that may produce noxious odor creating a potential nuisance. Poor litter conditions have been linked to behavioral (Schreiter and Freick, 2023) and health issues (Bist et al. 2023) in laying hens and humans at levels > 25 ppm. However, litter that is too dry and dusty also presents issues with particulate matter emissions. Ideally litter should have some moisture and it is generally recommended to be at ~25% moisture.

Litter can be checked by observing the floor for caked and wet spots. Litter friability can be estimated by picking up the litter in a gloved hand and squeezing it into a ball. The litter should lightly hold together then fall apart after squeezing. If the litter compacts into a tight ball and does not fall apart after opening the hand (in the extreme it drips liquid when squeezed) it is considered to be wet and capable of producing ammonia.



Recommendations for litter management can be found at:  
<https://www.udel.edu/academics/colleges/canr/cooperative-extension/fact-sheets/managing-built-up-litter/>.

**Housing for Pullets:** Some commercial egg producers may raise their own pullets (immature laying hen) for placement into layer housing. Pullets may begin egg production around 17-19 weeks of age depending on breed or strain. During this critical stage of growth, it is important for pullets to develop their physical and behavioral abilities that enable them to successfully navigate the layer house environment after placement, especially aviary or other multi-tiered cage-free housing systems (Liu et al. 2018; Kozak et al., 2016; Tahamtani et al. 2015). Research indicates that pullets raised in caged environments then placed into cage-free housing take longer to learn how to navigate the system, take longer to find resources on multiple tiers, and can sustain injuries (Pullin et al. 2022; Ali et al. 2019; Casey-Trott et al., 2017a; Regmi et al 2017; Regmi et al. 2015). Therefore, pullet housing should include similar features and resources the young hens will encounter when placed into the layer house including perches and other elevated structures and litter or other floor substrate after 4 weeks of age. The provision of litter or other floor substrate like chick paper (Tahamtani et al. 2016; Gilani et al. 2013) encourages foraging behavior, reduces the development of feather pecking, and promotes better feather condition (see review by Janczak and Riber, 2015).

Recommendations for pullet housing may be found in the United Egg Producers 2024 Guidelines for Cage Free production or refer to guidelines and standards for organic or other specially certified production. Providing pullets with early exposure to features of the adult housing system assists with successful navigation of complex cage-free environments and decreases bird injuries that can lead to higher mortality or culling rates necessitating greater carcass disposal.

**Maintenance:** When mechanical systems are utilized for feeding, watering, ventilating, egg collecting, manure removal, etc., properly trained personnel shall regularly check the operation of these systems and adjust and maintain them when necessary to prevent injury to the birds and maintain the health and comfort of the laying hens. All aspects of the housing facility must be checked regularly to assure both the structure and systems are operating correctly. Breakdowns or equipment failures can be responsible for unexpected bird mortality or culling causing increased disposal of dead birds.

**Cleaning of poultry houses:** Poultry houses should be cleaned periodically to provide a healthy environment for the birds by preventing disease, and higher gas and particulate matter emissions. The length of time between cleaning depends upon the type of housing, mechanical systems installed, removal of birds from the house and other factors peculiar to each individual farm. Typically, cleaning is done in the time period after culling of the old flock and before the arrival of the new flock. Manure management should conform to the recommendations presented in the current Right to Farm Practices (see current year Michigan Manure Management and Utilization GAAMP). Failure to implement good manure management practices can generate smells and increased fly

nuisance complaints from neighbors and contribute to poor environmental conditions leading to health problems for hens.

## HEALTH CARE AND MEDICAL PROCEDURES

Optimal management practices are essential to maintain good health status in the egg production facilities and should be in consultation with a veterinarian. A program of disease prevention and control should be established for both conventional and organic production programs.

Only federally approved medications and vaccines shall be used, following label directions in accordance with state and federal regulations.

### Pharmaceutical Use:

To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

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It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical

- treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
  3. the practicing veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

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**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

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## **BROILERS, TURKEYS, AND GAMEBIRDS**

### **MANAGEMENT OVERVIEW**

Nearly all commercial turkeys and commercial broiler facilities are kept in confinement housing with light control, power ventilation and mechanical feeding (National Chicken Council <https://www.nationalchickencouncil.org/policy/animal-welfare/>). Commercial gamebirds facilities, along with small farm hobby and backyard flocks, utilize a wide variety of free range and/or confinement shelters and housing (see small flock turkey production at <https://extension.psu.edu/small-flock-turkey-production>; see <https://dodge.extension.wisc.edu/files/2012/02/Avian-QB-Manual.9.Game-Birds1.pdf> or <http://extension.msstate.edu/agriculture/livestock/poultry/game-birds-and-ratites>).

These GAAMPs are intended to assist the broiler, turkey, and gamebird producer in attaining and maintaining a high quality of bird comfort and well-being in broiler, turkey, and gamebird production facilities and will focus on the birds' basic requirements.

## **MANAGEMENT PRACTICES (INCLUDING TRANSPORTATION)**

**Nutrition:** Feed and clean water should always be available to the birds and when new birds are placed in the housing system, care must be taken to ensure that the birds find the feed and water sources to reduce early morbidity and mortality. Birds should be fed a feed that is appropriate for the stage of life of the particular species and formulated for that species. Commercial turkeys typically are raised on 6 to 7 different diets starting with a 28 percent protein content in the feed and ending with a 16 percent protein in the feed. Commercial broilers typically are fed two, sometimes three different diets in their production period. In situations where high environmental temperatures can be encountered, additional water space per bird is recommended. See the National Research Council (1994) Nutrient Requirements for Poultry or the practical Cooperative Extension Service publications/websites that cover gamebird raising and production such as <https://www.aces.edu/blog/topics/farming/feeding-game-birds-pheasant-quail-and-partridge/>).

**Beak trimming and specs:** Due to the temperament of chickens, turkeys, and gamebirds toward feather picking, fighting and cannibalism, the beaks of birds can be trimmed to remove their sharp tips as an aid in prevention of these actions. Commercial broiler chickens typically do not require beak trimming or conditioning unless they are members of the breeding flock. Trimming should be done by properly trained workers and should be done at the prescribed times, generally at the hatchery. In addition, specs or blinders may be attached to the beak of the bird so that the birds can see to the right or left, but not straight ahead. This should be done by properly trained workers and should be done when the birds are of sufficient age to readily find the feed, water, and other visual environmental necessities.

**Toe trimming:** Due to the tendency of turkeys to inflict bodily damage upon each other with their toenails in commercial confinement housing, one or more toenails (generally the inside and middle toes on both feet) may be removed. Toe trimming should be conducted by properly trained workers and is generally completed at the hatchery. The procedure lowers the incidence of severe scratching and lacerations that can become infected causing higher morbidity or in extreme cases death (Schwean-Lardner 2018).

**Transportation:** Safety and comfort of the animals are of prime importance when transporting live poultry and gamebirds. When poultry and gamebirds are transported, they should be provided with proper ventilation for the conditions, and clean sanitized vehicles and equipment. A delay or cancellation of transport should occur for birds that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel.

**Chick and poultry delivery:** The day-old chick and poultry delivery vehicle should have the capability of maintaining a uniform temperature of 75°F (24°C) to 80°F (27°C)

regardless of ambient temperature. Air circulation must always be maintained around all chick-poultry boxes regardless of their location in the vehicle. The vehicle should not stop from the time it is loaded until it reaches its destination. Provisions for maintenance of proper ventilation and temperature control should be provided in case of vehicle's mechanical failure or any other unforeseen vehicle stop(s). The transportation vehicle should be properly cleaned and sanitized between deliveries.

**Adult poultry and gamebird delivery:** When adult poultry and gamebirds are transported, adequate ventilation, space and flooring should be provided. Hot weather is a time for particular caution. The birds should be protected from heat stress by being shaded and/or moved during the dark hours. Prompt unloading and/or auxiliary ventilation is essential when the birds reach their destination. During transportation in cold weather, birds should be protected by use of windbreaks, partial covering, etc. Ventilation must always be adequate.

**Range rearing:** The growing of chickens, turkeys, and gamebirds in range pens, after the brooding period, is an accepted practice and may be the system of choice, especially for several species of gamebirds. Range reared birds should have adequate space (see references) as well as protection from extremes in climatic conditions, predators and disease inherent with this growing system.

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

**Ventilation and lighting:** Ventilation in the grower house shall be such that a healthy, acceptable level of moisture, gases, dust, and temperature is maintained without drafts or dead air pockets (National Chicken Council, 2022). The ventilation system should be adjusted daily, or more often, as the environmental conditions dictate.

Lighting should be provided to allow effective inspection of all the birds and sufficient light for the birds to eat and drink. Light intensity within the house should be a minimum of 0.4 foot candles.

The housing should provide shelter from disturbing noises, strong vibrations, or unusual stimuli, regardless of origin.

## **FACILITIES AND EQUIPMENT**

**Housing:** The design, construction and management of a poultry housing system should meet the birds' need for shelter against undesirable environmental conditions such as extreme cold, excessive heat, rain and wind and modify these climatic conditions to conform to an adequate environment for broilers, turkeys, and gamebirds. They shall be constructed to minimize transmission of disease, parasites and other vermin infestation and optimize the principles of disease prevention. The housing should also protect the birds from all forms of predators and allow for daily visual inspection and care.

**Broilers:** Brooding and growing space requirements and water and feeder space should conform to the general needs as outlined in the particular broiler company's management guide, if applicable, e.g., Cobb's Broiler Management Guide (2021), National Chicken Council (2022) or Ross Broiler Management Guide (2018).

**Turkeys:** Brooding and growing space allowances and feeder and water space for turkeys should conform to the general needs as outlined by National Turkey Federation (2021) or Aviagen Turkey Management Guidelines (2021).

**Gamebirds:** Brooding and growing space allowances and feeder and water space for gamebirds should conform to the general needs Cooperative Extension resources are available for guidance on brooding and growing facilities for game birds (see <https://dodge.extension.wisc.edu/files/2012/02/Avian-QB-Manual.9.Game-Birds1.pdf> or <http://extension.msstate.edu/agriculture/livestock/poultry/game-birds-and-ratites>).

**Litter:** Many different types of litter can be used (wood shavings, rice hulls, etc.). All litter must be dry and friable and loosely compact when squeezed in a gloved hand (National Chicken Council, 2022) and of acceptable quality. It is acceptable to reuse litter for several successive flocks if ammonia and insects are controlled and there has been no disease outbreak.

Manure management should conform to the recommendations presented in the current Right to Farm Practices (Michigan Manure GAAMPs).

## HEALTH CARE AND MEDICAL PROCEDURES

Optimal management practices are essential to maintain good health status in the production facilities and may be in consultation with a licensed veterinarian. A program of disease prevention and control should be established, including producers participating in organic production programs. Only federally approved medications and vaccines shall be used, following label directions in accordance with state and federal regulations.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

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2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
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Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

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## DOMESTIC RABBITS

### MANAGEMENT OVERVIEW

Rabbits are raised for research, meat, wool, pelts, show, pets, and as a hobby (Cullere and Zotte, 2018). They are maintained under a wide variety of conditions ranging from single backyard hutches to large environment-controlled commercial production units. Rabbits are adaptable to a wide range of housing and management systems provided their needs for shelter, nutrition and health care are met.

If rabbits are raised and sold for laboratory use, they must be raised according to the provisions of the Animal Welfare Act (1966). Rabbitries producing rabbits for laboratory use must also be licensed by the U.S. Department of Agriculture.

### MANAGEMENT PRACTICES

**Nutrition:** Rabbits must be fed a sufficient quantity of wholesome, palatable feed to meet their nutrient requirements (Nutrition of the Rabbit 3<sup>rd</sup> Edition, 2020; Cheeke, 2012; National Research Council 1977). Each pen should be provided with suitable feed receptacles (typically a crock or metal feeder and a hay manger if loose hay is fed) to allow easy access to uncontaminated feed.

Rabbits must have access to clean, fresh water daily. Water receptacles (crops, water bottles, etc.) or automatic waterers may be used. Frequent watering or use of heating systems should be employed to assure that an adequate supply of drinking water is available to the animals during freezing temperatures.

Feeding young newly weaned rabbits between the ages of 6 and 10 weeks of age requires special attention as they are prone to infectious digestive disorders such as epizootic rabbit enteropathy. Feed restriction, as opposed to ad lib feeding, post-weaning has been shown to reduce digestive disorders in young rabbits. However, rabbits must be carefully monitored to ensure proper nutrition and growth and to prevent feed competition (Piles, et al. 2017; Gidenne, et al. 2012). With new rules regarding the feeding of antibiotics, feeding and management strategies that establish healthy growth, resistance to digestive problems, and promote a strong immune system should be employed.

**Handling and Transportation:** Proper handling of rabbits will help prevent injury to the animals, as well as to the handlers. Recommended methods for handling and examining rabbits are given in Rabbit Production (Cheeke, et al. 2000), the Official Guidebook: Raising Better Rabbits and Cavies and the Domestic Rabbit Guide (ARBA, undated) ), or training program materials on handling rabbits produced by the University of Wisconsin (UW-Milwaukee, 2021).

The safety and comfort of the animals are of prime importance when transporting rabbits. Wire carrying cages are recommended for transporting rabbits. Carrying cages should be of sufficient size to allow the rabbits to turn about freely and make normal postural adjustments. Carrying cages with wire ( $\frac{1}{2}$  inch by 1 inch) floors suspended above solid bottoms are recommended. Cat carriers are not recommended for transporting rabbits, as rabbits could be injured when removing them from the carrier. Rabbits should be provided with a non-toxic absorbent bedding material to prevent leakage in transit. Loading rabbits into transport crates or cages should be conducted with care. Carefully placing each rabbit into the transport crate or cage can help to minimize fear and distress associated with transport. Handlers must avoid hurried loading and rough handling such as inappropriate lifting and must not carry and throw rabbits into the crates. Post-mortem examination of rabbits at the slaughterhouse implicates poor handling as a primary factor in limb trauma pathologies (Valkova et al. 2021).

Rabbits being transported should be observed frequently and should have access to feed and water (or feed that will satisfy their water needs) if in transit for more than 6 hours. The shorter the transport (1 hour or less) the less likelihood of incidence of dead-on-arrival (DOA). Transport time greater than 3 hours paired with long holding times pre-slaughter (>7 hours) produced significantly more DOAs. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel. Season of the year and stocking density also impact incidence of DOAs. During hot weather, precautions should be taken to guard against heat stress (Caucci, et al. 2018).

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

It is essential that good sanitation and vermin (insects, ectoparasites, and avian and mammalian pests) control be provided whether rabbits are housed indoors or out-of-doors. The use of screens and approved sprays and baits are suggested to help control insects in the rabbitry. Pens, feed, and watering equipment should be cleaned and sanitized periodically. Accumulations of hair on rabbit pens should be removed. Frequent removal of manure from under the cages will help prevent unpleasant odors and ammonia fumes, as well as reduce environments that are conducive to insect propagation. All feed and bedding should be stored in bins or containers in a cool, dry, area which would not attract rodents.

## **FACILITIES AND EQUIPMENT**

**Housing:** Although rabbits may be housed under a variety of conditions, they should be provided a comfortable environment which will limit stress and risk of injury and afford good ventilation and protection from the elements. If rabbits are raised in outside hutches, the hutches should have watertight roofs. Hutches should be designed to protect the rabbits from wind, snow, rain, sun, and predators, yet allow for sufficient ventilation for removal of hot air in summer and moisture in winter. Hutches suspended above the ground with welded wire floors and sides are conducive to good air circulation

and sanitation, as opposed to solid wooden hutches. The size of hutch required will depend on the size and number of the rabbits to be housed (see pens below).

When rabbits are housed in a building, the building should provide adequate ventilation and drainage to maintain a healthy environment for the animals. Ventilation may be natural or by mechanical means (fans) when natural air movement is not sufficient. Typically, in indoor housing, single-tiered, all-wire pens are suspended. Single-tiered pens facilitate animal care and sanitation and are preferred over multi-tiered pens. Concrete or dirt floors with pits under the pens to contain the droppings are recommended for indoor rabbitries. Automatic pit cleaners are desirable but not essential. Disposal of manure should be in accordance with Michigan Manure GAAMPs.

Rabbits are herbivorous animals and under semi-wild conditions may spend up to 70 percent of their day searching for food and feeding (Nutrition of the Rabbit 3<sup>rd</sup> Edition, 2020; Cheeke, 2012; Torcino and Xiccato, 2004). Rabbits have an innate need to gnaw or chew. The provision of enrichments such as gnawing sticks within intensive cage or hutch environments may reduce the incidence of abnormal behavior (Stapleton, 2021). Cage biting is one abnormal behavior associated with barren environments and can cause tooth damage. Provision of enrichments may improve growth and carcass characteristics for meat rabbits (Stapleton 2021; Verga, et al. 2004). For example, recent research conducted with New Zealand White rabbits has indicated the provision of gnawing sticks can improve carcass traits and body weights (Mohammed and Nasr, 2016).

**Pens:** Rabbit pens must be clean, dry, and of sufficient size to allow the animals to perform their normal physiological functions, including rest, sleep, grooming, defecation, breeding, kindling, and raising young. Giant breeds of rabbits require larger pens than the small breeds. Suggested pen sizes for various size rabbits are given by Cheeke, et al. (2000), and the American Rabbit Breeders Association (see references). Pens should be structurally sound and constructed of durable, non-toxic materials which resist corrosion and are conducive to good sanitation. The pens should be maintained in good repair and afford protection to the rabbits from injury and predators.

It has been desirable to house rabbits in meshed wire bottom pens suspended above the ground to allow feces and urine to fall through the pen floors and for ease in removal of these waste products from under the pens. However, lifetime housing of domestic rabbits on wire mesh can produce painful foot lesions known as ulcerative pododermatitis especially in does (Rosell and de la Fuente 2009). Recent research comparing different floor types and its impact on rabbit foot health, soiling of fur, parasite control and the sanitation of pens indicate flat metal slatted floors, which can be easily cleaned, kept rabbits' cleaner, and lowered parasite counts (Tillman et al. 2019). A perforated plastic mat overlay (Rommers and de Jong, 2011) also decreased incidence of sore and soiled feet and hocks especially in breeding does. In the Netherlands, Dutch rabbit farmers have implemented the use of a simple plastic mat to reduce foot lesions in housed does (degree and Rommers, 2021).

Another study examined the impact of stocking density and collective housing on behavior and stress in male and female rabbits (Torcino et al. 2018). They found that floor type (wooden slats) was more challenging to rabbit welfare than higher stocking density regardless of gender. Solid floored pens may be more suitable for some giant breeds of rabbits that are prone to foot problems. Rabbits housed in wire mesh bottom cages should be provided with a section of flat surface that can be sanitized for foot resting to help eliminate foot problems. Solid floored pens should be provided with clean, dry litter and should be cleaned frequently. A solution of household bleach with water and sunshine are effective disinfectants.

Bred does should be provided with an adequately sized nest box in which to raise their young during the first few weeks after kindling. The nest box should contain a suitable bedding material and should be placed in the pen a few days prior to kindling. Several types of bedding, including straw, wood chips or sawdust (do not use cedar which is a respiratory irritant or walnut which can be toxic), crushed/shredded sugar cane, and newspaper, can be used. Nest boxes may be constructed of wood, metal, plastic, or wire. Disposable liners should be used with wire nest boxes. In non-heated rabbitries during cold weather, well insulated nest boxes should be provided, or the does should be moved to a warm area to kindle and raise their litters for the first few weeks. Good nest box sanitation is essential. Studies on the impact of group housing on breeding does indicate issues with maintaining health status, kit survivability, and stress (Pérez-Fuentes et al. 2020; Zomeña et al. 2018). A recent review of research outcomes on doe housing was published by Szendrő, et al. 2019.

## HEALTH CARE AND MEDICAL PROCEDURES

Optimal management practices are essential to maintain good health status in the rabbitry. A program of disease prevention and control should be established and may include consultation with a veterinarian. Rabbit breeders should be on the lookout for signs of illness. Any sick or injured animals should be immediately treated, or if necessary, humanely euthanized. Rabbits that are under quarantine or suspected of having an infectious disease should be separated from other rabbits to minimize the spread of disease. Organic production programs should work with a veterinarian to ensure adequate protection and treatment for sick animals.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.



As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
3. the veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

**Euthanasia:** Animals that are seriously injured or ill and show no promise for recovery should be euthanized immediately. Farmers should consult with their veterinarian to determine the options and guidelines for euthanizing such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Euthanasia (American Veterinary Medical Association, 2020) and state law.

**Depopulation:** AVMA definition of the term depopulation refers to the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable. Farmers should consult with their veterinarian to determine the options and guidelines for depopulation such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Depopulation (American Veterinary Medical Association, 2019 Edition) and state law.

**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.

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DRAFT

## **FARM-RAISED MINK AND FOX**

### **MANAGEMENT OVERVIEW**

The humane raising of mink or fox under farm conditions requires a thorough knowledge of the animals' natural life cycle and their normal behavior including breeding cycles, whelping and lactation behavior, weaning and separation procedures, growing and furring periods. The mink or fox farmer must have a working knowledge or access to the nutritional needs of the animals throughout their life cycle. It is imperative to have adequate facilities to supply and maintain proper housing, a reliable supply of clean drinking water and storage capabilities for quality feed. Proper protocols must be in place for the daily recording and treatment of sick or injured animals, the monitoring of death losses, extreme environmental conditions, manure management, pest control and euthanasia. The mink or fox farmer must assure the welfare of their mink, which includes developing the skills of observation and the management knowledge/training to properly ensure quality welfare for the mink, as well as ensuring that employees on the farm are competent, properly trained individuals who have a good understanding of all the farm management protocols that they will be involved with. The mink or fox farmer should develop a site plan of the farm, and ensure it is present on the farm. A written entrance biosecurity policy for both farm employees and visitors to the farm should be in place with signage to identify bio-secure areas and directions and/or contact information to instruct visitors. Farm employees who are involved with the care of the mink or fox must be trained to practice proper animal handling and understand proper animal husbandry. A record should be kept by the farm indicating when each employee was trained, and the employee must sign-off that he/she completed the training. There should be an employee Code of Conduct developed to instruct all employees that all farm specific protocols and biosecurity measures must be adhered to, that all mink or fox need to be handled with care and require that all employees, if they witness any practice that causes avoidable pain or suffering, that employee must immediately notify a supervisor.

These GAAMPs for the care of farm-raised mink and fox were compiled primarily from the Standard Guidelines for Operation of Mink Farms in the United States Fur Commission U.S.A., 2019 and the Standard Guidelines for the Operation of Fox Farms in the United States (North Central Fox Producers and U.S. Fox Shipper's Council, 2006). These guidelines were developed by the Fur Commission U.S.A. (mink) and the North Central Fox Producers and U.S. Fox Shipper's Council (fox) and adopted by the mink and fox farming industries to promote sound husbandry and humane treatment of these animals in accordance with current accepted moral and ethical standards. Other pertinent guidelines include the Code of Practice for the Care and Handling of Mink (National Farm Animal Care Council, 2013) and the Code of Practice for the Care and Handling of Farmed Fox (National Farm Animal Care Council, 2013).

## MANAGEMENT PRACTICES

**Nutrition:** Mink and fox should be fed a complete diet that fulfills the animals' various nutritional needs and modified as nutritional requirements of the life stages of the mink or fox change. Nutritional information is available from a variety of sources (National Research Council, 1982; Rouvinen-Watt et al., 2005). The farm should have a nutritionally balanced ration developed through consultation with a nutritionist or purchase a fully balanced complete feed. Analysis of mixed food rations, when needed, should be obtained from a qualified laboratory. Feed ingredients should be tested for nutritional value (protein, carbohydrates, fat, moisture) and for bacterial levels (plate count). The total mixed ration should be tested for nutritional value (protein, carbohydrates, fat, moisture) and bacterial levels (plate count) at least quarterly throughout the year. Complete dry and/or complete ready-mixed wet foods must be stored and fed according to the manufacturer's instructions. Ready access to potable water is particularly important to animals fed dry diets and during extremely warm weather and periods of freezing temperatures.

**Feed Storage and Preparation:** When the farmer is handling fresh and frozen animal by-products that can deteriorate quickly, the collection, storage and preparation of feed should be carried out under sanitary conditions. Transport vehicles and containers used for collection of animal by-products should be drip-proof and be thoroughly washed after each collection. Animal by-products should be refrigerated or preserved to ensure freshness and nutritional value. Feed preparation machinery, grinders, mixers, and blenders should be cleaned after use and regularly maintained. Dry foods such as cereals and supplements should be stored under dry and pest-free conditions. Individuals involved with feed preparation should be properly trained.

**Feed Distribution:** Sufficient feed must always be given to ensure the health and well-being of the animals. Feed should be placed in such a position that animals can easily reach it. This is particularly important with young animals and during periods of extreme cold. Feed must be provided at least daily to growing and mature animals. Once full growth is achieved, it may be desirable to skip feed occasionally to aid conditioning. Feed carts used to deliver wet feed, hoppers for dry feed and the wet feed area of cages should be cleaned and maintained on a routine schedule. Waste feed should be disposed of in accordance with the farm's waste management plan.

**Watering Systems:** Farmers must ensure that clean, fresh water is always readily available to animals. When either a fully automatic or semiautomatic system is used, an alternative supply of water should be available. Care must be taken so that automatic water systems remain clean and that individual valves or nipples function properly. Regular maintenance must be carried out to prevent leaking of valves and connections that can cause wet areas on the farm. The watering system must ensure easy access to drinking water and the system should be checked during hot weather to ensure uninterrupted availability. In areas where weather can be uncomfortably warm in the summers, water mist systems in the sheds are recommended to ensure the comfort of animals. The farm's water source should be tested for its component content (i.e. pH,



nitrites, lead, salt) and bacterial content at least once yearly or after any major repair work is done on the system. The farm should have a written back up plan in place in the event the primary watering system fails (i.e., equipment breakdown, power failure, freezing). The watering systems must be checked daily to be sure that they are functioning.

**Handling and Transportation:** Precautions must be taken when handling mink and fox to prevent injury to the animals and the handler. Mink are routinely handled with heavy leather gloves, while fox are most commonly handled with metal tongs.

Transportation of mink and fox requires special attention to traveling crates design, care of the animals in transit, and where required, proper documentation. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel. Detailed recommendations for transportation of mink and fox can be found in the Standard Guidelines for Operation of Mink Farms in the United States (Fur Commission U.S.A., 2019) and the Standard Guidelines for the Operation of Fox Farms in the United States (North Central Fox Producers and U.S. Fox Shipper's Council, 2006), respectively.

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

The mink or fox farmer must develop an effective hygienic and sanitary program to promote a healthy environment. Farmers must observe all local, state, and federal laws intended to protect ground and surface water quality and should cooperate with officials in their jurisdictions to develop appropriate management practices. The farm should follow a written waste management plan and have a water quality control program. Sheds/barns should be designed to keep rainwater off the manure. Feed preparation buildings and surroundings areas must be kept clean. Pens and nest boxes must be cleaned regularly as dictated by the time of year. The farm should have a plan in place to address manure buildup on false cage bottoms. The farm should have a written pest management plan that addresses the housing area and the feed storage and preparation areas.

## **FACILITIES AND EQUIPMENT**

**Site:** A new mink or fox farm's location must be carefully selected. Due consideration must be given to local environmental conditions, artificial light, foreseeable neighborhood development, and subsequent development of the farm. The location must comply with local, state, and federal environmental regulations. A protective fence must be constructed around the perimeter of the area where mink or fox are housed or the buildings housing the animals are closed to protect the animals from predators and/or disease-carrying wildlife, and to keep unconfined mink or fox from exiting a bio-secure environment. A site plan of the farm needs to be available at the farm office, showing all sheds and describing the types, number, dimensions, maximum animal densities of the specific pens, date of construction and date of any major repairs of all pens within the

specific sheds. The farm must have a process in place to capture any mink that have escaped. Live traps must be checked daily or as appropriate.

**Sheds:** Any building erected to house mink or fox must provide proper ventilation as well as clean, hygienic conditions, and at the same time afford protection from the elements. The sheds should be constructed to allow for adjustments to protect against weather extremes and the farm should develop a written plan to address extreme heat or cold. The sheds should be constructed in a way that allows for adequate light to observe the animals and designed to allow for exposure to natural or artificial light that mimic the needed natural photoperiod stimulation. Sheds may be constructed to hold any number of rows, providing air quality and farm manure management protocols are met. Air quality can be measured by determining ammonia levels at the cage level; 25 ppm is the standard and maximum acceptable level. Sheds should be designed to keep the rainwater off the manure found below the pens. The areas under the pens must allow the efficient removal of manure and used bedding materials. The pens that house mink or fox should be a minimum of 12 inches above ground level to allow feces to fall out of the pen. The alleyways between the pens should be wide enough to allow for ease in observing and handling the animals and allow movement of any needed equipment.

**Pens:** Mink and fox are typically reared singly or in pairs or as littermates (foxes) from weaning through pelting. It is recommended that breeder mink be housed singly while breeder fox may be housed singly or in breeding pairs. Pens must provide sufficient area for animals to perform natural physical movement and must allow for comfort activities such as rest, sleep, grooming, defecation, and in the case of breeding pens, the rearing of young. Recommended pen sizes for mink and fox are provided in the Standard Guidelines for the Operation of Mink Farms in the United States (Fur Commission U.S.A., 2019) and the Standard Guidelines for the Operation of Fox Farms in the United States (North Central Fox Producers and U.S. Fox Shipper's Council, 2006), respectively. Current guidelines for mink (Fur Commission U.S.A., 2013) state that whelping pens should have a volume of 4,300 cubic inches and furring pens of 3,800 cubic inches for the first two animals and 900 cubic inches for each additional mink. The nesting box volume counts as additional space when attached to the outside of the pen. To ensure timely weaning of kits, the minimum height all pens should be 12 inches. Pens containing single breeder females should have a minimum width of 6 inches and those containing single breeder males, a minimum width of 7.5 inches. Pens designed for single mink should have a minimum of 2,500 cubic inches.

Guidelines for minimum dimensions of pens constructed after January 1, 2019 are given in the table on the following page.

New Pen Construction Table

Pen density	Minimum height	Minimum width	Nest box size	Minimum living space (floor, nest box, shelf)
Single female	15 inches	7.5 inches	45 sq. inch minimum	225 sq. inch minimum (shelf is not counted)
Single male	15 inches	9 inches	60 sq. inch minimum	275 sq. inch minimum (shelf is not counted)
Female with litter	15 inches	12 inches	80 sq. inch minimum	440 sq. inch minimum (100 sq. inch max countable living space for a shelf)
2 juveniles	15 inches	12 inches	80 sq. inch minimum	440 sq. inch minimum (100 sq. inch max countable living space for a shelf)
More than 2 juveniles				75 sq. inches of living space per each additional female and 100 sq. inches of living space per each additional male

Pens should be durably constructed with non-toxic, corrosion-resistant materials to contain the animals securely and to prevent animals from injuring themselves or those in adjacent pens. Pens should be of sufficient height above the ground to allow feces to fall from the pen and to allow for clearing of manure. In the case of mink, breeding pens should permit the fitting of a false floor to prevent the young from falling to the ground.

The arrangement of pens should enable visual and physical inspection of all areas and all housed animals. In each pen, there should be a fresh water source available that is easily accessible by the animal and allows inspection and cleaning by the farmer. All pens need some form of enrichment that adds complexity to the pen environment (jump-up nest box, drop-in nest box, feed board, shelf, hammock, tube and/or manipulative enrichment fulfill this requirement).

**Nest Boxes:** Each pen should be provided with a clean, dry nest box or "nester" in the form of a wooden box or wire-nester of adequate size where the mink or fox can rest or sleep comfortably. A clean, dry nester should be designed to accommodate appropriate nesting materials such as marsh hay, straw, wood shavings, excelsior, or crushed sugarcane. Nesters should be designed to provide sufficient space according to the sex and size of the animal, to permit each animal to rest and sleep comfortably. Breeder nest

boxes should allow sufficient space for the mother and her litter. Special consideration should be given at time of whelping to methods of avoiding unnecessary exposure of the mother and her young. Guidelines for minimum nest box sizes for pens constructed after January 1, 2019 are given above.

## HEALTH CARE AND MEDICAL PROCEDURES

Developing a close working relationship with a licensed veterinarian will facilitate development of a program of disease prevention and control. The mink or fox farmer should consult with their veterinarian at least once per year. Mink and fox farmers and their employees must be aware of the well-being of the animals and must be able to detect signs of a distressed or sick animal including abnormal behavior, change in appetite, abnormal feces and other indicators of ill health. All mink and fox should be observed at least once a day. Any sick or injured animals should be immediately treated or, depending upon the severity of their condition, humanely euthanized. A veterinarian should investigate unexplained deaths, if possible. The farm should keep written treatment records and written records of daily mortalities. The farm should maintain some basic medicines and supplies to treat basic illnesses and injuries through consultation with a veterinarian. An abnormal increase of mortalities should be investigated by a veterinarian. The mink or fox farm should have a vaccination protocol developed through consultation with a veterinarian and the mink farm should have an Aleutian Disease Virus testing protocol through consultation with a veterinarian.

When mink herds are infected with Aleutian Disease virus, animals should be tested, infected animals culled, facilities appropriately cleaned and disinfected with parvocidal disinfectants and biosecurity improved. Recommendations for biosecurity procedures can be found in Appendix (Biosecurity Protocols for the Operation of Mink Farms in the United States) of the Standard Guidelines for Operation of Mink Farms in the United States (Fur Commission U.S.A., 2019).

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following

statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. there is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and,
3. the veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

**Euthanasia:** It is imperative that mink and fox farmers utilize humane techniques for euthanasia of their animals. Euthanasia methods used must have an initial depressive action on the central nervous system to ensure immediate insensitivity to pain without causing fear and anxiety. The Standard Guidelines for Operation of Mink Farms in the United States (Fur Commission U.S.A., 2019) and the Standard Guidelines for the Operation of Fox Farms in the United States (North Central Fox Producers and U.S. Fox Shipper's Council, 2006) recommend acceptable procedures for euthanasia of mink and fox that are described in the AVMA Guidelines on Euthanasia (AVMA, 2020). The American Veterinary Medical Association (AVMA) and Fur Commission USA (FCUSA) recommend pure, carbon monoxide or carbon dioxide in cylinders. The farm should have a written euthanasia protocol and all personnel involved with the euthanasia of mink and fox should be trained and have a documented understanding of the euthanasia protocol. The euthanasia chamber should be purpose built and in good repair. The chamber should be mobile, easy to clean and provide for consistent performance, ease of operation and safety to the operator. Carbon monoxide is a highly toxic gas. Since it has no odor, it must be used only under well-ventilated conditions, and personnel administering it must adhere strictly to appropriate safety practices. Carbon monoxide euthanasia chambers must be charged at a minimum rate of 4 percent carbon monoxide by volume. Carbon dioxide euthanasia chambers must be charged at a minimum rate of

80 percent carbon dioxide by volume. When animals are removed from the chamber, they must be checked to ensure that death has occurred. Farmers should consult with their veterinarian to be in accordance with guidelines and state laws.

**Depopulation:** AVMA definition of the term depopulation refers to the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable. Farmers should consult with their veterinarian to determine the options and guidelines for depopulation such animals in accordance with practices outlined by the American Vet Medical Association (AVMA) Guidelines on Depopulation (American Veterinary Medical Association, 2019 Edition) and state law.

**Dead Animal Disposal:** Whether there is an individual animal or mass depopulation of animals, each farm should have a plan on file to manage animal tissue, whole carcasses, or portions thereof, must be disposed of according to the Michigan Bodies of Dead Animal Act, Act 239 of 1982, Amended Act No. 311, Public Acts of 2008, December 18, 2008.



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## AQUACULTURE SPECIES

### MANAGEMENT OVERVIEW

Aquaculture is regulated and afforded rights of agriculture enterprises under the Michigan Aquaculture Development Act (Act 199 of 1996). The definition of aquaculture as stated within this act is: “the commercial husbandry of aquaculture species on the approved list of aquaculture species, including, but not limited to, the culturing, producing, growing, using, propagating, harvesting, transporting, importing, exporting, or marketing of aquacultural products under an appropriate permit or registration”.

Aquaculture facilities are required to obtain an aquaculture registration from the Michigan Department of Agriculture and Rural Development. Rearing of fishes for the aquarium trade in closed indoor systems is exempted from registration. Individuals purchasing fish for stocking in public waters shall also obtain a permit from the Michigan Department of Natural Resources and fishes must be certified free of specific diseases prior to release into public waters. Michigan complied laws and permit requirements for aquaculture and baitfish industries are summarized on the North Central Regional Aquaculture Center (NCRAC) website: [https://www.ncrac.org/import\\_regulations/michigan\\_](https://www.ncrac.org/import_regulations/michigan_).

Michigan aquaculturists are composed mainly of small firms concentrating on trout production which includes a mixture of food fish and shrimp, fee-fishing, planting stock sales, and aquaponics.

Because of the diversity of aquaculture species approved for aquaculture production and the variety of husbandry systems used, recommendations for their care must be general in nature. More specific management practices for a wide variety of aquatic species can be found through the search engine on the NCRAC home web page: <http://www.ncrac.org/>.

Water quality should be monitored and maintained within species specific concentration ranges. Parameters farmers should keep in mind, depending on system, species, and environment, may include: DO, suspended solids, pH, CO<sub>2</sub>, conductivity (salinity), alkalinity, hardness, phytoplankton/chlorophyll A, nitrogen (N<sub>2</sub>, total ammonia nitrogen, nitrite, nitrate), phosphorus (total and reactive), sulfur, and other trace elements found commonly in the supplying water source.

### MANAGEMENT PRACTICES

**Stock Procurement:** An established list of approved species for aquaculture production is contained in the Michigan Aquaculture Development Act. Only aquaculture species on the approved list are allowed for purposes of aquaculture production. Any movement, importing, or exporting of aquaculture species must be in compliance with the Animal Industry Act, 1988 PA 466, MCL Section 287.729a; as amended.

Acceptable sources of aquaculture species should be certified to be pathogen free. Live fishes obtained from an out-of-state hatchery must be certified as being free of certain diseases which are summarized on the North Central Regional Aquaculture Center website: "State Importation and Transportation Requirements for Cultured Aquatic Animals". Pre-entry permits must also be obtained from the Michigan Department of Agriculture and Rural Development prior to importation of fish to an aquaculture facility from outside the state.

Newly acquired aquaculture species should be checked to determine that they are in good condition, regardless of the availability of health history information. Healthy aquaculture species should show good coloration with no obvious abrasions or lesions.

**Transportation:** Healthy aquaculture species may be safely and easily transported as long as care is taken to reduce the associated stress. Feed should be withheld from farm-reared species for two days prior to transport to reduce fouling of the transport water. Since the stress of transport often results in animals going off feed, withholding feed for one or two days after receipt, followed by a gradual return to normal feeding levels, may be beneficial.

To minimize stress, the temperature of transport water should remain as close as possible to the supplier's ambient water temperature. However, aquaculture species will generally travel better in cool water because of lowered oxygen requirements and higher levels of available dissolved oxygen. It is equally, if not more important to emphasize trying to match the hauling temperature to that of the receiving water. The practice of tempering the hauling water to match the receiving water should be considered.

Salt, in a mild concentration (<.05-1.0 percent), is commonly used to reduce stress during transportation of freshwater fish depending on the species. Ice can also be added to the bags, but know the temperature limits of your species. Also, a mild anesthesia may be employed during transport; however, this is usually unnecessary.

Small numbers of aquaculture species are commonly shipped in plastic bags with use of pure oxygen (oxygen bagging). Plastic (polyethylene) bags should be filled about third with water, the remaining air being expelled and replaced with pure oxygen. The top of the bag should be firmly tied by twisting and bending over on itself. The bag should preferably be placed inside another similar one and then placed in a protective container or box for short term shipping. For long term direct and air shipments, oxygen bagging, followed by packaging in insulated containers is also common practice and a method recommended by the International Air Transport Association (IATA). Ice packs could be placed inside the insulated container if necessary, for cold water species. Most aquaculture species packed in this manner may be shipped for period of 48 hours without inducing significant stress and subsequent diseases.

It is difficult to generalize on the number or weight of an aquaculture species that may be safely transported in each volume of water. Safe transport densities vary according to

species, age, water temperature, oxygenation, and the distance and length of time over which they are to be transported.

The practice for shipping eyed eggs is very different. Eyed salmonid eggs are usually shipped wrapped in damp fiber-reinforced cloths, rather than in water filled containers. They most often are shipped in trays, stacked in insulated boxes, with the top tray holding ice cubes rather than eggs. Each tray can hold 1-2 liters of eggs wrapped in the damp cloths. The individual trays have holes in them to allow water from the melting ice to drip through. The ice serves two purposes: 1. Keeping the eggs at the proper temperature; and 2. Keeping the eggs moist to facilitate oxygen uptake as the ice melts during shipping. Overnight (express) shipping should always be used to ensure that the eggs arrive in good shape.

Keep in mind that eggs may be extremely susceptible to damage at certain stages in their incubation. For example, salmonid eggs may be transported for a period of approximately two days immediately after fertilization and water hardening (1-2 hours), or after they have become "eyed" (eyes of the embryo visible through the shell). Between these periods, eggs should not be transported or handled.

**Handling:** Handling should be minimized to reduce stress and damage to the skin leading to bacterial and fungal disease. Nets and other materials for handling aquaculture species should be sanitized before and after use to reduce disease transfer.

**Nutrition:** Active feeding is often a good indicator of the health status of aquaculture species. Sick animals often quit eating before other disease signs become noticeable. Commercially prepared pellets are available for a variety of aquaculture species which are often acceptable to other similar species. Live feeds may be required for rearing some aquaculture species; however, live feeds may not meet the nutritional needs of the aquaculture species unless multiple species of feed items are used.

Optimum feeding rates vary depending on species, size, feed composition, water temperature, and desired growth response (maintenance vs. maximum growth rate). Feeding tables have been developed for some aquaculture species which can be used for general care recommendations. Feeding once or twice a day for the five working days is usually adequate; however, larval stages and young animals may require more frequent feedings which should extend throughout the entire week.

## RECOMMENDATIONS FOR THE ENVIRONMENT

Aquaculture species are in constant, intimate contact with their aquatic environment and even minor changes in water quality may cause stress that predisposes them to disease. Chemical, physical, and biological factors in the water environment will affect different aquaculture species in different ways.

Water temperature is an important environmental factor. Aquaculture species are, with a very few exceptions, unable to physiologically control their body temperature. Most body

functions, such as rate of growth, appetite, respiration, and heart rate, are temperature dependent. Each aquaculture species has a preferred temperature that is affected by its acclimation temperature. In general, the preferred temperature range for cold water fishes is 46-60°F, for cool water fishes is 60-68°F, for warm water fishes is 64-72°F, and for tropical fishes is 73-86°F. Temperatures outside these ranges may, however, prove perfectly acceptable, depending on the species and other variables involved.

The acclimation of aquaculture species to a new temperature, either when introducing new animals to a facility or when adjusting temperatures within a facility, should proceed as gradually as possible. If possible, changes should be limited to between 1–3 degrees Fahrenheit per hour and should be even more gradual at the extremes. Aquatic animals should be carefully observed for 1–2 weeks after transport and/or handling for signs of stress induced bacterial diseases. When adjusting water temperatures, all other stresses (e.g., handling) should be minimized.

**Oxygen (O<sub>2</sub>):** Oxygen is another key factor in aquaculture, and oxygen concentrations are closely related to temperature. As the temperature of water rises, its holding capacity for O<sub>2</sub> decreases. At the same time however, the O<sub>2</sub> requirements of the aquaculture species increases because of an increased metabolic rate. At temperatures in the preferred range, decreasing availability with increasing demand usually causes no problem as there is still enough O<sub>2</sub> available. When waters are above preferred temperature ranges, polluted or heavily overstocked, there may be insufficient O<sub>2</sub> available. Respiratory stress syndrome may occur if energy expenditures in obtaining the limited O<sub>2</sub> available exceed the potential energy gain. Respiratory stress syndrome can result in death.

Variables other than temperature, that under normal circumstances affect O<sub>2</sub> requirements, include: species - active aquaculture species require more O<sub>2</sub> than slower moving aquaculture species; size – within an aquaculture species smaller animals require relatively more O<sub>2</sub> per unit of body mass than larger animals; and plane of nutrition - aquaculture species require additional O<sub>2</sub> for metabolism of feeds. As a general guide for cold-water fish, it is recommended to maintain O<sub>2</sub> concentrations at or above 5-6 ppm. However, fish have to expend energy to draw oxygen out of the water if it reaches levels lower than 7.0 ppm, so that is advised as the lower desirable level. The fish may not exhibit any signs of stress until the levels get well below 5.0 ppm, but they are doing “work” to get oxygen at levels below 7.0 ppm.

With trout, it is advised to keep the dissolved oxygen above 7 ppm as much as possible, but due to daily differences in source water, levels in the 6 ppm range can occur and be regarded as acceptable. However, be extra careful with feeding management on those days to avoid spikes in oxygen demand. Anything below 6 ppm will trigger interventions, including withholding feed and potentially addition of more aeration to the system. A high degrees of flow rate vigilance is also mandated with anything below 6 ppm.

For warm water fish, the lower limit for survival is 1.0-1.5 ppm. So acceptable levels for healthy fish should be 2-3 ppm. A general rule is to keep DO at 50% or more of saturation (this is dependent on temperature and barometric/hydrostatic pressure).

Spring, well, and surface water can be acceptable sources of water for aquaculture in Michigan. Spring and well water are generally excellent water sources for aquaculture. The ground acts as a filter to remove microbial flora and parasites. Ground water temperatures at most locations will remain relatively constant, often varying by little more than 2 degrees throughout the year. However, water temperatures will vary considerably across the state. Levels of dissolved oxygen can be low and well waters may be supersaturated with nitrogen or carbon dioxide. Symptoms of nitrogen supersaturation (nitrogen gas bubble disease) are exophthalmia (pop-eye) and gas emboli in gill lamellae and fin tissue. Gas emboli result in dead tissue that can lead to bacterial gill disease and fin erosion, along with secondary fungal and water mold infections.

Under such conditions aeration/degassing systems, such as packed columns, cascading weirs or pure oxygen systems may be essential in order to add oxygen to the water and to drive off other supersaturated gases. Nitrogen supersaturation is dealt with most effectively with vacuum degassing cans. Packed columns operating without a vacuum column will also work, but the negative pressure of a vacuum can is more effective. Cascading aeration and low head oxygenators can also remove some amount of excess nitrogen and can be used in combination with degassing cans/columns.

Surface waters are generally less bio-secure than closed (non-open) sources of water. pH and the form of nitrogen can also indicate some toxicity levels for fish. Nitrite can be very toxic to species (20x more toxic than ammonia) so the nitrogen cycle and form of which nitrogen is in should be considered for best practices (especially in ponds when phytoplankton blooms occur). Aeration can drive nitrification, so this is typically the easiest solution in aquaculture systems. In regards to water quality, it's usually a concern with 1) DO, 2) pH 3) Temperature and 4) Nitrogen. Bacterial gill disease (BGD) is also a typical sign that solids are not adequately flushed from the system holding fish.

## **FACILITIES AND EQUIPMENT**

Facilities and equipment needed for farming aquaculture species are primarily dictated by the species and life stage of the animals being raised and the type of operation. Aquaculture species can be raised in tanks, ponds, raceways, cages, and net pens. Each container should have its own gear, do not use gear from one container into another. The design and suitability of these systems depend on water availability and quality. Expert input needs to be sought and incorporated in the designs of systems to meet specific needs of the aquaculture species and production system.

## **HEALTH CARE AND MEDICAL PROCEDURES**

Stressors, such as changes in water quality or handling, may predispose aquaculture species to disease. However, most aquatic animal diseases can be treated and



controlled, especially when caught at early stages. It is very important to watch them when cleaning or feeding to see what healthy fish look like and they will tell you when they are sick.

Observation is a critical component in the health care of aquaculture raised aquatic animals. The earliest signs of disease are usually changes in behavior. For example, aquaculture species may aggregate at the inflow if O<sub>2</sub> levels are too low. Conversely, they may accumulate at the outflow of the tank, if a toxic substance is present in the inflow. Sick animals usually lose their appetite. Sick fish often congregate together, separating themselves from their healthier cohorts. Weak fish in flowing water systems will often be found near the water outlet. Sick fish may also exhibit other behavioral signs, including staying near the surface of the water because of hypoxia, scraping the body because of parasite irritation, or showing various behavioral abnormalities because of nervous system involvement. Symptoms and signs typically to look for include: history of fish, behavioral abnormalities such as increased respiratory rates, but also physical, external abnormalities such as abdominal swelling (dropsy), eye lesions (exophthalmos), skeletal deformities, color change, and general skin lesions.

Various changes in appearance also signal disease problems. Examples include a change in color (lighter or darker), excessive mucus production in gills and on skin, lesions, and fungal growth. Fungi are frequent secondary invaders on virtually any skin or fin lesion, regardless of its primary cause.

Very often parasites and microorganisms that have the potential to cause disease may be isolated from diseased aquaculture species. This can be accomplished at the facility, depending on the experience of the aqua-culturist, or diagnosed from samples in an aquatic animal health laboratory. The advantage of sending samples to a laboratory is the ability to obtain a full evaluation including hematology, histopathology, biochemistry and microbiology. Disadvantages of laboratory diagnostics include cost (e.g. cost prohibitive), the proximity of the laboratory to the facility, and/or the time required to obtain results may be far too long for a producer to take meaningful action. Aquatic animal health specialists and/or the Michigan Department of Agriculture and Rural Development should be consulted when a serious or reportable disease outbreak occurs.

The treatment of external parasitic, fungal, or bacterial disease includes the use of baths, flushes and dips with chemicals specifically approved for use with that specific aquaculture species. Treatment of some systemic diseases may require therapeutic agents administered in the feed to those animals still feeding. Such agents may act both externally and internally, being absorbed from the water. Drugs approved for disease treatment of fish in registered aquaculture facilities are very limited in number and are required to meet U.S. Food and Drug Administration and U.S. Fish and Wildlife Service (FWS) restrictions and regulations. A list of approved drugs for aquaculture use and additional information is available on the FWS website: <https://www.fws.gov/fisheries/aadap/home.htm>.

Disease prevention is much preferred over disease treatment. The aquaculturist can

help prevent disease by paying close attention to the long-term health history of the facilities and brood stocks from which they source their eggs and fish for importation to their facilities. Careful observation of populations within a facility, paired with close attention to maintaining a clean rearing environment are of the utmost importance. Other measures, including staying under stressful biomass levels and having dedicated fish culture tools and implements for each rearing unit are also critical.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

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It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

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2. There is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and
3. The veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the

veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

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## **SOUTH AMERICAN CAMELIDS**

### **MANAGEMENT OVERVIEW**

The Camelidae family consists of camels from Africa and Asia (Bactrian and Arabian) and those from South America (llamas, vicunas, alpacas, and guanacos). Llamas and alpacas make up the domestic population of camels owned in the United States. Llamas are most popular with fewer alpacas. Vicunas and guanacos are not as tame and considered less adaptable to domestic environments. Llamas and alpacas are used as pack animals, for producing textiles and clothing from their wool, as guard animals for sheep and goats, as companion animals, and in rare cases for meat and milk products; however recent indicators point to camelids playing a greater role in world food security (Zarrin, et al. 2020). Unlike our common species of farm livestock, information on the biological needs, breeding, genetics, behavior, nutrition and health management of camelids has not been studied as extensively. Owners of South American camelids should become knowledgeable to avoid problems associated with poor camelid welfare and management (Gunsser, 2013; also see: Llama and Alpaca Care... 2014).

Llamas and alpacas can be kept in conditions similar to cattle. They thrive more under natural conditions such as pasture, range, and well-managed dry lots, compared to confined areas such as stalls. They are ruminant-like animals similar to cattle, sheep and goats but walk on foot pads rather than hooves. Llamas and alpacas can be thrifty and have water conservation capability under dry conditions. They are considered medium sized animals with males being larger than females at maturity. Llamas are the largest of the South American camelids with males weighing up to 300 pounds. Alpacas are smaller and weigh up to 175 pounds. Both are considered docile animals with temperaments suited for domestic conditions. They may spit when threatened or provoked and can be protective of their offspring (cria).

### **MANAGEMENT PRACTICES**

**Nutrition:** Llamas and alpacas are three stomached animals. They are not true ruminates but possess complex multi-compartmentalized stomachs that engage foregut rather than hind gut fermentation. However similar to cattle, sheep, and goats regurgitate and chew cud (Bennett and Richards, 2015; San Martin and Van Saun, 2014). They are efficient foragers and browsers. Alpacas have similar nutritional habits and demands as llamas except alpacas are better browsers than grazers. Both can be fed grain concentrates to provide supplemental energy or protein. Grass or legume hays or grazing on quality pasture are excellent sources of roughage and general nutrition. Protein requirements for these camelids are lower than for common species of domestic livestock and range from 10 to 16 percent depending on stage of development or physiological state such as gestation and lactation (see National Research Council, 2007). As with other domestic livestock, water should be potable and easily accessible whether supplied from natural streams or ponds or artificial means such as buckets, troughs or automatic



devices. Troughs, buckets or other containers should be regularly cleaned. If animals are pastured, forage should be suitable for grazing and free of poisonous plants. Plants considered toxic to common livestock are also toxic to llamas and alpacas. Concentrate feeds or simple grains used for feeding other ruminant livestock are suitable for feeding llamas and alpacas. Texturized feeds, such as steam rolled corn and barley mixed with soy pellets, rather than a fully pelleted ration are preferred and result in less choking and compaction. Supplementation with mineral mix and salt is recommended. In selenium deficient areas supplementation with selenium is recommended along with Vitamin E. Good quality hay, free of molds and spoilage, can be fed in round or square bales and serve as a source of roughage when concentrates and/or brassicas are fed. The use of body condition scoring can assist in determining nutritional status of camelids (Bennett and Richards, 2015). A body condition score of three (1 – 5 scale) or six (1 - 10), with one being thin and three or six as obese, is considered to be ideal. Remedial action should be taken when body condition score is too low or too high. Monitoring of the body condition is recommended for females during pregnancy and lactation, cria during growth and all animals during the winter months. Feeder or trough and watered space should be sufficient to ensure that no distress or injury to animals is caused by competition for food and water. Camelids are hierarchal by nature and subordinate animals may get less feed or water when housed and fed in group situations.

**Reproduction:** Camelids are different from large livestock in reproductive traits. They are induced ovulators and behaviorally receptive to breeding throughout the year (Adams et al. 2018). Breeding occurs while the female is lying down. The normal length of camelid gestation is 335 to 365 days. The use of pasture and pen breeding is most common and an acceptable strategy. Consideration should be given to time of breeding with respect to season and average daily temperature at the time of birth. Winter births require close management of mother and young and can be difficult for the cria. Shelter should be provided for winter birthing and periods of inclement weather. Keeping the cria warm and vigilance with respect to energy intake is important to managing winter births.

**Handling:** The llama and alpaca are a social herd-dwelling prey animal. They respond best to calm, slow and quiet handling. Camelids are best handled using calm and gentle encouragement and visual and audio cues rather than physical contact. They are smart and instinctual animals and if they perceive danger, they will take flight. Camelids can be desensitized to environmental stimuli and trained for healthy interactions with humans (Bennett and Richards, 2015). Social order is kept through maintenance of a social hierarchy. Pregnant females or females with nursing young can be temperamental and protective. Intact males may show dominance and require more experienced handlers. Understanding the natural behavior of llamas and alpacas will help avoid injury to animals and human handlers (McLennan and Chapman, 2018). Llamas and alpacas can be halter broken and led. Halters should be adjusted so nose bands ride in the middle of the nose. Low riding nosebands may cut off breathing.

When loose, llamas and alpacas can be herded as a group. Llamas and alpacas may panic if separated from the herd. Unless specifically trained to calmly accept well-trained stock dogs, the use of dogs to herd llamas or alpacas is not recommended. Restraining

chutes or stocks that are adjusted to accommodate size and body shape work well for conducting preventative or therapeutic health procedures or standard care practices such as nail trimming. Depending on size, docility and training, many common care procedures can be carried out with minimal restraint. To prevent fear and induce calmness during common care procedures, camelids should not be hit, lifted by fleece, head, neck, ears, or tails twisted to gain cooperation. Electric prods are not recommended for use with camelids.

**Transportation:** Llamas and alpacas can be conditioned to ride in a variety of transport vehicles including trucks and trailers designed for livestock or vans that have been properly prepared for the animal and avoid injury or interference with the driver. Safety and comfort should be of primary importance in the transport of llamas or alpacas (Chastain, 2017). Llamas and alpacas can be loaded loose into a transport vehicle or led by halter and loaded. Larger animals can walk or lightly jump into the transport vehicle. Small adult or young llamas or alpacas can be carried into the vehicle. Principles of calm and quiet handling are important to low stress transport. Llamas and alpacas tend to lie down during transport and should not be tied inside the vehicle. Space allotment should sufficiently accommodate lying down, resting posture and standing-up without struggle or seriously impacting an adjacent animal if more than one animal is being transported. Attention to weather conditions such as high heat or extreme cold, vehicle ventilation and animal coat condition (wool or sheared) are important to avoiding heat or cold stress. Seriously debilitated or non-ambulatory animals should not be transported unless they can be appropriately accommodated without further injury or distress and the purpose of transport is to obtain medical care. A delay or cancellation of transport should occur for animals that appear unhealthy, dehydrated, or exhausted and unfit to withstand travel.

## **RECOMMENDATIONS FOR THE ENVIRONMENT**

Alpaca and llamas are known as being tidy. They tend to defecate in specific areas away from grazing and feeding areas. These areas should be cleaned of dung piles periodically depending on size of paddock. In barn situations manure should be managed to prevent significant build up or wet areas. Areas should be kept bedded and dry within covered facilities. Pastures should be managed to maintain forage base (if the primary source of nutrition) and minimize parasite loads (Bennett and Richards, 2015). A general rule of thumb for stocking rate on a good quality pasture is 2 – 3 llamas or 4-5 alpacas per 2 acres. Dry lots should be of sufficient size and well drained to avoid mud conditions during rainy periods and retain cover to prevent dusty conditions when dry. Protection of surface waters and conservation practices to minimize soil erosion is part of good environmental stewardship. As with any livestock operation good hygiene and adherence to current local, state (Michigan GAAMPs) and federal guidelines and requirements is important to maintaining good community relations.

## **FACILITIES AND EQUIPMENT**

**Shelter:** Llamas and alpacas are suited to outdoor and semi-confined housing systems such as three-sided sheds and barns of various configurations (Bennett and Richards,

2015). Attention should be given to provision of space within the shelter so that it is easily accessible to all animals in the group. As wool-bearing animals, special attention to hot conditions and the mitigation of heat stress through shearing and/or the provision of shade from natural or constructed shelter is recommended. Alpacas are especially hardy and adapted to cold weather conditions under normal cold conditions and under good care. The timing of shearing should be adapted to account for local weather conditions as the status of the fleece carries significant impact on the animal's vulnerability to weather conditions (Gerken, 2010). For animals housed outdoors, natural shelter belts or artificial shelters should be available for relief during extreme cold or inclement conditions. Crias are more susceptible to cold stress for a week after birth and should be sheltered during this period. Indoor housing should provide enough space such that all camelids are able to lie down and rest simultaneously and be kept dry and well ventilated. Waste and contaminated bedding material should not accumulate to the extent it poses a health threat to the animals. Waste disposal should be in accordance with the most current Michigan Manure GAAMPs.

**Fencing:** Exterior fencing should be higher than fencing used for common domestic livestock and should keep deer out. Deer fencing or custom constructed livestock fencing with heights sufficient to prevent escape or entrapment are strongly recommended. Electric fencing is not recommended for containment of camelids.

## HEALTH CARE AND MEDICAL PROCEDURES

Health care programs for llamas and alpacas include addressing nutritional requirements, preventative health care measures such as vaccinations, parasite control, foot care, and emergency procedures in case of injury or illness as appropriate to local conditions (Björklund et al. 2019; Jones and Boileau, 2009; see Llama and Alpaca Care., 2014). All animals should be observed daily for signs of illness, injury, or abnormal behavior. Procedures requiring invasion of the body cavity (like castration) or that result in pain or distress should be carried out by a veterinarian or properly trained and experienced individual. Assistance of a veterinarian in developing a health care program is strongly recommended.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for

use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. There is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and
3. The veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

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## HONEY BEES

### MANAGEMENT OVERVIEW

This section covers the care of European or Western honey bees (*Apis mellifera*). While other bees such as bumble bees and mason bees may be managed for pollination or other purposes, guidelines for their care are not covered here.

Honey bees can be managed for honey production, pollination services, breeding (queen, nuc, or package production), hive products (wax, pollen, or propolis), or a combination of these purposes. Beekeeping operations in Michigan vary from a few colonies to thousands of colonies. Many hobby and small-scale beekeepers maintain honey bee operations that are largely stationary, but most of the honey bee colonies in Michigan are transported within the state and throughout the country as part of commercial operations. As there is no system of registration for honey bees in Michigan, it is unknown how many colonies are managed in the state, and it is thought that relatively few feral or wild honey bee populations remain in Michigan.

Honey bees in Michigan are faced with a variety of interacting threats including pests, parasites, pesticides, and poor nutrition due to a lack of flowers on the landscape. Because of these threats, honey bee colonies generally require significant intervention in order to meet their nutritional needs and to maintain their health and well-being. Beekeepers should become knowledgeable in pest control, nutrition, disease management, and seasonal care in order to maintain colonies that can survive from year to year and remain in good health.

### MANAGEMENT PRACTICES

#### Handling:

Handling honey bees requires care and caution to minimize stress on the colony and stings to nearby humans and animals. Routine handling, including queen inspections, disease inspections, mite monitoring, miticide or antibiotic administration, feeding, splits, and adding or removing hive boxes should be scheduled and performed as efficiently as possible. Smokers should be judiciously used to lessen defensive behavior and to minimize crushing bees with equipment. Beekeepers should try to perform hive manipulations as quickly as possible while minimizing disturbance to the bees. It is best if extended hive manipulations, particularly removing honey, are carefully planned to accommodate neighbors' activities.

#### Nutrition:

Honey bee colonies should always have access to proper nutrition to maintain good health. Poor nutrition is a serious condition for honey bee colonies; insufficient nutrition can worsen the effects of pests and pathogens, and even short periods with insufficient food can have long-term consequences for the health of the colony. Honey bees require both protein and carbohydrates. Protein is available as pollen from flowering plants or

through commercially available supplemental products (i.e., pollen patties). Carbohydrates are available through nectar from flowering plants, stored honey in the hive, or supplemental feeding of sugars. Because of the risk of disease, bees should not be fed honey from other operations or purchased hive products, though honey bee colonies may be supplemented with food (frames of pollen or honey) from within a beekeeper's own operation.

In many places in Michigan, during most years, established, full-size honey bee colonies have access to adequate natural forage (flowers) to provide sufficient pollen and nectar for feeding and storage in the hive. However, there are times of the year when even full-size honey bee colonies may not be able to obtain sufficient food from the environment or may need supplemental feed to prepare for periods without food. Examples include droughts, periods of dearth (when food-producing flowers are not available), prolonged rain that hinders foraging, and in preparation for winter. In cases where bees do not have sufficient excess stores or when incoming food is not available, beekeepers should provide supplemental feed, so the colonies are never under nutritional stress. Colonies should never show signs of starvation, indicated by a lack of stored/excess resources (pollen and nectar/honey) in the hive.

Newly established colonies (nucs, splits, and packages) generally do not have enough foragers to provision the colony with sufficient resources for growth. Therefore, newly established colonies should be provided with both protein and carbohydrates. Liquid sugar feed should be supplied until the colony has reached sufficient size, indicated by either a cessation of accepting supplemental liquid feed or when the colony has grown sufficiently to add supers for honey collection and there is stored liquid feed and/or nectar stored in the hive. Pollen patties should be fed until excess stored pollen can be observed in frames in the brood nest.

**Recommendations for Neighbor Relations:** One of the primary issues with keeping bees is the real or perceived interaction between the bees and the people who live in or use the surrounding area. When honey bees are foraging, they are dispersed over a large area (several thousand acres), but special consideration should be taken in the vicinity of the hives. Beekeepers should manage the density, placement, and orientation of their hives as outlined below to minimize interaction and conflict with humans and animals.

**Hive Density:**

Lot sizes that are smaller than 1 acre can have no more than 6 full size colonies. Beekeepers may maintain additional nucleus colonies (<10 frames of bees) for making splits and swarm management.

**Hive Placement:** Appropriate placement of hives is an important consideration for responsible beekeeping. Unwanted disturbances and visits near the hives can be minimized by reducing the visibility of the hives from high traffic areas and by restricting access. For example, hives can be placed behind barriers, closed in with fencing, or placed on a rooftop. Hives should be placed on a part of the property that will minimize

interaction with humans and animals, and should not be directly adjacent to sidewalks, trails, public rights of way, or any places that receive high human or animal traffic.

**Hive Orientation:**

The area directly in front of the hive entrance (the flight path) can become busy with bees entering and leaving the hive, and therefore requires special consideration. The flight path area is directly in front of any hive entrance, extending for about 10 feet from each entrance. The flight path area is where bees are most likely to defecate and where humans and animals are more likely to get stung. As the high traffic of foragers can result in bees inadvertently becoming tangled in clothing or fur. Flight paths should be managed to minimize defecation on neighboring property such as cars and decks and to minimize the chance of human or animal interaction.

Flight paths can be managed by distance, hive entrance orientation, height, and/or barriers.

Hives should be oriented so that hive entrances are not pointing directly at high traffic areas, and the bees should be directed to fly above human height before they reach high traffic areas or neighboring property. Honey bee foragers that are flying high above human height are likely to stay at that height until they reach their destination. Flight paths can be directed above human height by keeping hives at a high level (e.g. roof tops). Distance can also be used as foraging bees reach a height of about 6 feet in a span of 15 feet (Matsuzawa 2022). In places where a 15 foot setback is not possible, flight paths may be managed by installing a barrier that redirects the bees to fly up above human height directly when leaving the hive. Appropriate barriers should be within 3-15 feet of the entrance (Matsuzawa 2022), should be at least 6 feet tall, and made of anything that is sufficiently dense to redirect the flight path, including shrubs, lattice, or privacy fences. The barrier should extend sufficiently past the hives to prevent the bees from flying directly around it; generally, a barrier 10 feet in length is sufficient, but this may have to be extended if the bees are flying around the barrier rather than being redirected up and over it.

For further information, and diagrams, refer to the document “Residential Beekeeping Best-Practices for nuisance-free beekeeping in Oregon”:

<https://catalog.extension.oregonstate.edu/em9186>

**Swarming:**

If unmanaged, a honey bee colony will naturally reproduce by swarming, with part of the colony remaining in the hive, and the other part of the colony (the swarm) seeking a new hive location. These swarms can become a nuisance when they set up hives in structures such as barns or houses, so beekeepers should manage their colonies to deter swarming. In Michigan, most swarming occurs during late spring and early summer, and colonies should be closely monitored during this time for signs of imminent swarming (backfilling of nectar into the brood nest and the appearance of queen cells) and should

take action to deter swarming. Generally, this requires dividing (splitting) the colony, but other methods may also be used, including brood chamber manipulation, removal of brood frames, swapping hive locations, or removal of the queen. These and other management practices to deter swarming are explained in detail in good beekeeping textbooks, online, and in the resource [Swarms: the biology and control of swarms in northern states](#).

Honey bee colonies can also swarm if the colony becomes overcrowded or the brood nest becomes filled with nectar. Beekeepers can avoid this issue by ensuring that there are adequate boxes (supers) to accommodate incoming resources and colony growth during the active season. Beekeepers who learn of a swarm should take reasonable measures to see that the swarm is retrieved if they can do so safely.

#### **Provision of Water:**

Bees use a large amount of water for drinking, to maintain temperature and humidity within the hive, and to re-liquefy crystalized honey. Beekeepers should assure an adequate and reliable source of water for their bees prior to establishing an apiary. Where adequate and consistent water from a nearby pond or stream is not available, beekeepers should establish a water source within the apiary that will be available consistently (without drying out) throughout the active flight season, and that is designed to have safe surfaces for the bees' access to minimize drowning.

**Queens:** When a colony exhibits unusually defensive characteristics (stinging or attempting to sting without provocation), or exhibits a frequent tendency to swarm,, it is the beekeeper's duty to re-queen from European stock.

It is also best practice to replace queens as they get older or as they begin to fail to ensure that the colony maintains strong numbers of healthy brood when needed.

#### **Facilities and equipment:**

Honey bee colonies should be kept in hives that allow the beekeeper to perform health inspections without causing unnecessary damage to the bees or to the comb. The comb must be managed on frames that allow the beekeeper to visualize cell contents for the purposes of inspecting for eggs to determine queen presence, for signs of disease, and for sufficient food. Honey bee colonies should be kept in hives that are large enough to allow for sufficient space for growth and incoming food resources.

Beekeepers should regularly replace comb to minimize pesticide and pathogen buildup within the hive. To prevent the buildup of hive pests such as small hive beetles and wax moths, old comb should be promptly disposed and should not be left in the open where other bees can rob from it.

**Robbing Behavior:** When nectar is scarce, honeybees may rob honey from other hives. Robbing plays a significant role in disease transmission, and beekeepers should work to minimize conditions that can encourage robbing behavior. Robbing is most common in late summer and fall, but can occur whenever there is insufficient forage, such as a drought. During times of insufficient forage (indicated by lack of nectar coming into the

hive), beekeepers should work in hives only as necessary and should minimize the time that hives are open. Care should be taken to cover exposed honey frames, sticky equipment, or spills that may encourage robbing. Robbing can also be minimized by reducing entrances, employing the use of robbing screens, and by combining small colonies into larger units. Beekeepers with sick or small colonies should maintain robbing screens or reduced entrances to prevent the spread of disease to neighboring colonies.

Special care should be taken at honey houses and extraction facilities, which can attract large numbers of honey bee foragers. All spilled honey should be cleaned up immediately, and wet frames (frames with honey) and equipment should be stored either in a bee tight area or away from humans and animals. Buildings and trailers used for honey extraction must be made bee-proof, as much as is practical.

**Transportation of Hives:** Beekeepers must take appropriate care when transporting hives of honeybees in order to minimize both stress to colonies and the potential to create a public nuisance. Loads of hives and equipment must be secured during transport to prevent shifting or loss. Bees being transported during daylight hours or where stops for fueling or other purposes are anticipated should have entrance screens affixed to each hive or should be confined as a group under netting to minimize the escape of bees during transport.

Overheating is a serious threat to honey bee colonies during transport, and honey bee colonies can die or become severely damaged as a result of high temperatures. In transport, hives should be arranged to allow for airflow around hives. When colonies are transported in enclosed trailers or vehicles, screens should be used to close off entrances while allowing airflow, and screened lids and bottom boards may also be employed to increase ventilation and reduce overheating risk. Care should be taken in timing of breaks so that bees are not kept without moving air and in high temperatures for extended periods. For more guidance on hive transport, see RTE3131A Transport livestock (bees):

[https://training.gov.au/TrainingComponentFiles/RTE03/RTE3131A\\_R1.pdf](https://training.gov.au/TrainingComponentFiles/RTE03/RTE3131A_R1.pdf)

### **Use of Consolidation Yards:**

Migratory beekeeping practices include the use of temporary consolidation yards (also known as holding yards or loading yards) where beekeepers bring many honey bee colonies together to facilitate inspection, management, and reallocation of colonies to production yards or pollination sites. Holding yards may contain hundreds or even thousands of colonies. Yards containing over 100 colonies should be over 200 feet from any non-farm residence or business.

During periods of cold, honeybees cluster in the hive and little or no activity is observed. It is considered acceptable practice to overwinter large numbers of colonies in one location to facilitate efficient feeding and care, and no problems are anticipated if the beekeeper disperses the colonies before the bees become active in the spring. There is no limit to the number of honeybee colonies that can be in a consolidation yard or



overwintering facility during periods when the bees are not active.

More information on best practices for indoor overwintering can be found in the Project Apis M. Guide to Indoor overwintering <https://www.projectapism.org/indoor-storage-of-honey-bees.html>

During the active season (when weather permits regular flight), bees in consolidation yards will begin to forage for food and water. In the case of overwintering yards, bees must have access to water as soon as weather permits flight, and all colonies must have sufficient stores of honey or should be provisioned with feed. For colonies that are shipped to holding yards as part of migratory beekeeping, adequate food and consistent access to water must be provided in holding yards no later than the day that bees are unloaded.

In most cases it is to the beekeeper's benefit to quickly disperse colonies from a consolidation or holding yard, and beekeepers should make an effort to efficiently relocate hives from consolidation yards to production yards or pollination contracts, reducing the local density of bees. However, unforeseen factors including weather and the timing of pollination needs can inhibit the dispersal of colonies and must be taken into account when deciding when where to bees can be safely unloaded.

## HEALTH CARE

**Disease Control:** Honey bee diseases must be managed for the welfare of the colony and to prevent the spread of disease to other operations within the flight range. Beekeepers should be extremely cautious about moving hive equipment between apiaries or purchasing hives or equipment from other operations.

**Pharmaceutical Use:** To ensure continued human and animal food safety, the US Food and Drug Administration (FDA) Center for Veterinary Medicine (CVM) has developed a 5 year Veterinary Stewardship Plan designed to slow the emergence of antimicrobial resistance that can arise from the use of antibiotics in animals while ensuring safe and effective use of medically important antibiotic use in animals and humans. Medically important antibiotics include cephalosporins, gentamicin, lincomycin, oxytetracycline, penicillin G procaine and benzathine, sulfadimethoxine, sulfamethazine and tylosin, are important to both human and animal health. The intent of this legislation is to ensure that these drugs are used under veterinary supervision, reducing the chance for antimicrobial resistance in humans.

As of June 11, 2023, the FDA expects that all over the counter (OTC) medically important antibiotics in dosage forms such as injectable, intramammary, and boluses, approved for use in animals (both food-producing and companion), will require a prescription from the veterinarian with whom they have a valid VCPR to purchase the drugs. The following statement will be included on the label ***“Caution: Federal law restricts this drug to use by or on the order of a licensed veterinarian”***.

It is imperative that those engaged in raising livestock (including bees) and poultry for human consumption understand the prudent and legal use of pharmaceutical products. To help ensure that health and welfare of livestock and poultry and the safety of food they produce for the public, a veterinary-client-patient relationship (VCPR) is highly recommended. In most cases, a valid VCPR is mandatory for acquiring and using pharmaceutical products in food producing animals i.e. veterinary feed directive and medically important antimicrobial drugs. Michigan currently follows the federal definition for a VCPR which states that a VCPR is considered valid if the following is observed (Code of Federal Regulations 530.3)

(<http://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm460406.htm>):

1. A licensed veterinarian has assumed the responsibility for making medical judgments regarding the health of (an) animal(s) and the need for medical treatment, and the client (the owner of the animal or animals or other caretaker) has agreed to follow the instructions of the veterinarian;
2. There is sufficient knowledge of the animal(s) by the veterinarian to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s); and
3. The veterinarian is readily available for follow-up in case of adverse reactions or failure of the regimen of therapy. Such a relationship can exist only when the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of examination of the animal(s), and/or by medically appropriate and timely visits to the premises where the animal(s) are kept.

### **Euthanasia**

There are two circumstances under which the euthanasia of a honey bee colony is recommended. The first and primary reason is to prevent the spread of pathogens from a sick colony to surrounding hives or operations. This is warranted if a colony is confirmed to be infected with *Paenibacillus larvae*, the causative agent of American foulbrood (AFB), due to the highly infectious and virulent nature of the disease and the persistence of infective spores in the environment. In this circumstance, burning and burial/proper disposal of hive material and sterilization of all material in contact with the hive is recommended. Wooden equipment should be burned where possible. Frames with plastic foundation, polystyrene hive bodies and other equipment not suitable for burning should be double bagged in thick plastic bags and taken to a disposal facility or commercial incinerator (Lopez-Urbe, 2019). Euthanasia may also be recommended for colonies where disease is too severe for the colony to be expected to recover and survive transport or overwintering, including severe European Foulbrood, laying workers, or unmanaged varroa mite populations.

The second reason where euthanasia is recommended is if a colony is displaying excessively defensive behavior that is deemed to be a risk to humans or surrounding livestock. Determining what constitutes excessively defensive behavior is often subjective

and requires the assessment of an experienced beekeeper.

In both cases euthanasia should take place in the late evening when foraging bees have returned to the colony or early morning before they have emerged, and the hive should be closed and sealed to prevent any bees from escaping. Humane methods of euthanasia must induce a rapid loss of consciousness and minimize pain and distress to the honey bees outlined and include a variety of options outlined in “Euthanasia and welfare of managed honey bee colonies” (Mutanelli, 2021). Diesel fuel, 70% isopropyl alcohol, and soapy water methods are all acceptable methods of euthanasia of a colony in the field, but soapy water is not appropriate for colonies that are in equipment that must be burned following euthanasia.

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### **Minimizing Pesticide Exposure During Pollination:**

While the risk of pesticide exposure is always present to foraging honey bees, special care should be taken when colonies are engaged in commercial pollination or in the vicinity of crops. Honey bee colonies should be placed in a manner to minimize exposure to pesticide drift, and beekeepers and growers should engage in open communication regarding spray schedules and risk. More information on minimizing pesticide exposure can be found in our state Managed Pollinator Protection Plan:

Communication strategies for reducing pesticide risk for managed pollinators in Michigan:  
<https://pollinators.msu.edu/programs/protection-plan>

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## **ADDENDUM: OTHER STATE AND FEDERAL LAWS AND REFERENCES**

In no way do the GAAMPs outlined in this publication supplant international, federal, and(or) state laws, regulations, and(or) standards as they relate to farm animal production and well-being. For that reason, examples of related practices that are intentionally omitted or otherwise covered only briefly in these GAAMPs include:

### **Federal and State Animal Welfare Regulations**

Although the U.S. Animal Welfare Act<sup>1</sup> does not provide comprehensive regulation for treatment of farm animals raised for food, it does regulate animal care in research, shows and exhibitions, and the transport of livestock, including the handling, loading, and unloading of animals. The Michigan Animal Industries Act<sup>2</sup> authorizes the state veterinarian within the Michigan Department of Agriculture and Rural Development (MDARD) to protect the human food chain and the livestock industry through prevention, control, and eradication of infectious or toxicological diseases of livestock.

### **Identification and Traceability of Livestock**

The United States Department of Agriculture (USDA) Animal Plant and Health Inspection Service – Veterinary Services (APHIS-VS) regulates required farm animal identification and traceability per the Animal Health Protection Act of 2002<sup>3</sup>. The Michigan Animal Industry Act<sup>2</sup> has additional requirements for animal identification, traceability, and farm animal premises registration.

### **Animal Enclosures**

Michigan law governs the keeping of farm animals<sup>4</sup> and privately owned cervidae<sup>5</sup> within defined boundaries.

### **Manure Management**

Federal authority is given to the Environmental Protection Agency (EPA) in the Clean Water Act<sup>6</sup>, to regulate discharge of pollutants, including manure, into the waters of the U.S. In Michigan, the Michigan Natural Resources and Environmental Protection Act (NREPA)<sup>7</sup> protects waters of the state from the release of pollutants in quantities and(or) concentrations that violate established water quality standards. The NREPA references the GAAMPs for Manure Management / Utilization<sup>8</sup>, which covers aspects of farm animal manure management including, runoff control, odor management, manure storage facility design, manure application to land, record keeping, and manure management system plans.

### **Site Suitability and Odor Control**

The GAAMPs for Site Selection and Odor Control for New and Expanding Livestock Facilities<sup>9</sup> provides guidance on the suitability of sites and construction of new and expanding livestock, livestock production, and(or) manure storage facilities.

### **Air Pollutants**



The federal Clean Air Act<sup>10</sup> regulates the emission of air pollutants, including those from livestock operations.

### **Animal Disease and Zoonotic Disease Transmission**

The major functions of the World Organization for Animal Health (WOAH) are to collect and disseminate information on the distribution and occurrence of animal diseases and to ensure that scientifically based standards govern international trade in animals and animal products. The WOAH helps to achieve this through the development and revision of international standards for diagnostic tests and vaccines, and for the safe trade of animals and animal products. The USDA APHIS-VS is authorized under the Animal Health Protection Act<sup>11</sup> to take actions to prevent the spread of animal diseases. The USDA APHIS-VS protects and improves the health, quality, and marketability of our nation's animals, animal products and veterinary biologics by preventing, controlling and(or) eliminating animal diseases, and monitoring and promoting animal health and productivity. Within Michigan the MDARD Animal Industry Division (AID) protects the public's health and the health of livestock. The State Veterinarian is responsible for overall livestock and poultry disease programs and toxic substance contamination concerns as they relate to animal health. The MDARD AID also works on the eradication of animal diseases under authority of the Michigan Animal Industries Act<sup>12</sup>.

### **Humane Harvest**

Conditions under which farm animal and poultry harvest is permitted and procedures for the humane handling, stunning, and slaughter is regulated federally by the Federal Meat Inspection Act<sup>13</sup>, Poultry Products Inspection Act<sup>14</sup>, and Humane Slaughter Act<sup>15</sup> and in Michigan is also regulated under Michigan Food Law<sup>16</sup>.

### **Euthanasia and Depopulation**

The USDA APHIS-VS is responsible for protecting animal health and welfare, as well as preventing the spread of animal diseases. The USDA APHIS-VS is authorized under the Animal Health Protection Act<sup>3</sup> to take actions to prevent the spread of animal diseases, including the depopulation of animals that are infected with or exposed to a serious and highly contagious disease. Federal authorities, in conjunction with State and Tribal agricultural officials and industry follow the recommendations outlined by the American Veterinary Medical Association for the euthanasia<sup>17</sup> or depopulation<sup>18</sup> of animals.

### **REFERENCES:**

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- <sup>14</sup> Poultry Products Inspection Act. 21 U.S.C. §§ 451–472. Available: <https://www.ecfr.gov/current/title-9/part-381>
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- <sup>17</sup> American Veterinary Medical Association. 2020. AVMA Guidelines for the euthanasia of animals: 2020 Ed. Available: <https://www.avma.org/sites/default/files/2020-02/Guidelines-on-Euthanasia-2020.pdf>
- <sup>18</sup> American Veterinary Medical Association. 2019. AVMA Guidelines for the depopulation of animals: 2019 Ed. Available: <https://www.avma.org/sites/default/files/resources/AVMA-Guidelines-for-the-Depopulation-of-Animals.pdf>

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# Generally Accepted Agricultural and Management Practices for Site Selection and Odor Control for New and Expanding Livestock Facilities

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**DRAFT 2025**

Michigan Commission of Agriculture  
and Rural Development  
P.O. BOX 30017  
Lansing, MI 48909

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**In the event of an agricultural pollution emergency such as a chemical or fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture and Rural Development (MDARD) and/or Michigan Department of Environment, Great Lakes, and Energy (EGLE) should be contacted at the following emergency telephone numbers:**

**MDARD Agriculture Pollution/Spills Hotline: 800-405-0101**

**EGLE Pollution Emergency Alerting System Hotline: 800-292-4706**

**If there is not an emergency, but you have questions on the Michigan Right to Farm Act, or items concerning a farm operation, please contact the:**

**MDARD Right to Farm Program  
P.O. Box 30017  
Lansing, Michigan 48909  
517-284-5619 Local Phone  
877- 632-1783 Toll Free Phone  
517-335-3329 FAX**

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## PREFACE

The Michigan Legislature passed into law the Michigan Right to Farm Act ([Act 93 of 1981](#))<sup>1</sup> which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). GAAMPs for Site Selection and Odor Control for New and Expanding Livestock Facilities (Site Selection) are written to fulfill this purpose and to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require necessary revision of these GAAMPs.

The eight GAAMPs are as follows:

- 1) 1988 Manure Management and Utilization
- 2) 1991 Pesticide Utilization and Pest Control
- 3) 1993 Nutrient Utilization
- 4) 1995 Care of Farm Animals
- 5) 1996 Cranberry Production
- 6) 2000 Site Selection and Odor Control for New and Expanding Livestock Facilities
- 7) 2003 Irrigation Water Use
- 8) 2010 Farm Markets

These practices were developed with industry, university, and multi-government agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices may be provided protection from public or private nuisance litigation under the Michigan Right to Farm Act.

This GAAMP does not apply in municipalities with a population of 100,000 or more in which a zoning ordinance has been enacted to allow for agriculture provided the ordinance designates existing agricultural operations present prior to the ordinance's adoption as legal nonconforming uses as identified by the Michigan Right to Farm Act for purposes of scale and type of agricultural use.

The website for the GAAMPs is <https://www.michigan.gov/mdard/environment/rtf> .

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<sup>1</sup> <https://www.legislature.mi.gov/documents/mcl/pdf/mcl-Act-93-of-1981.pdf>

## INTRODUCTION

Generally Accepted Agricultural and Management Practices for Site Selection and Odor Control for New and Expanding Livestock Facilities (Site Selection GAAMPs) are developed to establish uniform, statewide standards, and management practices to determine the suitability of sites to place or keep any number of livestock in Michigan.

These GAAMPs, which are based on sound science and recommendations from agency and industry experts, are reviewed annually, revised as considered necessary, and adopted by the Michigan Commission of Agriculture and Rural Development pursuant to the Michigan Right to Farm Act. They are intended to provide guidance for the placement and construction of livestock facilities, and/or associated manure storage facilities.

Site selection for new and expanding livestock facilities is a complex process, and each site should be assessed individually in terms of its proposed use, including water quality preservation, controlling odors, minimizing social conflicts, working within existing land ownership constraints, and compliance with all state and federal regulations. These GAAMPs emphasize the importance of site-specificity in siting decisions. Specific criteria are not equally applicable to all types of operations and all locations.

Appropriate use of technologies and management practices to utilize nutrients, mitigate odors, and prevent polluted runoff are components of the required Site Plan and Manure Management System Plan. The implementation and record keeping specified in these plans will minimize the risks of environmental degradation and nuisance odors associated with animal agriculture production.

These GAAMPs are referenced in Michigan's Natural Resources and Environmental Protection Act (NREPA), [Public Act 451 of 1994](https://legislature.mi.gov/Laws/MCL?objectName=MCL-ACT-451-OF-1994)<sup>2</sup>, as amended. NREPA protects the state's air and water quality from release of pollutants in quantities and/or concentrations that violate established water quality standards. Surface water discharges are regulated as violations of NREPA's [Part 31](https://legislature.mi.gov/Laws/MCL?objectName=MCL-451-1994-II-1-31)<sup>3</sup> Rules, Water Resources Protection. Obnoxious odor(s) is regulated as nuisance under [Part 55](https://www.legislature.mi.gov/(S(yhdb2h452diubtihenwzpt45))/documents/mcl/pdf/mcl-451-1994-II-1-AIR-RESOURCES-PROTECTION-55.pdf)<sup>4</sup>, Air Pollution Control, of the NREPA. Agricultural producers who voluntarily follow these practices may be protected from public or private nuisance litigation under the Michigan Right to Farm Act.

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<sup>2</sup> <https://legislature.mi.gov/Laws/MCL?objectName=MCL-ACT-451-OF-1994>

<sup>3</sup> <https://legislature.mi.gov/Laws/MCL?objectName=MCL-451-1994-II-1-31>

<sup>4</sup> [https://www.legislature.mi.gov/\(S\(yhdb2h452diubtihenwzpt45\)\)/documents/mcl/pdf/mcl-451-1994-II-1-AIR-RESOURCES-PROTECTION-55.pdf](https://www.legislature.mi.gov/(S(yhdb2h452diubtihenwzpt45))/documents/mcl/pdf/mcl-451-1994-II-1-AIR-RESOURCES-PROTECTION-55.pdf)

## DEFINITIONS

AS REFERENCED IN THESE GAAMPs:

**Adjacent Property** – Land owned by someone other than the livestock facility owner that borders the property on which a proposed new or expanding livestock facility will be located.

**Alternative Mitigation Plan** – A plan or description of alternative mitigation a livestock facility plans to use should the effectiveness of the original management practice(s) included in the Odor Management Plan, but not under the direct control of the livestock facility, diminishes.

**Animal Units** – Defined in

**Table 1.** For those instances not defined in **Table 1**, one animal unit is defined as one-thousand pounds of live weight.

**Community Relations Plan** – A strategy plan to be implemented to establish and maintain a working relationship with neighbors and community members. It is a plan within the Odor Management Plan.

**Distances Between a Livestock Facility and Non-Farm Residences** – The span from a livestock facility and a non-farm residence is measured from the nearest point of the livestock facility to the nearest point of the non-farm residence.

**Existing Livestock Facility** – A livestock facility that has not increased the animal unit capacity within the last three years where animals are confined.

**Expanding Livestock Facility** – A contiguous addition to an existing livestock facility to increase the animal unit capacity.

A manure storage structure change or installation to accommodate an increase in animal unit capacity within three years from the construction of the manure storage is an expanding livestock facility.

Manure storage structure change or installation at an existing livestock facility to accommodate already existing animal unit capacity is not an expanding livestock facility.

**High Public Use Areas** - Are locations with high density of individuals during certain periods of time, either time of day or time of year. High public use areas are hospitals; churches; licensed commercial elder care facilities; licensed commercial childcare facilities; school, government, commercial, professional, office or retail buildings; publicly accessible parks or campgrounds (excluding terrestrial and aquatic trails).

**Institutional Controls** – Land or resource use restrictions required by state or federal environmental laws to reduce or restrict exposure to hazardous substances, to eliminate a potential exposure pathway, to ensure the effectiveness and integrity of contaminant or exposure barriers, to provide for access, or to otherwise assure the effectiveness and integrity or response activities taken in response to environmental contamination.

Institutional controls include, but are not limited to, local ordinances or state laws and regulations that limit or prohibit the use of contaminated groundwater, prohibit the raising of livestock, prohibit development in certain locations, or restrict property to

certain uses.

**Livestock** – For purposes of the Site Selection GAAMPs, livestock means those species of farm animals used for human food, fiber, fur, recreation and (or) service to humans (e.g., horse and oxen to pull farm equipment). Livestock includes, but is not limited to, cattle, sheep, new world camelids, goats, bison, privately owned cervids, ratites, swine, equine, poultry, and rabbits.

**Livestock (cont'd)** For the Site Selection GAAMPs, livestock does not include dogs and cats. Site Selection GAAMPs do not apply to aquaculture and bees.

**Livestock Farm Residence** - A residential structure owned or rented by the livestock farm operation and those residential structures affiliated by contract or agreement with the livestock facility.

**Livestock Facility** – Any place where livestock are kept and/or the associated manure storage structures are located regardless of the number of animals. Sites such as loafing areas, confinement areas, or feedlots, which have livestock densities that preclude a predominance of desirable forage species as vegetation, are considered part of a livestock facility. This does not include pastureland. Any livestock facility within 1,000 feet of another livestock facility, and under common ownership, constitutes a single livestock facility.

**Manure Storage Structure Change or Installation** – An alteration or addition to manure storage at a livestock facility. Size is based on the greater of total animal units housed or animal units served by the facility's manure storage structures.

**Migrant Labor Housing Camp** – Agricultural employee housing that is licensable by MDARD. For purpose of this GAAMP, a migrant labor housing camp owned by a livestock producer applying for Site Selection GAAMP approval will be considered a livestock farm residence.

**New Livestock Facility** – A place where livestock will be kept and/or manure storage structure will be built at a new site and is not part of another livestock facility. A new livestock facility is also a place that is 1) expanding the animal unit capacity for livestock by 100 percent or greater and the resulting holding animal unit capacity will exceed 749 animal units, or 2) any construction to expand animal unit capacity within three years of completion of an existing facility documented in MDARD's final verification letter and the resulting animal unit capacity will exceed 749 animal units.

**Non-Farm Residence** – A residential structure that is habitable for human occupation and is not affiliated with the specific livestock facility.

**Odor Management Plan** – A plan of proposed practice(s) and action(s) to reduce frequency, intensity, duration, and offensiveness of odors.

**Offsite Manure Storage Facility** - A manure storage facility constructed at a site not adjacent to the livestock facility.

**Pastureland** – Land primarily used for the production of forage, upon which livestock graze. Pastureland is characterized by a predominance of vegetation consisting of desirable forage. Heavy-use areas within pastures are part of the pastureland. Examples of heavy-use areas include animal travel lanes and small areas immediately

adjacent to shade, feed, water, supplement, or rubbing stations.

**Primarily Residential** – Sites with more than 13 non-farm residences within 1/8 mile of the livestock facility or have any non-farm residence(s) within 250 feet of the livestock facility.

**Property Line Setback** – The distance from the livestock facility to the property line as measured from the nearest point of the livestock facility to the nearest point of the livestock facility owner's property line. If a producer owns land across a road, the road or right of way does not constitute a property line. Right of way setbacks for public roads, utilities, and easements apply.

**Table 1.** Animal Unit(s) (AU) Calculations

Animal Units	50 (AUs)	250 (AUs)	500 (AUs)	750 (AUs)	1,000 (AUs)
<b>Animal Type<sup>1</sup></b>					
<b>Slaughter and Feeder Cattle</b>	50	250	500	750	1,000
<b>Mature Dairy Cattle</b>	35	175	350	525	700
<b>Swine<sup>2</sup></b>	125	625	1,250	1,875	2,500
<b>Sheep and Lambs</b>	500	2,500	5,000	7,500	10,000
<b>Horses</b>	25	125	250	375	500
<b>Turkeys</b>	2,750	13,750	27,500	41,250	55,000
<b>Laying Hens or Broilers</b>	5,000	25,000	50,000	75,000	100,000
<sup>1</sup> All other animal classes, types, or sizes (e.g. Nursery pigs) not in this table but defined in the Michigan Right to Farm Act or described in the Michigan Commission of Agriculture and Rural Development Policy, are to be calculated as 1,000 pounds live weight equals one animal unit.					
<sup>2</sup> Weighing over 55 pounds.					

## DETERMINING ACCEPTABLE LOCATIONS FOR LIVESTOCK FACILITIES

All potential sites for new and expanding livestock facilities can be identified by four general categories. These are:

- Category 1. Sites normally acceptable for livestock facilities and generally defined as areas that are highly agricultural with few non-farm residences.
- Category 2. Sites where odor mitigation technologies and/or management practices could be needed to make new and expanding livestock facilities acceptable. These areas are predominantly agricultural but also have an increased number of non-farm residences.
- Category 3. Sites that are generally not acceptable for new and expanding livestock facilities with a capacity of 50 Animal Units (AU) or greater due to environmental concerns or other neighboring land uses.
- Category 4. Sites that are not acceptable for new and expanding livestock facilities. This includes livestock facilities that are located: at a site that is considered primarily residential in current land use; where institutional controls have been adopted to prohibit livestock agriculture; or where a new or expanding livestock facilities meets the criteria for Category 4 found in **Table 2**, **Table 3**, or **Table 4**. The placement or keeping of any number of livestock in this category does not conform to the Site Selection GAAMPs.

**Existing livestock facilities installing new, altering, or adding manure storage that is not related to an increase in animal unit capacity are not required to go through the site review and verification process, but must meet the applicable setback criteria under Section VI for Manure Storage Structure Change or Installation at Existing Livestock facilities to conform to the provisions of Siting GAAMPs.**

### Appeal of Site Suitability Approval Determination

The Site Suitability Determination decision by the Michigan Department of Agriculture and Rural Development may be appealed as directed in the Michigan Department of Agriculture and Rural Development Commission [Policy Number 10<sup>5</sup>](https://www.michigan.gov/mdard/about/boards/agcommission) (see **APPENDIX F**).

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<sup>5</sup> <https://www.michigan.gov/mdard/about/boards/agcommission>



## **Section I: Requirements For All New And Expanding Livestock Facilities**

### **Institutional Controls**

Sites where institutional controls have been adopted to prohibit livestock agriculture and meet all the criteria listed below, are considered a Category 4 site and are not acceptable for new and expanding livestock facilities. The following is considered a Category 4 site:

1. The institutional controls were approved by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) pursuant to the Natural Resources and Environmental Protection Act (NREPA), [MCL 324.101<sup>6</sup>](#) et seq., or the United States Environmental Protection Agency pursuant to the [Comprehensive Environmental Response, Compensation, and Liability Act<sup>7</sup>](#) or the [Resource Conservation and Recovery Act<sup>8</sup>](#); and,
2. The institutional controls are necessary to protect human or animal health; and
3. Unacceptability has been confirmed by a vote of the Michigan Commission of Agriculture and Rural Development.

## **Section II: Requirements For Livestock Facilities With Less Than 50 Animal Unit(s)**

### **Site Review and Verification Process**

A livestock facility with less than 50 Animal Unit(s) (AUs) is not required to complete the entire site review and verification process described in **APPENDIX A**. Instead, the livestock facility must submit a complete [GAAMPs Review Application<sup>9</sup>](#) form for determination of conformance. **This application must complete Sections 1, 2 and 3 at a minimum.**

A livestock facility with less than 50 AUs must conform to all the provisions in **Section I** and **Section II** of the Site Selection GAAMPs, as well as all other applicable GAAMPs to be considered in conformance.

### **Category Determination**

A livestock facility housing less than 50 AUs must not be located within an area that is considered primarily residential. **Table 2** provides the non-farm residence density and the property line setbacks for determining if a location is considered primarily residential.

**Table 2:** Non-farm Residence Density and Property Line Setbacks for Facilities Less Than 50 AUs

<b>Non-Farm Residences Within 1/8 Mile</b>	
Not Considered Primarily Residential <b>Acceptable Site</b>	13 or fewer non-farm residences and 0 non-farm residences closer than 250 feet
Category 4 Considered Primarily Residential <b>Not Acceptable Site</b>	More than 13 non-farm residences, or 1 or more non-farm residences closer than 250 feet, or Institutional controls enacted

<sup>6</sup> <https://legislature.mi.gov/Laws/MCL?objectName=MCL-324-101>

<sup>7</sup> <https://www.epa.gov/enforcement/comprehensive-environmental-response-compensation-and-liability-act-cercla-and-federal>

<sup>8</sup> <https://www.epa.gov/rcra>

<sup>9</sup> <https://tinyurl.com/38kes3w4>

### Site Plan

The applicant must submit a site plan, including the following features (to scale):

1. Property lines,
2. Size and location of the livestock facilities as defined in the Site Selection GAAMPs; and,
3. Location and distance to the non-farm residences within 1/8 mile.

### Manure Treatment and Storage Design Plans

Manure storage structures must be in conformance with the [Manure Management and Utilization GAAMPs<sup>10</sup>](#): Construction Design and Management for Manure Storage, Runoff Storage, and Treatment Facilities section (Refer to **APPENDIX E**).

### Manure Management System Plan

The [GAAMPs Review Application<sup>11</sup>](#) must include a Manure Management System Plan (MMSP) for the livestock facility which includes existing animals, if any, and those animals housed in a new facility. This plan describes the manure production, collection, transfer, treatment, storage, utilization, and related conservation practices implemented on the site for all proposed new and existing livestock facility. The MMSP must adhere to the guidelines described in the GAAMPs for Manure Management and Utilization. The MMSP for these GAAMPs must include the following two items:

1. The design and installation of manure management system components to ensure proper function of the entire system, and
2. Operation and Maintenance Plan - This written plan identifies the major structural components of the manure management system, and includes inspection frequency, areas to address, and regular maintenance records.

## **Section III: Requirements For Livestock Facilities With 50 Animal Units Or Greater**

### Site Review and Verification Process

Livestock facilities with a capacity of 50 AUs or greater are required to go through the site review and verification process described in **APPENDIX A**. The livestock facility must conform to all the provisions **Section I**, **Section III**, and **Section V**, as well as all other applicable GAAMPs to be in conformance with the Site Selection GAAMPs.

### Category Determination

The category of a site will determine the criteria a facility must meet to be found in conformance with this GAAMP. Category is based on the proposed number of AUs housed by the facility, non-farm residence density, and if the location is a new or expanding livestock facility.

1. Determine the number of non-farm residences within a specific radius of the site, measured from the nearest point of the livestock facility to the nearest point of the non-farm residence as defined in these GAAMPs:

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<sup>10</sup> <https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/2024-GAAMPs/Manure-Management-and-Utilization-2024-GAAMPs.pdf>

<sup>11</sup> <https://tinyurl.com/38kes3w4>

- I. For facilities with 50 – 749 animal units utilize a ¼ mile radius.
- II. For facilities with 750 animal units or greater, utilize a ½ mile radius.

2. Refer to **Table 3** to determine the Category of the site.

**Table 3:** Determining Category for Facilities Housing 50 AUs or More

Category	Number of Non-Farm Residences	
	New Livestock Facility	Expanding Livestock Facility
Category 1	5 or fewer	7 or fewer
Category 2	13 or fewer	20 or fewer
Category 3	More than 13 (Not Acceptable)	More than 20 with an acceptable odor management plan
Category 4 (Not Acceptable)	More than 13 or, institutional controls present	More than 20 and unacceptable odor management plan, or institutional controls present

Where a non-farm residence is closer than 250 ft it is considered primarily residential and not acceptable for a new or expanding livestock facility.

#### Notification to Non-farm Residences

All non-farm residences, within the applicable ¼ or ½ mile distance must be notified by the applicant of the proposed livestock facility and subsequent [Site Selection Application](#)<sup>12</sup>. Refer to **Section VII** for notification requirements or **APPENDIX A**.

#### Property Line Setbacks

New and expanding livestock facilities located at a Category 1 or Category 2 site must meet the minimum property line setbacks provided in **Table 4** and **Table 5** or have an approved variance, as outlined below.

For an expanding livestock facility located at a Category 3 site, property line setbacks are determined by an acceptable **Odor Management Plan** (OMP). The OMP for the expanded livestock facility must not incorporate any new non-farm residences within the MI OFFSET 5 percent odor footprint (Refer to APPENDIX B).

Property line setbacks must be determined by measuring from the nearest point of the livestock facility to the nearest point of the livestock facility owner's property line(s).

Property line setback variance agreements may be found in **Section VII** or **APPENDIX A**.

Alternatively, the applicant may obtain a setback distance reduction by requesting a variance from MDARD or obtaining a signed variance from the property owner(s) affected by the reduction, as outlined below.

<sup>12</sup> [https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/livestock\\_siting\\_application.pdf](https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/livestock_siting_application.pdf)

1. For new livestock facilities, applicants can submit a request to MDARD for a property line setback reduction of up to 50 percent of the setback distance in **Table 4** and **Table 5**. The setback reduction must not be less than 250 feet.
2. For existing livestock facilities, applicants can submit a request to MDARD for a property line setback reduction of up to 50 percent in **Table 4** and **Table 5**. The setback reduction must not be less than 125 feet.
3. Reductions beyond 50 percent or below the applicable 250 feet or 125 feet minimum setbacks require a signed variance from the affected property owner(s).
4. If a property line setback established by structures constructed before the year 2000 is used for livestock facility expansion and it is closer than 125 feet, a signed variance is required from the affected property owner(s).
5. A review of the OMP and local land uses will be conducted by MDARD for all requests meeting these criteria.

All variances from minimum property line setbacks must be proposed in advance of Site Suitability Approval.

**Table 4:** Category 1 Setback distances for Facilities Housing 50 AU or More

<b>Category 1 Property Line Set Back Distances</b>		
<b>Animal Units</b>	<b>New Facility</b>	<b>Expanding Facility</b>
50-249	250 ft	125 ft
250-499	250 ft	200 ft
500-749	400 ft	200 ft
750-999	400 ft	200 ft
1,000 or greater	600 ft	300 ft

**Table 5:** Category 2 Setback distances for Facilities Housing 50 AU or More

<b>Category 2 Property Line Set Back Distances</b>		
<b>Animal Units</b>	<b>New Facility</b>	<b>Expanding Facility</b>
50-249	250 ft	125 ft
250-499	300 ft	200 ft
500-749	400 ft	200 ft
750-999	500 ft	250 ft
1,000 or greater	600 ft	300 ft

### **Additional Environmental and Community Setbacks**

#### **1. High public use area**

Areas of high public use are subject to setbacks to minimize the potential effects of a livestock facility on the people that use those areas. New livestock facilities housing 50 or more animal units shall not be constructed within 1,500 feet of a high public use area. ~~This includes hospitals; churches; licensed commercial elder care facilities; licensed~~

~~commercial childcare facilities; school, government, commercial, professional, office or retail buildings; publicly accessible parks or campgrounds (excluding terrestrial and aquatic trails).~~

Existing livestock facilities housing 50 or more animal units or more may be expanded within 1,500 feet of high public use areas with appropriate MDARD review and site suitability determination and approval of the expansion. The review process will include input from the local unit of government and from people who utilize those high public use areas within the 1,500 feet setback.

## **2. Migrant housing camp**

New and expanding livestock facilities housing 50 or more animal units may not be constructed within 500 feet of any existing migrant labor housing camp unless a variance is obtained from the United States Department of Labor.

## **3. Wetlands**

New and expanding livestock facilities housing 50 or more AUs must not be constructed within a wetland as defined under [MCL Section 324.30301](#)<sup>13</sup> (NREPA, PA 451 of 1994, as amended).

## **4. Floodplain**

New and expanding livestock facilities housing 50 AUs or more must not be constructed in an area where the facilities would be inundated with surface water in a 25-year flood event.

# **Drinking Water Controls**

## **1. Wellhead Protection Areas**

New livestock facilities housing 50 AUs or more must not be constructed within a ten-year time-of-travel zone designated as a wellhead protection area as recognized by the EGLE, pursuant to programs established under the Michigan Safe Drinking Water Act, [P.A. 399 of 1976](#)<sup>14</sup>, as amended.

*An expanding livestock facility may be constructed within the Wellhead Protection Area provided the local unit of government administering the Wellhead Protection Program has reviewed and approved the proposed expansion.*

Well isolation distances found under the Public and Private Water Supplies section below must be followed along with this section.

## **2. Community Surface Water Source**

New and expanding livestock facilities housing 50 AUs or more must not be constructed within the 100-year flood plain of a stream reach where a community surface water source is located unless the livestock production facility is located downstream of the surface water intake.

## **3. Public and Private Water Supplies**

<sup>13</sup> <https://www.legislature.mi.gov/Laws/MCL?objectName=MCL-324-30301>

<sup>14</sup> <https://legislature.mi.gov/Laws/MCL?objectName=MCL-ACT-399-OF-1976>

Construction of new and expanding livestock facilities and offsite manure storages must meet the minimum well isolation distances established under the Michigan Public Health Code, Part 127, [P.A. 368 of 1978](#)<sup>15</sup> and Michigan Safe Drinking Water Act, P.A. 399 of 1976 or have an approved deviation or variance as outlined in **Table 6**. The well isolation distance criteria are outlined in **Table 6**.

### New Water Supplies

For the installation of a new public or private water supply at a livestock facility, the well must be installed according to a permit from either EGLE or the local health department. Well isolation distances outlined in **Table 6** must be met unless issued a permit or variance by EGLE (Type I and Type IIa) or the local health department (Type IIb, Type III, and private water supplies).

If the local health department does not issue permits for private water supplies, including agricultural wells, the criteria found in **Table 6** must be met to be in conformance with this GAAMP.

### Existing Water Supplies

For the installation of new and expanding livestock facilities and offsite manure storages near an existing public water supply, the well isolation distances outline in **Table 6** must be met. A variance may be requested, pursuant to the EGLE Office of Drinking Water and Municipal Assistance Policy Number [ODWMA-368-127-011](#)<sup>16</sup>. The well isolation reduction worksheets may be found in **Section VII**. Well isolation distances should be maximized to the extent possible.

Existing private water supplies must either meet the well isolation distance found in Table 6 or the livestock facility must have a variance from the local health department or EGLE.

\*=The isolation distances marked with an asterisk may be reduced by MDARD using the well isolation reduction worksheets for existing public water supplies found in **Section VII**.

**Table 6:** Required minimum well isolation distance from potential sources of agricultural contamination.

Source of Contamination	Required Minimum Isolation Distance (feet)		
	Private Well	Public Well (Type III/IIb)	Public Well (Type IIa/I)
Above grade solid stack manure storage structures (roofed or unroofed)	150	800*	2000*
Below grade liquid manure storage structures	150	800*	2000*
Above grade liquid manure storage tanks	150	800*	2000*
Manure/non mortality composting facilities	150	800*	2000*
Bedded pack facilities	50	75	200

<sup>15</sup> <https://legislature.mi.gov/Laws/MCL?objectName=MCL-368-1978-12-127>

<sup>16</sup> [https://cms7files.revize.com/genessecountymi/Document\\_Center/Department/Health%207-18-22/EH/Wells/DEQ-ODWMA\\_Minimum\\_Isolation\\_Distances-Private\\_and\\_Public\\_491026\\_7.pdf](https://cms7files.revize.com/genessecountymi/Document_Center/Department/Health%207-18-22/EH/Wells/DEQ-ODWMA_Minimum_Isolation_Distances-Private_and_Public_491026_7.pdf)



Pastureland	Livestock and manure must be precluded from direct contact with the wellhead		
Livestock lots and loafing areas without a predominance of vegetation	50	75	200
Livestock Housing without under barn manure storage	50	75	200
Waste transfer structures (concrete pits, tanks, hoppers, manholes, channels)	50	75	200

## **Section IV: Offsite Manure Storage Facilities**

### **Site Review and Verification Process**

Large offsite manure storages are required to go through the site review and verification process described in Appendix A. The storage facilities must conform to all the provisions **Sections I, IV, V**, and the Additional Environmental and Community Setbacks found in **Section III**. The offsite manure structures must also meet all applicable GAAMPs to be in conformance with the Site Selection GAAMP.

**Table 7:** Storage Surface Area defining Offsite Manure Storage Facilities

	Storage Surface Area		
	Operational Elevation for Liquid, Sq ft Base Elevation for Solid, Sq ft		
	Liquid Pond-Type	Liquid Fabricated-Type	Solid Manure
<b>Small Offsite Storage</b>	≤ 4,200 sq. ft.	≤ 2,000 sq. ft.	≤ 26,000 sq. ft.
<b>Large Offsite Storage</b>	> 4,200 sq. ft.	> 2,000 sq. ft.	> 26,000 sq. ft.

### **Category Determination**

Determine the number of non-farm residences within a specific radius of the site, measured from the nearest point of the livestock facility to the nearest point of the non-farm residence as defined in these GAAMPs:

1. For small offsite storage, utilize a ¼ mile radius.
2. For large offsite storages, utilize a ½ mile radius.

**Table 8:** Number of Non-Farm Residences of within applicable radius for offsite manure storages

	<b><u>Number of Non-Farm Residences Within Applicable Radius</u></b>
<u>Category 1</u>	<u>5 or fewer</u>
<u>Category 2</u>	<u>13 or fewer</u>
<u>Category 3</u> <u>(Not Acceptable)</u>	<u>More than 13</u>

<u>Category 4</u> <u>Considered Primarily</u> <u>Residential</u> <u>(Not Acceptable)</u>	<u>more than 13, or 1 more non-farm</u> <u>residences closer than 250 ft, or,</u> <u>institutional controls present</u>
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### **Notification of Non-farm Residences**

All non-farm residences, within the applicable ¼ or ½ mile distance, identified in Table 8, must be notified by the applicant of the proposed livestock facility and subsequent Site Selection Application. Please refer to Section VI notification requirements.

### **Property line Setbacks**

The property line setback requirements depend on the size of the structure. Property line setbacks for offsite manure storage can be found in **Table 9**. Property line setbacks must be determined by measuring from the nearest point of the livestock facility to the nearest point of the livestock facility owner's property line. The minimum property line setback for a large offsite manure storage is 250 feet but may be increased by the OMP. The MI OFFSET within the OMP must not indicate any non-farm residences within the 5% annoyance footprint. All variances from minimum property line setbacks must be proposed in advance of Site Suitability Approval.

Please refer to **Section VII** for property line set back reduction variance forms.

**Table 9: Property Line Setback**

	<b>Property Line Setback</b>
<b>Small Offsite Storage</b>	250 ft
<b>Large Offsite Storage</b>	TBD <sup>1</sup>
<sup>1</sup> the minimum set back distance is 250 feet but may be increased based on the odor management plan	

## **Section V: Management Plans**

The following management plans must be submitted with the Application for Site Suitability.

### **Site Plan**

A Site Plan is a comprehensive review of a proposed location and must include:

1. A site map, including the following features (to scale):
  - a. Property lines, easements, rights-of-way, and any deed restrictions.
  - b. Public utilities, overhead power lines, cable, pipelines, and legally established public drains.
  - c. Positions of buildings, wells, septic systems, culverts, drains and waterways, walls, fences, roads, and other paved areas.
  - d. Location, type, and size of existing utilities.
  - e. Location of wetlands, streams, and other bodies of water.
2. Existing land uses for contiguous land.
3. Names and addresses of adjacent property owners.

4. Basis of livestock facility design.
5. Size and location of structures.
6. A soils map of the area where all livestock facilities are located.
7. Location and distance to the non-farm residences within ½ mile.
8. Location and distance to the nearest high public use area.
9. Topographic map of site and surrounding area.

### **Manure Management System Plan**

The MMSP describes the system of structural components, biological processes (treatments), and management practices that the owner/operator utilizes, or plans to implement, on the site for all manure and other nutrient by-products accumulated at the site. All components that must be included in the MMSP are described in the [GAAMPs for Manure Management and Utilization](#)<sup>17</sup>. In addition, the MMSP for these GAAMPs must include:

1. Planning, design specifications and installation of manure management system components to ensure proper function of the entire system.
2. Operation and Maintenance Plan that identifies the major structural components of the manure management system, and includes inspection frequency, areas to address, and regular maintenance records.

### **Manure Treatment and Storage Design Plans**

Manure storage structures must be designed and constructed in accordance with the Michigan Natural Resources Conservation Service Waste Storage Facility [Standard 313](#)<sup>18</sup> or Midwest Plan Service Concrete Manure storages MWPS-36 as outlined in **Appendix E**.

### **Odor Management Plan**

An odor management plan (OMP) is required for:

1. All livestock facilities with 50 AU or more located in a Category 2 or Category 3 site.
2. Large offsite manure storage facilities.
3. Livestock facilities located in a Category 1 site where:
  - a. A property line setback reduction has been requested by the applicant.
  - b. An odor management practice or odor mitigation technology is utilized.
  - c. The proposed livestock facility will house 1,000 AU or greater.

Livestock facilities that are required to submit an OMP must use the Michigan OFFSET 2018 odor model and create a plan to provide 95 percent annoyance-free level of performance for surrounding non-farm residences. Please refer to **Section VII** for an odor variance agreement if needed.

An odor management plan must contain the following:

1. Identification of potential sources of significant odors.
2. Evaluation of the potential magnitude of each odor source.

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<sup>17</sup> <https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/2024-GAAMPs/Manure-Management-and-Utilization-2024-GAAMPS.pdf>

<sup>18</sup> <https://efotg.sc.egov.usda.gov/#/state/MI/documents/section=4&folder=-252>

3. Application and evaluation of odor nuisance potential using Michigan OFFSET 2018.
  - a. Non-farm residences may not be encompassed within the MI OFFSET 5 percent annoyance level footprint.
4. Identification of current, planned, and potential odor control practices.
5. A plan to monitor odor impacts and respond to odor complaints.
6. A strategy to develop and maintain good neighbor and community relations.

Identify and assess the odor impact using the worksheets found on MDARD's [website](#)<sup>19</sup>

1. Use the Odor Source Assessment Worksheet to identify, describe, and evaluate all odor sources associated with the livestock facility. Please note that land application areas are addressed separately in the MMSP.
2. Use the OMP Worksheet to identify odor management practices and/or mitigation technologies being implemented, planned or that could be considered if odor concerns arise.
3. Use the [MI OFFSET 2018 Centroid Worksheet](#)<sup>20</sup> to help identify potential odor sources and calculate an odor control factor to be incorporated into the MI OFFSET 2018 odor model. Please note that some odor sources identified in the odor source assessment worksheet are not considered in this tool. For these sources, a subjective potential odor magnitude evaluation of high, medium, or low, relative to other sources on the farm must be conducted.
4. Current odor mitigation technologies with reduction factors utilized in MI OFFSET 2018 include, ventilation bio-filters, manure storage covers, wet scrubbers, and vegetative buffers. The full list of odor mitigation technologies and associated odor reduction factors can be found in **Appendix B**. Please refer to **Section VII** if a review of a new odor mitigation technology review is needed.
5. Analyze potential odor impact on neighboring non-farm residences and other non-farm areas with the [Michigan OFFSET 2018](#)<sup>21</sup> tool, utilizing the 5 percent odor footprint.

#### **Mortality Management Plan –**

Identify the processes and procedures used to safely dispose of the bodies of dead animals (Bodies of Dead Animals Act, P.A. 239 of 1994<sup>22</sup> as amended). In Michigan all livestock mortality is subject to Bodies of Dead Animals Act, PA 239 of 1994, as amended. Information on handling of dead animals is available at: [www.michigan.gov/animaldisposal](http://www.michigan.gov/animaldisposal) and [https://www.canr.msu.edu/managing\\_animal\\_mortalities/composting\\_tools](https://www.canr.msu.edu/managing_animal_mortalities/composting_tools) . MDARD may request design criteria and operational standards of the selected method.

#### **Additional Plans**

Other items that may be included in the application:

1. Emergency Action Plan - Through development of an Emergency Action Plan, identify the actions to take and contacts to be made in the event of a spill or discharge.
2. Veterinary Waste Management Plan - Identify the processes and procedures used to safely dispose of livestock-related veterinary wastes accumulated on the farm.
3. Conservation Plan - Field-specific plan describing the structural, vegetative and

<sup>19</sup> <https://www.michigan.gov/mdard/environment/rtrf/gaamps>

<sup>20</sup> [https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtrf/mi\\_offset\\_centroid\\_worksheet.xlsx](https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtrf/mi_offset_centroid_worksheet.xlsx)

<sup>21</sup> <https://enviroweather.msu.edu/mioffset/>

<sup>22</sup> <https://www.legislature.mi.gov/documents/mcl/pdf/mcl-act-239-of-1982.pdf>

management measures for the fields where manure and other byproducts will be applied.

4. ~~Mortality Management Plan—Identify the processes and procedures used to safely dispose of the bodies of dead animals (Bodies of Dead Animals Act, P.A. 239 of 1994<sup>23</sup> as amended).~~

## **Section VI: Manure Storage Structure Changes or Installations at Existing Livestock Facilities**

### **Site Review and Verification Process**

A manure storage structure change or installation at an existing livestock facility is not required to complete the site review and verification process found in Appendix A. In the event of a right to farm compliant, the livestock facility must submit a GAAMPs Review Application form for determination of conformance [\(sections 1, 2, 3\)](#). This can be found at [GAAMPs Review Application<sup>24</sup>](#).

A manure storage structure change or installation at an existing livestock must conform to all the provisions in this section, as well as Manure Management and Utilization GAAMPs to be in conformance with the Site Selection GAAMPs.

### **Distance to non-farm residence**

All manure storage structures must be at least 250 feet from the nearest non-farm residence or no closer than the established setback distance (ESD). Established setback distance is where an established animal production structure exists (a lot or pasture fence line is not considered part of this criterion).

### **Property line Setbacks**

The property line setback requirements depend on the number of animal units. Property line setbacks must be determined by measuring from the nearest point of the livestock facility to the nearest point of the livestock facility owner's property line. All variances from minimum property line setbacks must be proposed in advance of Site Suitability Approval.

A reduction to the property line setback for a manure storage structure change or installation will require a signed variance by the property owners that are within the original setback distance affected by the reduction. Please refer to Section VII for property line set back reduction variance forms.

**Table 10: Required Property line setbacks for manure storage structure changes**

Existing Livestock Facility	
Animal Units	Property line Setback
50 - 249	125 ft or ESD

<sup>24</sup> [https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/gaamps\\_conformance\\_application.pdf](https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/gaamps_conformance_application.pdf)

<b>250-749</b>	<b>200 ft or ESD</b>
<b>750-999</b>	<b>250 ft or ESD</b>
<b>1,000 or greater</b>	<b>300 ft or ESD</b>

### **Manure Treatment and Storage Design Plans**

Manure storage structure changes or installations at existing livestock facilities must be in conformance with the Manure Management and Utilization GAAMPs: Construction Design and Management for Manure Storage, Runoff Storage, and Treatment Facilities section. Refer to **Appendix E** for further information.

## **Section VII: Notifications, Agreements, and Requests**

### **Notification to Non-farm Residences**

A livestock facility with a capacity of 50 animal units or more must individually notify all non-farm residences identified in **Table 3** or **Table 7**, as applicable, of the proposed new or expanding livestock facility and subsequent [Site Selection Application](#)<sup>25</sup>. Please note, the property lines are not included in the definitions of non-farm residence or livestock facility. *Required notification is based on structures, storages, lots, etc. as outlined in the definitions.* Documentation of notification has occurred is required as part of the Site Suitability Determination.

The “Certification of Notification of Non-Farm Residences” form is provided with the [Site Selection Application \(Appendix A\)](#).

### **Property Line Setback Reduction Agreement**

Property line setback reduction agreements are required to be submitted in advance of Site Suitability Approval.

- Property line setbacks may be reduced with a signed variance from the property owner(s) affected by the reduction.
- A property line setback reduction beyond a 50 percent reduction, or below the applicable 250 feet or 125 feet minimum setbacks, requires a signed variance from the property owner(s) affected by the reduction.
- For expanding livestock facilities, established property line setback distances by structures constructed before the year 2000 may be used. If the established property line setbacks are greater than those listed in **Table 4**, **Table 5**, and **Table** then the setbacks identified within tables, and the process detailed above, will be used for determining site suitability.

Facility Site Selection and Setback Variance Agreement” form is provided with the [Site Selection Application \(Appendix B\)](#).

### **Odor Variance Agreement**

If there is a non-farm residence within the 5 percent odor footprint, a signed variance must be obtained from the property owner to be in conformance with this GAAMP. All variances for odor must be submitted in advance of Site Suitability Approval.

<sup>25</sup> [https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/livestock\\_siting\\_application.pdf?rev=756f9c4736ff4eae46d1c6a23bce155&hash=452C889DCD6CEAB03A257FE5740F254E](https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/livestock_siting_application.pdf?rev=756f9c4736ff4eae46d1c6a23bce155&hash=452C889DCD6CEAB03A257FE5740F254E)



Facility Site Selection and Setback Variance Agreement” form is provided with the [Site Selection Application \(Appendix C\)](#).

### **Odor Mitigation Technologies Request**

If the Odor Management Plan (OMP) incorporates a new odor mitigation technology(ies) that does not have an established odor control factor within MI OFFSET 2018, the applicant must submit documentation and/or literature for consideration as part of the [Site Selection Application](#). This documentation should include:

- Documentation the new odor mitigation technology is based on demonstrated performance for agriculture production or similar applications.
- Demonstrated performance or source(s) of independent verifiable data through publications from:
  - Local, state, or federal agencies, and/or universities.
  - Other independent research organizations: a manufacturer’s guarantee based on manufacturer’s literature and research results showing generally accepted good engineering practices; and/or actual operating experience.

### **Well Isolation Distances Deviation Request**

For existing public water supplies, the well isolation distances denoted with an asterisk in **Table 6** may be reduced by MDARD upon request by the applicant. The request must include the [well isolation reduction worksheets](#)<sup>26</sup>. Well isolation distances should be maximized. Utilization of this reduction criteria requires the existing well to be properly constructed in accordance with the Michigan Public Health Code, Part 127, Act 368, P.A. 1978 or Michigan Safe Drinking Water Act, Act 399, P.A. 1976.

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<sup>26</sup> [https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/Well\\_Isolation\\_Distance\\_Worksheet\\_2023.pdf?rev=b27a07a1cf63494dbd07b2d71ed6c73b&hash=182B994615486CF36EF9516296C10F67](https://www.michigan.gov/mdard/-/media/Project/Websites/mdard/documents/environment/rtf/Well_Isolation_Distance_Worksheet_2023.pdf?rev=b27a07a1cf63494dbd07b2d71ed6c73b&hash=182B994615486CF36EF9516296C10F67)

## **APPENDIX A**

### **Site Selection GAAMPS Determination Process**

Livestock facilities requesting a Site Selection GAAMPS determination in Categories 1, 2, or 3 should submit an application to MDARD prior to the construction of a new or expanding livestock facility. The review of the application will use criteria applicable to the animal units capacity for the proposed livestock facility. Either a formal complaint, or a request by the livestock producer for a GAAMPS determination, will result in a program review of determination of conformance to the Site Selection GAAMPS and adjacent land uses to the livestock facility.

Local government (county and township where the livestock facility is located) is notified at several points in the process. Local government is used to describe the township and county where the livestock facility is located. If the livestock facility is located on the county line, or township line, the adjoining unit of government will also be notified.

To begin the Site Selection GAAMPS determination process, contact the MDARD, Right to Farm Program at 877-632-1783. Or via email at [MDARD-LivestockSiting@michigan.gov](mailto:MDARD-LivestockSiting@michigan.gov). Additional information is available on our website at [www.michigan.gov/righttofarm](http://www.michigan.gov/righttofarm).

#### **The following steps outline the process:**

1. **Application:** All applications must include a Siting Request Letter from the farm to the MDARD, Right to Farm Program, outlining the proposed construction or expansion project, any areas of concern, agencies, and individuals the farm is working with, and the proposed timeline. Farms may utilize recognized industry consultants, university specialists, and agency professionals in the development of their application, site plan, and manure management system plan.

**Livestock facilities with a capacity of less than 50 AU:** Farms must submit a complete GAAMPS Review Application for determination of conformance. The application can be found at: [GAAMPS Review Application \(michigan.gov\)](http://www.michigan.gov/gaamps)

**Livestock facilities with a capacity of 50 AU or greater:** Farms must submit a complete Livestock Site Selection Application for determination of conformance. The application and a checklist are available at <https://www.michigan.gov/mdard/environment/rtf/gaamps> under site selection. The checklist will assist in identifying and addressing all components of the Site Selection GAAMPS. If special technologies or management practices are to be implemented for the successful operation of the livestock facility, these must be included in the Livestock Site Selection Application.

2. **Application Review:** Upon receipt of a Siting Request Letter and application, MDARD, Right to Farm program will send an acknowledgement letter to the farm, with forwarded copies to local government. MDARD will review materials and notify the farm of any deficiencies.
3. **Initial Site inspection:** MDARD will conduct an inspection to verify the information outlined in the application and identify any areas of concern or deficiencies that need to be addressed. At the request of the farm, a preliminary site visit may be conducted prior to submission of the application.

4. **Site Suitability Determination:** Site and management plan review has been completed and a Site Suitability Determination has been made. MDARD will send a letter to the farm and to local government. The determination will be posted on MDARD's RTF website. Construction must begin within three years from the date of the Site Suitability Approval letter. An additional two-year extension to begin construction may be requested in writing to MDARD. The start of construction is defined as the physical movement of soil or installation of permanent structures.
5. **30-day Public Comment period to Appeal the Site Suitability Determination:** MDARD will open a 30-day public comment period, starting on the day the determination is posted on the Right to Farm's Website. It may be appealed by the owner of the proposed livestock facility, the local unit of government where the site is located, as well as property owners and adjacent local unit of government within one-half mile of the livestock facility. It is recommended a livestock facility does not begin construction until the 30-day appeal window has ended.
6. **Appeal Process, if requested:** The Site Suitability Determination decision by the Michigan Department of Agriculture and Rural Development, Right to Farm Program, may be appealed as per Michigan Department of Agriculture and Rural Development Commission Policy number 10. This policy can be found in Appendix F and at [http://www.michigan.gov/mdard/0,4610,7-125-1572\\_2878---,00.html](http://www.michigan.gov/mdard/0,4610,7-125-1572_2878---,00.html)
7. **Construction Plan Review:** Design plans for the manure storage structures and site layout, stamped by a licensed engineer, must be submitted for review and approval, and should be submitted prior to construction. If the preconstruction design plans meet the required specifications, MDARD will issue an approval to construct letter to the farm. A qualified individual as described in Appendix E must inspect the installation of the manure storage structures and provide documentation that the structures were built as designed (known as an 'as built' determination). MDARD may also conduct construction site inspections for quality assurance. The owner should notify MDARD one month prior to beginning the installation of the manure storage facility.
8. **Final Conformance Determination:** MDARD will conduct a final inspection, preferably, prior to animal population, and review submitted as-built construction documentation, stamped by a professional engineer. The livestock facility must be completed as stated in the Siting Request Letter or Livestock Site Selection Application that has been approved. MDARD will send a final letter of determination for Site Selection GAAMPs Conformance to the farm. This letter will be copied to the local unit(s) of government.

## APPENDIX B

### Michigan Odor Management Plan Resources

Utilize the MI OFFSET 2018 Centroid Worksheet located at <https://www.michigan.gov/mdard/environment/rtf/site-selection> when assessing odor mitigation technologies.

Use the identified Odor Control Factor to adjust the centroid location to be used in the MI OFFSET 2018 model <https://enviroweather.msu.edu/mioffset/>.

Maximum Potential Odor Mitigation Technology Adjustment Factors		
Odor Mitigation Technologies		Odor Control Factor
Biofilter on All Exhaust Fans		0.1
Biofilter on Pit Fans		0.55
Geotextile Cover ( $\geq 25.4$ mm or 1 inch)		0.5
Straw or Natural Crust on Manure	2" Thick	0.5
	4" Thick	0.4
	6" Thick	0.3
	8" Thick	0.2
Impermeable Cover		0.1
Vegetative Environmental Buffer		0.8
Wet Scrubbers		0.55

## **APPENDIX C**

### **Example Dairy Odor Management Plan**

*The Odor Management Plan includes the following text and tables and output from Michigan OFFSET 2018, which is not shown here.*

#### **Overview**

The existing 1,200 cow facility is expanding to 1,700 cows. The proposed expansion involves the addition of another 500 cow freestall barn, expansion of the primary sand- laden manure storage, and the addition of another earthen storage for milking center wastewater. All the additional facilities are located to the south and west of the existing facility.

#### **Odor Source Identification & Assessment**

Refer to attached Odor Source Assessment table.

#### **Odor Management Practices**

Refer to attached Odor Management Practices table.

#### **Potential Odor Impact Analysis**

Michigan OFFSET 2018 has identified two non-farm residences that are within the odor impact zone prior to the expansion and three additional homes that are likely impacted (see Michigan OFFSET 2018 output). An additional five homes are added to the odor awareness zone as a result of the proposed expansion.

The potentially odor-impacted homes are at the following addresses:

(List addresses and homeowner names in order of proximity to odor source.)

All homeowners, except for one, have signed a letter acknowledging the proposed expansion and indicating that they do not object to it proceeding. The lone exception is the residence at *(list address)*. This resident was reluctant to sign a letter but has verbally accepted the expansion. He is also a livestock producer whose odor awareness zone from Michigan OFFSET 2018 would likely overlap the dairy farms. He also has a working relationship with the Example Dairy as a producer of corn grain for dairy feed.

Of the other homes in the odor awareness zone, three are currently or very recently have been active dairy farmers themselves. Another is a landlord of property that is rented and included in the farm CNMP/MMSP.

The three remaining homes are the most distant from the center of the odor awareness zone and furthest from the specific area of the facility expansion.

## **Odor Tracking and Response**

Tracking of odor concerns includes two approaches:

1. All farm employees and some routine farm service providers will be asked to report noticeable offensive odor events as they come and go from the farm and travel the community.
2. The intent is to establish and maintain an effective, open line of communication with immediate neighbors so that they too will be comfortable reporting odor events to example dairy.
3. Response to odor complaints or events reported by neighbors will include investigation of the primary odor incident source on the farm. For example, is it associated with storage agitation, field application, or no specific farm activity? The farm will report back to the person reporting the odor event within 24 hours, or as soon as possible thereafter. Included in the response will be the reason for the odor event, an acknowledgement of the concern, steps – if any – to be taken to prevent it in the future, and a thank you for bringing it to the farm's attention.

If a pattern is identified among odor event complaints by neighbors, an outside observer, such as MSU Extension or MDARD, will be asked to provide an objective analysis of the situation. If the concern is confirmed to be legitimate by a second objective observer, actions will be taken to further control odor per, or comparable to, odor management practices identified in the Odor Management Plan.

## **Community Relations**

To develop and maintain a positive relationship with the entire community, the following steps are planned:

4. Keeping the farmstead area esthetically pleasing will continue to be a high priority.
5. Each spring, a farm newsletter will be sent to all appropriate community members describing farm activities, personnel, and management.
6. A community picnic and farm tour will be held at least semi-annually for all in the immediate community and manure application areas.
7. Example Dairy Farm will make itself available to local schools for farm visits as field trips or school projects as appropriate.
8. We will seek to participate in local community events and youth activities, such as the local town festival and youth athletic teams.
9. Additional opportunities to strengthen community relations will be considered whenever they arise.
10. Notify potentially impacted neighboring residences at least 24 hours in advance of manure application.

(The above list of community relations practices may be longer than most farms find necessary, but it provides several examples that farms might consider.)



### Odor Source Assessment – Proposed Facility

Potential Odor Source	Description	Odor Emission Number <sup>1</sup>	Odor Control Factors <sup>2</sup>			Odor Emission Factors <sup>1,3</sup>		
			current	planned	potential	current	planned	potential
Large Manure Storage	Sand Land Manure storage for center-drive through barns (170 x 340)	13	0.5 + NV			168.9		
Freestall Barns	Freestall barns (187,104 sq. ft.)	6		NV		112.3		
Milking Center Wastewater	Earthen storages for milking center wastewater. Is recycled to flush holding and treatment areas. (49,600 sq. ft.)	13	NV		0.1	50.4		5.0
Run Off Storage	Collects rain runoff from open lot and silage pads (90 x 120)	13	NV			14		
Outside Lots	Outside concrete housing lot (16,200 sq. ft.)	4			NV	6.5		
Settling Basins	Holding area flushed material settling area prior to pumping of liquid to milking center wastewater storage (30 x 60)	28	NV	NV	NV	5		
Bedded Open Housing Barns	Maternity & sick pens (22,620 sq. ft.)	2				4.5		
Open Lot Manure storage	Short-term manure storage (70 x 20)	13	0.5 + NV			.9		
Agitation	Agitation of manure storages	Medium				M	M	M
Land Application	Field application of liquid manure	High	NV			M	M	M
Silage & Feed Storage	Concrete pad and bunker silos (300 x 350)	Medium	NV			L	L	L

1. Michigan OFFSET 2018 value if available or High, Medium, Low for sources not addressed in Michigan OFFSET 2018

2. NV = No Value available in Michigan OFFSET 2018; however, a defensible odor control factor is applicable per Odor Management Practices table.

3. Odor Emission Factors are equal to the odor emission number, multiplied by the surface area (ft<sup>2</sup>) and odor control factor, divided by 10,000.

### Odor Management Practices

Odor Source	Odor Management Practices & Reduction Factor		
	Current	Planned	Potential
Large Manure Storage	<ol style="list-style-type: none"> <li>1. Approximately eight months of potential storage results in agitation being required only 2-3 times per year.</li> <li>2. The natural plant fiber in the manure results in a crusting of the manure. (OCF = 0.5)</li> </ol>		
Freestall Barns		1. Plans include the planting of a tree shelterbelt the length of the freestall barns, parlor, and treatment area.	
Milking Center Wastewater	<ol style="list-style-type: none"> <li>1. Fills from bottom.</li> <li>2. Long term storage facilitates minimal disturbance of only about two times per year.</li> </ol>		3. Impermeable synthetic cover (OCF = 0.1)
Run Off Storage	1. Long-term storage, disturbed only 1-2 times per year		
Outside Lots			1. Lot could be reduced in size.
Settling Basins	1. Cleaned out frequently, about every ten days, minimizing anaerobic production of odors.	2. Plans include the planting of tree shelterbelt between the basins and the road/property line.	
Bedded Barns			
Open Lot Manure Storage	<ol style="list-style-type: none"> <li>1. Storage is emptied frequently so that anaerobic activity is limited.</li> <li>2. Storage crusts (OCF = 0.5)</li> </ol>		
Agitation			
Land Application	<ol style="list-style-type: none"> <li>1. Manure is injected or incorporated whenever field conditions permit.</li> <li>2. Weekend and holiday application is avoided.</li> </ol>		
Silage & Feed Storage	<ol style="list-style-type: none"> <li>1. Silage piles are covered with plastic with clean water diverted off of the pile.</li> <li>2. Forages harvested at recommended moisture.</li> <li>3. Concrete pad is mechanically swept at least once per week.</li> </ol>		

## **APPENDIX D**

### **Comprehensive Nutrient Management Plan**

A Comprehensive Nutrient Management Plan (CNMP) is the next step beyond a Manure Management System Plan (MMSP). All efforts put towards an MMSP may be utilized in the development of a CNMP as it is founded on the same eight components as the MMSP, with a few significant differences. Some of the “optional” sub-components of an MMSP are required in a CNMP. Examples include veterinary waste disposal and mortality management. In addition, the “production” component is more detailed regarding management of rainwater, plate cooler water, and milk house wastewater.

Thorough calculations are also needed to document animal manure production.

Another difference between an MMSP and a CNMP is in the “Utilization” component. With an MMSP, nutrients need to be applied at agronomic rates and according to realistic yield goals. However, with a CNMP, a more extensive analysis of field application is conducted. This analysis includes the use of the Manure Application Risk Index (MARI) to determine suitability for winter spreading, and the Revised Universal Soil Loss Equation (RUSLE) to determine potential nutrient loss from erosive forces, and other farm specific conservation practices. More detail regarding the timing and method of manure applications and long-term cropping system/plans must be documented in a CNMP.

Additional information on potential adverse impacts to surface and groundwater and preventative measures to protect these resources are identified in a CNMP. Although the CNMP provides the framework for consistent documentation of several practices, the CNMP is a planning tool not a documentation package.

Odor management is included in both the MMSP and CNMP.

Implementation of an MMSP is ongoing. A CNMP implementation schedule typically includes long-term changes. These often include installation of new structures and/or changes in farm management practices that are usually phased in over a longer period. Such changes are outlined in the CNMP implementation schedule, providing a reference to the producer for planning to implement changes within their own constraints.

As is described above, a producer with a sound MMSP is well on their way to developing a CNMP. Time spent developing and using a MMSP will help position the producer to ultimately develop a CNMP on their farm if they decide to proceed to that level or when they are required to do so.

### WHO NEEDS A CNMP?

1. Some livestock facilities receiving technical and/or financial assistance through USDA-NRCS Farm Bill program contracts.
2. A livestock facility that a) applies for coverage with the EGLE's National Pollutant Discharge Elimination System (NPDES) permit, or b) is directed by EGLE on a case-by-case basis.
3. A livestock facility that is required to have a CNMP as a result of NPDES permit coverage that desires third party verification in the MDARD's Michigan Agriculture Environmental Assurance Program (MAEAP) Livestock System verification.

For additional information regarding the permit, go to: [www.michigan.gov/EGLE](http://www.michigan.gov/EGLE).

For additional information regarding MAEAP, go to: [www.maeap.org](http://www.maeap.org) or telephone 517-284-5609.

## **APPENDIX E**

### **New, Expanding, or Existing Manure/Waste Storage or Treatment Facility Plan**

Construction plans detailing the design of new manure/waste storage components must be submitted to MDARD for review and approval. Structures must be designed and constructed in accordance with appropriate design standards (e.g., Michigan NRCS eFOTG Waste Storage Facility (No.) 313 or Midwest Plan Service MWPS-36 Concrete Manure Storages Handbook), that are current at the time of approval of this GAAMP.

Standards and specifications for manure/waste storage and treatment facilities need to follow industry standards, state codes for structures, or under university guidance and technology development. For further information, refer to the NRCS-MI Conservation Practice Standard (CPS) Waste Storage Facility 313 (USDA-NRCS-MI FOTG) and Chapter 10, Appendix 10D of the Animal Waste Management Field Handbook (AWMFH), part 651, (USDA-NRCS-2009). Additional publications include the Rectangular Concrete Manure Storages Handbook MWPS-36, 2<sup>nd</sup> Ed (MidWest Plan Service, 2005), the Circular Concrete Manure Tanks, TR-9 (MidWest Plan Service 1999), and the Building Code Requirements for Structural Concrete industry standard of the American Concrete Institute ACI-318-19 (ACI Committee 318, 2022).

Plans for new or expanding must include the following information:

- Design Standards utilized and construction requirements/specifications.
- Identify the design storage volume as justified by the nutrient utilization plan, runoff volume, precipitation volume, freeboard, and emergency storage depths. Use of the NRCS Animal Waste Management (AWM) program with reports are recommended.
- Identify the size of structure, including length, width, and depth.
- Floodplain documentation – use the FEMA website or the local county GIS documentation.
- Materials to be utilized for the construction of the structure, this should include specifications for concrete mixes, flexible membranes, and soil data, as appropriate.
- Subsurface Investigation information to include an adequate representation of soil borings to determine any evidence of a seasonal high-water table. The borings must extend to a depth of at least two feet below the bottom of the structure and must indicate the depth to a high water and any seeps encountered. The soils must be classified according to the Unified Soil Classification System (USCS) using ASTM D2487 or ASTM D2488.
  - Soil test locations are to be provided on a site map with the planned storage or treatment facility location.
  - Soil tests are to show and document the soils encountered and associated depths with elevations that are all based on an established surveyed benchmark that tied together the following:
    - Surface ground elevation
    - Elevations of the proposed structure
    - Surface depth of soil borings with total depth of each soil boring

- Elevation and depth of changing soil types within the soil boring (USCS)
- For a new compacted earth-lined structure, a laboratory permeability test, or Plasticity Index (PI) with Atterberg Limits must be submitted documenting the planned liner material is adequate to meet the permeability rate and liner thickness and in conformance with the NRCS Conservation Practice Standard (CPS); 313 – Waste Storage Facility (WSF) and/or the associated Pond Sealing or Lining CPS (520, 521, 522).
- Document isolation distance from the waste structure or treatment facility to any drinking water well, use [the “Well Isolation Distance Worksheet for Major and Potential Sources of Contamination for Type IIA, IIB and III Public Wells and Private Wells on Farm Operations” reduction criteria worksheet](#) where applicable.
  - Evaluate any drinking water well within 2000 feet of the planned facility.
- Describe the method used to remove solids from the waste storage while still maintaining the liner integrity.
- Where a manure/waste or treatment facility system such as, an anaerobic digester, gasification, or odor mitigation technology will be utilized, all associated design plans, treatment flow diagram, and specifications, with an operation and maintenance plan must be submitted for review.
- Submittals of As-built documentation requirements:
  - Updated site plan showing installed location, elevations, and dimensions based on the established surveyed benchmark as red lined As-builts.
  - Earthen Lined Structure:
    - Submit an in-situ permeability test (ASTM D5084-Hydraulic Conductivity) of the compacted liner to verify the liner meets the minimum requirements for thickness and seepage.
    - Document the thickness of the soil cover over the compacted liner.
  - Concrete Structure:
    - Submit the concrete mix design used, with any additives used.
    - Document the thickness of concrete installed.
    - Submit any concrete quality control documentation that the installed concrete meets the mix design specified.
  - Subsurface Drainage system:
    - Document any subsurface drainage system installed associated with the installation of the waste storage structure and identify the drainage outlet location.
  - Waste Treatment Facility:
    - Identify location of equipment or system installed.

All manure/waste storage structures or treatment facilities must be designed and constructed by individuals or companies qualified in the appropriate area of expertise for that work. Qualified



individuals may include Geologist, Soil Scientist, licensed professional such as Engineers, or a professional business that constructs manure/waste storage or treatment facilities or conducts engineering soil testing procedures in accordance with ASTM standards.

New designs must be sealed by a Michigan licensed Professional Engineer (P.E.) or a licensed professional for smaller conservation practices such as an above ground dry stacking facility. The P.E. is required to sign a statement that the structure was installed according to identified standards and meet all requirements on the Design and red line As-builts must be sealed with a date and state license number.

#### **Existing Manure/Waste Storage Structure:**

As part of the MDARD Site Review and Verification process, existing storages must also be evaluated for structural integrity and soundness. This is referred to as an Evaluation of Existing components (EEC). The existing storage must be evaluated by a qualified individual for the type of storage being evaluated indicating that the structure currently meets the environmental performance equivalent to the applicable NRCS 313-WSF practice standard and/or 520- Pond Sealing or Lining, Compacted Soil Treatment for earthen structure liner permeability or specific discharge: industry standards such as MWPS, or ACI for concrete structures, and American Institute of Steel Construction (AISC) for Steel type fabricated structures.

For guidance on EEC equivalence by manure/waste storage structures use the NRCS-MI CNMP Guidance for CEMA 227 - ([NRCS CEMA-227 EEC Guidance 2024 January.docx](#)).

## **APPENDIX F**

### **Michigan Commission of Agriculture and Rural Development Policy No. 10**

Policy Title: **APPEALS FROM MDARD'S SITE SUITABILITY DETERMINATIONS**

Under the Generally Accepted Agricultural and Management Practices for Site Selection and Odor Control for New and Expanding Livestock Facilities (Site Selection GAAMP), farms may request a site suitability determination from MDARD. MDARD's site suitability determinations are sent to the farmer and the local unit of government and posted on MDARD's RTF website. MDARD's site suitability determination can be appealed to MDARD's Director as provided below.

#### **A. Who can request to appeal MDARD's site suitability determination?**

The following people or entities can request to appeal MDARD's site suitability determination:

- The owner of the proposed livestock facility.
- A person with property within one-half mile of the site of the proposed livestock facility.
- The local unit of government in which the site for the proposed livestock facility is located.
- Local unit of government which is within one-half mile of the proposed livestock facility.

#### **B. Timing of a request to appeal**

A request to appeal must be filed within 30 days from the date MDARD's site suitability determination is posted on MDARD's Right to Farm Siting website.

#### **C. Contents of a request to appeal**

A request to appeal MDARD's site suitability determination is made by sending a written description of the appeal including all documentation supporting the appeal to MDARD's Director through the Commission email at [MDA-Ag-Commission@michigan.gov](mailto:MDA-Ag-Commission@michigan.gov).

The request to appeal must identify with specificity the section or requirement in the Site Selection GAAMPs that the requestor believes MDARD failed to or improperly applied when it made its site suitability determination.

The request for appeal must include relevant facts, data, analysis, and supporting documentation for the appellant's position.

A request to appeal that does not identify with specificity the way MDARD failed to or improperly applied the Site Selection GAAMPs or does not provide supporting documentation will be denied. The Director will notify the Site Selection GAAMPs Chair, as well as the Commission of Agriculture and Rural Development of this decision. MDARD will send a letter to the entity who submitted the request to appeal stating the reason the request has been denied. A denial of a request to appeal is a final agency decision on MDARD's site suitability determination.

A request to appeal that meets the requirements of this section will be approved and will proceed through the appeal process outlined below. MDARD shall make all determinations

regarding requests to appeal within 14 days after the close of the 30- day appeal window.

#### **D. Appeal process**

Once MDARD approves a request to appeal, the following process will be initiated:

1. MDARD will ask the Chairperson of the Site Selection GAAMPs Committee to convene a panel of recognized professionals to review MDARD's site suitability determination. The panel of recognized professionals may include, but are not limited to, personnel from the following: conservation districts, industry representatives, Michigan Department of Environment, Great Lakes, and Energy, professional consultants and contractors, professional engineers, the United States Department of Agriculture - Natural Resources Conservation Service, university agricultural engineers, and other university specialists and shall contain no less than three recognized professionals.
2. Within 28 days, the panel of recognized professionals shall review MDARD's site suitability determination and consider the information provided by the Appellant. The panel of recognized professionals shall create a written report to be considered at the Commission's next scheduled public meeting.
3. The Commission will consider the panel of recognized professionals report, oral or written comments from the appellant(s), and other public comments regarding MDARD's site suitability determination.
4. The Commission shall make a recommendation to the MDARD Director. The Commission's recommendation can take one of three forms: (i) approve MDARD's site suitability determination; (ii) reverse MDARD's site suitability determination; or (iii) send the case back to the panel of recognized professionals or MDARD staff with instructions to consider certain factors or issues that were not sufficiently considered during the panel's initial review, including a timeframe for providing the information to the Commission. In the event of a tie vote by the Commission, the matter shall be submitted to the Director without a recommendation from the Commission.
5. The Director shall issue a written final decision regarding the site suitability determination within 14 days of the Commission's recommendation/ submission.
6. Following the Director's final decision, the farmer, appellant, and local unit of government will be sent MDARD's final decision, and the final decision will be posted on the MDARD RTF Siting website.

Approved in St. Johns, Michigan

May 15, 2019

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# Generally Accepted Agricultural and Management Practices for Farm Markets

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**DRAFT 2025**

Michigan Commission of Agriculture & Rural  
Development  
PO BO 30017  
Lansing, MI 48909

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**In the event of an agricultural pollution emergency such as a chemical/fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture & Rural Development and/or Michigan Department of Environment, Great Lakes, and Energy should be contacted at the following emergency telephone numbers:**

<b>Michigan Department of Agriculture &amp; Rural Development:</b>	<b>800-405-0101</b>
<b>Michigan Department of Environment, Great Lakes, and Energy's Pollution Emergency Alert System:</b>	<b>800-292-4706</b>

If there is not an emergency, but you have questions on the Michigan Right to Farm Act, or items concerning a farm operation, please contact the:

**Michigan Department of Agriculture & Rural Development  
Right to Farm Program  
P.O. Box 30017  
Lansing, Michigan 48909  
517-284-5619  
877-632-1783  
517-335-3329 FAX**

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## **PREFACE**

The Michigan legislature passed into law the Michigan Right to Farm Act (Act 93 of 1981, as amended) which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). These practices are written to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require necessary revision of the practices. The GAAMPs are reviewed annually and revised as considered necessary.

The GAAMPs that have been developed are as follows:

- 1) 1988 Manure Management and Utilization
- 2) 1991 Pesticide Utilization and Pest Control
- 3) 1993 Nutrient Utilization
- 4) 1995 Care of Farm Animals
- 5) 1996 Cranberry Production
- 6) 2000 Site Selection and Odor Control for New and Expanding  
Livestock Facilities
- 7) 2003 Irrigation Water Use
- 8) 2010 Farm Markets

These practices were developed with industry, university, and multi-governmental agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices are provided protection from public or private nuisance litigation under the Right to Farm Act.

The website for the GAAMPs is <http://www.michigan.gov/righttofarm>.

## **INTRODUCTION**

As farmers look for ways to keep their businesses economically viable, many have chosen to shift their operations from a farmer-to-processor to a direct market business model. This includes selling raw and value-added products directly to the consumer through on-farm establishments, farmers markets, and other agricultural outlets. This allows farms to take advantage of consumer interest in agritourism, the “buy local” movement, and a desire for a connection with farmers and food production. These activities have far-reaching economic impacts. Many regions have capitalized on the growth of farm markets by developing regional farm market and culinary trails, and tourism promotion based on authentic culinary experiences offered by local farm markets. Farm markets provide the opportunity for visitors to meet a farmer, learn about modern agricultural practices, and gain access to fresh, local, nutritious food. Finally, farm markets and the associated farm, help maintain green space adding to the quality of life. Thriving farmland enhances the beauty of communities, retains residents, and attracts visitors. As farm operations engage in direct sales and on-farm activities, conflicts have arisen regarding oversight of these businesses.

Michigan is a Right to Farm (RTF) state and the RTF Act defines a “farm operation” as meaning the operation and management of a farm or a condition or activity that occurs at any time as necessary on a farm in connection with the commercial production, harvesting, and storage of farm products. This definition includes, but is not limited to, marketing produce at roadside stands or farm markets. Farm markets offer farm related experiences and farm products through a variety of agritourism activities. The experience in turn promotes sale of more farm products and provides an added income stream to support the farm business, the farm family, and surrounding communities; and keeps farmland in production.

Although the RTF Act includes farm markets in the definition of a farm operation, this definition does not define a farm market or describe specific marketing activities. These GAAMPs for Farm Markets were developed to provide guidance as to what constitutes an on-farm market and farm market activities.

## **DEFINITIONS**

**Affiliated** – “Affiliated” means a farm under the same ownership or control (e.g., leased) as the farm and does not need to be on the same parcel of land.

**Expanding Farm Market** – An addition to an existing farm market that increases the square footage of the farm market.

**Farm** – A “farm” means the land, plants, animals, buildings, structures, including ponds used for agricultural or aquacultural activities, machinery, equipment, and other appurtenances used in the commercial production of farm products.

**Farm Market** – A farm market is a year-round or seasonal location where transactions and marketing activities between farm market operators and customers take place.

A farm market may be a physical structure such as a building or tent, or simply an area where a transaction between a customer and a farmer is made. The farm market does not have to be a physical structure. The farm market must be located on property owned or controlled (e.g., leased) by the producer of the products offered for sale at the market. Fresh products as well as processed products may be sold at the farm market. At least 50 percent of the farm products offered must be produced on and by the affiliated farm measured by retail floor space during peak production season, or 50 percent of the average gross sales for up to the previous five years or as outlined in a business plan. Processed products will be considered as produced on and by the farm if at least 50 percent of the product’s primary or namesake ingredient was produced on and by the farm, such as apples used in apple pie, maple sap in maple syrup, strawberries in strawberry jam, etc.

**Farm Product** – A “farm product” means those plants and animals useful to humans produced by agriculture and includes, but is not limited to forages and sod crops, grains and feed crops, field crops, dairy and dairy products, poultry and poultry products, cervidae, livestock (including breeding and grazing), equine, fish and other aquacultural products, bees and bee products, berries, herbs, fruits, vegetables, flowers, seeds, grasses, nursery stock, trees and tree products, mushrooms and other similar products, or any other product which incorporates the use of food, feed, fiber, or fur as determined by the Michigan Commission of Agriculture & Rural Development.

**Marketing** – Promotional and educational activities at the farm market incidental to farm products with the intention of selling more farm products. These activities include, but are not limited to, farm tours (walking or motorized), demonstrations, cooking and other classes utilizing farm products, and farm-to-table dinners.

**Processed** – A farm product or commodity that has been converted into a product for direct sales. Processing may include, but is not limited to, packing, washing, cleaning, grading, sorting, pitting, pressing, fermenting, distilling, packaging, cutting, cooling, storage, canning, drying, freezing, or otherwise preparing the product for sale.

## PHYSICAL CHARACTERISTICS OF A FARM MARKET

### Location

A new or expanding farm market that is greater than 120 square feet must meet a minimum setback of 165 feet from all non-farm residences.

New or expanding farm markets are not authorized under this GAAMP on platted lots within a subdivision created under the Michigan Land Division Act (Act 288 of 1967, MCL 560.101, *et seq.*) or preceding statutes and on condominium units within a condominium (sometimes referred to as “site-condos”) created under the Michigan Condominium Act (Act 59 of 1978, MCL 559.101, *et seq.*). However, farm markets are permitted in such areas if authorized by association rules or pursuant to a local ordinance designed for that purpose, unless prohibited by association rules.

A farm market should have a written site plan for potential MDARD review that preempts local government regulations.

### Buildings

If the farm market is housed in a physical structure as defined and regulated by the Stille-Derossett-Hale Single State Construction Code Act (Act 230 of 1972), the structure must comply with the Stille-Derossett-Hale Single State Construction Code Act (Act 230 of 1972), including road right-of-way areas and ingress and egress points.

### Parking and Driveways

Parking and driveway surfaces may be paved, vegetative, ground, gravel, pavement, or other unpaved suitable material. ~~However, other parking and driveway requirements must comply with all applicable regulations.~~

### Vehicle Ingress and Egress

Any farm market and affiliated parking operating along a public road must obtain all appropriate ingress and egress permits.

### Signage

~~The operator of the farm market must comply with all applicable state and federal regulations for signs.~~ A minimum of one roadside sign is allowed. ~~pursuant to local sign ordinance setbacks, lighting, height, and size requirements.~~

For further information concerning this GAAMP you may contact the Michigan Department of Agriculture and Rural Development or Michigan State University Extension.



## **APPENDICES**

### **Appendix A: Considerations for Farm Markets**

#### **Statement of Intent**

Appendix A is explicitly intended as a reference for informational and educational purposes only. Information contained in Appendix A is not intended to be utilized by Michigan Department of Agriculture and Rural Development (MDARD) Right to Farm Program as part of any Generally Accepted Agricultural and Management Practices (GAAMPs) conformance determination process.

#### **GAAMPs Conformance and Other Regulatory Permits**

Depending on the nature and location of a GAAMPs conformant farm market operation, other local, state and/or federal regulations may still apply. It is the responsibility of the farm market owner or their representative acting on the owner's behalf to contact the appropriate regulatory authorities to determine if additional permits for compliance are required prior to beginning any activity or construction.

MDARD Right to Farm Program does not have authority to determine applicability of, or compliance with, any regulation other than conformance to the management practices described within the GAAMPs.

#### **Non-Farm Product Sales, Processing and Miscellaneous Activities**

Michigan Right to Farm Act provides nuisance protection for farms and farm operations in conformance with GAAMPs including the production of farm products and the marketing and sales of farm products at farm markets. This protection may not extend to sales of non-farm products (e.g., hats, t-shirts, jewelry, etc.), on-site processing of farm products (e.g., baking pies, brewing hard cider, etc.) or other on-farm activities (e.g., wedding/event barns, bed & breakfast/lodging, restaurants, glamping, etc.). A GAAMPs-conformant farm market operation may still be subject to other local, state and/or federal regulations (see *GAAMPs Conformance and Other Regulatory Permits* above).

#### **Signage**

Farm Markets GAAMPs allows for a minimum of one roadside sign; however, this sign (and any additional signs, if permitted) may be subject to other local ordinance requirements (e.g., setbacks, lighting, height, and size)

#### **Agritourism**

'Agritourism' currently has no legal definition or recognition in Michigan law. Activities commonly identified as, and/or associated with, agritourism may or may not comply with GAAMPs. These activities must be assessed on a case-by-case basis and may be subject to additional local, state and/or federal regulations (see *GAAMPs Conformance and Other Regulatory Permits* above).

## **Resources**

There are many professional resources available to assist farmers, government officials and others navigating Right to Farm and GAAMPs-related issues. Resources include, but are not limited to, MDARD Right to Farm Program, Michigan State University Extension, Michigan Townships Association, Michigan Farm Bureau, and Michigan Agritourism Association.

## **REFERENCES**

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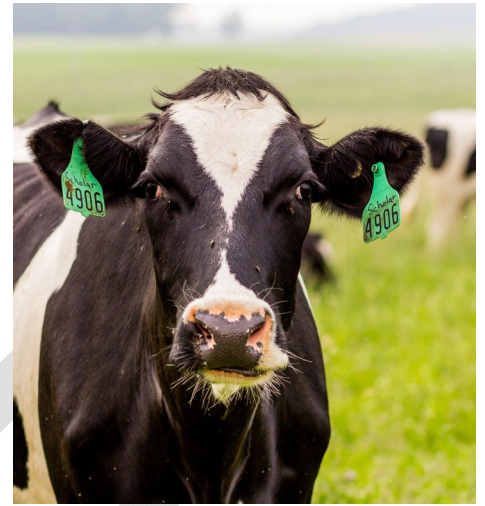
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# Generally Accepted Agricultural and Management Practices for Manure Management and Utilization

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**DRAFT 2025**

Michigan Commission of Agriculture & Rural  
Development  
PO BOX 30017  
Lansing, MI 48909



**In the event of an agricultural pollution emergency, such as a chemical/fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture & Rural Development and/or the Michigan Department of Environment, Great Lakes, and Energy should be contacted at the following emergency telephone numbers:**

**Michigan Department of Agriculture & Rural Development: 800-405-0101  
Michigan Department of Environment, Great Lakes, and Energy's Pollution  
Emergency Alert System: 800-292-4706**

If there is not an emergency, but you have questions on the Michigan Right to Farm Act, or items concerning a farm operation, please contact the:

**Michigan Department of Agriculture & Rural Development  
Right to Farm Program**

**P.O. Box 30017**

**Lansing, Michigan 48909**

**517-284-5619**

**517-335-3329 FAX**

**(Toll Free) 877-632-1783**

**[www.michigan.gov/righttofarm](http://www.michigan.gov/righttofarm)**

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## PREFACE

The Michigan legislature passed into law the Michigan Right to Farm Act (Act 93 of 1981, as amended), which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). These practices are written to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require necessary revision of the GAAMPs.

The GAAMPs that have been developed are as follows:

- 1) 1988 Manure Management and Utilization
- 2) 1991 Pesticide Utilization and Pest Control
- 3) 1993 Nutrient Utilization
- 4) 1995 Care of Farm Animals
- 5) 1996 Cranberry Production
- 6) 2000 Site Selection and Odor Control for New and Expanding Livestock Facilities
- 7) 2003 Irrigation Water Use
- 8) 2010 Farm Markets

These GAAMPs were developed with industry, university, and multi-governmental agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices are provided protection from public or private nuisance litigation under the Right to Farm Act.

This GAAMP does not apply in municipalities with a population of 100,000 or more in which a zoning ordinance has been enacted to allow for agriculture provided the ordinance designates existing agricultural operations present prior to the ordinance's adoption as legal non-conforming uses as identified by the Right to Farm Act for purposes of scale and type of agricultural use.

The MDARD website for the GAAMPs is  
<https://www.michigan.gov/mdard/environment/rtf>

## INTRODUCTION

Like all other segments of our economy, agriculture has changed significantly during the past 50 years and will continue to change in the future. The trend toward larger facilities (the overwhelming majority being family owned and operated) has resulted in farm operations being more capital intensive and less labor intensive. A larger farm size offers marketing advantages and generally lower unit cost of production compared to smaller sized operations. However, increased farm size brings new management challenges for environmental protection, animal care, and neighbor relations.

Animal agriculture in Michigan must have the flexibility and opportunity to change agricultural enterprises and adopt new technology to remain economically viable and competitive in the marketplace while being protective of the environment. If a healthy, growing livestock industry in Michigan is to be assured, efforts must continue to address concerns of livestock producers and their neighbors, particularly in two areas: (1) producers who use GAAMPs in their livestock operations should be protected from harassment and nuisance complaints and (2) persons living near livestock operations, who do not follow GAAMPs, need to have concerns addressed when odor nuisance or water quality problems occur.

No two livestock operations in Michigan can be expected to be the same, due to the large number of variables, which together determine the nature of a particular operation. The GAAMPs presented in this document provide options to assist with the development of environmental practices for a particular farm that prevents surface water and groundwater pollution.

These GAAMPs are referenced in Michigan's Natural Resources and Environmental Protection Act (NREPA), Act 451 of 1994, as amended. NREPA protects the waters of the state from the release of pollutants in quantities and/or concentrations that violate established water quality standards. In addition, the GAAMPs utilize the nationally recognized construction and management standards to provide runoff control for a 25-year, 24-hour rainfall event. Air quality issues related to production agriculture are addressed in the Odor Management Section.

### About this Document

Management practices are presented as a numbered list and categorized in four areas: (1) runoff control and wastewater management, (2) odor management, (3) construction design and management for manure storage and treatment facilities, and (4) manure application to land.

Appendix A provides essential data for manure management system planning.

Appendix B discusses the difference between Manure Management System Plans (MMSP) and Comprehensive Nutrient Management Plans (CNMP) and explains who needs a CNMP.

Appendix C shows a sample MMSP to help the reader become more familiar with the type of information that is typically included in an MMSP.

The final portion of this document is a list of references that can provide detailed information not supplied in this document.

## **RUNOFF CONTROL AND WASTEWATER MANAGEMENT**

Rainfall and snowfall-induced runoff from uncovered livestock facilities (regardless of the facility's surface characteristics) requires control to protect neighboring land areas and prevent direct discharge to surface or groundwaters. Livestock facilities, which require runoff control, include all holding areas where livestock density precludes sustaining vegetative growth on the soil surface. Exclude nonpolluted runoff from impacted locations to the fullest extent practical except where including the runoff is advantageous to the operation of the agricultural waste management system (NRCS-MI Conservation Practice Standard Waste Storage Facility 313).

- 1. Runoff control is required for any facility if runoff from a lot leaves the owner's own property or adversely impacts surface and/or groundwater quality. Examples include runoff to neighboring land, a roadside ditch, a drain ditch, stream, lake, or wetland.**
- 2. Milk parlor and milk house wastewater shall be managed in a manner to protect groundwater and surface waters.**
- 3. Leachate and runoff from stored manure, silage, food processing by-products, or other stored livestock feeds shall be managed in a manner to protect groundwater and surface waters.**

For runoff control and wastewater management guidance, refer to the USDA Natural Resources Conservation Service (NRCS) Michigan (MI) Conservation Practice Standard *Wastewater Treatment, Milkhouse 627* (USDA-NRCS-MI Field Office Technical Guide [FOTG]), chapter 4 of *Livestock Waste Facilities Handbook 3<sup>rd</sup> Edition*, (MidWest Plan Service, 1993), and the *Guideline for Milking Center Wastewater* (Wright and Graves, 1998) For construction Design standards and specifications, see GAAMP Number 19, Construction design for manure storage, runoff storage, and treatment

facilities must meet standards and specifications.

### **Storage Facilities for Runoff Control**

Runoff control can be achieved by providing facilities the option to collect and store the runoff for later application to cropland.

- 4. Runoff storage facilities should be designed to contain normally occurring direct precipitation and resulting runoff and manure that accumulate during the storage times projected in the MMSP. In addition, storage volume should be provided that will contain the direct rainfall and runoff that occur as a result of the average 25-year, 24-hour rainfall event for the area.**

Refer to the NRCS-MI Conservation Practice Standard *Waste Storage Facility 313* for controlling seepage from waste impoundments (USDA-NRCS-MI FOTG). Additional guidance can also be found in Chapter 10, Appendix 10D of the *Agricultural Waste Management Field Handbook (AWMFH)*, Part 651, (USDA-NRCS, 2008).

### **Land Application of Wastewater and Runoff**

Equipment must be available for land application of stored runoff wastewater. Land application should be done when the soil is dry enough to accept the water.

- 5. Application rates should be determined based upon the ability of the soil to accept and store the runoff and wastewater and the ability of plants growing in the application area to utilize nutrients. Land application should be done when the wastewater can be used beneficially by a growing crop. On fields testing over 150 ppm P (300 lb. P/acre) soil test Bray P1, (202 ppm or 404 lb./acre Mehlich-3 P) there may be instances where on-farm generated wastewater, <1 percent solids, can be utilized if applied at rates that supply 75 percent or less of the annual phosphorus removal for the current crop or next crop to be harvested.**

In these instances, the following conditions must be met:

- a) Annual sampling of the applied wastewater to determine its P content, so P2O5 loadings can be calculated.
- b) soil P test levels must show a progressive decline over time.
- c) no other phosphorus can be applied to the crop field from other sources.
- d) when using irrigation as an application method, the GAAMPs for Irrigation Water Use must be followed to ensure irrigation scheduling is used to meet and not exceed evapotranspiration needs of the crop/soil system to avoid excess wastewater disposal that would flush soluble phosphorus past the depth of crop rooting; and,

- e) tile drained fields must be monitored in accordance with GAAMP 29.**

Sprinkler irrigation methods will provide uniform application of liquid with minimum labor requirements. Directing lot runoff through a structure for settling solids can reduce odor from the liquid storage and application.

### **Infiltration Areas**

- 6. An alternative to a storage structure is a structure for settling solids with a vegetated infiltration area for handling lot runoff, and/or silage leachate wastewater. The vegetative area may be a long, grassed, slightly sloping channel or a broad, flat area with minimal slope for positive drainage and surrounded by a berm or dike. All outside surface water should be excluded from the infiltration area so that the only water applied is lot runoff and/or diluted silage leachate and direct precipitation. Vegetation should be maintained and harvested at least once per year so that the nutrients contained in the plant material are removed, in order to prevent excessive nutrient, build up in the soil of the infiltration area.**

Design information about infiltration areas, such as sizing, establishment, and maintenance, is available in the NRCS MI Conservation Practice Standard *Vegetated Treatment Area 635* (USDA-NRCS-MI FOTG), chapter 4, about runoff and infiltration areas, and chapter 5, about settling basins, in the *Livestock Waste Facilities Handbook 3<sup>rd</sup> Edition*, (MidWest Plan Service, 1993), and the *Vegetative Treatment Systems for Open Lot Runoff: A Collaborative Report* (USDA-NRCS, 2006). These systems are not practical for every situation.

### **Pasture Systems**

Pastureland is land that is primarily used for the production of forage upon which livestock graze. Pastureland is characterized by a predominance of vegetation consisting of desirable forage species. Sites such as loafing areas, confinement areas, or feedlots which have livestock densities that preclude a predominance of desirable forage species are not considered pastureland.

- 7. Stocking densities and management systems should be employed which ensure that desirable forage species are present with an intensity of stand sufficient to slow the movement of runoff water, control soil erosion and movement of manure nutrients from the pastureland.**
- 8. Livestock should be excluded from actual contact with streams or water courses except for controlled crossings and accesses for watering.**

As authorized by the Riparian Doctrine, producers are entitled to utilize surface waters traversing their property. However, this use is limited to activities which do not result in

water quality degradation. The goal for controlling livestock access to surface waters is to prevent water quality degradation. Livestock can impact water quality by the erosion of sediment and nutrients from stream banks and by the direct deposition of manure nutrients, organic matter, and pathogens into surface water.

Direct deposition is effectively prevented by restricting livestock to controlled access locations. Banks are effectively stabilized by maintaining vegetation or, as in the case of controlled watering accesses and crossings, stream banks and beds may be stabilized with appropriate protective cover, such as concrete, rocks, crushed rock, gravel, or other suitable cover. In addition to addressing environmental and public health aspects, controlling livestock access to surface water and providing alternate drinking water sources may improve herd health by reducing exposure to water and soil-borne pathogens.

For more information, see the NRCS-MI Conservation Practice Standard *Prescribed Grazing* 528 (USDA-NRCS-MI FOTG) or Bulletin E-3066 entitled *Acceptable Practices for Managing Livestock along Lakes, Streams and Wetlands* (Michigan State University Extension, 2008).

**9. Runoff from pasture feeding and watering areas should travel through a vegetated filter area to protect surface and groundwater.**

See the NRCS-MI Conservation Practice Standards *Wastewater Treatment Area* 635 and *Filter Strip* 393 (USDA-NRCS-MI FOTG) for criteria.

**Outside Lots**

**10. Provisions should be made to collect, store, utilize, and/or treat manure accumulations and runoff from outside open lots used for raising livestock.**

Outside open lots used for raising livestock are areas of animal manure accumulation. Maintenance of open lot systems requires manure handling methods to periodically remove accumulated solid or semisolid manure and control lot runoff. Solid manure is typically transferred from the lot to storage facilities or equipment for application to cropland. The frequency of removal of accumulated manure will depend on the animal density (square feet of lot area per animal), the amount of time the animals spend on the lot, the animal size, and the type of feed system. Clean runoff should be diverted away from the livestock lot area.

While paved lots generally result in more runoff than unpaved lots, a paved surface improves manure collection and runoff control and minimizes the potential for groundwater contamination.

**ODOR MANAGEMENT**



The goal for effective odor management is to reduce the frequency, intensity, duration and offensiveness of odors, and to manage the operation in a way that tends to create a positive attitude toward the operation. Because of the subjective nature of human responses to certain odors, recommendations for appropriate technology and management practices are not an exact science. The recommendations in this section represent the best professional judgment available.

The following eight management practices (GAAMPs numbered 11 to 18) provide guidance on how to minimize potential odors from livestock operations. Producers should select those practices which are applicable to their livestock operations and develop an Odor Control Plan as part of their MMSP. See Appendix C, Section IX, for a sample MMSP that contains an example Odor Control Plan.

**11. Livestock producers should plan, design, construct, and manage their operations in a manner that minimizes odor impacts upon neighbors.**

The proximity of livestock operations to neighbors and populated areas is usually the most critical factor in determining the level of technology and management needed to minimize odor impacts upon neighbors. Therefore, site selection is an important factor in minimizing odor impacts for and upon neighbors. The more remote the livestock operation, the better the likelihood that odors will not become an annoyance for neighbors; and, therefore, a lower level of technology and management will adequately manage odors at the livestock facility. However, the distance which a livestock operation should be located from neighboring land uses to effectively control odors is not easily established. Additional information and recommendations can be found in the current GAAMPs for Site Selection and Odor Control for New and Expanding Livestock Facilities.

The principles upon which the most common and effective techniques for odor control are based include (a) reducing the formation of odor-causing gases and (b) reducing the release of odorous gases into the atmosphere. The degree to which these principles can be applied to the various odor sources found in livestock operations depends on the level of technology and management that can be utilized. Feed materials and manure are the most common and predominant sources of odor and are discussed in the following subsections.

**Outside Lots**

Outside open lots are acceptable for raising livestock in Michigan. In these systems, manure is deposited over a relatively large surface area per animal (compared to a roofed confinement system for example) and begins to decompose in place. Odor impacts can be mitigated by keeping the lot surface as dry as possible; thus, limiting the microbiological activity that generates odors. Providing adequate slopes, orientation that

takes advantage of sunlight, diverting up-slope runoff water away from the lot, and using recommended stocking densities will enhance drying of the lot surface. The *Beef Cattle Notebook* (Beef Cattle Resource Committee, 1999) provides details and alternatives to accomplish this. Most feed additives and odor control chemicals applied to feedlot surfaces have not been demonstrated to be effective in reducing odors from feedlots in humid areas, such as Michigan.

**12. New outside lot systems should not be located in close proximity to residences and other odor-sensitive land uses.**

In spite of good facilities design and management, odors may be generated from outside livestock lot systems. The intensity of these odors is somewhat proportional to the surface area of the odor producing sources. The frequency of impact and offensiveness to neighbors is often related to the distance to neighbors' houses and their location relative to prevailing winds. They should not be located uphill along a confining valley leading toward residences. For additional guidance refer to the current GAAMPs for Site Selection and Odor Control for New and Expanding Livestock Facilities (MDARD, 2024)

**Feed Materials**

Using fermented feeds, such as corn or hay silage, is an acceptable animal husbandry practice throughout Michigan for dairy and beef cattle, horses, sheep, and goats. Some odors associated with the storage and feeding of these materials are normal for these livestock operations.

**13. The odor of fermented feed materials, such as corn or hay silage, can be minimized by harvesting and storing them at an appropriate dry matter content (generally greater than 33 percent dry matter).**

The practice of feeding human foodstuffs, surplus and processing by-products (e.g., cull potatoes, dairy milk or whey, cereal by-products, surplus garden and orchard produce, pastry by-products, sugar beet pulp, and sweetcorn husks) to livestock is a generally accepted practice. This is especially common where livestock operations exist within close proximity to food production and food processing facilities. Using these materials for livestock feed diverts useful by-products (that can pose a substantial load on local sewage treatment plants and a major problem for food processing plants) from the waste stream and converts them into a valuable resource. Properly handled in a livestock operation, these feeds pose no threat to the environment. These products may require special feed handling systems and may substantially increase or change the manure generated by the animals to which they are fed. Some by-products themselves and/or the manure produced by livestock with their consumption can be the source of unusual, offensive, and intense odors. In these situations, feed handling and manure management practices should be used to control and minimize the frequency and

duration of such odors. Garbage is defined in the Animal Industry Act 466 of 1988, as amended; Section 287.703 as products containing animal materials and cannot be fed to livestock in Michigan.

### **Manure**

Fresh manure is usually considered to be less odorous than anaerobically decomposing manure. Fresh manure emits ammonia but in general is not accompanied by other products of decomposition, which contribute to odors.

- 14. Frequent (daily or every few days) removal of manure from animal space, coupled with storage or stacking and followed by application to cropland at agronomic rates, is an acceptable practice throughout Michigan.**

Manure odors are generally those associated with the anaerobic (in the absence of oxygen) decomposition of organic material by microorganisms. The intensity of odors depends upon the biological reactions that take place within the material, the nature of the excreted material (which is dependent upon the species of animal and its diet), the type of bedding material used, and the surface area of the odor source. Sources of decomposing manure can include stacked solid manure, outside lots when manure is allowed to accumulate, uncovered manure storages, manure treatment systems, and land application areas.

- 15. Do not locate manure storage in close proximity to residential areas unless site conditions do not allow, and covers are applied as described in GAAMPs 17 and sequential GAAMPs are followed.**

Additional information and recommendations can be found in the current GAAMPs for Site Selection and Odor Control for New and Expanding Livestock Facilities in the Manure Storage Structure Change or Installation Section.

### **Stacked Solid Manure**

- 16. Solid manure that may contain bedding materials and/or is dried sufficiently, such as that from poultry, cattle, sheep, swine, horse, and fur-bearing animal facilities, can be temporarily stacked outside the livestock building.**

### **Farmstead Stockpiling**

Stockpiling manure at a farmstead is an acceptable practice that should be protective of the environment and mindful of neighbors. Manure should be stockpiled on a hard surface pad (such as concrete or asphalt) with sides to prevent leachate and runoff. Stockpiling manure on the ground is also an acceptable practice with appropriate

management such as rotating locations and complete periodic removal of manure from the location annually or more frequently, records documenting timing of removal and location used, and seeding of the previous location after removal to allow for vegetation to take up the nutrients that have accumulated in the soil. Stockpile locations should remain vegetated without stockpiled manure for a minimum of three years before reusing the site. In addition, the stockpile should be in a location that does not allow for runoff to flow onto neighboring property or into surface waters. The location should also consider odors and pests if the stockpile is in close proximity to homes, schools or other high use areas. Practices such as covering stockpiled manure with a tarp, fleece blanket<sup>1</sup>, straw, woodchips or other materials, planting or establishing a screen, shaping the stockpile into a conical shape, placing the stockpile to avoid overland flow of precipitation runoff, or using additives such as lime, can be used to help reduce odors and pests. Manure stockpiles need to be kept at least 150 feet from non-farm homes, if possible. If not possible, stockpiles need to be kept at least 50 feet from the property line or, if neither setback distance is possible, a tarp, fleece blanket<sup>1</sup>, or straw cover must be maintained.

### **Field Stockpiling**

Stockpiling, or staging, of manure at field application sites may be necessary when crop production and field conditions preclude immediate application to cropland, when it does not exceed 12 months. Rotating and use of the footprint for crop production is recommended. The stockpile should be in a location that does not allow for runoff to flow onto neighboring property or into surface waters. The location should also consider odors and pests if the stockpile is in close proximity to homes, schools or other high use areas.

Proximity to surface water, field drainage, predominate wind direction, field slope and applicable conservation practices should be factored into infield manure stacking locations. Manure stockpiles need to be kept at least 150 feet from non-farm homes. Manure stockpiles also need to be kept at least 150 feet from surface waters or areas subject to flooding unless conservation practices are used to protect against runoff and erosion losses to surface waters.

Leachate from solid stacked manure is subject to control as described in Section II, Runoff Control and Wastewater Management, GAAMP No. 3. When initially placed in the field, stockpiles should be at least 6 feet high and have a conical shape. Moderate compaction and a sloped surface enhance the shedding of precipitation and lessen leaching. Manure that is temporarily stockpiled in the field should be spread as soon as field and weather conditions allow. Stockpiled manure must be spread onto fields within

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<sup>1</sup> A fleece blanket is a non-woven textile material made from synthetic fibers, such as polypropylene. The non-woven texture of a fleece blanket prevents rainfall from penetrating into the composting material but allows the necessary exchange of carbon dioxide and oxygen.

six months of initial pile placement if uncovered, or within twelve months if covered with an impermeable cover for the additional time until spread. Covering is recommended for the entire time the manure is stockpiled in the field. Timely application of stockpiled manure to land at agronomic rates and soil incorporation within 48 hours after application will help to control odors and may have nutrient management crop production benefits. Practices such as a tarp, a straw cover, or additives such as lime, can be used to help reduce odors and pests. Odors from such manure stockpiles should be minimized, except when disturbed such as during removal for application to land.

Livestock operations may utilize a variety of bedding materials as part of their manure management system. The use of straw, hay, sand, sawdust, wood shavings, wastepaper, or other suitable materials, either individually or in combination as livestock or poultry bedding, is a common generally accepted practice. Bedding materials should be of an appropriate size to maximize absorptive properties and to prevent blowing and dispersion when subsequently applied to cropland. Waxed paper, aluminum foil, and plastics should not be present in bedding material.

### **Storages and Acceptable Covers**

#### **17. Use covered manure storage if technically and economically feasible.**

The primary objective of storage is to temporarily store the manure before application to land. However, some biological activity occurs in these storages, and the gases generated can be a source of odors. If storage facilities are left uncovered, the potential for manure odors to be carried away by air movement will increase. Various types of covers can be used to prevent wind driven air from coming into direct contact with a liquid manure surface and incorporating odors.

Acceptable covers that can retard odor escape from manure storages include the following:

- a) Natural fibrous mats similar to those which develop on liquid manure storages receiving manure from beef and dairy cattle fed a high roughage diet. Slotted flooring or other underbuilding tanks. Ventilation must be provided in the building to prevent accumulation of noxious and flammable gases.
- b) A flexible plastic, or similar material, that covers the liquid surface and is of such strength, anchorage and design that the covering will not tear or pull loose when subjected to normal winds that have an average recurrence interval of 25 years. Gas escape vents should be provided which allow any gas that may evolve to escape.
- c) A solid covering such as concrete, wood, plastic or similar materials that covers the entire liquid surface and is of such strength, anchorage, and design that it will withstand winds and expected vertical loads. Adequate air exchange should be provided which will prevent the occurrence of explosive concentrations of

flammable gases.

## **Treatment Systems**

A biological treatment system is designed to convert organic matter (e.g., feed, bedding, animal manure, and other by-products) to more stable end products. Anaerobic processes (without free oxygen) can liquefy or degrade high BOD (biochemical oxygen demand) wastes. They can decompose more organic matter per unit volume than aerobic treatment processes. Aerobic processes require free oxygen and are helpful in reducing odor but are generally not considered economical for livestock operations. Extreme environmental changes alter microbial activity. When microorganisms are stressed by their environment, waste treatment processes can malfunction, and odors may become more intense.

## **Lagoons and Storage Facilities**

Anaerobic treatment lagoons are generally basins containing diluted manure and are designed to provide degradation of the organic material. Well-designed and managed anaerobic lagoons can be short-term odor sources. The occurrence of purple sulfur-fixing bacteria can significantly reduce odors from an anaerobic treatment lagoon. The intensity of odors is usually greatest during the early spring and occasionally in the fall.

Aerobic treatment of manure liquids can be accomplished by natural or mechanical aeration. In a naturally aerated system, such as a facultative oxidation treatment lagoon, an aquatic environment occurs in which photosynthesis from algae and surface aeration from the atmosphere provides an aerobic zone in the upper regions of the treatment lagoon. A transition zone occurs below this aerobic zone that has a limited amount of oxygen. This is the facultative zone where bacteria are present that can live either with or without oxygen. At the bottom, there may be a sludge layer that is anaerobic. The processes that occur in the aerobic zone have a low odor potential, and the odorous compounds that are created in the facultative and anaerobic zones are converted to low odor forms in the aerobic zone. For a naturally aerated system to function properly, design specifications and quantities of manure solids to be treated must be closely followed.

An aerobic treatment lagoon should be loaded at a rate no higher than 44 pounds of ultimate BOD/day/acre. The material in the treatment lagoon should be diluted enough to allow light to penetrate three to four feet into the water. The lagoon should be a minimum of four feet deep (or deeper to allow for accumulation of sludge) to prevent rooted vegetation from growing from the bottom of the lagoon.

Mechanically aerated systems can be used to treat animal manures to control odors, decompose organic material, remove nitrogen, conserve nitrogen, or a combination of these functions. When adequate oxygen is supplied, a community of aerobic bacteria

grows that produce materials with low odor potential. Alternative treatment systems to accomplish mechanical aeration include facultative lagoons, oxidation ditches, or completely mixed lagoons.

Storage facilities are designed for manure storage only with no manure treatment. Treatment lagoons (aerobic and anaerobic) are designed specifically for manure treatment.

Effluent from treatment lagoons and storage basins should be land applied to avoid long-term and extensive ponding and to utilize manure nutrients at agronomic rates (see Section V). Construction design for treatment lagoons and storage basins should conform to the recommendations in Section IV.

### **Composting**

Composting is a self-heating process carried on by actinomycetes, other bacteria, and fungi that decompose organic material in the presence of oxygen. Composting of organic material, including livestock and poultry manures, can result in a rather stable end product that does not support extensive microbial or insect activity, if the process and systems are properly designed and managed. The potential for odors during the composting process depends upon the moisture content of the organic material, the carbon-nitrogen ratio, the presence of adequate nutrients, the absence of toxic levels of materials that can limit microbial growth, and adequate porosity to allow diffusion of oxygen into the organic material for aerobic decomposition of the organic material. Stability of the end product and its potential to produce nuisance odors, and/or to be a breeding area for flies, depends upon the degree of organic material decomposition and the final moisture content. Additional information and guidance about alternatives for composting manures are available in the *On-Farm Composting Handbook* (Rynk, 1992), the *National Engineering Handbook*, Part 637, Chapter 2 (USDA-NRCS, 2000), and NRCS Practice Standard 317- Composting Facility. The occurrence of leachate from the composting material can be minimized by controlling the initial moisture content of the composting mixture to less than 70 percent and controlling water additions to the composting material from rainfall. Either a fleece blanket or a roofed structure can be used as a cover to control rainfall additions or leachate from composting windrows.

Provisions should be made to control and/or treat leachate and runoff to protect groundwater and surface water. If the composting process is conducted without a cover, provisions must be made to collect the surface runoff and it either be temporarily stored (see Section IV) and applied to land (see Section V), added to the composting material for moisture control during the composting process, or applied to vegetated infiltration areas (see Section II).

### **Anaerobic Digesters**



Methane can be produced from organic materials, including livestock and poultry manures by anaerobic digestion. This process converts the biodegradable organic portion of animal wastes into biogas (a combination of methane and carbon dioxide). The remaining semi-solid is relatively odor free but still contains all the nitrogen, phosphorus, and potassium originally present in the animal manure, although some of the nitrogen can be lost after storage in a holding structure. Anaerobic digestion is a stable and reliable process, as long as the digester is loaded daily with a uniform quantity of waste, digester temperature does not fluctuate widely, and antibiotics in the waste do not slow biological activity.

### **Application of Manure to Land**

Manure applications can and should be managed to avoid and minimize nuisance odor conditions that may be experienced by neighbors. Livestock and poultry manure applied to cropland at agronomic rates followed by timely soil incorporation, where feasible, helps to control excessive odors and reduce ammonia (NH<sub>3</sub>) loss. The following list of practices may be used to reduce the amount of odor and the impact of odor during the application of manure to land. Appropriate implementation will help reduce complaints of odors.

- a) Avoid spreading when the wind is blowing toward populated areas.
- b) Avoid spreading on weekends/holidays when people are likely to be engaged in nearby outdoor and recreational activities.
- c) Spread in the morning when air begins to warm and is rising, rather than in late afternoon.
- d) Use available weather information to best advantage. Turbulent breezes will dissipate and dilute odors, while hot and humid weather tends to concentrate and intensify odors, particularly in the absence of breezes. Take advantage of natural vegetation barriers, such as woodlots or windbreaks, to help filter and dissipate odors.
- e) Establish vegetated air filters by planting conifers and shrubs as windbreaks and visual screens between cropland and residential developments.

**18. Incorporate manure into soil during, or as soon as possible after, application. This can be done by (a) soil injection or (b) incorporation within 48 hours after a surface application when weather conditions permit. Incorporation may not be feasible where manures are applied to pastures, forage crops, wheat stubble, or where no-till practices are used to retain crop residues for erosion control.**

Incorporation typically means the physical mixing or movement of surface applied manures and other organic byproducts into the soil profile so that a significant amount of the material is not present on the soil surface. The physical mixing can be done by using minimal disturbance tillage equipment such as aeration tools. Incorporation also

includes soaking of liquid material materials into the soil profile by infiltration into soils that are not saturated and have void air space. These liquid materials include, but are not limited, barnyard manure runoff, liquid manure, silage leachate, milk parlor and house wash water. wastewater and liquids from a manure treatment process that separates liquids from solids. These materials may be applied directly to soils or in combination with irrigation water using conventional manure application equipment or irrigation equipment.

Irrigation of manure to land can be an effective land application method for delivering manure to land in a short period of time without the potential damage to soil structure that can occur with other methods. However, the process can be odorous for a short period of time.

Land application of liquid manure through an irrigation system is an acceptable method. Three methods are commonly used: center pivot spray, center pivot with drop tubes, and volume guns either stationary or movable. Center pivots offer excellent uniformity of application, minimize compaction, and allow for timely application. Except for pivots with drop tubes, all the irrigation systems have potential for odor release.

If liquid manure is applied through an irrigation system, care should be taken to assure that runoff does not occur due to application rates exceeding the soil infiltration rates. On fractured soils or those with preferential flow paths, care must be taken to assure that manure does not flow into subsurface drains. On systems where the manure is diluted with well or surface water, a check valve assembly must be installed to prevent back flow of manure into the well or surface water source.

Spray irrigation produces aerosol sprays that can be detected for long distances. Wind direction and impact on neighbors need to be observed closely. An alternative to traveling big guns that reduces odor is a boom fitted with drop tubes to place the manure below the plant canopy on the soil surface. Research in Europe has shown this method to be effective in minimizing odors.

## **CONSTRUCTION DESIGN AND MANAGEMENT FOR MANURE STORAGE, RUNOFF STORAGE, AND TREATMENT FACILITIES**

### **Construction Design**

#### **19. Construction design for manure storage, runoff storage, and treatment facilities must meet standards and specifications.**

Standards and specifications for manure storage and treatment facilities need to follow industry standards, state codes for structures, or under university guidance and technology development. For further information, see NRCS-MI Conservation Practice

Standard *Waste Storage Facility 313* (USDA-NRCS-MI FOTG) and Chapter 10, Appendix 10D of the *AWMFH*, Part 651, (USDA-NRCS, 2008). Additional publications that can be used are the *Rectangular Concrete Manure Storages Handbook* MWPS-36, 2<sup>nd</sup> Ed. (MidWest Plan Service, 2005), the *Circular Concrete Manure Tanks* publication TR-9 (MidWest Plan Service 1999), and the *Building Code Requirements for Structural Concrete* industry standard of the American Concrete Institute ACI-318-14 (ACI Committee 318, 2014).

### **Seepage Control for Earthen Basins**

#### **20. To protect groundwater from possible contamination, utilize earthen liners that meet standards and specifications that meet acceptable seepage rates.**

For more information on acceptable seepage rates for earthen liners, see the section about “Additional Criteria for Waste Storage Ponds” in the NRCS-MI Conservation Practice Standard *Waste Storage Facility 313* (USDA-NRCS-MI FOTG) and Chapter 10, Appendix 10D of the *AWMFH*, Part 651, (USDA-NRCS, 2008). Liners include bentonite treatment, soil dispersant, compacted clay treatment, concrete, and flexible membranes.

### **Management**

#### **21. All manure storage structures shall maintain a minimum freeboard of twelve inches (six inches for fabricated structures) plus the additional storage volume necessary to contain the precipitation and runoff from a 25-year, 24-hour storm event.**

When considering total storage volume, include all bedding, storm runoff water, milk house and parlor wastewater, and silage leachate that enter the storage structure. In addition, manure storage structure integrity should also be maintained by means of periodic inspections. During these inspections, identify any item that would minimize integrity, such as animal burrows, trees and shrubs growing on the berm, and low areas in the structure that may be conducive to leakage.

## **MANURE APPLICATION TO LAND**

One of the best uses of animal manure is as a fertilizer for crop production. Recycling plant nutrients from the crop to animals and back to the soil for growth of crops again is an age-old tradition. Depending on the species of animal, 70-80 percent of the nitrogen (N), 60-85 percent of the phosphorus (P), and 80-90 percent of the potassium (K) fed to the animals as feed will be excreted in the manure and potentially available for recycling to soils.

Livestock operations can generate large amounts of manure and increase the challenge of recycling manure nutrients for crop production. Good management is the key to ensure that the emphasis is on manure utilization rather than on waste disposal. Utilizing manure nutrients to supply the needs of crops and avoiding excessive loadings achieves two desirable goals. First, efficient use of manure nutrients for crop production will accrue economic benefits by reducing the amounts of commercial fertilizers needed. Second, water quality concerns for potential contamination of surface waters and groundwater by nutrients, microorganisms and other substances from manure can best be addressed when nutrients are applied at agronomic rates and all GAAMPs for manure applications are followed.

Application of animal manure to fields used for crop production is the predominant form of manure recycling. Three overriding criteria that need to be considered for every manure application are environmental protection, neighbor relations, and nutrient utilization. The manure should be managed in a manner to retain the nutrients in the soil-plant system. The rate and method of application are influenced by soil and weather conditions. For liquid manure, the receiving soil needs to have enough air space for timely infiltration. All manure applications need to be managed to control odors and prevent runoff from the cropland where the manure is applied. Nutrient utilization management includes the use of current soil test results, manure nutrient analysis or book values, and realistic yield goals. Manure applications may provide certain nutrients for multiple years of crop production; and, in some cases, the additional carbon supplied as organic matter improves the tilth of mineral soils.

The following management practices are suggested for livestock producers to help them achieve the type of management that will accomplish these two goals. However, adverse weather conditions may, in part, prevent responsible livestock producers from adhering to these practices for a short duration of time. In addition to effective nutrient management and water quality protection, applying manure to land warrants close attention to management practices so potential odor problems can be minimized or avoided. Section III contains odor control measures, which should be implemented as part of the land application program.

### **Soil Fertility Testing**

#### **22. All fields used for the production of agricultural crops should have soils sampled and tested on a regular basis to determine where manure nutrients can best be utilized.**

One goal of a well-managed manure application program is to utilize soil testing and fertilizer recommendations as a guide for applying manures. This will allow as much of the manure nutrients as possible to be used for supplying crop nutrient requirements. Any additional nutrients needed by the crop can be provided by commercial fertilizers. Soil test results will change over time depending on fertilizer and manure additions,

precipitation, runoff, leaching, soil erosion, and nutrient removal by crops. Therefore, soil testing should be done once every one to four years, with the frequency of soil sampling dependent on (a) how closely an individual wants to track soil nutrient changes, (b) the crop(s) grown, (c) cropping rotation, (d) soil texture, and (e) the approach used for sampling. For information about soil fertility testing see Warncke, 1998 and Warncke and Gehl, 2006.

### **Fertilizer Recommendations**

#### **23. Use current fertilizer recommendations, consistent with those of Michigan State University (MSU), Tri-State Fertilizer Recommendations, or other appropriate recommendations to determine the total nutrient needs for crops to be grown on each field that could have manure applied.**

Fertilizer recommendations made by MSU Extension (Warncke *et al.*, 2009a and 2009b) or Tri-State Fertilizer Recommendations (Bulletin 974) are based on the soil fertility test, soil texture, crop to be grown, a realistic yield goal (average for past 3-5 years), and past crop. Fertilizer recommendations can then be utilized by the livestock producer to help identify on which fields manure nutrients will have the greatest value in reducing the amounts of commercial fertilizers needed, thereby returning the greatest economic benefit. For additional information, see the current GAAMPs for Nutrient Utilization.

### **Manure Analysis**

#### **24. To determine the nutrient content of manure, analyze it for percent dry matter (solids), ammonium N ( $\text{NH}_4\text{-N}$ ), and total N, P, and K.**

Several factors which will determine the nutrient content of manures prior to land application are: (a) type of animal species, (b) composition of the feed ration, (c) amount of feed, bedding, and/or water added to manure, (d) method of manure collection and storage, and (e) climate. Because of the large variation in manure nutrient content due to these factors, it is not advisable to use average nutrient contents provided in publications when determining manure nutrient loadings for crop production. The best way to determine the nutrient content of manure and provide farm-specific information is to obtain a representative sample(s) of that manure and then have a laboratory analyze the sample(s). In order to establish "baseline" information about the nutrient content of each manure type on the farm, sample and test manures for at least a two-year period. MSU Extension (MSUE) can provide information on collecting representative manure samples and where to send samples for analysis. A second approach to determine the nutrient content of manure is the use of mass balance as described by ASABE (2014) in the bulletin entitled *Manure Production and Characteristics*.

## **Manure Nutrient Loadings**

- 25. The agronomic (fertilizer) rate of N recommended for crops (consistent with current MSU or Tri-State N fertilizer recommendations) should not be exceeded by the amount of available N added, either by manure applied, or by manure plus fertilizer N applied, and/or by other N sources. For legume crops, the removal value of N may be used as the maximum N rate for manure applications. The available N per ton or per 1000 gallons of manure should be determined by using a manure analysis and the appropriate mineralization factors for organic N released during the first growing season following application and the three succeeding growing seasons.**

Excessive manure applications to soils can: (a) result in excess nitrate-N ( $\text{NO}_3\text{-N}$ ) not being used by plants or the soil biology and increase the risk of  $\text{NO}_3\text{-N}$  being leached down through the soil and into groundwater; (b) cause P to accumulate in the upper soil profile and increase the risk of contaminating surface waters with P where runoff/erosion occurs; and, (c) create nutrient imbalances in soils which may cause poor plant growth or animal nutrition disorders for grazing livestock. The greatest water quality concern from excessive manure loadings, where soil erosion and runoff are controlled, is  $\text{NO}_3\text{-N}$  losses to groundwater. Therefore, the agronomic fertilizer N recommendation (removal value for legumes) should never be exceeded.

The availability of N in manure for plant uptake will not be the same as highly soluble, fertilizer N. Therefore, total manure N cannot be substituted for that in fertilizers on a pound-for-pound basis, because a portion of the N is present in manure organic matter which must be decomposed, before mineral (inorganic) forms of N are available for plant uptake.

The rate of decomposition (or mineralization) of manure organic matter will be less than 100% during the first year and will vary depending on the type of manure and the method of manure handling. Therefore, in order to estimate how much of the total manure N in each ton, or 1000 gallons of manure, will be available for crops (and a credit against the N fertilizer recommendation), some calculations are needed. The total N and  $\text{NH}_4\text{-N}$  content from the manure analysis can be used with the appropriate mineralization factors to calculate this value. Management tools to assist with these calculations include (a) *Recordkeeping System for Crop Production (E2342)--Manure Management Sheet #2* (Jacobs, 2015), (b) *Utilization of Animal Manure for Crop Production* Bulletins MM-2 and MM-3 (Jacobs 1995a and b), (c) *Nutrient Recommendations for Field Crops in Michigan* Bulletin E-2904 (Warncke *et al.*, 2009a), (d) *Nutrient Recommendations for Vegetable Crops in Michigan* Bulletin E-2934 (Warncke *et al.*, 2009b) or the Computer Assisted Nutrient Management Planning Program (CANMaPP) at <https://iwr.msu.edu/canmapp/>.

In addition to the amount of plant-available N provided during the first year after a manure application, more N will be released from the residual organic matter not decomposed the first year. This additional decomposition and release of N will occur during the second, third and fourth years and should be estimated and included as an N credit against the fertilizer recommendation to avoid excessive N additions to the soil-plant system. At the present time, organic N released (mineralized) during the second, third and fourth cropping years is estimated to be 50 percent, 25 percent, and percent, respectively, of the amount released the first year. To assist with the calculations for estimating this carryover N from previous manure applications, the same management tools listed in the preceding paragraph can be used.

**26. If the Bray P1 soil test level for P reaches 150 lb./acre<sup>2</sup> (75 ppm), (Mehlich-3 P 202 lb./acre, 101 ppm) manure applications should be managed at an agronomic rate where manure P added does not exceed the P removed by the harvested crop. (If this manure rate is impractical due to manure spreading equipment or crop production management, a quantity of manure P equal to the amount of P removed by up to four crop years may be applied during the first crop year. If no additional fertilizer or manure P is applied for the remaining crop years, and the rate does not exceed the N fertilizer recommendations for the first crop grown). If the Bray P1 soil test reaches 300 lb./acre (150 ppm) or higher, manure applications should be discontinued until nutrient harvest by crops reduces P test levels to less than 300 lb./acre. To protect surface water quality against discharges of P, adequate soil and water conservation practices should be used to control runoff, erosion and leaching to drain tiles from fields where manure is applied.**

While the availability of N and P in manure may be considerably less than 100 percent, the availability of K in manure is normally considered to be close to 100 percent. Periodic soil testing can be used to monitor the contribution made by P and K to soil fertility levels, but soil tests have not been very effective to determine the amount of N a soil can provide for plant growth.

When manures are applied to supply all the N needs of crops, the P needs of crops will usually be exceeded, and soil test levels for P will increase over time. If Bray P1 soil test P levels reach 300 lb./acre (150 ppm), the risk of losing soluble P and sediment-bound P by runoff and erosion (i.e., nonpoint source pollution) increases. Therefore, adequate soil and water conservation practices to control runoff and erosion should be.

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<sup>2</sup> To convert between BrayP1 and Mehlich-3P values, multiply Bray P1 values by 1.35 to obtain Mehlich-3P values or conversely divide Mehlich-3P values by 1.35 to obtain Bray-P1 values (<https://www.canr.msu.edu/soilfertility/Files/Bulletins/Bray%20to%20Mehlich%20conversion.pdf>). Above 300 ppm, the Mehlich-3P extractant extracts proportionally more P than Bray-P1. Thus, the conversion values reported above should not be used if values are above 300 ppm Bray-P1."



implemented. For example, conservation tillage can enhance infiltration of water into soils, thereby reducing runoff, soil erosion, and associated P loadings to surface waters. Nevertheless, if Bray P1 soil test P levels reach 300 lb./acre, no more manure (or fertilizer) P should be applied until nutrient harvest by crops reduces P test levels to less than 300 lb./acre.

To avoid reaching the 300 lb./acre Bray P1 soil test level, manure application rates should be managed to provide the P needs of crops rather than providing all of the N needs of crops and adding excess P. Therefore, if the Bray P1 soil test level for P reaches 150 lb./acre (75 ppm), manure applications should be managed at a rate where manure P added does not exceed the P removed by the harvested crop. The quantity of manure  $P_2O_5$  that should be added can be estimated from Tables A1 and A2 (Appendix A), using a realistic yield goal for the crop to be grown. Fertilizer P recommendations are given in, and fertilizer P is sold as, pounds of phosphate ( $P_2O_5$ ). For example, if a yield of 120 bu./acre for corn grain is anticipated, the amount of manure  $P_2O_5$  added to this field should be limited to no more than 44 lb./acre (120 bu./acre X 0.37 lb.  $P_2O_5$ /bu. nutrient removal rate).

Up to four crop years of  $P_2O_5$  removal is allowed to be applied as manure  $P_2O_5$  when the Bray P1 soil test is 150-299 lb. P/acre. A two-to-four-year crop removal rate of  $P_2O_5$  will accommodate application rates more practical for manure spreading equipment and crop rotations when one crop (e.g., alfalfa) will be grown for two to four years, making manure applications to this crop difficult. An acceptable manure application rate can be calculated using the  $P_2O_5$  content of the manure and the  $P_2O_5$  crop removal (Tables A1 and A2, Appendix A) for the crop(s) to be grown and yields expected for up to four crop years. However, the calculated manure application rate cannot apply more plant-available N (calculated as described above following Practice No. 32) than the amount of the N fertilizer recommendation for the crop to be grown the first year.

Once a suitable manure application rate is calculated, the manure  $P_2O_5$  that is applied becomes a  $P_2O_5$  credit for that field. No additional fertilizer or manure  $P_2O_5$  can be applied to this field until accumulative crop  $P_2O_5$  removal by harvest (Tables A1 and A2, Appendix A) for one or more years has equaled this  $P_2O_5$  credit. Since several fields and different time periods for individual fields may be used for this two-to-four-year  $P_2O_5$  option, a good recordkeeping system tracking these  $P_2O_5$  credits should be used.

### **Manure Nutrient Loadings on Pastureland**

In pasture systems where the grazed forage is the sole feed source for livestock, nutrients from manure deposited by the grazing livestock will not exceed the nutrient requirement of the pasture forage. These types of pasture systems may actually require supplemental nutrient applications to maintain forage quality and growth. Pasture systems utilizing supplemental feed (e.g., swine farrow/finish) often result in manure

nutrient deposition in excess of pasture forage requirements. Therefore, nutrient management with rotation to harvested forage or row crops is necessary. Available nutrient deposition should be quantified based on livestock density and nutrient mineralization factors. Manure nutrient loadings should be based on the rotational crop nutrient requirement consistent with those recommended by MSU, as noted above.

### **Method of Manure Application**

#### **27. Manures should be uniformly applied to soils. The amount of manure applied per acre (gallons/acre or tons/acre) should be known, so manure nutrients can be effectively managed.**

As is true with fertilizers, lime and pesticides, animal manures should be spread uniformly for best results in crop production. Also, in order to know the quantity of manure nutrients applied, the amount of manure applied must be known. Determining the gallons/acre or tons/acre applied by manure spreading equipment can be accomplished in a variety of ways. One method is to measure the area of land covered by one manure spreader load or one tank wagon of manure. A second method is to record the total number of spreader loads or tank wagons applied to a field of known acreage. With either approach, the capacity of the spreader (in tons) or the tank wagon (in gallons) must be known, and some way to vary the rate of application will be needed, such as adjusting the speed of travel or changing the discharge settings on the manure spreading equipment. Guidance is available from MSUE to help determine the rates of manure application that a livestock producer's equipment can deliver.

Incorporating manure immediately (i.e., within 48 hours following surface application) will minimize odors and ammonia ( $\text{NH}_3$ ) loss. When manures are surface applied, available N can be lost by volatilization of  $\text{NH}_3$ . These losses will increase with time and temperature and will be further increased by higher wind speeds and lower humidities. Therefore, injecting manures directly into the soil or immediately incorporating surface-applied manure will minimize  $\text{NH}_3$  volatilization losses and provide the greatest N value for crop production. Table A3 (Appendix A) shows potential volatilization losses when manures are applied to the soil and allowed to dry on the surface before incorporation. When dilute effluents from lagoons that contain low solids (<2 percent) are applied/irrigated at rates that do not cause ponding, most of the  $\text{NH}_4\text{-N}$  will likely be absorbed into the soil and retained. Surface application of manures through irrigation (or other methods without incorporation) provides alternatives to producers who use (a) reduced or no-till soil management, (b) supplemental irrigation of crops, or (c) application to land with established pasture or other forages, etc.

#### **28. Manures should not be applied to soils within 150 feet of surface waters or to areas subject to flooding unless: (a) manures are injected or surface-applied with immediate incorporation (i.e., within 48 hours after application) and/or (b) conservation practices are used to protect against runoff and**

**erosion losses to surface waters.**

- 29. Liquid manure applications should be managed in a manner to optimize nutrient utilization and not result in ponding, soil erosion losses, or manure runoff to adjacent property, drainage ditches or surface water. Manure applications to cropland with field drainage tiles should be managed in a manner to keep the manure within the root zone of the soil and to prevent manure from reaching tile lines.**

To reduce the risk of runoff/erosion losses of manure nutrients, manures should not be applied and left on the soil surface within 150 feet of surface waters. Manures that are injected or surface applied with immediate incorporation can be closer than 150 feet, as long as conservation practices are used to protect against runoff and erosion. A vegetative buffer between the application area and any surface water is a desirable conservation practice. Manure should not be applied to grassed waterways or other areas where there may be a concentration of water flow, unless used to fertilize and/or mulch new seedlings following waterway construction. Manure should not be applied to areas subject to flooding unless injected or immediately incorporated. Liquid manures should not be applied in a manner that will result in ponding or runoff to adjacent property, drainage ditches, or surface water. Therefore, application to saturated soils, such as during or after a rainfall, should be avoided.

Manure applications to cropland with field drainage tiles should be managed in a manner that keeps manure from reaching tile lines. Liquid manure has the risk of following preferential flow paths through cracks, worm holes, and other soil macropores to field drainage tiles. Liquid manure can also reach field drainage tiles when soils are saturated. This flow can result in a discharge of manure nutrients and contaminants to surface waters. Risks of manure entering field tile can be reduced by analyzing field conditions prior to land application of liquid manure such as tile location and depth, tile inlets, soil type, evidence of soil cracking and soil moisture holding capacity. Recent precipitation and forecasted precipitation should be considered. Enviroweather (<https://www.enviroweather.msu.edu/>) and Michigan Enviroimpact (<http://www.enviroimpact.iwr.msu.edu/>) are tools that can help in making land application decisions although neither are designed to be used exclusively.

Whenever possible, tile outlets should be observed before and after land application. Observations should note the relative amount of flow, color, and odor to confirm that no flow of manure nutrients is occurring. Indications of a discharge may be confirmed by an odor or change in discharge watercolor or cloudiness from observation done prior to application, oil films, floating solids, or foams (EPA, 1999). Tile which is flowing prior to land application may be an indication that the soil is saturated. A saturated soil does not have any additional holding capacity. Land application to saturated soils should be avoided. Manure application rates and application methods should be based on field and weather conditions.

Complementary information and preventative actions can be found in *Keeping Land-Applied Manure in the Root Zone Part 2: Tile-Drained Land* Bulletin WO-1037 (Harrigan *et al.*, 2007)) and the NRCS MI Conservation Practice Standard *Drainage Water Management 554* (USDA-NRCS-MI FOTG). These actions are not a substitute for properly evaluating field and weather conditions as described above.

Guidance and specific actions to take in response to a discharge of manure from a crop field subsurface drainage tile line that reaches surface water include reporting a manure spill to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) district office during business hours or the Pollution Emergency Alerting System at 1-800-292-4706 during other times.

- 30. As land slopes increase from zero percent, the risk of runoff and erosion also increases, particularly for liquid manure. Adequate soil and water conservation practices should be used which will control runoff and erosion for a particular site, taking into consideration such factors as type of manure, bedding material used, surface residue or vegetative conditions, soil type, slope, etc.**

As land slopes increase, the risk of runoff and erosion losses to drainage ways, and eventually to surface waters, also increases. Soil and water conservation practices should be used to control and minimize the risk of nonpoint source pollution to surface waters, particularly where manures are applied. Injection or surface application of manure with immediate incorporation should generally be used when the land slope is greater than six percent. However, a number of factors, such as liquid versus solid or semi- solid manures, rate of application, amount of surface residues, soil texture, drainage, etc. can influence the degree of runoff and erosion that could pollute surface water. Therefore, adequate soil and water conservation practices to control runoff and erosion at any particular site are more critical than the degree of slope itself.

### **Timing of Manure Application**

- 31. Where application of manure is necessary in the fall rather than spring or summer, using as many of the following practices as possible will help to minimize potential loss of NO<sub>3</sub>-N by leaching: (a) apply to medium or fine rather than to coarse textured soils; (b) delay applications until soil temperatures fall below 50°F; and/or (c) establish cover crops before or after manure application to help remove NO<sub>3</sub>-N by plant uptake.**

Ideally, manure (or fertilizer/other source) nutrients should be applied as close as possible to, or during, periods of maximum crop nutrient uptake to minimize nutrient loss from the soil-plant system. Therefore, spring or early summer application is best for conserving nutrients, whereas fall application generally results in greater losses, particularly for nitrogen as NO<sub>3</sub>-N on coarse textured soils (i.e., sands, loamy sands,

sandy loams).

- 32. Application of manure to frozen or snow-covered soils should be avoided, but where necessary, (a) solid manures should only be applied to areas where slopes are six percent or less and (b) liquid manures should only be applied to soils where slopes are three percent or less. In either situation, provisions must be made to control runoff and erosion with soil and water conservation practices, such as vegetative buffer strips between surface waters and soils where manure is applied.**

Winter application of manure is the least desirable in terms of nutrient utilization and prevention of nonpoint source pollution. Frozen soils and snow cover will limit nutrient movement into the soil and greatly increase the risk of manure being lost to surface waters by runoff and erosion during thaws or early spring rains. When winter application is necessary, appropriately sized buffer strips should be established and maintained between surface waters and frozen soils where manure is applied to minimize any runoff and erosion of manure from reaching surface waters. Particular attention to field slopes, reductions in manure application rates, and fields with surface water inlets can help prevent runoff and erosion from frozen and/or snow-covered soils where manure is applied. Weather forecasts should be considered when planning winter applications to avoid a significant rain or melting event.

A field-specific assessment, such as the *Manure Application Risk Index v 4.0 (MARI)*; Grigar, 2013) and the Michigan P Assessment Tool v 2.0 (Gangwer, 2012) will help evaluate the risk for runoff losses. MARI and Michigan P Assessment Tool can be found at USDA-NRCS-MI, 2018, in Section IV, "Conservation Practices" sub section, "Nutrient Management Tools (AC) (590)", folder "Nutrient Management Tools and References" subfolder.

### **Management of Manure Applications to Land**

- 33. Records should be kept of manure analyses, soil test reports, and rates of manure application for individual fields. Records should include manure analysis reports and the following information for individual fields:**

- a. Soil fertility test reports.**
- b. date(s) of manure application(s).**
- c. rate of manure applied (e.g., gallons or tons per acre).**
- d. previous crops grown on the field; and,**
- e. yields of past harvested crops.**

Good record keeping demonstrates good management and will be beneficial for the producer.

An important ingredient of a successful program for managing the animal manure generated by a livestock operation is "planning ahead". An early step of a manure application plan is to determine whether enough acres of cropland are available for utilizing manure nutrients without resulting in excess nutrient application to soils. This is often referred to as 'agronomic balance'.

Determination of agronomic balance requires estimates of manure quantities and manure nutrients produced by different types of livestock and estimates of crop nutrient removal. Balance is most often determined for phosphorus but may also include projections for other nutrients. Animal manure and crop removal estimates may be obtained using the following:

- Table A4 of these GAAMPs which was derived by ASAE (2014) using the default or average for each animal type. Together, Table A4 and A5 can provide further guidance regarding N losses that can occur during handling and storage or manures before they are applied.
- Nutrient Recommendations for Field Crops in Michigan Bulletin E-2904 (Warncke *et al.*, 2009a)
- Nutrient Recommendations for Vegetable Crops in Michigan Bulletin E-2934 (Warncke *et al.*, 2009b).
- Tri-State Fertilizer Recommendations Bulletin 974 (Culman, Fulford, Camberato, and Steinke, 2020)

Computer software has been developed to assist with development of manure spreading plans, the determination of agronomic balance, and the maintenance of manure spreading-crop production records:

- The Computer Assisted Nutrient Management Planning Program (CANMaPP) at <https://iwr.msu.edu/canmapp/>.
- *Manure Management Planner* (Purdue Research Foundation, 2014)
- *Nutrient Inventory* (Koelsch and Powers, 2010; 2013).

This information can be used to compare the quantity of available manure nutrients against the quantity of nutrients removed by the crops to be grown in the livestock operation. If the quantity of manure nutrients being generated greatly exceeds the annual crop nutrient needs, then alternative methods for manure utilization should be identified. For example, cooperative agreements with neighboring landowners to provide additional land areas to receive and properly utilize all of the manure nutrients may be necessary.

Another consideration is to use good judgment when planning manure applications in conjunction with normal weather patterns, the availability of land at different times during the growing season for different crops, and the availability of manpower and

equipment relative to other activities on the farm which compete for these resources. Having adequate storage capacity to temporarily hold manures can add flexibility to a management plan when unanticipated weather occurs, preventing timely applications. Nevertheless, unusual weather conditions do occur and can create problems for the best of management plans.

Finally, good recordkeeping is the foundation of a good management plan. Past manure analysis results will be good predictors of the nutrient content in manures being produced and applied today. Records of past manure application rates for individual fields will be helpful for estimating the amount of residual N that will be available for crops to use this coming growing season. Changes in the P test levels of soils with time, due to manure P additions, can be determined from good records, and that information can be helpful in anticipating where manure rates may need to be reduced and when additional land areas may be needed. Recordkeeping systems, such as that described in MSUE Bulletin E-2340 (Jacobs, 2015) or available as a microcomputer program called MSUNM (Jacobs and Go, 2001), may be helpful in accomplishing this goal.



## APPENDICES

### APPENDIX A

Table A1. Approximate nutrient removal (lb./unit of yield) in the harvested portion of several Michigan field crops.<sup>4</sup>

Crop		Unit	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
			---- lb. per unit ----		
Alfalfa	Hay	ton	45 <sup>5</sup>	13	50
	Haylage	ton	14	4.2	12
Barley	Grain	bushel	0.88	0.38	0.25
	Straw	ton	13	3.2	52
Beans (dry edible)	Grain	cwt	3.6	1.2	1.6
Bromegrass	Hay	ton	33	13	51
Buckwheat	Grain	bushel	1.7	0.25	0.25
Canola	Grain	bushel	1.9	0.91	0.46
	Straw	ton	15	5.3	25
Clover	Hay	ton	40 <sup>5</sup>	10	40
Clover-grass	Hay	ton	41	13	39
Corn	Grain	bushel	0.90	0.37	0.27
	Grain <sup>6</sup>	ton	26	12	6.5
	Stover	ton	22	8.2	32
	Silage	ton	9.4	3.3	8.0
Millet	Grain	bushel	1.1	0.25	0.25
Oats	Grain	bushel	0.62	0.25	0.19
	Straw	ton	13	2.8	57
Orchardgrass	Hay	ton	50	17	62
Potatoes	Tubers	cwt	0.33	0.13	0.63
Rye	Grain	bushel	1.1	0.41	0.31
	Straw	ton	8.6	3.7	21
	Silage	ton	3.5	1.5	5.2
Sorghum	Grain	bushel	1.1	0.39	0.39
Sorghum-Sudangrass (Sudax)	Hay	ton	40	15	58
	Haylage	ton	12	4.6	18
Soybeans	Grain	bushel	3.8	0.80	1.4
Spelts	Grain	bushel	1.2	0.38	0.25
Sugar Beets	Roots	ton	4.0	1.3	3.3
Sunflower	Grain	bushel	2.5	1.2	1.6
Timothy	Hay	ton	45	17	62
Trefoil	Hay	ton	48 <sup>5</sup>	12	42
Wheat	Grain	bushel	1.2	0.63	0.37
	Straw	ton	13	3.3	23

<sup>4</sup> Source: Warncke *et al.*, 2009a.

<sup>5</sup> Legumes get most of their nitrogen from air.

<sup>6</sup> High moisture grain.

Table A2. Approximate nutrient removal (lb./unit of yield) in the harvested portion of several Michigan vegetable crops.<sup>7</sup>

Crop <sup>8</sup>	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
	---- lb./ton <sup>9</sup> ----		
Asparagus crowns, new planting, or established	13.4	4.0	10
Beans, snap	24	2.4	11
Beets, red	3.5	2.2	7.8
Broccoli	4.0	1.1	11
Brussels Sprouts	9.4	3.2	9.4
Cabbage, fresh market, process Chinese	7.0	1.6	6.8
Carrots, fresh market or processing	3.4	1.8	6.8
Cauliflower	6.6	2.6	6.6
Celeriac	4.0	2.6	6.6
Celery, fresh market or processing	5.0	2.0	11.6
Cucumbers, pickling (hand or machine harvested)	2.0	1.2	3.6
Cucumber, slicers	2.0	1.2	3.6
Dill	3.5	1.2	3.6
Eggplant	4.5	1.6	5.3
Endive	4.8	1.2	7.5
Escarole	4.8	1.2	7.5
Garden, home	6.5	2.8	5.6
Garlic	5.0	2.8	5.6
Ginseng	4.6	1.2	4.6
Greens, Leafy	4.8	2.0	6.0
Horseradish	3.4	0.8	6.0
Kohlrabi	6.0	2.6	6.6
Leek	4.0	2.6	4.8
Lettuce, Boston, bib	4.8	2.0	9.0
Lettuce, leaf, head, or Romaine	4.8	2.0	9.0
Market Garden	6.5	2.8	5.6
Muskmelon	8.4	2.0	11
Onions, dry bulb or green	5.0	2.6	4.8

<sup>7</sup> Source: Warncke *et al.*, 2009b

<sup>8</sup> Values used for some crops are estimates based on information for similar crops.

<sup>9</sup> 1 ton = 20 cwt.

Table A2. Continued.

Crop <sup>8</sup>	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
	---- lb./ton <sup>9</sup> ----		
Pak Choi	7.0	1.6	6.8
Parsley	4.8	1.8	12.9
Parsnip	3.4	3.2	9.0
Peas	20	4.6	10
Peppers, bell, banana, or hot	4.0	1.4	5.6
Pumpkins	4.0	1.2	6.8
Radish	3.0	0.8	5.6
Rhubarb	3.5	0.6	6.9
Rutabagas	3.4	2.6	8.1
Spinach	10	2.7	12
Squash, hard	4.0	2.2	6.6
Squash, summer	3.6	2.2	6.6
Sweet Corn	8.4	2.8	5.6
Sweet potato	5.3	2.4	12.7
Swiss Chard	3.5	1.2	9.1
Tomatoes, fresh market or processing	4.0	0.8	7.0
Turnip	3.4	1.2	4.6
Watermelon	4.8	0.4	2.4
Zucchini	4.6	1.6	6.6

Table A3. Ammonium nitrogen volatilization losses for surface application of solid and semi-solid manures.<sup>10</sup>

Days Before Incorporation	Retention Factor (RF)	Loss Factor (LF)
0-1 day	0.70	0.30
2-3 days	0.40	0.60
4-7 days	0.20	0.80
>7 days	0.10	0.90

<sup>10</sup> Source: Jacobs, 2015.

Table A4. Manure and manure nutrients produced by different livestock species.<sup>11</sup>

Species	Type and production grouping	Manure/day			Nutrients-lb./day		
		Total ft <sup>3</sup>	Total lb. wet	Total solids-lb.	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Dairy	Calf-330 lb.	0.300	19.0	3.20	0.140	0.046	0.048
	Heifer-970 lb.	0.780	48.0	8.20	0.260	0.101	0.132
	Lactating cow-1376 (88 lb. milk/d)	2.400	150.0	20.00	0.990	0.389	0.276
	Dry cow	1.300	83.0	11.00	0.500	0.151	0.396
	Veal-260 lb.	0.120	7.8	0.27	0.033	0.023	0.053
Beef	Growing calf-450 to 750 lb. in confinement	0.810	50.0	6.00	0.290	0.126	0.228
	Finishing-750 to 1215 lb. and 153 d growth	1.046	64.0	5.10	0.350	0.110	0.298
	Cow-confinement, not lactating, in first 6 mo. of pregnancy	2.000	125.0	15.00	0.420	0.222	0.360
Swine	Nursery pig-27.5 lb.	0.039	2.4	0.28	0.025	0.010	0.012
	Growing & finishing-154 lb.	0.167	10.0	1.00	0.083	0.032	0.044
	Gestating-440 lb.	0.180	11.0	1.10	0.071	0.046	0.058
	Lactating-423 lb.	0.410	25.0	2.50	0.190	0.126	0.144
	Boar-440 lb.	0.130	8.4	0.84	0.061	0.048	0.047
Sheep	Lamb-100 lb. feeder	0.060	4.0	1.05	0.040	0.020	0.040
Horse	Average of sedentary and exercised-1100 lb.	0.910	57.0	8.50	0.270	0.117	0.252
Poultry-per 100 birds	Chicken layers – 3 lb. average	0.310	19.0	4.90	0.350	0.252	0.156
	Chicken broilers-2.6 lb. average in 48 d growth	0.354	22.9	5.83	0.250	0.167	0.170
	Turkeys-toms 17 lb. average in 133 d growth	0.977	58.6	15.04	0.902	0.620	0.514
	Turkeys-hens 8 lb. average in 105 d growth	0.581	36.2	9.33	0.543	0.349	0.286
	Ducks-4 lb. average in 39 d growth	0.590	35.9	9.49	0.359	0.282	0.209

<sup>11</sup> Source: ASAE, 2019. Where the ASAE D384.2 excretion estimates could not be made, values were obtained from Chapter 4 of the AWMFH, Part 651, and Midwest Plan Service Publication MWPS-18, Section 1 (2000) and are presented in the table as bolded text.

Table A5. Nitrogen losses during handling and storage.<sup>12</sup>

Manure Type	Handling System	Nitrogen Lost (percent)
Solid	Daily scrape & haul	20-35
	Manure pack	20-40
	Open lot	40-55
	Deep pit (poultry)	25-50
	Litter	25-50
Liquid	Anaerobic pit	15-30
	Above-ground	10-30
	Earth Storage	20-40
	Lagoon	70-85

<sup>12</sup> Source: MidWest Plan Service, 1993.

Table A6. Michigan 25-Year, 24-Hour Precipitation by County.<sup>13</sup>

County	Precipitation (inches)	County	Precipitation (inches)
Alcona	3.49	Lake	4.50
Alger	3.70	Lapeer	4.05
Allegan	4.67	Leelanau	3.98
Alpena	3.39	Lenawee	4.15
Antrim	3.92	Livingston	4.05
Arenac	3.87	Luce	3.69
Baraga	4.14	Mackinac	3.67
Barry	4.41	Macomb	3.97
Bay	4.17	Manistee	4.42
Benzie	4.18	Marquette	3.96
Berrien	4.63	Mason	4.69
Branch	4.43	Mecosta	4.43
Calhoun	4.28	Menominee	3.91
Cass	4.71	Midland	4.24
Charlevoix	3.82	Missaukee	4.39
Cheboygan	3.64	Monroe	3.98
Chippewa	3.69	Montcalm	4.47
Clare	4.10	Montmorency	3.59
Clinton	4.34	Muskegon	4.98
Crawford	3.88	Newaygo	4.64
Delta	3.82	Oakland	4.12
Dickinson	3.96	Oceana	4.96
Eaton	4.14	Ogemaw	3.81
Emmet	3.62	Ontonagon	4.40
Genesee	4.08	Osceola	4.25
Gladwin	4.10	Oscoda	3.54
Gogebic	4.75	Otsego	3.87
Grand Traverse	4.01	Ottawa	4.92
Gratiot	4.43	Presque Isle	3.53
Hillsdale	4.27	Roscommon	3.88
Houghton	4.04	Saginaw	4.34
Huron	3.94	Sanilac	3.92
Ingham	4.08	Schoolcraft	3.72
Ionia	4.50	Shiawassee	4.24
Iosco	3.69	St Clair	3.97
Iron	4.19	St Joseph	4.58
Isabella	4.34	Tuscola	4.12
Jackson	4.06	Van Buren	4.64
Kalamazoo	4.49	Washtenaw	3.96
Kalkaska	3.95	Wayne	3.98
Kent	4.71	Wexford	4.19
Keweenaw	3.70		

<sup>13</sup> Source: *National Oceanic and Atmospheric Administration Atlas 14, (NOAA-14), Volume 8, Version 2, 2015.* <http://hdsc.nws.noaa.gov/hdsc/pfds/>

## **APPENDIX B**

### Manure and Nutrient Management Plans

Manure and nutrient management plans are management tools that provide detailed information about your farm and any operations dealing with the farm regarding the GAAMPs previously discussed. Every farm should have a plan, and one may be needed to determine conformance to the GAAMPs, especially if a complaint is registered with the MDARD's complaint response program.

#### **Manure Management System Plan**

A Manure Management System Plan (MMSP) focuses on two subject areas: (1) management of manure nutrients and (2) the management of manure and odor. The most critical aspect of a MMSP to ensure that a livestock operation remains environmentally sustainable is to determine the quantity of manure nutrients (nitrogen, phosphate, and potash) that is being generated by the operation. Then you must determine how these nutrients can be utilized in accordance with the aforementioned GAAMPs either on the livestock farm or transported off the farm for utilization elsewhere. Good management of manure nutrients for crop uptake and nutrient utilization will help prevent loss of nutrients into surface water and groundwater resources.

A MMSP will include most, but probably not all, of the following components:

1. Production refers to the amount of volume of manure and any other agricultural by-products produced and the associated nutrient content. Examples include total manure produced, silage leachate, milk house wastewater, and/or rainwater that flow through the barnyard.
2. Collection refers to how manure and any other by-products will be gathered for management. This includes collection points, method and scheduling of collection, and structural facilities needed. Examples include: solid stacking, a scraping system, a flushing system, slotted floors, etc.
3. Transfer occurs throughout the system and may take different forms at different steps in the system. Transfer includes movement between production and collection points, storage facilities, treatment facilities, and land application. The plan may specify the method, distance, frequency, and equipment needs for transfer.
4. If storage facilities are part of the system, the type of storage device should be described (e.g., underground concrete tank, solid manure stack, earthen basin). The plan should include the intended storage time, storage volume, shape and dimensions, and site location.
5. Treatment of manure and any other by-products may occur either before or after storage, depending on the system, and can be physical, biological, and/or



chemical. Common forms of treatment include solids separation, anaerobic and aerobic lagoons, composting and methane digesters. Treatment usually involves more intensive management and may require specialized equipment, but it is not a necessary component for all systems.

6. Utilization refers to the end-use of the manure and other livestock operation by-products. A use needs to be identified for the full quantity of manure and other by-products, as described in the "production" section. For most livestock operations, manure and other by-products are used as a nutrient source for crops. Soil test information, manure and by-product nutrient content, crops to be grown, realistic yield goals, and availability of crop fields are key elements in scheduling land applications and utilizing manure and other by-products for nutrients. Other end-uses may include, but are not limited to, use as a feed supplement and use of composted manure as a mulch, soil amendment, or as bedding material.
7. Recordkeeping plays a critical role in helping make decisions that lead to effective environmental protection and beneficial use of manure related materials. Records also play a critical role in documenting, communicating, and assessing sound manure management practices that can help assure the general public that the environment is being protected.
8. Odor management practices that reduce the frequency, intensity, duration, and offensiveness of odors may be included in any of the above steps. Air quality is an important factor when considering neighbor relations and environmental impacts.

A MMSP accurately and completely describes the current physical system and the associated management practices, along with records that document implementation of the plan, and demonstrate responsible management. For additional assistance on developing a MMSP, contact MSU Extension, USDA NRCS, Conservation Districts, or a private consultant.

### Comprehensive Nutrient Management Plan

A Comprehensive Nutrient Management Plan (CNMP) is the next step beyond a MMSP. All efforts put towards a MMSP may be utilized in the development of a CNMP, as it is founded on the same eight components as the MMSP, with a few significant differences. Some of the "optional" sub-components of a MMSP are required in a CNMP. Examples include veterinary waste disposal and mortality management. In addition, the "production" component is more detailed regarding items such as rainwater, plate cooler water, and milk house wastewater. More thorough calculations are also needed to document animal manure and by-product production.

Another difference between a MMSP and a CNMP is in the "utilization" component. With a MMSP, nutrients need to be applied at agronomic rates and according to realistic yield goals. However, with a CNMP, a more extensive analysis of field application is

conducted. This analysis includes the use of the MARI (Gangwer, 2008; Grigar, 2013) to determine suitability for winter spreading, and the Revised Universal Soil Loss Equation, Version 2 (RUSLE2; USDA-ARS, 2014) to determine potential nutrient loss from erosive forces, and other farm specific conservation practices. More detail regarding the timing and method of manure applications and long-term cropping system/plans must be documented in a CNMP.

Additional information on potential adverse impacts to surface and groundwater and preventative measures to protect these resources are identified in a CNMP. Although the CNMP provides the framework for consistent documentation of a number of practices, the CNMP is a planning tool not a documentation package.

Odor management is included in both the MMSP and CNMP.

Implementation of a MMSP is ongoing. A CNMP Implementation Schedule typically includes long-term change. These often include installation of new structures and/or changes in farm management practices that are usually phased in over a longer period of time. Such changes are outlined in the CNMP Implementation Schedule, providing a reference to the producer for planning to implement changes within their own constraints.

As is described above, a producer with a sound MMSP is well on his/her way to developing a CNMP. Time spent developing and using a MMSP will help position the producer to ultimately develop a CNMP on their farm, if they decide to proceed to that level or when they are required to do so.

#### WHO NEEDS A CNMP?

1. Some livestock production facilities receiving technical and/or financial assistance through USDA-NRCS Farm Bill program contracts.
2. A livestock production facility that a) applies for coverage with the EGLE's National Pollutant Discharge Elimination System (NPDES) permit<sup>13</sup>, or b) is directed by EGLE on a case-by-case basis.
3. A livestock farm that is required to have a CNMP as a result of NPDES permit coverage that desires third party verification in MDARD's Michigan Agriculture Environmental Assurance Program (MAEAP) Livestock System verification<sup>14</sup>.

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<sup>14</sup> For additional information regarding the NPDES permit, go to: <https://www.michigan.gov/egle/about/organization/water-resources/npdes>.

<sup>15</sup> For additional information regarding MAEAP, go to: [www.maeap.org](http://www.maeap.org) or telephone 517-284-5609.

## **APPENDIX C**

### **Sample Manure Management System Plan (MMSP)**

#### **I. General Overview**

Dairy farm is currently a partnership between a farmer and his two sons. The dairy currently has 150 head of cows in the milking herd and approximately 100 replacement stock on the farm (one animal unit equals 1,000 pounds), which includes lactating and dry cows, replacement heifers and calves. The land base of the operation is approximately 1,275 acres. Crops grown on the farm are corn grain, corn silage, wheat, and alfalfa. The purpose of this plan is to indicate how manure produced on the farm is managed to meet the current Michigan Right-To-Farm management practices, while utilizing the nutrients for crop production, without causing any adverse environmental impacts. Currently, there are no plans of any future expansion of the operation.

Soil testing is being done on the crop fields to have current soil tests on hand. Soil testing will be done on any field, which does not have a current soil test (no more than three years old). Manure testing is planned for the spring of 2010 to obtain nutrient levels of the manure. Manure tests will be done at least three times during the first year to establish a base line and then at least once a year thereafter, or more often if feed rations or bedding types and quantities are changed.

#### **II. Volume and Nutrient Production from All Sources**

Table C1. Estimated Annual Volume and Nutrient Production from All Sources

<b>Name of M Storage</b>	<b>Numbers of Animals (Size)</b>	<b>Consistency/ Contents</b>	<b>Estimated Annual Manure and Nutrient Production (values rounded)</b>			
			<b>Volume* (ft<sup>3</sup>)</b>	<b>Total N<sup>16</sup> (lb.)</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O (lb.)</b>
Free Stall Barn	150 (1,400 lb.)	Liquid/Sand	131,000	44,900	23,000	26,300
Loafing Barn	50 (250 lb.)	Solid/Straw	5,840	1,460	360	1,280
Calf Barn	25 (150 lb.)	Solid/Straw	1,820	460	90	360
Open Heifers	25 (750 lb.)	Solid/Straw	9,120	2,100	640	2,010
<b>Totals</b>			148,000	48,900	24,100	30,000

<sup>16</sup> The nitrogen value does not include any nitrogen losses from storage, handling or land applications.

\*These volumes do not include bedding. (If manure storage facilities are to be built, the volume of bedding that will be included with the stored manure will need to be determined in order to size the storage appropriately.)

The manure produced is currently scraped daily and hauled from the free stall barn and parlor. The heifer barns, calf barn, and loafing barn are dry packed for up to one month and sometimes two, if needed, due to weather conditions. See the attachments for the locations of manure storage and animal numbers per barn.

Straw bedding in the additional barns is also hauled to the fields with the manure when the barns are cleaned. Any spoiled feed is hauled and spread on crop fields.

### **III. Manure Collection**

The free stall barn is scraped and hauled daily. This manure is scraped to a ramp where the manure spreader is parked below for loading. The milkhouse wastewater and parlor wash water are collected in an earthen structure south of the parlor. Any manure in the parlor is scraped away prior to flushing with clean water. The flush water is also collected in the earthen structure.

The manure from the young stock is dry packed in the corresponding barns (see attachment). All manure is under cover of the barns so polluted runoff is not a concern from the housed animals. The feed lot could be a potential source of polluted runoff, but any runoff will be contained on the farm and not allowed to move off site.

### **IV. Manure Storage**

The heifer barn is 30 ft. x 50 ft., the calf barn is 28 ft. x 48 ft., and the loafing barn is 62 ft. x 100 ft. The dry pack will vary from one to two feet in depth, depending on the spreading schedule. This allows for at least two months storage of manure.

There currently are no plans for additional storage facilities or expansion within the near future.

### **V. Manure Treatment**

There currently is no additional treatment of manure.

### **VI. Manure Transfer and Application**

The manure spreader used is a John Deere 785 Hydra Push Back. The box capacity is 243 cu. ft. or 1,818 gallons. This spreader is used for both liquid and solid manure.

The manure from the free stall barn is scraped from the barn down a ramp. The manure spreader is parked below the ramp, and the manure is scraped directly into the box. A front-end loader is used to load the spreader with the dry packed manure from the young stock barns.

Manure is typically applied during the summer after wheat, in the fall after corn harvest, through the winter, as needed, and in the spring just before planting. Manure, which is spread during the winter, is applied only to fields with slopes no greater than 6%. A 150 feet setback from surface water will be followed when spreading manure. Manure is incorporated within 48 hours after application in the summer. In order to assess the potential for polluted runoff from the spreading of manure in winter, all fields to which manure may be applied will be evaluated using MARI. Manure is transported from 1/4 to 1 1/2 miles from the headquarters. Most fields are located directly adjacent to the headquarters.

The manure spreader has not been calibrated in the past, but it has been planned for the summer of 2002. The Groundwater Stewardship Technician from MSU Extension is available to assist in calibrating the manure spreader.

## **VII. Manure Utilization**

Table C2. Estimated Annual Farm Nutrient Balance for Fields Receiving Manure

<b>Crop Grown</b>	<b>Yield Goal</b>	<b>Acres (Typ Year)</b>	<b>Nitrogen (lb.)</b>	<b>Estimated Crop Nutrient Removal</b>	
				<b>P<sub>2</sub>O<sub>5</sub> (lb.)</b>	<b>K<sub>2</sub>O (lb.)</b>
Corn	125 bu.	580	83,500	26,825	19,575
Corn Silage	20 tons	70	13,160	5,040	10,920
Alfalfa Haylage	20 tons	150	21,000	4,800	23,400
Alfalfa Hay	10 tons	150	21,000	4,800	23,400
Wheat	50 bu.	100	4,000	3,100	1,900
<b>Totals</b>		1050	142,680	44,565	79,195
Annual nutrient production from Table C1			45,920	20,656	30,918
Nutrients needed to balance cropping system			96,760	23,909	48,277

The manure nutrients will be utilized as fertilizer in the production of the field crops. The manure will provide approximately 45,920 lbs. of nitrogen (which does not include any N losses due to storage, handling or land application), 20,656 lbs. of P<sub>2</sub>O<sub>5</sub> and 30,918 lbs. of K<sub>2</sub>O annually. The manure will be land applied after the harvesting of the crops and in the spring before planting, with daily spreading throughout the year.

The crop rotation will be a corn, hay, and wheat rotation. Refer to Table C2 for realistic crop goals and acres planted during a typical year. The soils on this farm are loamy sands and sandy loams with clay loam inclusions. The slopes on these fields run from 2 percent to 10 percent.

To help determine rates of manure that can be applied to individual fields, a list of fields is included showing the average Bray P1 soil test levels in Table C3. The fields have been grouped by those fields having Bray P1 test levels <150 lb. P/ac, 150-299 lb. P/ac, and ≥300 lb. P/ac. Fields having <150 lb. P/ac will usually have manure applied to provide all of the N recommended for the crop and yield to be grown. To be in compliance with the Right to Farm GAAMPs, fields having soil test levels of 150-299 lb. P/ac will receive manure P<sub>2</sub>O<sub>5</sub> loadings equal to the P<sub>2</sub>O<sub>5</sub> expected to be removed by the harvested crop, and fields with soil tests ≥300 lb. P/ac will not receive any manure (currently, 225 of 1,275 acres will not be receiving manure i.e. applications).

Table C3. Field Identification Bray P1 Soil Test Results and Crops Grown.

Field Number	Acres	Bray P1 (lbs./ac.)	2010 Crop	2009 Crop
Fields with Bray P1 soil test levels <150 lb. P/ac				
7	40	114	Corn	Corn
8	80	102	Corn	Corn
5	160	97	Corn	Corn
6	150	132	Alfalfa Hay	Corn
13	150	128	Alfalfa Hay	Corn
4	100	142	Wheat	Corn Silage
Fields with Bray P1 soil test levels 150-299 lb. P/ac				
2	60	192	Corn	Corn
9	80	246	Corn	Alfalfa Hay
10	70	178	Corn Silage	Wheat
12	160	163	Corn	Alfalfa Hay
Fields with Bray P1 soil test levels ≥300 lb. P/ac				
1	75	354	Corn	Alfalfa Hay
11	110	315	Corn Silage	Corn Silage
3	40	456	Corn	Alfalfa Hay

## **VIII. Manure Recordkeeping System**

Yearly records will be kept on the following:

- Soil test results (three years old or less) on all fields where manure will be applied.
- manure analysis (most recent).
- manure and fertilizer spreading by field (where, when, how much, weather conditions, etc.).
- crops grown and yield data.
- date of spreader calibration; and,
- cropping plan.

These records will be kept in a three-ring binder located at the farm headquarters.

## **IX. Odor Control Plan**

Odors from manure applications will be controlled by using the following practices:

- Spreading during times when neighbors may be spending time outside, such as on holidays or weekends will be avoided.
- Spreading during hot humid days when the air is heavy and still will be avoided as much as possible.
- Manure will be incorporated immediately or at least within 48 hours of application, unless being applied to alfalfa.

Odors from the facility will be controlled by using the following practices:

- Install visual screen through tree lines or fence rows to contain odors and reduce complaints from neighbors.
- Clean water will be diverted to help keep the facility dry.
- A cover will be kept on the silage, or it will be kept in "Ag Bags".

**THE FOLLOWING ITEMS ARE OPTIONAL, BUT ARE STILL GOOD IDEAS TO INCLUDE IN YOUR PLAN:**

## **X. Community Relations**

To develop and maintain a positive relationship with the entire community, one or more of the following should be considered:

- Keeping the farmstead area esthetically pleasing should be a high priority.
- Each spring, a farm newsletter could be sent to all appropriate community



- members describing farm activities, personnel, and management.
- A community picnic and farm tour could be held once a year for all in the immediate community and manure application areas.
- Your farm could be made available to local schools for farm visits as field trips or school projects.
- Participate in local community such as a local town festival, parade, etc., where there is an opportunity to do so.
- Communicate with your neighbors before and after applying manure near their respective homes.

## **XI. Emergency Manure Spill Plan**

Points that should be covered:

- Detailed procedure to be used in the event of a spill (e.g., listing contact people and notification phone numbers).
- include the Michigan Department of Agriculture & Rural Development Ag Pollution Hotline 800-405-0101.
- plan for spills that might happen at various places including a breach of the storage structure, at loading, during transport, and in the field.
- a large part of the Manure Spill Plan should have to do with prevention and monitoring (e.g., maintaining a minimum freeboard in your manure storage to prevent overflows, mowing manure storage berms and inspecting for burrowing animal activity periodically to prevent manure releases); and,
- include a farm map showing all structures at the farmstead.

## **XII. Veterinary Waste Disposal**

Explain how veterinary waste will be disposed of by farm staff or attending veterinarian(s).

- Any veterinary waste generated from farm medicating will be disposed of by having it picked up by a sanitary waste disposal company (residential trash removal).
- Any sharps (e.g., needles) will be placed in a closed container (such as an empty plastic bleach bottle, water bottle, juice bottle, etc.) to prevent needle pricks from occurring to any potential handler of the waste.

## **XIII. Mortality Disposal**

Explain how dead animals will be handled.

- Dead animals will be picked up by a rendering service within 24 hours.
- If animals are going to be buried, the Michigan Bodies of Dead Animals Act will

be consulted for proper burial procedures.

#### **XIV. Conservation Plan**

Points that should be covered:

- Farm field soil conservation measures being used, such as conservation tillage, no till, and grass filter strips.
- Storm water runoff control measures, such as berms, retention basins, and infiltration strips.
- Runoff from driveways, silo aprons, and open feed lots; and,
- Measures used to keep clean roof runoff out of manure.

**This Manure Management System Plan was prepared by:**

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# Generally Accepted Agricultural and Management Practices for Pesticide Utilization and Pest Control

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**DRAFT 2025**

Michigan Commission of  
Agriculture & Rural Development  
PO BOX 30017  
Lansing, MI 48909

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**In the event of an agricultural pollution emergency such as a chemical/fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture & Rural Development (MDARD) and/or Michigan Department of Environment, Great Lakes, and Energy (EGLE) should be contacted at the following emergency telephone numbers:**

**Michigan Department of Agriculture & Rural Development: 800-405-0101**

**Michigan Department of Environment, Great Lakes, and Energy (EGLE)  
Pollution Emergency Alerting System (PEAS): 800-292-4706**

**If there is not an emergency, but you have questions on the Michigan Right to Farm Act, or items concerning a farm operation, please contact the:**

**Michigan Department of Agriculture & Rural Development (MDARD)  
Right to Farm Program (RTF)  
P.O. Box 30017  
Lansing, Michigan 48909  
(517) 284-5619  
(877) 632-1783-Toll Free  
(517) 335-3329 FAX**

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## PREFACE

The Michigan legislature passed into law the Michigan Right to Farm Act (PA 93 of 1981, as amended), which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). These practices are written to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require necessary revision of the practices.

The GAAMPs that have been developed are as follows:

- 1) 1988 - Manure Management and Utilization
- 2) 1991 - Pesticide Utilization and Pest Control
- 3) 1993 - Nutrient Utilization
- 4) 1995 - Care of Farm Animals
- 5) 1996 - Cranberry Production
- 6) 2000 - Site Selection and Odor Control for New and Expanding Livestock Facilities
- 7) 2003 - Irrigation Water Use
- 8) 2010 - Farm Markets

These practices were developed with industry, university and multi-governmental agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices are provided protection from public or private nuisance litigation under the Right to Farm Act.

This GAAMP does not apply in municipalities with a population of 100,000 or more in which a zoning ordinance has been enacted to allow for agriculture provided that the ordinance designates existing agricultural operations present prior to the ordinance's adoption as legal non-conforming uses as identified by the Right to Farm Act for purposes of scale and type of agricultural use.

The website for the GAAMPs is <https://www.michigan.gov/righttofarm>

## INTRODUCTION

American agricultural producers have been able to meet the demands of the public for food through the use of improved agricultural technology. Agricultural technology has included the use of pesticides and other pest management techniques. Virtually all agricultural commodities produced in Michigan may be threatened by serious pest problems and treated with pesticides to prevent or overcome insect, disease, nematode, vertebrate, or weed pests. Currently, agricultural pesticides, as broadly defined by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), are utilized for livestock and crop protection and production.

The use of pesticides can, however, cause environmental and human safety concerns. These include the appearance of pesticide contamination in surface and groundwater in Michigan, destruction of beneficial or non-target organisms, appearance of resistant pest species, and pest population resurgence. Strategies for managing pests continue to be developed to reduce undesirable pesticide effects.

Agricultural producers in Michigan are encouraged to adopt practices that utilize pesticides only as needed. Such practices employ the appropriate use of all available information, methods, and technologies to achieve the desired commodity quality and yield while minimizing adverse effects on non-target organisms, humans, and the environment. Such practices include, but are not limited to, Integrated Pest Management (IPM), organic production methods, or sustainable agriculture. These practices normally involve environmental and biological monitoring such as scouting, trapping, use of pest prediction models, etc., to help producers determine when pest populations reach the economic action threshold and selection and use of safe and effective control measures. These may include, but are not limited to, biological, chemical (biopesticides and reduced risk pesticides), cultural, mechanical, regulatory -controls (e.g. inspections, quarantines, fumigation, sanitation, etc.), and other pest management methods.

Agricultural producers who comply with pesticide labels and labeling, relevant state and federal laws, Michigan State University (MSU) pesticide recommendation bulletins, and follow pertinent sections of these Generally Accepted Agricultural and Management Practices (GAAMPs) for Pesticide Utilization and Pest Control, will meet provisions of PA 93 of 1981, as amended, the Right to Farm Act, which is administered by the Michigan Department of Agriculture & Rural Development (MDARD).

A farm or farm operation that conforms to these and other applicable current GAAMPs adopted under the Michigan Right to Farm Act (PA 93 of 1981, as amended) shall not be found to be a public or private nuisance. This protection also covers farm operations that existed before a change in the land use or occupancy of land within one mile of the boundaries of the farmland, if before that change, the farm would not have been a

nuisance. Likewise, this conditional protection applies to any of the following circumstances:

- a. A change in ownership or size.
- b. Temporary cessation or interruption of farming.
- c. Enrollment in governmental programs.
- d. Adoption of new technology.
- e. A change in type of farm product being produced.

## **PESTICIDE UTILIZATION AND PEST CONTROL PRACTICES**

### **PESTICIDE LABELS**

All pesticides intended for sale bear labels mandated by law that contain their legal and authorized uses and information on how to store, mix, apply, and dispose of the product and container. In addition to labels, manufacturers also provide supplemental labeling, which includes other specific use directions. Everyone using pesticides must follow label and labeling instructions.

Pesticide labels and labeling contain specific information that constitutes the legal parameters for pesticide use. Labels and product information may contain the following:

1. Trade name, common name, chemical name, inert ingredients of toxicological concern, formulation, U.S. Environmental Protection Agency (EPA) registration number, amount of active ingredient per unit, and net contents of the package.
2. Manufacturer or formulator name, address and telephone number, and EPA establishment number.
3. Required signal words and precautionary statements by toxicity category:
  - a. Danger-Poison includes skull and crossbones; poisonous if swallowed. Do not breathe vapor. Do not get in eyes, on skin, or on clothing.
  - b. Warning may be fatal if swallowed. Do not breathe vapors. Do not get in eyes, on skin, or on clothing.
  - c. Caution harmful if swallowed. Avoid breathing vapors. Avoid contact with skin.
  - d. Caution no caution statement required.
4. Use classification:
  - a. Restricted use - requires applicator certification to purchase and use.



- b. General use - applicator certification not required.
5. Statement of practical treatment: includes first aid for human exposure.
  6. Precautionary statements: includes worker safety rules, environmental hazards, endangered species, physical hazards, and the statement "KEEP OUT OF REACH OF CHILDREN."
  7. General information about the pesticide.
  8. Information on storage and disposal of the pesticide and container.
  9. Application procedures (may include equipment, volume, pressure requirements, weather, adjuvants, mixing, cleaning, field preparation, etc.).
  10. Pests controlled.
  11. Directions for Use, including but not limited to: site, maximum allowable rate, timing, crop and pest life stage, rotational restrictions, minimum number of days between last application and harvest, etc.
  12. Worker Protection Standard (WPS) Agricultural Use Requirements - Reentry interval, and/or restricted entry interval.
  13. Use restrictions (Examples: depth to groundwater, soil types, sensitive sites, setbacks, etc.).
  14. Reference to State Management Plans for Groundwater Protection.
  15. Endangered Species Act guidance for protection of endangered species.
  16. Pesticide Resistance action group number.

***For detailed information on specific label requirements, refer to MSU Extension Bulletins E- 3007 kit Private Pesticide Applicator Core Training Manual and Michigan Addendum and E-3008 kit Commercial Pesticide Applicator Core Training Manual kits with Michigan Addendum.***

### CERTIFICATION

Purchasers and applicators of restricted-use pesticides must comply with the certification requirements of the 1994 Michigan Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended (PA 451), Part 83 and detailed in Regulation 636 "Pesticide Applicators." This requires studying training manuals prepared by MSU Extension and passing an examination administered by MDARD.

Recertification is required every three years and may be obtained by one of two methods. The private applicator may study a training manual (Extension Bulletin E-3007kitp) and pass an examination, or attend classes accredited by MDARD for continuing education credits and obtain sufficient credits for the specific category of certification. Both methods ensure that additional information was provided to applicators in the safe and effective use of restricted-use pesticides.

For more information about the certification process and a current listing of approved pesticide applicator certification training seminars can be found at

[https://www.michigan.gov/mdard/0,4610,7-125-1569\\_16988\\_35289---,00.html](https://www.michigan.gov/mdard/0,4610,7-125-1569_16988_35289---,00.html)

<http://www.mda.state.mi.us/schedule/schedule.html> or

[www.canr.msu.edu/ipm/pesticide\\_education\\_safety](http://www.canr.msu.edu/ipm/pesticide_education_safety).

The listing for the pesticide certification exams can be found by following these steps: Go to <https://www.michigan.gov/pestexam>, click Enter as Guest; and click on a county highlighted or region to find date(s) and time(s).

### APPLICATION EQUIPMENT, METHODS, AND PESTICIDE FORMULATIONS

There are many types of pesticide application equipment and many pesticide formulations. Application methods for particular formulations may be specified on the label. To prevent degradation of water resources (and therefore, to comply with federal and state laws) the applicator should choose a method that is accurate in applying the pesticide to the target. A person applying pesticides may employ any equipment or method of application not contrary to the “Directions for Use” on the pesticide label or labeling.

Generally accepted methods of pesticide application include, but are not limited to, the following equipment, methods, and formulations:

EQUIPMENT	METHOD	FORMULATION
airplane/helicopter	aerial	aerosol
air assisted applicator	banding	aqueous suspension
air blast sprayer	chemigation	bait
backpack sprayer, duster	controlled droplet application (cda)	control release formulation
controlled droplet applicator	dips & drenches	dispersible granule
electrostatic sprayer	dusting	dry flowable
fabric mesh & other products impregnated with pesticides	early pre-plant (epp)	dry soluble
fogger	foliar spray	emulsifiable concentrate
fumigation equipment	hopperbox treatment	emulsifiable solution
granular applicator	granular surface application	encapsulated

ground sprayer	impregnated on fertilizer	flowable
hand gun	In furrow	gas
hand sprayer	Injection	granule
hopperbox application	pre-emergence (pre)	Liquid
incorporation into asphalt	pre-transplant	oil solution
injector	Pre-plant incorporated (ppi)	pellet
irrigation equipment (chemigation)	post-directed	ready to use
low volume applicator	post-emergence (post)	soluble granules
mister	post-transplant	soluble powder
recycling sprayer	ropewick	water dispersible granule
roller	seed treatment	wettable powder
speed treated	ultra-low volume (ulv)	suspension concentrate
spreader		soluble liquid
transplanter & seeder		water soluble packet
wick		microencapsulated

### EQUIPMENT USE AND CALIBRATION

The operator shall inspect and maintain all pesticide application equipment to ensure the proper and safe operation of equipment, as well as, the appropriate rate and distribution of application. Equipment must be correctly calibrated at least annually, and leaks minimized to apply specific materials and formulations of pesticides at the intended rate and distribution pattern.

***For detailed information on specific label requirements refer to MSU Extension Bulletin E-3007kitp.***

### WORKER AND HANDLER SAFETY

Any person applying or handling pesticides or working in pesticide treated areas must be knowledgeable in the safe use and handling of pesticides. Everyone must use safety equipment specified on pesticide labels.

The Federal Worker Protection Standard as revised in 2015 protects employees involved in the production of agricultural products on farms, forests, greenhouses, and nurseries from occupational exposure to agricultural pesticides. For both handlers and workers, the standard requires training, notification, and information on the proper use of protective equipment. Handlers include those who apply, load, mix, transport, clean and repair pesticide application equipment, etc. Workers include persons who may physically come in contact with pesticides in treated areas while performing tasks

related to production and harvesting of agricultural plants. Both need to be trained on the recognition of pesticide poisoning symptoms, how to avoid exposure, and emergency assistance, as well as, be provided personal protective equipment and transportation for medical assistance. Handlers need additional training. Employers are required to provide the training, personal protective equipment, decontamination sites, transportation, central notification points, field posting for the duration of the restricted-entry intervals, and maintain pesticide application records for two years. For specific information concerning this law, refer to the EPA-prepared book, "How to Comply With the 2015 Revised Worker Protection Standard For Agricultural Pesticides" "What Owners and Employers Need To Know". (<https://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps>)

Enforcement of the standard occurs in two phases. Label specific requirements will be enforceable when they appear on pesticide labels. These requirements include:

1. Using label-specified personal protective equipment;
2. Obeying label-specific restrictions on entry to treated areas during the restricted-entry intervals; and
3. Obeying the requirement on labels that provide oral warnings and/or treated area posting.

The generic requirements of worker protection standards include:

1. Providing decontamination supplies
2. Annual training of workers and handlers
3. Providing certain notification and information
4. Cleaning, inspecting, and maintaining personal protective equipment
5. Respirator medical evaluation and fit testing
6. Application exclusion zones
7. Emergency assistance.

## ALTERNATIVE PEST MANAGEMENT TECHNIQUES

Growers may use alternatives to pesticides to manage pests. These may include, but are not limited to, audible cannons, ultra-sonic and audio sound equipment, strobe lights, firearms, balloons, scarecrows, streamers, netting, traps and fences for wildlife management, tillage for weed control, controlled burning, traps for pest management, transgenic plants, introduced or managed biological control agents, mechanical

controls, resistant varieties, cover crops, crop vacuums, flammers, mulching, composting, crop rotation, pheromones for mating disruption and trapping, weather monitoring equipment for pest prediction, etc. All such techniques should be used according to dealer and/or manufacturer recommendations and must be used according to federal and state agency recommendations and/or regulations.

Specialized approaches are often needed to address risks of crop injury from bird pests. Bird management strategies can be grouped into several categories: 1) scaring strategies, 2) barrier strategies (for example netting), 3) cultural management practices, for example encouraging natural predators, 4) deterrent sprays and 5) lethal control. Scaring strategies that involve noise, for example, propane cannons, should be used in a manner that considers neighbor relations, for example, not running them all the time and only when necessary. Detailed recommendations for each can be found in the Michigan Fruit Management Guide (MSUE bulletin E-0154).

## PROTECTION OF THE ENVIRONMENT

Agriculture involves management of biological systems to produce food, feed, fur, and fiber. Pesticides and other pest management practices cause a specific effect in a biological system.

For agriculture to be sustained at biologically and economically sound production levels, growers should recognize their responsibility to be stewards of the soil and the environment. Growers should be aware of environmentally sensitive conditions in their production system and adjust management practices to ensure future productivity and environmental integrity. For example, growers should limit use of highly or moderately leachable pesticides in areas with coarse-textured soils or high water tables. NRCS CPS Integrated Pest Management 595

([https://efotg.sc.egov.usda.gov/api/CPSFile/5052/595\\_MI\\_CPS\\_Integrated\\_Pest\\_Management\\_2011](https://efotg.sc.egov.usda.gov/api/CPSFile/5052/595_MI_CPS_Integrated_Pest_Management_2011))[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb1044470.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044470.pdf) ;  
<https://www.canr.msu.edu/ipm/index> )

A person applying pesticides in agricultural production should follow label instructions and use good judgment to avoid adverse effects to human health and the environment. A pesticide applicator should make a determined effort to:

1. Assess pest populations and apply pesticides only when needed to manage these pests during the vulnerable or appropriate stage of their life cycle.
2. Avoid directing a pesticide application beyond the boundaries of the target site.
3. Avoid the potential for drift or runoff. (See page 11 - #2. Pesticide Drift for information regarding a drift management plan.)
4. Avoid applications that would result in exposure of persons within or adjacent to the target site, except when such pesticides have approved use patterns

permitting treatment of populated areas for specific pest management programs. (e.g., gypsy moth, mosquito, etc.)

5. Avoid applications that would lead to contamination of aquifers (PA 451 of 1994 as amended, Part 87, and Part 31, Rule 2203) or runoff to surface waters (Pest Management Conservation System (Code 595)).
6. Utilize safety measures including backflow safety devices when applying pesticides through irrigation systems.

### AGRICULTURE POLLUTION EMERGENCIES

The Michigan Department of Agriculture and Rural Development has a toll-free, 24-hour hotline available for reporting agricultural pesticide, fertilizer, and manure spills. The **MDARD Agriculture Pollution Emergency (APE) Hotline, 1- 800-405-0101**, is designed to improve response time and provide appropriate technical assistance, reducing the environmental risk associated with an agricultural chemical spill.

Users of agricultural pesticide, fertilizer, and manure products should report all un-contained spills or releases to the MDARD APE Hotline. MDARD has the responsibility to initiate response activities to immediately stop or prevent further releases at agrichemical spill sites and will do so through possible interaction and assistance from the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The main goal of the MDARD Spill Response Program is to clean up all agrichemical spills quickly and completely and get the recovered material out to where it can be used for its intended purpose. This goal is accomplished through providing immediate response, technical assistance, a common sense approach to clean up, and utilization of legal land application of recovered materials.

This 24-hour hotline should be used for reporting accidental agricultural pesticide, fertilizer and manure spills. (Chemical spills not agriculture-related should be referred to EGLE's Pollution Emergency Alerting System (PEAS) number, 1-800-292-4706.) (<https://www.michigan.gov/egle/contact/environmental-emergencies>)

### EXCESS SPRAY MIXTURES AND RINSATES

Use excess mixtures or rinsates on labeled application sites at or below labeled rates as listed on the label. Excess pesticide mixtures include, but are not limited to: leftover solution when spraying is done; haul-back solutions from a spraying job interrupted by weather, and equipment breakdown. All rinsates, including pesticide container rinsate, should be put in the sprayer as part of the mixing solutions.

### MIXING AND LOADING

Pesticides should be mixed and loaded according to label directions in a manner that does not harm individuals, animals, or the environment. The greatest risk occurs when handling pesticide concentrates. Follow these practices to reduce risk:

1. Pesticide mixing and loading areas should be located in such a manner as to reduce the likelihood of a spill or overflow contaminating a water supply. Acceptable areas may include temporary or permanent sites, which are described in MSU Extension Bulletin E-3007kitp.
2. Review the label before opening the container so that you are familiar with current mixing and usage directions. If two or more pesticides are to be mixed, they must be compatible and mixed in the proper order.
3. Measure accurately. Keep all measuring devices in the pesticide storage area to avoid their being used for other purposes. Measuring containers or devices should be rinsed and the rinse water put into the spray tank.
4. Avoid back-flow when filling a spray tank to prevent water source contamination. The simplest technique is an air gap where the fill hose does not come in contact with the tank water. Back-flow prevention devices may also be used. (Reference MSU Extension Bulletin E-3007 kitp).
5. A sprayer must be monitored while it is being filled.
6. Mix only the amount you plan to use immediately. Pesticides should be applied as soon as possible to maintain product effectiveness and reduce the potential for accidental discharge.
7. Clean up spills immediately. Material spilled during mixing or loading may be applied to labeled sites at or below labeled rates. All spills to the soils and/or waters of Michigan must be reported to the state of Michigan according to the Natural Resources and Environmental Protection Act of 1994. Spills exceeding reportable quantities, under SARA Title III, must be reported to the appropriate agencies (Reference MSU Extension Bulletin E-2575 "Emergency Planning for the Farm"- currently being revised available at ([https://maeap.org/wp-content/uploads/2019/03/E2575\\_Emergency\\_Plan\\_on\\_the\\_Farm.pdf](https://maeap.org/wp-content/uploads/2019/03/E2575_Emergency_Plan_on_the_Farm.pdf)) ) as well as the Michigan Department of Agriculture & Rural Development, APE Hotline, (800) 405-0101.

## APPLICATION AND STANDARDS FOR USE

The 1994 Act 451, Part 83, Pesticide Control and Pesticide Use (<http://legislature.mi.gov/doc.aspx?mcl-451-1994-II-2-83>) contain components that are applicable to private applicators using pesticides for agricultural operations, including but not limited to the following.

### 1. Spill Kits

Any person who mixes, loads, or otherwise uses pesticides shall have immediate access to a spill kit. The spill kit requirement does not apply to a person who



used single containers of use dilution pesticides in a quantity that is less than 16 ounces.

Spill kits should contain materials appropriate to the material being applied and equipment being used.

## 2. Pesticide Drift

All pesticide applications are required to be made in a manner that minimizes off-target drift. When pesticide off-target drift is anticipated due to the nature of the application, a Drift Management Plan shall be utilized by the applicator to minimize the occurrence and adverse effects of off-target drift.

The Drift Management Plan shall include drift minimization practices. Such practices may include, but are not limited to, any of the following:

- The use of the largest spray droplets that are created by a combination of special nozzles, pressures, and particulating agents to accomplish the objectives of the applications.
- The use of specialized equipment that is designed to minimize off-target drift.
- The use of the closest possible spray release to the target.
- The use of the lowest effective rates of application of the pesticide.
- The establishment of a no-spray buffer zone. The buffer zone may be treated with non-powered equipment.
- The identification of the maximum wind speed and direction under which applications can be made.
- The use of wind shields or windbreaks to contain spray drift or deflect spray drift away from sensitive areas.
- Other specific measures stated in the plan that are effective in minimizing the incidence of off-target drift.

A Drift Management Plan shall be in writing, and MDARD will consider the presence and use of a written Drift Management Plan as a factor in determining appropriate enforcement action in the event of drift. Pesticide off-target drift does not include the off-target movement of a pesticide by means of erosion, volatilization, or windblown soil particles after the application of a pesticide.

## RECORD KEEPING

Farm operators must maintain accurate records of all agricultural crop applications of pesticides for at least three years, and preferably five years.

The federal pesticide recordkeeping regulations, the federal worker protection standards, and the Michigan Right to Farm current GAAMPs all have requirements related to pesticide recordkeeping. The following table is intended to clarify which data are required for each. The federal recordkeeping regulations and worker protection standards are laws. Right to Farm GAAMPs are voluntary guidelines.

### USDA Record Keeping Regulations (Redkp)

The data required by these regulations must be kept by private pesticide applicators for each restricted use pesticide application.

### Worker Protection Standards (WPS)

The information listed in the table must be posted for at least 30 days after the end of the restricted-entry interval (REI), or, if there is no REI, for at least 30 days after the end of the application.

### Michigan Right to Farm (RTF)

A portion of the Right to Farm document addresses pesticide recordkeeping. By following these voluntary guidelines, producers can reduce their liability.

### Table Comparing Record Keeping Requirements for Private Pesticide Applicators

Federal Recordkeeping Regulations (Redkp), Worker Protection Standards (WPS), Michigan Right to Farm (RTF)

Data to Record	Redkp	WPS	RTF
Month/day/year	x	x	x
Time of application		x	
Pesticide brand/product name	x	x	x
Pesticide formulation			x
EPA registration number	x	x	x
Active ingredient(s)		x	
Restricted-entry interval (REI)		x	
Rate per acre or unit			x
Crop, commodity, stored product, or site that received the application	x		x
Total amount of pesticide applied	x		x
Size of area treated	x		x
Applicator's name	x		x
Applicator's certification number	x		x
Location of the application	x	x	x
Method of application			x
Target pest			x
Carrier volume per acre			x

Developed by the Michigan State University Pesticide Education Office

Commercial applicators must send a copy of records required by USDA to clients within 30 days of application. If a medical emergency occurs within 30 days, commercial applicators must provide the necessary information immediately upon request.

For federally restricted use pesticides (RUP), records must incorporate all information required by Title XIV of the Federal Food, Agriculture, Conservation and Trade Act Subtitle H, Section 1491, Pesticide Record Keeping.

## TRANSPORT OF PESTICIDES

A person transporting pesticides will do so in such a manner as to avoid discharge into the environment, human exposure, and contamination of animal feed and human food.

## DISPOSAL OF UNUSED PESTICIDES

Michigan residents may dispose of unused and unwanted pesticides through the Michigan Clean Sweep Program. The Michigan Agriculture Environmental Assurance Program (MAEAP), in cooperation with county and local units of government, has established permanent Clean Sweep sites located throughout the state. More information can be found here: <https://www.michigan.gov/mdard/plant-pest/pesticide-enforcement/cleansweep>

Individual Michigan residents may dispose of pesticides by taking them to one of these Clean Sweep sites where they will be collected, packaged for shipping, and disposed of properly. There is no charge for this service. Program costs are covered by MAEAP and a grant from the EPA, and services are provided by the local cooperators.

## DISPOSAL OF PESTICIDE CONTAINERS

Always dispose of containers in a way that minimizes impact on the environment and is consistent with the label specifications. It is desirable to use reusable, returnable, or recyclable containers when available. Pesticide containers should be emptied completely, rinsed when appropriate, and in general rendered into a non-hazardous waste.

1. Triple rinse or use other recommended practices, such as pressure rinsing to clean all glass, metal, or plastic containers to render them non-hazardous waste (MSU Extension Bulletin E-2784 and E-3007kitp) ([https://archive.lib.msu.edu/DMC/extension\\_publications/e2784/E2784-2002.PDF](https://archive.lib.msu.edu/DMC/extension_publications/e2784/E2784-2002.PDF)) .
2. After rinsing, puncture metal and plastic containers. They can then be recycled or buried in a sanitary landfill approved under PA 451 of 1994, as amended, Part 115.
3. Michigan has had an agriculture plastic pesticide container recycling program in operation since 1992. This program allows for the grinding and recycling of clean

plastic containers. For more information on this program, contact MDARD at (517) 284-5612 or visit: <https://www.michigan.gov/mdard/plant-pest/pesticide-enforcement/cleansweep>

4. Dispose of rinsed glass containers in a sanitary landfill approved under PA 451 of 1994, as amended, Part 115.
5. Open burning of pesticide containers is prohibited by state statute, PA 451 of 1994, as amended, Part 55.

## ON FARM STORAGE AND CONTAINMENT OF PESTICIDES

All pesticides must be stored in a manner that maintains environmental quality, ensures human and animal safety, and preserves product and container integrity. (Reference MSU Extension Bulletin E-2335, E-3007kitp, and NRCS Practice Standard 309, Agrichemical Handling Facility). Legal storage requirements are on pesticide labels. ([https://archive.lib.msu.edu/DMC/extension\\_publications/e2335/E2335-1996.PDF](https://archive.lib.msu.edu/DMC/extension_publications/e2335/E2335-1996.PDF) ; <https://efotg.sc.egov.usda.gov/api/CPSFile/4689/>)

1. Bulk pesticide storage site - A site should be selected that minimizes potential for contamination of surface or groundwater by drainage, runoff, or leaching. Locate the storage site an adequate distance away from wells, surface water, and other sensitive areas. For purposes of these practices, a bulk storage area is an area where pesticides are stored over 15 days in a single container greater than 55 gallons (liquid) or 100 pounds (dry material).
  - a. Bulk pesticide storage areas should be located a minimum of 150 feet from any single-family residential water well or a minimum of 50 feet with secondary containment for the pesticide storage; 800 feet from a Type IIB or III public water supply, or a minimum of 75 feet with secondary containment of the pesticide storage; and a minimum of 200 feet from surface water. Dairy farms and farms with employees generally have Type III public water supply. If an existing bulk storage area is located closer than 150 feet from a single--family residential water well, 800 feet from a public water supply, or less than 200 feet from surface water, appropriate security measures should be taken to prevent pesticide contamination of surface water or groundwater.
  - b. The pesticide storage set-back distance from any Type I community public water supply or Type II non-community public water supply well is 2,000 feet, if the public water supply does not have a well-head protection program. If there is a well-head protection program, the facility must be located outside the delineated well-head protection area. For more information on well set-back distances from pesticide storages, contact the Michigan Department of Agriculture and Rural Development Environmental Stewardship Division engineering staff.

These set-back distances pertain to bulk pesticide storage sites and facilities and do not include application sites. A storage facility is a place for the safe keeping of pesticides. An application site is where pesticides can be used according to label specifications.

2. Storage facility - Pesticides should be stored in a facility that is securable to prevent unauthorized access (MSU Extension Bulletin E----3007kitp).

- Keep all pesticides out of the reach of children, pets, livestock, and unauthorized people.
- Within the storage area, store pesticides in a manner to prevent cross contamination with other pesticides or accidental misuse. Store pesticides away from food, feed, potable water supplies, veterinary supplies, seeds, and protective equipment.
- The storage facility should be ventilated to reduce dusts and fumes.
- Keep pesticides cool, dry, and out of direct sunlight. Consider freeze protection as required by labels.
- Post the pesticide storage area with highly-visible, weather-proof signs that indicate that pesticides are stored there. Also post "NO SMOKING" signs.
- Store pesticides only in their original labeled containers, or containers appropriate for pesticide storage that are properly labeled.
- Have absorbent materials, such as cat litter box filler or sawdust and clean-up equipment immediately available. A fire extinguisher approved for chemical fires should also be easily accessible.
- The storage of combustible and flammable chemicals may require special storage and reporting requirements. Contact your local fire chief and refer to the Standard 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages, for further information (<https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=30A>). To report pesticides in storage under SARA Title III Tier II (<https://www.michigan.gov/egle/regulatory-assistance/emergency-planning-and-community-right-to-know/tier-ii-reporting>).

## PESTICIDE USE RECOMMENDATIONS AND TECHNICAL ASSISTANCE

Michigan State University Extension provides education and recommendations on correct and effective use of pesticides on most agricultural commodities grown in Michigan (See Appendix II).

Growers meet pesticide rate standards for GAAMPs if they apply pesticides at or less than legal labeled rates. Pesticide uses for commodities not included in MSU recommendations but in accordance with their respective labels or labeling will also meet the application rate requirements of these GAAMPs.

The Natural Resources Conservation Service (NRCS) role is to provide technical and financial assistance to agricultural producers. Its Field Office Technical Guide (FOTG) provides the standards, which establish elements of conservation planning designed to maintain soil productivity and protect the environment. Financial assistance may be available through USDA Farm Bill programs.

Financial assistance may be available through USDA Farm Bill programs. The Michigan Agriculture Environmental Assurance Program (MAEAP) provides for technical assistance for agricultural producers to facilitate improvement of their practices that may impact groundwater and surface water.

Spill Response Program - This program helps reduce environmental impacts associated with pesticide, fertilizer, and manure spills. If a spill occurs, agri-chemical users must call MDARD's 24-hour hotline at 1-800-405-0101. This gives access to information, technical assistance, and in some cases, financial assistance for dealing with the control, containment, and cleanup of a spill. MAEAP provides funding for this program.

Clean Sweep Program - Individuals can bring unwanted pesticides to one of Michigan's Clean Sweep sites for proper disposal at little or no cost to themselves. The Michigan Agriculture Environmental Assurance Program (MAEAP), along with the Environmental Protection Agency and local agencies, pays for the disposal of these pesticides. A list can be found at: <https://www.michigan.gov/mdard/plant-pest/pesticide-enforcement/cleansweep> or by contacting MDARD at 517-284-5612.

The Michigan Certified Crop Adviser (CCA) program is a nationally-recognized, voluntary certification program developed through the collaborative effort of the public sector and the agriculture industry to ensure high standards for crop advisers. It is intended for anyone who makes nutrient, pesticide, crop, or environmental recommendations to producers. This includes dealers, distributors, applicators, consultants, manufacturers, allied industries, and state and federal government agency personnel. The CCA program is administered by state boards in association with the American Society of Agronomy, which handles similar programs for specialists in agronomy, crop consulting, weed science, and other agricultural disciplines. In Michigan, the Michigan Agri-Business Association manages the program (<https://www.miagbiz.org/programs/cca-designation>).

## APPENDICES

### APPENDIX I: REFERENCES ON STATE AND FEDERAL LAWS AND REGULATIONS

State and Federal Laws and Regulations: A person applying agricultural pesticides in Michigan must comply with all relevant state and federal laws and regulations. These include, but are not limited to:

1. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1947, as amended. This is the basic federal law regulating pesticide registration and use in the United States. A new part of this law requires states to implement a state management plan for specific pesticides that may contaminate groundwater. Pesticide applicators are required to adhere to state components of this plan.
2. Federal Worker Protection Standard of 1992. This regulation was written by U.S. Environmental Protection Agency (EPA) governing the protection of employees on farms, forests, nurseries, and greenhouses from occupational exposures to agricultural pesticides. They are intended to reduce the risk of pesticide poisoning and injuries among agricultural workers and pesticide handlers through appropriate exposure reduction measures. The regulations expand the requirements for ensuring warnings about pesticide applications, use of personal protective equipment, and restriction on entry to treated areas. New requirements are added for decontamination, emergency assistance, maintaining contact with handlers of highly toxic pesticides, and pesticide safety training. (<https://www.epa.gov/pesticide-worker-safety/agricultural-worker-protection-standard-wps> )
3. Federal Record Keeping. Authorized by the 1990 Federal Food, Agriculture, Conservation and Trade Act (Farm Bill), new requirements are being developed for record keeping of federally restricted use pesticides (RUP) by certified applicators.
4. The Superfund Amendments and Reauthorization Act (SARA) of 1986 Title III: Emergency Planning and Community Right-to-Know. This federal law provides mechanisms to prepare for chemical emergencies. Persons storing pesticides that are considered to be extremely hazardous by EPA above "Threshold Planning Quantities", must notify the State Emergency Response Commission within Michigan Department of Environment, Great Lakes and Energy (EGLE), the Local Emergency Planning Committee and the local fire chief that they store at least one of these chemicals above threshold at some time. The location of the storage facility and name and telephone number of a responsible person must be reported also. If there is a spill or release of one of these chemicals above the "Reportable Quantity", the same organizations must be notified. MSU Extension Bulletin E-2575 contains information to help farmers comply with the law.



5. The Endangered Species Act (ESA) of 1973, as amended. This federal law protects endangered species and their habitats from the adverse effects of pesticides. Pesticide labels contain information on endangered species and restricted use areas.
6. National Fire Prevention Association (NFPA) Standard Code 30A. The Michigan State Fire Marshall has adopted the NFPA Code 395, which regulates the storage of combustible and flammable liquid chemicals with a flash point below 200° F on the farm. If you construct a new chemical storage facility, contact your local building inspector to be sure you are in compliance with the code's construction, diking, and location requirements. The code sets requirements for the amount and location of stored chemicals; the type, construction and size of containers and fire prevention devices that need to be incorporated into structures. (Code 30A, according to the NFPA website: <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=30A> )
7. The Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended.
  - Part 31, Water Resources Protection. This part provides broad substantive bases for protection and conservation of surface and groundwater resources of the state.
  - Part 55, Air Pollution Control. EGLE has statutory authority, powers, duties, functions, and responsibilities for rule making and issuance of permits and orders for air pollution control including burning of pesticide containers. The Part provides for control of air pollution that may be in the form of a dust, fumes, gas, mist, odor, smoke, or vapor, in quantities that are or can become injurious to human health or welfare, animal life, plant life, or to property, or that interfere with the enjoyment of life or property.
  - Part 83, Pesticide Control. This part regulates registration, distribution, labeling, storage, disposal, and application of pesticides in Michigan. The Act was amended in 1993 to allow MDARD to respond to incidents of confirmed groundwater contamination.
  - Applicator Certification Regulation 636 and Pesticide Use Regulation 637 were established as a requirement of Part 83 Pesticide Control, PA 451 of 1994, the Natural Resources and Environmental Protection Act, as amended to provide regulation for pesticide use.
  - Part 87, Groundwater and Freshwater Protection. This establishes the necessary legal authorities to develop and implement voluntary, proactive management practices for pesticides and fertilizers that are protective of groundwater. The Act provides for technical assistance, grants, and research and demonstration projects that will be available to agricultural

producers so they can change current practices that may be impacting groundwater. The Act also establishes a statewide advisory committee and regional groundwater stewardship teams that will work directly with producers.

- Part 111, Hazardous Waste Management. This part protects public health and the natural resources of the state from harmful effects of hazardous wastes. When pesticides are not used according to label directions, are out of condition, or are suspended or canceled, they may become hazardous wastes and have strict transportation, treatment, storage, and disposal requirements. This also includes pesticide containers that are not triple rinsed or power washed.
  - Part 115 Solid Waste Management. This part provides for proper design and licensing of non-hazardous landfills and provides disposal requirements for various types of wastes. It lists over 60 approved licensed landfills that can accept properly rinsed pesticide containers. The EGLE Environmental Resource Management Division number is 517-373-2730.
  - Part 201, Environmental Response. This part provides for the identification, risk assessment, and priority evaluation of environmental contamination and provides for response activity at certain facilities and sites. This Act also provides an exemption from liability for farmers if they follow the pesticide label and Generally Accepted Agricultural and Management Practices. Any spills or discharges of polluting material (including pesticides) that may potentially reach any surface or ground water must be controlled and reported to the EGLE's Pollution Emergency Hot Line at 1-800-405-0101, or EGLE's PEAS at 1-800-292-4706.
8. PA 154 of 1974, the Michigan Occupational Safety and Health Act (MIOSHA), as amended. The Michigan Department of Health and Human Services and Michigan Department of Labor and Economic Opportunity jointly enforce this law to protect workers who handle or during normal working conditions might be exposed to pesticides. Employers are required to develop and implement a written employee training program as well as ensure that all pesticides or other hazardous chemical containers are properly labeled. For hazardous chemicals other than pesticides, the employer is required to have Material Safety Data Sheets available for employee review. In case of pesticide, labeling information may be furnished if Material Safety Data Sheets are unavailable. Copies of Material Safety Data Sheets for pesticides are normally available from pesticide manufacturers or distributors. Additionally, farmers are advised to cooperate with their local fire department and local emergency planning committees in furnishing requested information.
9. PA 399 of 1976, the State of Michigan Safe Drinking Water Act, as amended. An Act to protect the public health; to provide for supervision and control over public

water supplies; to provide for the classification of public water supplies; and to provide for continuous, adequate operation of privately owned, public water supplies. This act sets forth standard isolation distances from any existing or potential sources of contamination and regulates the location of public water supplies with respect to major sources of contamination.

10. PA 368 of 1978, the Michigan Public Health Code, as amended. An Act to protect and promote the public health; to codify, revise, consolidate, classify, and add to the laws relating to public health; to provide for the prevention and control of diseases and disabilities; and to provide for the classification, administration, regulation, financing, and maintenance of personal, environmental, and other health services and activities.

## APPENDIX II: REFERENCES ON AGENCY RECOMMENDATIONS

Michigan State University pesticide use and pest control recommendations are contained in, but not limited to, the following publications and computer programs available from the MSU Educational Materials Distribution Center at [www.shop.msu.edu](http://www.shop.msu.edu) or by calling 517-353-6740 or from the local MSU Extension office:

E-0154	Michigan Fruit Management Guide
E-0312	Midwest Vegetable Production Guide for Commercial Growers
E-0434	Weed control guide for field crops
E-0433	Weed control guide for vegetable crops
E-2676	Christmas Tree Pests Manual
E-3245	Minimizing Pesticide Risk to Bees in Fruit Crops

MSU Extension bulletins and other resources relevant to these Generally Accepted Agricultural and Management Practices can be obtained through the MSU Educational Materials Distribution Center at this Web site [www.shop.msu.edu](http://www.shop.msu.edu) or from the local MSU Extension office.

E-3007 kitp	Private Pesticide Applicator Core Training Manual and Michigan Addendum (Order from: <a href="https://npsecstore.com/pages/michigan">https://npsecstore.com/pages/michigan</a> )
E-3007	Spanish National Applicator Core Training Manual & Michigan Private Applicator Addendum
E-3008 kitc	Commercial Pesticide Applicator Core Training Manual and Michigan Addendum (Order from: <a href="https://npsecstore.com/pages/michigan">https://npsecstore.com/pages/michigan</a> )
E-3008	Commercial Pesticide Applicator Core Training Manual and Michigan Addendum (also available in Spanish)
E-2579	Commodity Fumigation: Training Manual, Commercial & Private Applications
E-2342	Recordkeeping System for Crop Production
E-2343	Field File Folders: Recordkeeping System for Crop Production

Useful USDA Natural Resources Conservation Service publications include:

Pest Management Conservation System (code 595)

NRCS Practice Standard 309, Agrichemical Handling Facility  
([https://efotg.sc.egov.usda.gov/api/CPSFile/4689/\\_](https://efotg.sc.egov.usda.gov/api/CPSFile/4689/_) )

Useful Worker Protection Standard Publications include:

How to Comply With the 2015 Revised Worker Protection Standard For  
Agricultural Pesticides” “What Owners and Employers Need To Know”

Resources for revised WPS publications:  
National Pesticide Safety Education Center:  
<https://npsecstore.com/pages/michigan>  
Pesticide Educational Resources Collaborative:  
[pesticideresources.org//index.html](https://pesticideresources.org//index.html)

These may be available at the EPA National Agricultural Compliance Assistance Center  
located at 901 North 5<sup>th</sup> Street, Kansas City, KS 66101, (888) 663-2155,  
website: <https://www.epa.gov/agriculture/about-epas-national-agriculture-center>  
**website for MSUE Bulletins:** <https://www.shop.msu.edu>

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# Generally Accepted Agricultural and Management Practices for Irrigation Water Use

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**DRAFT 2025**

Michigan Commission of Agriculture & Rural  
Development  
PO BOX 30017  
Lansing, MI 48909

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**In the event of an agricultural pollution emergency such as a chemical/fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture and Rural Development and/or Michigan Department of Environment, Great Lakes, and Energy should be contacted at the following emergency telephone numbers:**

**Michigan Department of Agriculture & Rural Development: 800-405-0101**  
**Michigan Department of Environment, Great Lakes, and Energy's Pollution**  
**Emergency Alert System: 800-292-4706**

If there is not an emergency, but you have questions on the Michigan Right to Farm Act, or items concerning a farm operation, please contact the:

**Michigan Department of Agriculture & Rural Development**  
**Right to Farm Program**  
**P.O. Box 30017**  
**Lansing, Michigan 48909**  
**517-284-5619**  
**877-632-1783**  
**517-335-3329 FAX**

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## PREFACE

The Michigan legislature passed into law the Michigan Right to Farm Act (Act 93 of 1981, as amended) which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). These practices are written to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require necessary revision of the Practices.

The GAAMPs that have been developed are as follows:

- 1) 1988 Manure Management and Utilization
- 2) 1991 Pesticide Utilization and Pest Control
- 3) 1993 Nutrient Utilization
- 4) 1995 Care of Farm Animals
- 5) 1996 Cranberry Production
- 6) 2000 Site Selection and Odor Control for New and Expanding  
Livestock Facilities
- 7) 2003 Irrigation Water Use
- 8) 2010 Farm Markets

These practices were developed with industry, university, and multi-governmental agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices are provided protection from public or private nuisance litigation under the Right to Farm Act.

This GAAMP does not apply in municipalities with a population of 100,000 or more in which a zoning ordinance has been enacted to allow for agriculture provided the ordinance designates existing agricultural operations present prior to the ordinance's adoption as legal non-conforming uses as identified by the Right to Farm Act for purposes of scale and type of agricultural use.

The website for the GAAMPs is <http://www.michigan.gov/righttofarm>

## INTRODUCTION

The Generally Accepted Agricultural and Management Practices (GAAMPs) for Irrigation are based on the core principle of stewardship. Stewardship in irrigation management includes stewardship of water quantity, water quality, soil, plant quality, and crop yield.

- Stewardship of the water quantity means using water as efficiently as possible while providing for the crop/landscape water needs. Utilizing more water than necessary for production of a quality crop is wasteful of the water resource and can have negative environmental and production impacts resulting from leaching of nitrogen and possibly pesticides. With certain exceptions, over-irrigation is when water applications exceed the quantity needed to replace the soil/substrate moisture deficit. The amount of irrigation water to apply generally is equal to the total evapotranspiration since the last irrigation minus any precipitation that occurred during the period.
- Stewardship of the water quality means being careful to apply water at a rate that will infiltrate uniformly into the soil/substrate and be properly stored for crop use while not causing surface runoff or water movement below the root zone.
- Stewardship of the soil means following management practices that will sustain and improve soil surface infiltration characteristics and soil moisture holding capacity through increasing organic matter levels and biological activity while reducing compaction.
- Stewardship of the crop means managing water to promote plant establishment, sustain plant development, and foster the long-term sustainability of the managed landscape system.
- Stewardship of the agricultural sector of the Michigan economy means producing high-quality crops that maintain and enhance Michigan's reputation as a superior supplier in the marketplace.

These GAAMPs do not establish legal criteria to resolve water use conflicts, nor do they confer priority rights to water use. Individual water users who are concerned about their rights or abilities to establish new uses or to continue or increase their water withdrawals are encouraged to consult with advisors at Michigan State University Extension (MSUE), the USDA Natural Resources Conservation Service (NRCS), the Michigan Department of Agriculture and Rural Development (MDARD), the Michigan Department of Environment, Great Lakes, and Energy (EGLE), or an attorney versed in this area of law.

# GENERALLY ACCEPTED AGRICULTURAL AND MANAGEMENT PRACTICES FOR IRRIGATION WATER USE

## **System Management**

Proper management of an agricultural irrigation system is an integral part of GAAMPs. Six practices contribute to proper system management.

- 1. Select an appropriate source of water. Common sources of irrigation water include, but are not limited to groundwater, lakes, ponds, rivers, streams, drainage ditches, reservoirs, and municipal water supplies.**

Irrigation systems are designed to provide the water needed by the crop that is not met by natural rainfall. As a general rule of thumb, five to seven gallons per minute per irrigated acre are required for common irrigation systems (i.e., 200– 280 gallons per minute discharge is required for a 40-acre field). Deep wells may have a steel or plastic casing with a shaft drive turbine or submersible electric pump. Shallow suction wells and horizontal wells are used when the static water level is near the land surface. They use a centrifugal suction pump or a submersible pump.

Irrigation water is pulled from lakes, ponds, rivers, streams, drainage ditches and reservoirs by use of a centrifugal suction pump. Suction pipes are typically suspended or anchored in place to avoid movement with water flow and the inlet is usually set at least 24 inches below the water surface to avoid drawing air. Screens, rotary screens, and water jets are often used at the inlet end of the pipe to prevent debris from entering the pump.

Drainage ditches often require a deepened area in the bottom of the ditch or a temporary constructed flow restriction to provide the depth for the suction inlet below the surface. Irrigation ponds should be constructed deep enough to accommodate the screen or suction line and need to be adequately sized to meet the irrigation system demand. Typical irrigation ponds or reservoirs are half acre or greater in area and eight or more feet deep to provide water storage volume and to increase the chance of adequate discharge from groundwater.

Before construction or installation of the water supply, refer to the material in the background section of this document “*Water Law, Agricultural Water Use, Permits and Regulatory Compliance*” including the requirements for large volume water users and requirements related for construction near existing water features.

- 2. Determine all water applications accurately.**

The objective of this practice is to accurately apply a known amount of water with each irrigation. To do this, irrigators need to accurately determine the water delivery. Application amount may be determined by knowing the actual flow delivered when the system is operating at a set pressure and monitoring time of application. Another method is to have a flow meter installed that will measure the flow. In addition to indicating the irrigation application rate and total flow, these meters will also serve as a

warning of potential problems with wells or pumps. On pressurized systems, the flow meter used in conjunction with a pressure gauge can show whether the system is performing as it was designed. To be accurate, flow meters must be installed according to manufacturer's specifications.

### **3. Evaluate the irrigation system uniformity.**

Ensure the irrigation system hardware is in good operating condition and the irrigation system is functioning as designed. System uniformity evaluation involves 1) the overall condition of the system, and 2) how the design and management of this system work together to achieve high distribution uniformities and application efficiencies.

Observe the system at the time of construction to ensure the system as built matches the design. After any major repair work involving the water distribution equipment, observe the sprinklers or distribution equipment to make sure the repair stays true to the design. Replace sprinklers that will not apply water uniformly or that exhibit malfunction in water distribution pattern.

Ensure center pivot interlock systems are present that stop water flow if the distribution system stops moving.

### **4. Maintain the irrigation system in good working condition.**

Maintain the system so that it operates as designed. An important aspect of uniformity is to make sure every component is in good operating condition. Regular observation for visible equipment malfunctions such as clogged emitters, sprinkler rotation, leaky pipelines, or riser gaskets should take place. Make sure cornering arm or Z arm control integrity is maintained when the system is used and repair any malfunction identified. Make sure that micro-emitters have not shifted location and are no longer watering the target.

### **5. Accurately measure irrigation system supply pressure at the manifold for each distribution system.**

Observe pressure at start up in the spring and at mid-season or time of peak use. Correct malfunctions or leaks that have resulted in water supply pressure being out of design parameters. Pressure variations can be an early indication of problems with a pump, indicate a supply line leak or malfunction, or an incorrectly set valve. Correct system pressure is essential for efficient operation.

### **6. Operate sprinkler systems to minimize drift and off-target application.**

Systems should be both designed and managed to avoid off-target application of water. Observe the system at start up to minimize drift or direct spraying of water over roads, adjacent property, or structures due to system placement or high winds. Observe end guns and traveler systems at start up to ensure they are operating as designed to avoid over- or under-application of water.

**7. Ensure that irrigation system output does not greatly exceed the infiltration rate of the soil or substrate.**

The objective of this practice is to maintain system uniformity and infiltration into the soil or substrate (potting mix) and reduce transported sediments and other pollution to surface water. This is accomplished by ensuring the application rate of the sprinkler system is always lower than the infiltration rate of the soil or substrate during irrigation. This practice can be implemented by checking the application rate versus the infiltration rate of the soil or substrate and modifying the application rate when it is appropriate to do so. Runoff can be managed to some extent by applying lower amounts per irrigation and/or, in the case of container production, by increasing the gap between the container rim and the substrate surface. If runoff is noted, reduce the application amount, and increase the frequency of irrigation. Check to see if there is a soil structure problem or if surface crusting is caused from too large of water droplets being applied. Center pivot sprinkler systems vary in application rates over the span of the pivot. The application rates under the pivot center are much lower than the rates near the end. This is because the field areas covered by the outside portions are much greater than those covered by the inside. Since the pivot will pass over a spot much more rapidly toward the outside end of the pivot, yet apply the same amount of water, the amount applied per hour is much greater.

Irrigation systems used for container production include traditional overhead sprinkler systems, flood, trickle or drip, low volume or micro- systems, and sub-surface. Each system employs technology, equipment, and materials to satisfy the delivery requirements. It is important that the application characteristics of the irrigation system match the targeted plants, production and/or management operations, intake characteristics of the soil/substrate, and subsequent collection/ drainage systems.

**8. Provide noise control for engine driven pumping units.**

Where an internal combustion engine is used to power a part of the irrigation system, such as a pump or electric generator, provisions should be made for sound control. This may be in the form of mufflers specifically designed to quiet the sound from the engine or sound baffles to minimize sound carrying toward neighboring properties. Sound travels easily over water bodies. Placement of engines should be considered carefully with respect to population density and sound transmission.

**Record Keeping**

Written documentation of an agricultural irrigator's water applications and management practices is an integral part of generally accepted agricultural and management practices.

**9. Records should conform to the requirements of the Michigan Water Use Reporting laws and regulations.**

**10. Keep records on all system inspections and repairs that influence uniformity and leaks.**



- 11. Maintain records of regularly calibrated chemigation equipment, if used.**
- 12. Keep records of the results each time the sprinkler system uniformity is evaluated.**

### **Irrigation Scheduling**

Irrigation scheduling for each field or unit to be irrigated is an integral part of GAAMPs. Irrigation scheduling is the process of determining when it is necessary to irrigate and how much water should be applied during each irrigation event.

Various irrigation scheduling aids exist to help the irrigator keep track of the soil/substrate moisture balance, determine when to irrigate, and the quantity of water to apply. However, these aids do not replace the need for good judgment on the part of the irrigator, who must balance a multitude of factors in managing irrigation, such as:

- Soil variations within an irrigation unit
- Species variations within an irrigation unit
- The time from start to finish of an irrigation cycle
- The probability of rainfall in the near-term future
- Stage of plant growth and its susceptibility to a moisture deficit
- Wind and heat energy impacts
- Potential environmental impacts

Scheduling can be done by manually keeping a running balance of the soil moisture status in each field or irrigation unit using a balance sheet approach, by using various instruments to measure soil moisture status and trigger irrigation, or by using a computerized approach to do the record keeping. All irrigators schedule by some method, and they should keep sufficient records so that they accurately apply the correct amount of water.

Irrigation scheduling helps the irrigator determine the appropriate timing and amount of water to be applied to the growing crop. The primary factors in scheduling are:

Available soil water per unit depth of soil.

- Depth of rooting for the crop being scheduled.
- Soilless substrates, water retention, and container volume in nursery and

greenhouse operations.

- Allowable soil/substrate moisture depletion at each stage of crop growth.
- Crop evapotranspiration at each stage of crop growth as determined by measured evaporation multiplied by the crop co-efficient. The crop co-efficient relates the actual evapotranspiration for a crop to the potential evapotranspiration. It depends on the crop development stage, is low during the initial stage, and reaches a peak at mid- season.
- Rainfall in the field.

**13. Avoid applying irrigation water in excess of the quantity of water needed to replace the soil/substrate moisture deficit in the root zone.**

Plant water stress occurs when soil moisture has been depleted below some critical level, expressed as a percentage of available soil water. For a particular soil, *available soil water* is the amount of moisture held between its field capacity or drained upper limit (the amount of water retained in the total soil pore space after saturated soil has drained) and the permanent wilting point (the point at which plants can no longer obtain water from the soil and thus wilt and die). In Michigan, this difference for most soils is typically on the order of 0.07 to 0.15 inches of water for every inch in soil depth (e.g., a 10-inch layer of soil with a 0.13 inches of available water per inch of soil would contain 1.3 inches of plant available water at the drained upper limit). The coarser-textured soils more commonly irrigated in the state fall closer to the lower end of this range. The amount of available soil water for crops in a particular soil largely depends on its texture (the proportion of sand, silt, and clay particles), organic matter content, and the effective rooting depth of the crop in that soil. It may also vary with depth, as does soil texture. In general, the amount of available soil water increases with increasing clay content of the soil. For the highly variable soil textures and types in Michigan, this translates to a typical range of three to eight inches of plant available water in the top 6 feet of the soil profile. However, because losses of yield and quality occur long before the permanent wilting point is reached, the amount of available soil water that can be depleted without inducing damage is less than the total available. This amount is defined as the *allowable depletion*, and it is crop specific.

Available water holding capacity data for a specific soil type can be obtained from *USDA/Natural Resources Conservation Service's Field Office Technical Guide*, Section II at <http://www.mi.nrcs.usda.gov>. These data can be used to calculate the available soil water within the rooting depth of a crop grown on that soil. An average or representative value can then be determined for each field and can be used to calculate the allowable depletion for the field.

**14. Know the available water for each unit scheduled.**

**15. Know the depth of rooting for each crop irrigated.**

The amount of water needed for irrigation and the frequency of application also

depends on the crop to be irrigated. Some crops, such as alfalfa, have a very extensive primary and secondary rooting system that penetrates to greater depths. The effective rooting depth of alfalfa will vary from three to six feet, or more depending on soil physical properties and depth of the water table. Corn also has a very good branching root system and can effectively use water to a depth of four feet or more. Soybeans, however, have a tap root system with secondary branch roots and seldom use water effectively from more than two feet deep. Field grown nursery stock usually has roots concentrated in the upper two feet of soil. Lettuce and many other vegetable crops have a very shallow root system and will rarely use water below one or two feet. Shallow rooted crops need to be irrigated frequently with small amounts of water, while deep rooted crops may be irrigated with larger applications of water at less frequent intervals.

**16. Use container capacity in scheduling irrigation for container grown crops.**

In container production systems, soilless substrates contain a limited amount of water and roots and are confined to the container volume (*Southern Nurserymen's Association*, 1997). Container capacity refers to the container's capacity to hold moisture. It is used to define the maximum volume of water a substrate can hold following irrigation and drainage, expressed as the percent water retained relative to the substrate volume. Container capacity depends on the type of substrate and the container dimensions. A substrate is a mixture of different components to provide desired physical and chemical properties for proper plant growth. Increasing the percentage of fine particle substrate components, such as peat and sand, increase the moisture holding capacity of a substrate.

However, addition of too many fine particle components can result in inadequate drainage. Container capacity is also influenced by the height/diameter ratio of the container. Recommended container capacities range from 45 to 65 percent, with the resultant available moisture ranging from 25 to 35 percent.

Weather conditions, the availability of water, the particular plants grown, and production cycles, are used in determining the scheduling of irrigation. Irrigation often occurs daily during the season and starts earlier and extends later in the season compared to traditional field operations.

**17. Know the allowable soil moisture depletion at each stage of crop growth.**

Most soils must be maintained above 40 percent to 65 percent of available water in the rooting zone to avoid plant stress, and that critical value varies by crop. During certain stages of crop growth of some sensitive crops, it is necessary to maintain very uniform soil moisture above 70 to 75 percent of available water, to avoid impacting yield and quality.

Examples are tomatoes during fruit set and potatoes during tuber formation.

**18. Measure, estimate, or use published evapotranspiration data and crop**

### **co-efficient (when available) to determine crop water use.**

For some crops, you may wish to consult an irrigation specialist for assistance.

Because of the difficulty and expense of direct measurement of available soil water, most irrigation scheduling is based on an indirect measure. In this case, irrigation is scheduled according to a water budget in which crop water use estimated using meteorological measurements is balanced against water applied as irrigation and measured precipitation. Crop water use or evapotranspiration is the sum of two forms of water loss – evaporation from the soil surface and transpiration from the plants. Evapotranspiration is affected by several climatic factors and plant characteristics. It increases as solar radiation, air temperature, and wind velocity increase, and as the size of the plant canopy (leaf area) increases. It decreases as relative humidity increases and as stomata on the leaves close in response to water (or other forms of) stress. In relatively humid climates such as Michigan's, the most important meteorological factors in determining the evapotranspiration rate are solar radiation and temperature. Evapotranspiration data is available from Enviroweather at <https://enviroweather.msu.edu>.

Even with good evapotranspiration estimation and accounting, the available water should be monitored in the field or container to determine when the allowable depletion has been reached. This can be accomplished by judging the feel and appearance of the soil at depths throughout the root zone, or by using direct measurement and monitoring instruments, such as tensiometers, Time Domain Reflectometry, or electrical conductivity sensors.

Guides to Michigan crop water use are available from your local NRCS or MSUE office that provide accurate estimates of water use patterns of specific crops.

### **19. Measure rainfall in each field irrigated.**

Natural rainfall and irrigation applications work together to replace water used by plants. Accurate determination of how much irrigation water is needed depends directly on knowing how much rain falls in the field where irrigation is being scheduled. Rainfall events, especially summer storms, are variable and may drop widely varying amounts of water in locations that are not far apart geographically. Every field being managed for irrigation must have a rain gauge in the field to accurately manage irrigation water applications.

### **Scheduling methods**

Irrigation scheduling programs must be tailored to take into account soils and climatic conditions at a given location and the requirements of different types of crops at different stages of growth. These programs can then calculate daily depletions of available water, usually from estimates of evapotranspiration. They also estimate how much water needs to be added when allowable depletion has been reached.

Irrigation scheduling programs commonly use the following data:

- Allowable depletion (AD) of soil moisture determined for the field or container.
- Initial AD balance – the portion of AD that is present at crop emergence, or when irrigation scheduling begins.
- Amount of rain and irrigation water added to the field.
- Daily potential evapotranspiration estimate based on calculations done by the manager or obtained from local sources.
- Percent canopy cover (or other coefficient) to adjust the evapotranspiration estimate when the crop is at less than full cover (These coefficients are crop specific and adjusted for stage of growth).

The program then provides the following information for management:

- Evapotranspiration estimate adjusted for the crop at less than full cover.
- Current AD balance – the portion of AD present in the field.
- Projected AD balance for the next 24 and 48 hours

The manager then can decide how much and when water should be applied. Scheduling recommendations are adjusted to allow for the crops changing water needs at various growth stages.

### **Additional Reasons to Irrigate**

- 20. At certain times during the growing season, the need for irrigation may be compelling even though water applications are not driven by the need to replenish a soil moisture deficit.**

Examples of such other reasons to apply irrigation water include:

- Frost protection: Application of water through sprinkler irrigation systems, during radiation frosts and conditions where the temperature drops below freezing for a few hours, may prevent crop damage. As water freezes, it releases heat that keeps the crop from freezing even though ice builds on the foliage. Irrigation must be sustained until all the ice is off the plant to prevent the thawing water from extracting heat from the plant.
- Aid in seed germination or transplant establishment: Light applications of irrigation water may be needed at planting to assist in seed germination, assist transplants through the shock of being placed in the soil, and stimulate root movement into moist surrounding soil.

- Aid in herbicide activation: Herbicides require moisture within the first few days of application to enhance the release of the active ingredients. A light irrigation application can be used to provide the needed moisture.
- Reduction of disease: Some disease organisms proliferate under dry conditions. A timely water application can function as a natural disease-control agent.
- Establishment of post-harvest cover crops: Soil moisture may be limiting, when cover crops are seeded or irrigation water application may assist soil contact for seeds, if they are broadcast.
- Control of wind erosion in small and emerging crops: Wind erosion can destroy small, tender seedlings of crops like vegetables and sugar beets, just as they are emerging, by blowing soil particles against them and essentially cutting them off. Irrigation to maintain a moist soil surface can be used to reduce wind erosion.
- Post-harvest maintenance of ornamentals: post-harvest maintenance refers to care and handling between harvest and subsequent use, whether use is replanting in continued production systems or shipping to an end user. Plants are held during this period as bare root, balled and burlaped, or in some form of a container and require appropriate irrigation for the stock type.
- Provision of proper soil conditions for harvesting crops: Harvest of some crops requires soil moisture above a critical level. Irrigation may be needed to provide proper conditions. Optimal soil moisture aids in the efficient use of equipment, allows for the ease of soil separation from roots/tubers in specific crop types, and minimizes damage to the desired plant part. Soil moisture is especially critical in the lifting of bare-root seedlings and in harvesting root/tuber crops and plants with soil balls.
- Chemigation: Application of fertilizers and pesticides through irrigation equipment with properly chosen, usually small, amounts of irrigation water can be beneficial and reduce field operations and/ or aerial applications. Correct amounts of water can assist soil incorporation or apply the chemical primarily to the foliage, as needed.
- Crop cooling in special cases: Certain sensitive crops may benefit from light applications of water through an overhead irrigation system to wet plant surfaces and keep the plant cooler through evaporation.
- Establishment and maintenance of a water table for sub-surface irrigation: Sub-surface irrigation is not generally addressed in these GAAMPs, but application of water through specially designed tile drainage systems may be used to control the water table in certain soil conditions and provide capillary movement unto the root zone of crops to provide their water need from below.

## **Application Practices**

Irrigation can be applied at or below the quantity of water needed to replace the soil/substrate moisture deficit.

### **21. Choose irrigation application amounts that will avoid surface runoff under sprinkler irrigation.**

The amount to apply with each irrigation cycle will depend on the soil type (or container substrate) and its infiltration rate. Runoff can be minimized when irrigating soil by reducing application rates to not exceed the soil infiltration rate. By adjusting the frequency and amount of irrigation water applied, the irrigator should maintain adequate soil moisture within the rooting zone. More frequent applications of smaller amounts may be desirable for some crop, soil, and cultural practice combinations. The application rate at which water can be applied is determined by the infiltration characteristics of the soil. The actual intake rate varies with soil structure, organic matter content, tillage practice, and the amount of crop residue remaining on the surface. Soils with good soil structure, high organic matter, and plenty of plant residues on the surface have higher rates of water intake than compact soils low in organic matter or without residues on the surface. Management practices that include cover crops and other practices to increase surface residue and soil organic matter, along with practices to reduce compaction, will help improve infiltration and soil moisture holding capacity. No-till and conservation tillage result in higher intake rates than clean tillage.

## **Nutrient Leaching**

Leaching of nitrate-nitrogen or any other contaminant into groundwater should be prevented as much as possible. Manage irrigation systems to minimize nutrient leaching. The following list of practices may be used to minimize nutrient leaching:

- 22. Assure that sprinkler application rates are below the soil infiltration rate to prevent runoff and accumulation of water in lower areas, which may result in excess infiltration and leaching.**
- 23. When irrigation is used, split application of nitrogen fertilizer or use controlled release fertilizer.**

Multiple applications will help to ensure that nitrogen is available when plants need it most and to minimize the amount that can be leached.

- 24. Incorporate appropriate backflow-prevention safety devices if a chemigation system is used. A chemigation valve contains a functional check valve, vacuum relief valve, and a low-pressure drain.**
- 25. Irrigation systems used for applying chemigation should have a properly installed, maintained, and tested chemigation valve, reduced pressure zone valve, or air gap. An air gap is twice the diameter of the fill pipe or 6 inches, whichever is greater. Repair or replacement of any**



**nonfunctioning components should be done with a professionally manufactured valve.**

- 26. The chemigation check valve device should be inspected by the operator annually to ensure it is working properly and written records of the inspection must be maintained for a minimum of five years.**

The annual test shall consist of the following:

- Opening the inspection port and checking the condition of the check valve seat and the internally loaded (i.e., spring) check is functioning.
  - With the system pressurized and the well pump off, remove the low-pressure drain to ensure the main check valve is not leaking. *[This may only be possible for vertical turbine pump systems]*
  - Visual inspection of the air/vacuum relief, low-pressure drain and plunger, low-pressure drain hose, and injection line check valve for signs of failure.
- 27. Irrigation systems used for applying chemigation should have adequate interlock and safety systems to prevent over application of pesticide, fertilizer, and water when pumps continue to run, and the distribution system stops moving.**

### **Practical Considerations**

Many Michigan soils are variable. Thus, it is necessary to decide which soil type or which zone in the field should govern irrigation management. This decision may compromise the moisture stress situation for another soil type in the field. The irrigator must always consider the time it takes for the irrigation system to complete the irrigation cycle in any given field. An irrigation cycle may need to be started when part of a field still has some allowable depletion left in the profile. This decision is made for the system to irrigate the entire field before any segment of the crop has gone beyond the allowable depletion and moisture stress has resulted. Field soil variability should be taken into consideration when designing drip irrigation systems. Drip irrigation systems should be zoned, when possible, with zones designed so that the soil within a zone is as consistent as possible.

Monitor pumping plant efficiency. The objective of this practice is to maintain the design pressure and flow in the irrigation system while maximizing energy use efficiency. The distribution uniformity and the potential application efficiency of many irrigation systems are dependent on maintaining the design flow and pressure from the pumping plant. If the flow or pressure during operation are not as designed, something may be wrong with the pumping plant. The system may not be set up correctly, is being operated incorrectly, or there may be worn nozzles.

Other management factors that influence irrigation include crop scouting schedules, crop protectant application schedules, and any restricted entry intervals that must be observed. For example, growers may use a custom applicator and may not have total

control of the timing of applications, which can complicate irrigation management. In all of these situations, growers need to consider good stewardship practices, as well as the crop needs, with the goal of producing profitable yields and acceptable quality and promoting environmental stewardship.

## **BACKGROUND**

*The material in this section of the document is educational and informational in nature and should not be interpreted as containing specific generally accepted agricultural and management practices. The GAAMPs and their explanation are in Section II.*

### **Irrigation in Michigan**

The importance of irrigation in agricultural production is recognized worldwide and is especially important in the United States. According to the *2012 Census of Agriculture*, irrigated farms represented just 14 percent of U.S. farms, but contributed about 39 percent of the country's farm sales—over \$152 billion. For high value crops, the proportion produced under irrigation is even higher.

In Michigan, only 7.7 percent of our land is irrigated, but the irrigated area produces primarily high value crops, making the value of the irrigated crops as a percentage of all crops produced higher than 7.7 percent. High-value crops such as vegetables, potatoes, seed crops, turf, and ornamentals are almost 100 percent produced and/or managed under irrigation.

The major reason for irrigation is to minimize or eliminate the negative impacts of moisture stress and thereby produce a high-quality crop at a profit. The goal of irrigators should be to maximize crop quality and profit while minimizing the effect on the environment and water resources of the state. Michigan is a water-rich state, but rain-fed crops often suffer from a moisture deficit during a part of the growing season. Rainfall records show that Michigan is the driest state east of the Mississippi River during the critical growing months of July and August. However, annual rainfall exceeds annual crop and landscape water use. Therefore, there is typically water available to recharge aquifers and supply surface water needs in rivers, lakes, and wetlands during other parts of the year. In much of the state, groundwater is abundant and can be used for irrigation. However, these GAAMPs do not establish legal criteria to resolve water use conflicts, nor do they confer priority rights to water use.

Water used in irrigation replaces water extracted by plants from the soil profile or substrates in container nursery and greenhouse systems. The main reason that plants use water is to moderate their temperature and remain in a productive state through evaporative cooling. Only a very small fraction of the water taken up by plants is used in their metabolic processes such as photosynthesis. Plant growth and associated crop production are dependent on the ability of the plant to remain within an acceptable temperature range. If the plant gets too hot, it wilts and dies, or at the very least, experiences a loss of productive potential. As long as plants can access soil/substrate moisture, they can transport water to plant surfaces that are exposed to the energy from the sun and make water available for evaporation from the plant surface (typically the

leaves), thus cooling the plant. If insufficient water is available, the plant then must try to reduce the energy it is absorbing by curling or dropping the leaf so that less area is exposed to the sun. When the plant is stressed in this way, it not only is likely to get warmer than normal but suffer a reduction in its ability to produce new dry matter, whether in the form of foliage, floral, fruit, or grain. Irrigation allows the producer to maintain soil moisture at a level where plants can extract the water they need for cooling. Thus, the main effect of irrigation is to provide the moisture plants need to stay cool and productive.

Agricultural irrigation water use in Michigan began to develop rapidly in the early 1970's with the availability of highly mechanized sprinkler irrigation equipment and the recognition that in certain low-water-holding soil areas of the state there was abundant water available. Irrigation could greatly increase production, crop quality, and the number of crops that could be grown. The ability to irrigate meets contract requirements to grow certain high value crops, maintains crop production requirements for a wide variety of commodities, and allows managers to reduce risks. High-value crops currently grown could not be produced in Michigan without irrigation. Examples are potatoes, seed corn, vegetables, turf and landscape, and nursery and greenhouse crops. Loss of the ability to produce these crops would not only jeopardize the farms on which they are grown but would have serious adverse economic ripple effects in both the agricultural and non-agricultural sectors of the economy. Access to irrigation water for these crops is the keystone in the production of the quality and reliability of yield that Michigan growers have accomplished.

The amount of water applied through irrigation in Michigan augments natural precipitation, which ranges from 28 inches annually in northeastern sections of the state to over 38 inches in far southwestern and northwestern counties. While in some areas of the country, irrigators may need to provide for the total crop water needs through irrigation, in Michigan, only some of the plant water is provided through irrigation. Irrigation water requirements vary greatly depending on the rainfall, the crop grown and its stage of development, weather conditions, and the water holding capacity of the soil. There are usually episodes or periods of the growing season when precipitation is not sufficient to meet crop needs. The ability to irrigate enables growers to effectively minimize or eliminate soil/substrate moisture deficit periods by increasing the moisture available for plant growth.

Limitations to utilizing irrigation include the significant capital and energy costs, labor and management requirements, and the availability of adequate water supplies that are impacted by a variety of environmental, economic, and legal factors. Most important of these is the availability of a sufficient supply of surface water and/or groundwater. Irrigation is concentrated during the summer months when stream flows and lake levels are at their lowest. This makes careful evaluation of the adequacy of the water source available at a site before irrigation is started and the subsequent good management of the water resource very important.

## **Overview of Existing GAAMPs and their Relation to Irrigation**

The Michigan Right to Farm Act, PA 93 of 1981, as amended, states that “generally accepted agricultural and management practices” means practices defined by the Michigan Commission of Agriculture and Rural Development. The Act indicates that the Commission, in developing these practices, shall give due consideration to information available from:

- Michigan Department of Agriculture and Rural Development
- Michigan State University Extension
- Michigan Agricultural Experiment Station
- USDA Natural Resources Conservation Service and Farm Service Agency  
Michigan Department of Natural Resources
- Michigan Department of Environment, Great Lakes, Energy
- Other professional and industry organizations

Other GAAMPs mention irrigation. The current *Manure Management and Utilization* GAAMPs recognizes (Section III) that irrigation is one method whereby manures may be applied to the surface and indicates that the irrigation must be done in such a manner that it does not cause ponding or runoff. The current GAAMPs for Nutrient Utilization discuss irrigation in Practices 16 and 17. It recognizes that proper irrigation management can help assure plant growth and yields that are sufficient to remove applied nutrients and that irrigators should use modern scheduling techniques to avoid applying excess water that could result in movement of nitrates below the root zone. The *GAAMPs for Nutrient Utilization* recommend that irrigation water be applied in a manner such that after irrigation, some soil water holding capacity remains unfilled to hold rainfall should it occur shortly after irrigation. Specifically, it recommends that “irrigation should occur when 40 percent to 70 percent of the available soil water is depleted, depending upon the soil, crop, and capacity of the irrigation system...” and that “irrigation water should not fill the soil rooting profile to more than 80 percent” of its moisture holding capacity. The nutrient management GAAMPs also indicates that “irrigators should use multiple applications of N-fertilizer to improve N-efficiency and minimize potential losses of nitrate-N to groundwater.” It states that “nitrogen fertilizer applied through the irrigation system, referred to as fertigation (or chemigation) offers special advantages to irrigators, and 1) may be applied when the crops demand is the greatest, and in trickle-irrigated orchards, where roots are the most concentrated; 2) the technique requires little energy for application; and, 3) it is well suited to sandy soils where irrigation is needed and leaching may be a problem.” The GAAMPs cautions producers who fertigate should test the uniformity of their irrigation system to assure that no extremely high or low zones of water application occur. Irrigation systems used for pesticide and nutrient application must have appropriate back flow prevention safety devices.

The Nutrient Utilization GAAMPs, under the *FERTILIZATION AND IRRIGATION PRACTICES OF CONTAINER-GROWN PLANTS* section, states that “frequent fertilization and irrigation of container grown plants are needed since common root media lack nutrient and water holding capacity.” In such conditions, it is important that effective management practices be adopted to minimize water and fertilizer leaching and/or runoff.

The current *Pesticide Utilization and Pest Control GAAMPs* recognize that chemigation (application of pesticides through irrigation equipment) is one generally accepted method for application. Page 8, Practice No. 6, states that when utilizing chemigation, the applicator should make a determined effort to “utilize safety measures including back flow safety devices” to prevent possible contamination of the water source.

### **Water Law, Agricultural Water Use, Permits, and Regulatory Considerations**

The Michigan Right to Farm Act, PA 93 of 1981, as amended, provides Michigan farmers with limited protection from nuisance suits. The statute authorized the Michigan Commission of Agriculture and Rural Development to develop and adopt GAAMPs for farm operations. Adherence to the GAAMPs does not provide a complete barrier against lawsuits, but it does give protection from nuisance litigation in many circumstances. The Act [MCL 286.472, Sec. 2 (b) (iii)] defines “farm operation” as including:

“The operation of machinery and equipment necessary for a farm including, but not limited to, irrigation and drainage systems and pumps ...”

It also states in MCL 286.473, Sec. 3 (1):

“A farm or farm operation shall not be found to be a public or private nuisance if the farm or farm operation alleged to be a nuisance conforms to generally accepted agricultural and management practices ...”

In addition, in MCL 286.473, Sec. 3 (3):

“A farm or farm operation that is in conformance with subsection (1) shall not be found to be a public or private nuisance as the result of any of the following:

- (a) A change in ownership or size
- (b) Temporary cessation or interruption of farming
- (c) Enrollment in government programs
- (d) Adoption of innovative technology
- (e) A change in type of farm product being produced”

These GAAMPs do not establish legal criteria to resolve water use conflicts or disputes. Complaints against agricultural use high-capacity wells ( $\geq 70$  gpm) from small well

owners (< 70 gpm.) are handled by the MDARD Aquifer Protection and Dispute Resolution Program. More information on the program can be found at: <https://www.michigan.gov/mdard/environment/rtf/aquifer-protection-and-dispute-resolution-program>

These GAAMPs do not confer priority rights to water use. Individual water users who are concerned about their rights or abilities to establish new uses or to continue or increase their water withdrawals are encouraged to consult with advisors at MSUE, NRCS, MDARD, EGLE, or an attorney versed in this area of law. Water withdrawal for irrigation purposes has the potential to impact other adjacent property owners, other riparian surface water users, and/or the natural resources of the area. Several regulatory programs exist to consider those potential impacts.

In accordance with Part 327 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, all properties with the capacity to withdraw more than 100,000 gallons of water per day averaged over any consecutive 30-day period (i.e. all properties with at least 70 gallons per minute or more in pump capacity) are required to be registered and have their water use reported annually to the state by the property owner. This requirement applies to all agricultural water uses (e.g. irrigation, crop cooling, animal watering, etc.) and to withdrawals from all water sources (natural and man-made surface water bodies, and groundwater). Information is available from MDARD's website at <https://www.michigan.gov/mdard/environment/maeap/maeap-technical-assistance/wateruse> or by contacting Abigail Eaton at 517-284-5612 or [eatona@michigan.gov](mailto:eatona@michigan.gov)

As of July 9, 2009, the owners of all proposed new or increased withdrawals of 70 gpm or more in pump capacity must use the Water Withdrawal Assessment Tool prior to installation and withdrawals must be registered with EGLE in accordance with Part 327. The Water Withdrawal Assessment Tool is at <https://www.egle.state.mi.us/wwat>.

Part 327 requires EGLE to notify registered water users and local government officials when a new withdrawal is registered in an area with increased likelihood of adverse resource impacts. Water users and local government officials are notified of their authority to establish a water users committee to assist in water resources planning, and water users are required to review and consider implementing the water conservation measures found in these GAAMPs for Irrigation Water Use. For information about water user committees, or about registering withdrawals, contact Andrew LeBaron, EGLE Water Use Program, at 517-599-3792 or [lebarona@michigan.gov](mailto:lebarona@michigan.gov).

EGLE administers regulatory programs involving wetlands, groundwater, lakes, and streams under the authority granted by the state legislature and the federal government. EGLE administers what are commonly known as the Inland Lakes and Streams part and the Wetlands Protection part of NREPA, as well as the federal Clean Water Act. Permit applications for construction activities in regulated wetlands, lakes, and streams are submitted to EGLE's Water Resources Division.

Inland Lakes and Streams, Part 301 of NREPA, requires permits where construction activities will occur in a lake or stream to facilitate the withdrawal of water. A state inland

lakes and streams permit will generally be required for dredging in the water body, construction of a structure in or over the stream, stream relocations, creation of a lake (water body five acres or larger), or creation of a pond within 500 feet of a lake or stream. Wetlands Protection, Part 303 of NREPA, may require permits where irrigation activities will result in the drainage of or construction in a regulated wetland. Regulated wetlands include any of the following:

- (a) Wetlands located within 500 feet of other surface waters, or within 1,000 feet of the Great Lakes, regardless of wetland size.
- (b) Isolated wetlands larger than five acres.
- (c) Other wetland areas deemed essential to the preservation of the natural resources of the state and where the property owner has been so notified.

A state wetlands permit will generally be required for work in regulated wetlands where the project will require grading, filling, construction of dikes, construction of ditches, and/or the placement of other structures within the wetland area.

EGLE has a Wetland Identification Program (WIP) whereby a person can request the wetlands be identified and their regulatory status is determined. The findings of EGLE under this program are guaranteed for a three-year period. Application forms for a WIP assessment can be obtained at the EGLE website at

<https://www.michigan.gov/egle/about/Organization/Water-Resources/Wetlands>. State

wetland inventory maps which combine information from the Michigan Resources Information System (MIRIS), the US Fish and Wildlife Service National Wetland Inventory maps (NWI), and the USDA Natural Resources Conservation Service soil surveys are available at the County Register of Deeds, the County Clerk's office, the County Extension Service, and at the EGLE website:

<https://www.michigan.gov/egle/about/Organization/Water-Resources/Wetlands>

Additional background information relating to GAAMPs can be found at:

<http://www.egr.msu.edu/bae/water>.



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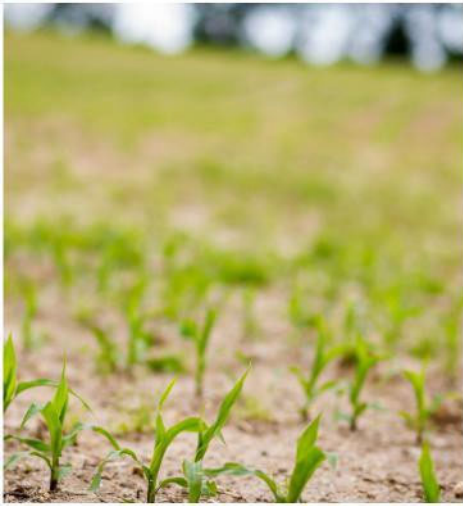
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# Generally Accepted Agricultural and Management Practices for Nutrient Utilization

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**DRAFT 2025**

Michigan Commission of  
Agriculture & Rural Development  
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**In the event of an agricultural pollution emergency such as a chemical/fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture & Rural Development and/or Michigan Department of Environment, Great Lakes and Energy should be contacted at the following emergency telephone numbers:**

**Michigan Department of Agriculture & Rural Development: 800-405-0101  
Michigan Department of Environment, Great Lakes, and Energy's Pollution  
Emergency Alerting System (PEAS): 800-292-4706**

**If there is not an emergency, but you have questions on the Michigan Right to Farm Act, or items concerning a farm operation, please contact the:**

**Michigan Department of Agriculture & Rural Development (MDARD)  
Right to Farm Program (RTF)  
P.O. Box 30017  
Lansing, Michigan 48909  
517-284-5619  
877-632-1783  
517-335-3329 FAX**

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## PREFACE

The Michigan legislature passed into law the Michigan Right to Farm Act (Act 93 of 1981), which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). These practices are written to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require revision of the GAAMPs during the annual review.

The GAAMPs that have been developed are the following:

- 1) 1988-Manure Management and Utilization
- 2) 1991-Pesticide Utilization and Pest Control
- 3) 1993-Nutrient Utilization
- 4) 1995-Care of Farm Animals
- 5) 1996-Cranberry Production
- 6) 2000-Site Selection and Odor Control for New and Expanding Livestock Facilities
- 7) 2003-Irrigation Water Use
- 8) 2010-Farm Markets

These current GAAMPs were developed with industry, university, and multigovernmental agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices are provided an affirmative protection from public or private nuisance litigation under the Right to Farm Act.

This current GAAMP does not apply in municipalities with a population of 100,000 or more in which a zoning ordinance has been enacted to allow for agriculture provided the ordinance designates existing agricultural operations present prior to the ordinance's adoption as legal non-conforming uses as identified by the Right to Farm Act for purposes of scale and type of agricultural use.

The website for the GAAMPs is <http://www.michigan.gov/righttofarm>



## **BEST MANAGEMENT PRACTICES (BMPS)**

### **VERSUS GENERALLY ACCEPTED AGRICULTURAL MANAGEMENT PRACTICES (GAAMPS)**

Agricultural Best Management Practices (BMPs) are the most effective technologies or management practices to mitigate adverse environmental impacts from agricultural systems. Best Management Practices are dynamic and evolve with scientific knowledge and technological advance. Scientific evidence and proven technologies are the basis of the Generally Accepted Agricultural Management Practices (GAAMPs). The Nutrient Utilization GAAMPs allow for a range of flexible technological and management options, which reflect the site-specific nature and challenges of local implementation based on environmental and economic conditions. They embody an understanding that an appropriate set of technologies and management practices depend on the context of their use. They are practical, science-based, acceptable approaches to management forged through a consensus of knowledgeable local and regional producers, university educators, industry, government, and regulatory stakeholders.

## **INTRODUCTION**

The desire to protect surface- and groundwater quality and farm profitability are strong incentives to improve the efficiency of fertilizer use on Michigan farms. Rainfall intensity, tillage practices, and other factors affect nutrient use efficiency and loss from the application site. Management practices such as tillage incorporation, subsurface placement, and application timing can improve fertilizer use efficiency and reduce fertilizer runoff (Gildow et al., 2016; Guo et al., 2021). Sustainable nutrient management is a key to building soil health, protecting water quality, and maintaining farm profitability. Producer awareness and confidence in the effectiveness of conservation and management practices to reduce nutrient loss is likely to increase the adoption of conservation practices (Prokopy et al., 2019).

Michigan cropland totaled about 9.7 million acres in 2021, down almost 7% from 2002 (USDA-NASS, 2022). Michigan has the country's second most diverse agricultural industry, only second to California. Fertilizers are the primary source of purchased crop nutrients for agricultural producers. Michigan growers purchased 220,830 tons of nitrogen (N) and 55,130 tons of phosphorus (as  $P_2O_5$ ) in 2011 (USEPA, 2022). These volumes reflect an eight percent decline in N and a 25% decline in  $P_2O_5$  compared to 2003.

Although the use of other fertilizer nutrients has increased, changes in soil test levels of nutrients such as potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), and micronutrients have not been dramatic. These nutrients are not causing any known environmental damage, and there are no concerns about their continued use as long as they benefit the farmer agronomically and economically.

As a result of modern agricultural practices, Michigan's agricultural industry has become one of the most productive in the world. Many factors are responsible for this increase in productivity. Government policy, farm programs, improved hybrids, new varieties, and many technological advances, including improved and readily available fertilizer products at reasonable prices, are some of the major factors responsible for today's modern agricultural practices and increased productivity.

The environmental impacts linked to modern agriculture are a cause of public concern. The median soil test level for P in soil samples received by the Michigan State University (MSU) Soil Testing Laboratory in the 1994-95 season was 106 pounds of Bray P1 per acre (Warncke and Dahl, 1995). The median soil test has declined 30 percent over the years to 74 pounds per acre in 2015 (Silva, 2016). Based on current MSU nutrient recommendations, more than 50 percent of the corn and soybean fields represented by these samples would not need more P to be applied until the soil test levels are drawn down to recommended levels (Culman et al., 2020). Christenson (1989), and Vitosh and Darling (1990), have demonstrated the validity of MSU fertilizer recommendations on corn, soybeans, dry beans, and sugar beets on numerous Michigan farms.

Evidence shows that fertilizer nutrients are finding their way into surface and groundwater. Significant P loading of Michigan's lakes and streams has been documented (DNR, 1985). Michigan's 1988 Nonpoint Pollution Assessment Report (DNR, 1988) indicates that agricultural fertilizer was a likely nonpoint source pollutant in 71 percent of the 279 watersheds in Michigan.

Nitrate contamination of groundwater in Michigan has also been documented (Bartholic, 1985; Ellis, 1988; Vitosh *et al.*, 1989; MI-EGLE, 2021). Cummings *et al.* (1984) reported that nitrates in groundwater in Van Buren County were related to fertilizer use patterns, the number of irrigated acres, and the amount of irrigation water applied. Demonstrations have shown that many corn producers may use more N fertilizer than necessary (Vitosh *et al.*, 1991).

The increasing presence of P in surface water and nitrates in groundwater, and the fact that some farmers are using excess fertilizer, have led to the conclusion that the Nutrient Utilization of GAAMPs should be encouraged to protect the environment. This document aims to present acceptable and recommended agricultural practices that will significantly reduce the potential for nitrate movement to groundwater and nonpoint losses of P to surface water.

Adopting these management practices for nutrient utilization will not eliminate nutrient movement into surface water or groundwater because nutrients are an integral part of the natural hydrologic cycle. However, following these GAAMPs will contribute to environmental protection from surface water and groundwater nutrient pollution.

As amended, these GAAMPs are referenced in Michigan's Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994. NREPA protects the state's waters from releasing pollutants in quantities and/or concentrations that violate established water quality standards. Discharges are regulated as violations of Part 4 Rules, Water Quality Standards, of Part 31, Water Resources Protection, of the NREPA. Agricultural producers who voluntarily follow these practices are protected from public or private nuisance litigation under Public Act 93 of 1981, as amended, the Michigan Right to Farm Act, Michigan Department of Agriculture & Rural Development.

## **ON-FARM FERTILIZER STORAGE AND CONTAINMENT PRACTICES**

Fertilizer should be stored in a manner that protects the environment, ensures human and animal safety, and preserves the product and container integrity. Well-water

surveys have indicated that improper or defective fertilizer storage and containment facilities can be a source of surface water and groundwater contamination. Before fertilizers are stored on the farm several concerns should be reviewed and precautions observed.

### **Security for Fertilizer Storage Areas**

- 1. Fertilizer storage areas, valves, and containers should be secured when not in use to prevent access by unauthorized personnel, children, or animals.**

Security of the fertilizer storage area should be provided by use of locks, fencing, and/or lighting. Fertilizers should not be stored in the direct presence of fuel products or pesticides due to the increased potential for explosions and significant disposal problems.

### **Fertilizer Storage Facilities**

- 2. Dry fertilizer should be stored inside a structure or device capable of preventing contact with precipitation and/or surface water. Bulk dry fertilizer should be stored in accordance with Regulation No. 641, "On Farm Fertilizer Bulk Storage," NREPA, Part 85.**

The storage area should be able to handle and contain fertilizer spills properly. The structure or device should consist of a ground cover or base and a cover or roof top. Walls and floors should prevent absorption or loss of fertilizer. Dry fertilizer in an individual quantity of more than 2,000 pounds is considered "bulk fertilizer" and is regulated by Regulation No. 641, "Commercial Fertilizer Bulk Storage." Producers are encouraged to follow the guidance provided in Regulation No. 641 when bulk quantities of dry fertilizer are stored on their farm.

Following these regulations is not required for bulk storage of liming materials or for the temporary staging of potash in a field where it is being applied.

- 3. Liquid fertilizer should be stored in containers approved for and compatible with the fertilizer being stored. Bulk liquid fertilizer should be stored in accordance with Regulation No. 642, "On Farm Fertilizer Bulk Storage," NREPA, Part 85.**

All liquid fertilizer storage areas should have secondary containment that will properly handle and contain spills. The floor of the containment area should be constructed to prevent the absorption or loss of fertilizer. Secondary containment areas should not have a working floor drain unless it leads to a collection sump. All liquid fertilizer storage containers should be labeled properly. Containers, valves, gauges, and piping should be made of materials compatible with the products being stored. Backflow protection is recommended when liquid fertilizers are associated with any water supply. The level of

the liquid in the containers should be able to be determined readily.

Under Regulation No. 642, "bulk fertilizer" means fluid fertilizer in a single container that has a capacity of more than 2,500 United States gallons, or a combined total capacity for all storage containers or tanks located at a single site or location greater than 7,500 United States gallons. Storage of liquid fertilizers on the farm at these capacities is regulated by Regulation No. 642, so the producer must follow specific requirements in siting and locating new bulk storage facilities. Existing bulk storage facilities will have five years from August 2003 to comply with Regulation No. 642.

- 4. Fertilizer storage areas should be inspected at least annually by the owner or the person responsible for the fertilizer to ensure safe storage of fertilizers and to minimize mishaps.**

Fertilizer storage containers should be inspected prior to use to ensure container integrity. Replace containers as needed to prevent leaks. Regular inspection of bulk fertilizer storage facilities is required by Regulation No. 642.

#### **Location of Bulk Fertilizer Storage Areas**

A site should be selected that minimizes potential for contamination of surface water or groundwater by drainage, runoff, or leaching. Locate the storage site at an adequate distance away from wells, surface water, and other sensitive areas, as herein described. For the purpose of this section, "surface water" means a body of water that has its top surface exposed to the atmosphere and includes lakes, ponds, or water holes that cover an area greater than 0.25 acres, and streams, rivers, or waterways that maintain a flow year-round. "Surface water" does not include waterways with intermittent flow. For bulk liquid fertilizer, reference Regulation No. 642.

- 5. Existing bulk fertilizer storage areas shall be located a minimum of 50 feet from any single-family residential water well, a minimum of 200 feet from Type I or Type IIA public water supply wells, and a minimum of 75 feet from Type IIB and Type III public water supply wells.**

Existing bulk fertilizer storage areas are those areas that were used to store or hold bulk liquid fertilizers on a farm before August 2003. Type III water supplies include farms that hire at least one employee. See MSU Extension Bulletin E-2335 (Wilkinson, 1996) and Regulation No. 642 for information on protection measures for existing storage sites.

- 6. New bulk fertilizer storage areas shall be located a minimum of 150 feet from any single-family residential water well, a minimum of 200 feet from surface water, and above a floodplain. The set-back distance from any Type I or Type IIA public water supply well (communities with 25 or more persons and large resorts including municipalities, subdivisions, condominiums, and apartment complexes) is 2,000 feet, if the public water**

**supply does not have a well-head protection program. If there is a well-head protection program, the facility must be located outside the delineated wellhead protection area. For Type IIB and Type III public water supply wells, which include noncommunity water supplies such as schools, restaurants, industries, campgrounds, parks, and motels, the setback is 800 feet.**

To the greatest extent possible, new bulk fertilizer storage areas shall meet these water supply set-back distances. A new bulk fertilizer storage area may be located closer than these distances, upon obtaining a deviation from the well isolation distance through Michigan Department of Environment, Great Lakes, and Energy (EGLE) or the local health department. Additionally, a new bulk fertilizer storage area that meets the requirements of Regulation No. 641 or Regulation No. 642 may be located closer than the above water supply set-back distances, but not less than those distances specified in Practice #5.

When planning a new facility, see MSU Extension Bulletin E-2335 (Wilkinson, 1996) and Regulation No. 642 for information on design and construction and for the required setback distance from drinking water supplies. Additional detailed information on the design or construction of new fertilizer and pesticide containment facilities is available in the MidWest Plan Service Handbook No. 37 (MidWest Plan Service, 1995) or in the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) Agrichemical Containment Facility (702), Michigan Standard.

For more information on these set-back distances, reference Public Act 399, the State of Michigan Safe Drinking Water Act of 1976, and Public Act 368, the Michigan Public Health Code of 1978, as amended. These storage set-back distances pertain to bulk fertilizer storage sites and facilities, but do not include staging and application sites. A storage facility is a place for safekeeping of fertilizer. A staging site is an area where fertilizer is temporarily stored, loaded, and/or otherwise prepared in a field where it is being applied. An application site is where fertilizers may be appropriately used.

New bulk liquid fertilizer storage areas shall be located above a floodplain, which means any land area that, is subject to a 1 percent or greater chance of flooding, or equivalent to a 100-year flood event (as defined in Regulation No. 642). All fertilizer should be stored and handled in a manner which minimizes the potential for drinking water contamination or nutrient losses to surface water.

## **FERTILIZATION PRACTICES FOR LAND APPLICATION**

The following management practices are suggested for farmers to help achieve efficient and effective use of fertilizers and to reduce the potential for nutrient contamination of surface water and groundwater.

### **Soil Fertility Testing and Tissue Analysis**

- 7. All fields used for the production of agricultural crops should have soils sampled and tested on a regular basis before fertilizer nutrients are applied. For small fruit and tree crops, using tissue analysis and/or observing seasonal growth, are better methods to determine their nutrient requirements.**

Routine soil testing for pH, P, K, Ca, and Mg is one of the best tools available for determining the availability of nutrients in soil for most crops. One of the keys to a good soil testing program is proper soil sampling. MSU Extension Bulletins E-498 (Warncke, 2000), E- 1616 (Meints and Robertson, 1983), E-498S (Warncke and Gehl, 2006), and E-2904 (Warncke et al., 2009) and the Tri-State Fertilizer Recommendations for Corn, Soybean, Wheat, and Alfalfa Bulletin 974 (Culman, Fulford, Camberato, and Steinke, 2020) give instructions on how to obtain a good representative soil sample and how often soils should be re-sampled. Once the capability of the soil to supply nutrients has been assessed, the appropriate amount of supplemental nutrients can be determined. Soil test results will change with time depending on fertilizer and manure additions, precipitation, runoff, leaching, soil erosion, and nutrient removal by crops. Therefore, soil testing should be done on a regular basis (i.e., every 3-4 years) where the appropriate frequency of soil sampling may depend on (a) how closely an individual wants to track soil nutrient changes, (b) the crop(s) grown, (c) cropping rotation, (d) soil texture, and (e) the approach or precision used for sampling fields (Warncke and Gehl, 2006; Culman, Fulford, Camberato, and Steinke, 2020).

The nutrient requirements of small fruit and tree crops are best monitored by tissue analysis. Tissue samples should be taken every three to five years according to instructions in MSU Extension Bulletin E-2482 (Hanson and Hull, 1994). The nitrogen status of fruit plantings can also be monitored effectively by observing leaf color, shoot growth, and production levels, as described in MSU Extension Bulletin E-852 (Hanson, 1996).

For cranberry production, see the current "Generally Accepted Agricultural and Management Practices for Cranberry Production".

### **Fertilizer Recommendations**

- 8. Fertilizer use should follow recommendations consistent with those of Michigan State University (MSU) or Tri-State Fertilizer Recommendations for Corn, Soybean, Wheat, and Alfalfa Bulletin 974 (Tri-State) and should consider all available sources of nutrients.**

Michigan State University fertilizer recommendations for field crops and vegetables are found in Extension Bulletins E-2904 and E-2934 (Warncke *et al.*, 2009, 2004) and Tri-State Fertilizer Recommendations for Corn, Soybean, Wheat, and Alfalfa Bulletin 974 (Culman, Fulford, Camberato, and Steinke, 2020). Recommendations are based on a

soil fertility test, soil texture, crop to be grown, and for most field and vegetable crops, yield goal. Choosing a realistic yield goal is one of the most important steps in obtaining economic and environmentally sound recommendations. Excessively high yield goals that are seldom achieved result in 1) revenue loss for the grower, and 2) over-fertilization which may threaten water quality. A yield goal that is both realistic and achievable should be based on the soil productivity potential and the level of crop management utilized. A realistic yield goal is one which is achievable at least 50 percent of the time. If the yield goal is seldom achieved, the entire crop management system should be reevaluated to identify those factors other than soil fertility that are limiting yields.

Many commercial soil testing laboratories use similar soil test procedures which are described in the North Central Regional Research Publication No. 221 (Nathan and Gelderman, 2015). Soil tests from these laboratories can be used to determine both MSU Extension and Tri-State fertilizer nutrient recommendations (Warncke *et al.*, 2009, 2004; Culman, Fulford, Camberato, and Steinke, 2020).

Occasionally, fertilizer recommendations vary between MSU and agribusinesses. When differences exist, farmers should follow the MSU recommendations because they have been proven to be sound agronomically, economically, and environmentally (Warncke *et al.*, 2009, 2004; Culman, Fulford, Camberato, and Steinke, 2020).

Michigan State University fertilizer recommendations for fruit crops are found in MSU Extension Bulletins E- 852 (Hanson, 1996) and E-2011 (Hanson and Hancock, 1996). Fertilizer recommendations for these crops are often adjusted for each specific planting by tissue testing and observing crop performance (see above bulletin).

Recommended fertilization practices for field-grown perennial woody ornamentals are available from MSU (Fernandez, 2004). Rates of fertilization are based on soil testing, foliar analysis, and growth rates of the crop. Fertilization of annual and perennial field grown cut flowers is based on similar criteria, but published recommendations are not currently available.

The MSU [Extension Soil and Plant Nutrient Laboratory](#) can provide nutrient recommendations for most crops grown in Michigan that include fruit, turfgrass, flowers, shrubbery, and trees. When MSU recommendations are not available for a specific crop or soil type, other land grant university recommendations developed for the region may be used.

Essential plant nutrients from sources other than inorganic fertilizers may also be used to satisfy the nutrient recommendations for crops. These sources of nutrients can include animal manure and composts, inorganic by-products, irrigation water, and residual soil nutrients present from previous growing seasons.

Nonfertilizer materials should be tested for their nutrient content, and residual mineralizable N should be estimated (when possible) to determine the appropriate



quantities of nutrients that should be credited against the nutrient recommendations.

### **Nutrient Credits**

#### **9. Take credit for nutrients supplied by organic matter, legumes, and manure or other biological materials.**

The contribution of soil organic matter to plant nutrition should be taken into account before determining the final or actual N recommendation. High organic matter soils will need less fertilizer N to obtain the same crop yield because they often can mineralize more N than low organic matter soils. Michigan State University N fertilizer recommendations are based on soils with between two to four percent organic matter. See MSU Extension Bulletin WQ-25 (Vitosh and Jacobs, 1996) for suggested N credits for field and vegetable crops grown on soils with higher organic matter levels. Since soil organic matter levels do not change rapidly, routine analysis of organic matter is not necessary. Organic matter content, however, is important in determining proper herbicide rates, so you may want to periodically determine soil organic matter content for this purpose.

Legumes are often grown and plowed under to improve the fertility and tilth of soils in field and vegetable crop rotations. The rotational crop N credit supplied by legumes due to biological N fixation within root nodules may be credited for subsequent crops in the nutrient management plan. The amount of credit given for legume N fixation depends on the type of legume, how long the legume has been growing, and the density of the legume stand when it is killed by tillage or applying an herbicide. See MSU Extension Bulletin E-2904 (Warncke *et al.*, 2009) for suggested legume N credits.

Livestock manure is also a good source of plant nutrients. Manure should be analyzed periodically to determine the appropriate credit for the nutrients supplied. See the current "Generally Accepted Agricultural and Management Practices for Manure Management and Utilization" for recommended management practices when utilizing manure.

Other organic (biological) materials, such as biosolids, septage, food processing by-products, industrial organic by-products, wood, and municipal refuse can potentially be used as a source of plant nutrients. Most of these materials are regulated by EGLE. More information on the use of these organic materials and by-product liming materials can be found on pages 21-33 of these GAAMPs.

### **Nitrogen Management Practices**

#### **10. To enhance N uptake, match N fertilizer applications to the demand of the crop and the conditions of the soil.**

Efficient use of N fertilizer is important economically, agronomically, and

environmentally. Greater efficiencies and grain yields can simultaneously be achieved when using university recommended rates of N fertilizer, by using sources of N fertilizer compatible with the crop and the environment, and by following good N management practices.

### Nitrogen Fertilizer Rate

The amount of N fertilizer applied is crucial for efficient use by plants. Excessive applications can lead to contamination of both surface water and groundwater. The amount of N fertilizer used for field and vegetable crops should be based on a realistic yield goal and the amount of N available from the soil, previous crop, manure, and/or other biological materials. See MSU Extension Bulletins E-2904 and E-2934 (Warncke *et al.*, 2009, 2004; Culman, Fulford, Camberato, and Steinke, 2020) for more information on selecting the appropriate rate of N fertilizer. Recommended N rates for fruit crops are given in MSU Extension Bulletins E- 852 (Hanson, 1996) and E-2011 (Hanson and Hancock, 1996).

### Forms of Nitrogen Fertilizer

Nearly all N fertilizers are soluble in water and are subject to movement in soils as soon as they are applied. However, certain forms of N fertilizers have greater potential for movement out of the root zone. Nitrate N (in calcium nitrate, ammonium nitrate, or urea ammonium nitrate (UAN)) is readily available for plants but is subject to immediate leaching when added to soil.

Under conditions of high leaching potential, nitrate forms of N should not be used unless the plants are actively growing and can utilize the applied nitrate N. Where there is a high potential for leaching, (e.g., sandy soils), ammonium forms of N including urea, ammonium sulfate, and anhydrous ammonia are preferred sources of N. Ammonium in soil is held on clay and organic matter and must first be converted to nitrate N before it can be used by the growing crop, leached or denitrified. This process, known as nitrification, occurs rapidly under warm, moist conditions.

Urea and N solutions containing urea are subject to volatilization loss as gaseous ammonia if surface applied and not incorporated. Conditions which favor this loss are high temperatures, high soil pH, moist soils, and high levels of plant residue on the soil surface. Volatilization loss of urea-based fertilizers are difficult to assess, and since it represents an economic loss to the farmer, urea-containing fertilizers should be incorporated whenever possible. See MSU Extension Bulletin E-896 (Vitosh, 1990) or the Tri-State Fertilizer Recommendations (Culman, Fulford, Camberato, and Steinke, 2020) for more information on fertilizer types, uses and characteristics. In fruit plantings and sod production fields where incorporation is not possible, apply urea when conditions are cool and not conducive to volatilization.

### Time and Placement of Nitrogen Fertilizer

A small amount of N in a starter fertilizer applied to annual row crops at planting time is often desirable and can have a beneficial effect on P uptake, particularly under cool, wet

conditions. Crops on sandy soils low in organic matter and residual N are also more likely to respond to starter N fertilizer.

Spring applications of N on corn in Michigan are clearly superior to fall applications (Vitosh, 1991). Fall applications of N for spring or summer-seeded crops are not recommended. Climatic conditions from fall to spring can significantly affect the amount of N movement from the plant root zone. Estimates of N loss from fall applications vary from 10 to 20 percent on fine to medium textured soils (e.g., clay, clay loams, and loams) and 30 to greater than 50 percent on coarse textured soils (e.g., sandy loams, loamy sands, and sands).

For establishment of winter small grains, such as winter wheat or rye, small applications of N fertilizer (20-30 lbs./acre) can be made in the fall at planting time. The remainder of the N requirement for these crops should be applied just prior to spring green-up. Avoid applications of N to frozen and snow-covered ground with slopes greater than six percent. Nitrogen applications on highly sloping land should be made after the spring thaw.

Split applications of N fertilizer during the growing season on corn and most vegetable crops are frequently beneficial on coarse textured soils (Vitosh, 1986). The benefits of split N applications on corn grown on fine textured soils have become more frequent as spring and summer climate variability increase. Starter fertilizer strategies should supply enough N until side dress application timing. Fruit plantings on coarse textured soils may also benefit from split applications of N. Apply part of the N in early spring and part in late spring. Rates in the second application can be adjusted for anticipated yield.

For sod production, a small application of N fertilizer (20-40 lbs./acre) can be made in the fall at seeding time. During the growing season, multiple small applications of N can be made at four to six-week intervals if roots are actively growing. This practice will help to maintain turf density and reduce the need for herbicides.

Additional N fertilizer may be used in emergency situations, such as when heavy rains occur early in the growing season causing excessive leaching and/or denitrification. The use of additional N fertilizer in these situations may be necessary to prevent severe yield losses. Adding N fertilizer after heavy rains or flooding late in the season is usually not agronomically or economically effective and should be done only after careful consideration of the benefits and the effect on the environment.

#### **11. Use special N management practices on sandy soils and in groundwater-sensitive or well-head protection areas.**

Many site-specific management practices and tools can be adopted which may improve N recovery and reduce the potential for nitrate contamination of groundwater. Crop rotations, forage crops, cover crops, plant analysis, soil sampling for nitrate, split N applications, and use of enhanced efficiency fertilizers including urease or nitrification

inhibitors and controlled release N are some of the special N management practices that can be used on sandy soils and other groundwater-sensitive areas to minimize groundwater N contamination. See MSU Extension Bulletin WQ-25 (Vitosh and Jacobs, 1996) or MSU Nutrient Recommendations for Field Crops in Michigan E-2904 (Warncke *et al.*, 2009) for more information on these management practices. The USDA NRCS Field Office Technical Guide, located in each conservation district office or available at <https://efotg.sc.egov.usda.gov/#/>, contains information for identification of groundwater-sensitive areas.

## **Phosphorus Management Practices**

### **12. Apply phosphorus fertilizer based on soil tests or plant tissue analyses using MSU or Tri-State recommended rates and methods of application that will enhance P recovery and uptake.**

Michigan State University fertilizer recommendations are found in Extension Bulletins E-2904 (Warncke *et al.*, 2009) E-2934, (Warncke *et al.*, 2004), E-852 (Hanson, 1996), and E-2011 (Hanson and Hancock, 1996), and the Tri-State Fertilizer Recommendations (Culman, Fulford, Camberato, and Steinke, 2020). When soils have a Mehlich-3P test above 40 ppm or 80 lbs./acre (corn, soybean) or above 50 ppm or 100 lbs./acre (wheat, alfalfa), fertilizer recommendations for P<sub>2</sub>O<sub>5</sub> are zero for most crops and yields grown in Michigan. Increasing soil test P levels beyond this range will usually not be agronomically or economically beneficial. To convert between BrayP1 and Mehlich-3P values, multiply Bray P1 values by 1.35 to obtain Mehlich-3P values or conversely divide Mehlich-3P values by 1.35 to obtain Bray-P1 values (<https://www.canr.msu.edu/soilfertility/Files/Bulletins/Bray%20to%20Mehlich%20conversion.pdf>). Above 300 ppm, the Mehlich-3P extractant extracts proportionally more P than Bray-P1. Thus the conversion values reported above should not be used if values are above 300 ppm Bray-P1.

Band application of starter fertilizer to the side and below the seed at planting time is considered the most efficient placement of P for field and vegetable crops when grown in rows. Broadcast applications of P are less efficient and normally will result in lower yields than band applications when soil test P levels are low. When broadcast applications are necessary, the P fertilizer should be applied and incorporated prior to establishment of the crop, to improve nutrient utilization by plants and prevent excessive nutrient runoff. For no-till crops, such as soybeans and wheat planted with a narrow row drill, the necessary broadcast application should be made just prior to planting. For established crops, such as grass sod, pastures, legumes, and other forages, where it is impossible to incorporate the fertilizer, the P fertilizer may be broadcast when soil conditions are favorable for rapid growth, and soil compaction is minimized.

For no-till row crops, all P should be banded at planting time. For perennial crops, P fertilizer should be applied in the spring when soil conditions allow fertilizer applications to be made with minimal soil compaction. The need for P on perennial crops should be determined from plant tissue analyses.

Establish and maintain filter strips between surface waters and fields where fertilizers are applied to prevent any soil erosion and runoff of fertilizer nutrients from reaching surface waters. For more information on filter strips, see the USDA NRCS-FOTG Conservation Practice Standard No. 393A.

**13. Avoid broadcast applications of phosphorus fertilizers on frozen or snow-covered ground.**

Fertilizer applied in the winter is the least desirable from a nutrient utilization and environmental point of view. Frozen soils and snow cover limit nutrient movement into the soil and greatly increase the risk of nutrients being carried to surface waters by runoff and erosion following rainstorms or rapid snow melt.

**Nutrient Management Practices for Organic Soils**

**14. Manage water table, irrigation, and nutrients to minimize runoff and soil loss.**

Organic soils are unique in that they contain 1.0 to 1.7 percent N and may have an annual mineralization rate of 320 to 530 lbs. N per acre. Of this vast amount of mineralized N, nearly 90 percent is denitrified to form gaseous N. While the remaining ten percent is available for plant use, it is also susceptible to movement into surface water and groundwater. Thus, it is important to apply only the amount of N needed by the crop at times when it can be utilized. Nitrogen should not be applied in the fall or winter because leaching could be excessive. Cover crops should be planted after harvest to utilize and hold N in a non-leachable form. For sod production, small N applications (20 to 40 lbs./acre) can be made in the fall if turf roots are actively growing.

Mineralization is an aerobic process, which can be reduced by keeping the water table high enough to obtain good crop yields while allowing for the least amount of soil decay. For most cropping situations, this depth is 24 to 30 inches.

Nitrate N concentrations in drainage water can be reduced by controlling the level of the water table and by slowing the movement of water in drainage ditches. For more information on this subject see Lucas and Warncke (1985).

**Recordkeeping**

**15. Maintain records of soil test reports and quantities of nutrients applied to individual fields.**

Good recordkeeping demonstrates good management and will be beneficial for the crop producer, if the producer's management practices are challenged. Annual records should include the following for individual fields:

- a. Most recent soil fertility test(s) and/or plant tissue analysis reports;
- b. previous crop grown and yield harvested;
- c. date(s) of nutrient application(s);
- d. the nutrient composition of fertilizer or other nutrient-supplying material used (If the nutrient composition, availability or solubility is not provided with the purchase of the nutrient-supplying material, then representative samples of this material should be analyzed to provide nutrient composition information. Grass clippings and non-legume crop residues grown in the field and left to recycle nutrients are not considered to be nutrient additions.);
- e. amount of nutrient-supplying material applied per acre;
- f. method of application and placement of applied nutrients (i.e., broadcast and incorporated, broadcast and not incorporated, subsurface-banded, surface-banded, soil injected, applied through an irrigation system, etc.);
- g. the name of the individual responsible for fertilizer applicator calibration, and the dates of calibration (If the equipment is owned by a fertilizer dealer, or someone else who is responsible for proper calibration, then the name of the individual and/or business responsible for calibrating fertilizer application equipment should be retained); and,
- h. vegetative growth and cropping history of perennial crops.

A recordkeeping system, such as that described in MSU Extension Bulletins E-2343 and E-2344 (Jacobs *et al.*, 2000) or available as a computer program like MSU Soil Fertility and Nutrient Management (<https://www.canr.msu.edu/soilfertility/>), may be helpful in accomplishing this goal.

### **Fertilizer Application Equipment Adjustment**

#### **16. Check all fertilizer application equipment for proper adjustment so the desired rate of application and placement are achieved.**

Fertilizer can be applied in either dry or liquid form. In either case, the application rate should be determined, and the equipment adjusted so that the desired rate of application is achieved. Details for the calibration of fertilizer applicators can be found in equipment manufacturers' publications, the American Society of Agricultural and Biological Engineers Standard EP371.2 (ASABE, 2022), in Circular 798 (Virk and Sumner, 2021), and in Circular 683 (Sumner and Bader, 2012). The equipment owner is responsible for providing instructions for proper calibration, and users of the equipment are responsible for following the instructions to the best of their ability.

## **SOIL CONSERVATION PRACTICES**

#### **17. Use soil erosion control practices to minimize nutrient runoff and soil loss.**

Soil erosion and runoff can result in a loss of soil and nutrients from cropland, which

reduce the land's productivity and increase the need for nutrient inputs. Sediment and sediment-borne nutrients are two types of nonpoint source pollution, which can be carried from cropland by runoff causing degradation of surface water. Whenever possible, soil and water conservation practices should be used, both to protect soil productivity and to control and minimize the risk of nonpoint source pollution to surface waters. Examples of such practices are conservation tillage, crop rotations, strip cropping, contour planting, cover crops, vegetative filter strips between cultivated cropland and adjacent surface waters, and runoff control structures.

When choosing soil and water conservation practices for a site, consider factors, such as land slope, surface residue or vegetative conditions, crop rotations, soil texture, and drainage. Local conservation districts and the NRCS can provide technical assistance for producers to plan and implement conservation practices. See the current USDA NRCS-FOTG for more information on conservation practice standards and specifications.

## **IRRIGATION MANAGEMENT PRACTICES**

Careful N management for irrigated crop production also involves careful management of irrigation water. Proper irrigation management can help assure plant growth and crop yields sufficient to remove nutrients that have been applied for realistic yield goals, while minimizing nitrate remaining in the soil that is subject to potential leaching. Excess water from irrigation and/or precipitation can cause nitrates to move below the root zone and eventually to groundwater.

### **18. Irrigators should use modern irrigation scheduling techniques to avoid applying excess water.**

Irrigation scheduling involves keeping track of the amount of water in the soil, or water losses to the atmosphere (evapotranspiration) and irrigating before plants are stressed. After irrigation, some soil water-holding capacity should remain to hold rainfall, should it occur. In most cases, irrigation should occur when 40 to 70 percent of the available soil water is depleted, depending on the soil, crop, and capacity of the irrigation system. Irrigation water should not fill the soil rooting profile to more than 80 percent. Precise scheduling of irrigation water during the growing season can minimize percolation losses (Vitosh, 1992). See the current "Generally Accepted Agricultural and Management Practices for Irrigation Water Use" for recommended irrigation management practices.

### **19. Irrigators should use multiple applications of N fertilizer to improve N efficiency and minimize potential loss of nitrate-N to groundwater.**

Multiple applications will help to ensure that N is available when plants need it most and to minimize the amount that can be leached. Any combination of application methods can be used, such as starter fertilizers at planting time, side dressing by soil injection, dribbling on the surface, application during cultivation, and/or by injection through the



irrigation system.

Nitrogen fertilizer applied through the irrigation system, referred to as fertigation or chemigation, offers several advantages: (1) N can be applied when the crop's demand is greatest, and in trickle-irrigated orchards, where roots are most concentrated; (2) the technique requires little energy for application; and (3) it is well suited to sandy soils where irrigation is needed and leaching may be a problem. Producers who fertigate should test the uniformity of their irrigation system to assure that no extremely high or low zones of water application occur. Careful adjustment of fertilizer injection equipment to obtain the desired rate of application is very important. Irrigation systems used for fertigation must have appropriate backflow-prevention safety devices. (Reference Public Act 368, the Michigan Public Health Code of 1978, as amended, and Public Act 399, the State of Michigan Safe Drinking Water Act of 1976, as amended). See MSU Extension Bulletin E-2099 (Hay *et al.*, 1988) and Northeast Regional Agricultural Engineering Service Bulletin NRAES-4 (NRAES, 1981) for proper and safe use of fertigation equipment.

## **FERTILIZATION AND IRRIGATION PRACTICES FOR CONTAINER-GROWN PLANTS**

Growing plants in greenhouses or outdoor container nurseries requires rapid growth to maintain production schedules and quality. Frequent fertilization and irrigation are needed since common root media lack nutrient and water-holding capacity. However, effective management practices can be adopted to minimize water and fertilizer leaching and/or runoff (Horticultural Water Quality Alliance, 1992).

### **Runoff Prevention**

- 20. Use management practices that prevent or minimize water and fertilizer runoff, such as selecting good quality root media, using slow-release fertilizer, improving irrigation systems, reducing leaching, and scheduling irrigations.**

### **Root Media**

Greenhouse root media composed primarily of peat, bark, and other components, such as vermiculite, perlite, or rockwool should be formulated to provide high water-holding capacity, while maintaining adequate drainage and air space. When preparing root media, components, and additives, like wetting agents, which increase the rate of absorption of water, should be incorporated. Commercially prepared root media with high water holding capacity are available for greenhouse use. For outdoor nursery production, root media are composed primarily of bark, peat, and other components and must be porous enough to drain excess water under heavy rainfall conditions.

### **Fertilization**

Essential nutrients should be applied based on plant nutrient requirements, plant growth rate, and root media nutrient availability. Pre-plant incorporation of water-soluble nutrients like N and P that will readily leach from the root media should be minimized.

Current fertilizer recommendations are based on the concentration of water-soluble fertilizer to be applied weekly or at every watering. However, nutrient levels in the root media are a function of both the concentration and volume applied. With reduced leaching, fertilizer concentrations can be decreased (Biernbaum, 1992). Sampling of root media, testing electrical conductivity, and completing an elemental analysis will help determine actual fertilizer requirements. Media analysis for longer term outdoor nursery crops may be conducted less frequently. Test results generated by MSU, other Land Grant Universities, and approved commercial testing laboratories using the testing methodology of the North Central Committee on Soil Testing and Plant Analysis (Chapter 14 of Brown, 1998), can be used for making nutrient recommendations.

Recommended root media nutrient levels and nutrient recommendations are available in MSU Extension Bulletin E-1736 (Warncke and Krauskopf, 1983) for greenhouse crops. Nutrient recommendations for container-grown and field-grown nursery crops can be found in "Management Practices for Michigan Wholesale Nurseries" (Fernandez, 2004). Guidelines for nutrient levels in plant foliar tissue for nursery crops are available (Fernandez, 2004). For greenhouse pots and container-grown nursery crops, water management and use of controlled release fertilizers are important to maintain adequate nutrient levels for optimum plant growth and to minimize leaching and loss of soluble nutrients (Horticultural Water Quality Alliance, 1992; Fernandez, 2004).

Slow-release fertilizer, such as sulfur-coated or polymer-coated urea (SCU, PCU) can be incorporated into the root media or surface-applied to reduce water-soluble fertilizer applications and nutrient leaching. With outdoor, overhead irrigation of container-grown nursery stock where heavy rainfall can leach the root medium, SCU or PCU can be used to prevent runoff of water-soluble fertilizer. Formulations containing a variety of nutrient levels and release rates are available. Nevertheless, SCU or PCU may not be an acceptable alternative for some cropping situations. Problems due to excess nutrient release may occur during the summer when root medium temperatures in the containers become too high, or during over-wintering of nursery crops when nutrient uptake decreases. Therefore, use proper monitoring to avoid these high soluble salt conditions.

When water-soluble fertilizers are added to irrigation systems, fertilizer injectors or diluters should be checked regularly for proper operation and dilution. Backflow preventers and anti-siphon devices must be installed on all water supplies when fertigation or chemigation is used (Reference Public Act 368, the Michigan Public Health Code of 1978, as amended, and Public Act 399, the State of Michigan Safe Drinking Water Act of 1976, as amended).

## Irrigation Systems

Overhead sprinklers, traveling booms, and drip systems should be designed to maximize uniformity of application and water absorption by the root media. Overhead fertigation of container-grown nursery plants with water-soluble fertilizers should be avoided unless runoff can be collected and recirculated. Overhead irrigation with sprinklers, or traveling booms, can be efficient if growing containers are closely spaced, as in the production of bedding plants in flats. Low-volume drip systems can also be designed to be efficient with 90 percent or more of the water available for plant uptake. Subirrigation with water recirculation is very efficient, but is not always practical or affordable (Biernbaum, 1993).

### Leaching

In greenhouse production, application of a sufficient quantity of water to facilitate leaching with every irrigation is advised routinely to prevent the accumulation of fertilizer and other salts (Biernbaum, 1992). For container nursery production, rainfall is often sufficient to adequately leach containers.

However, during periods of little or no rainfall, container soluble salt levels should be monitored, and leaching conducted when necessary (Fernandez, 2004). When the irrigation water contains elevated levels of boron, chloride, sodium, or other elements, some leaching may be needed. However, when soluble salts in the root zone are a result of over-application of water-soluble fertilizer, the fertilizer concentration should be reduced, or clear water should be applied for several irrigations to bring levels down gradually rather than making heavy applications of water to leach the fertilizer salts. To reduce leaching, water-soluble fertilizer applications with irrigation systems can be made with multiple, short pulses rather than one long application. In some greenhouse situations, plastic trays can be placed under growing containers to catch irrigation water so more of what is applied is available to the plant.

### Irrigation Scheduling

Although many peat and bark-based media can be irrigated frequently and heavily without waterlogging, growth may be reduced due to excessive leaching of nutrients. Irrigation should be scheduled based on crop water requirements. Measuring water availability and scheduling irrigation of root media in small containers is not practical with currently available soil moisture monitoring equipment and is generally done based on personal observation and monitoring. When computer equipment is available, water requirements and irrigation schedules can be predicted based on environmental conditions, such as accumulated solar radiation and/or vapor pressure deficit measurements.

### Runoff Collection

- 21. When runoff or leaching of fertilizer cannot be controlled, water that contains fertilizer should be collected and reused.**

Runoff water and fertilizer solutions can be collected from concrete greenhouse floors, field drains under greenhouses or container nursery areas, and then recycled. Filtering of the water to remove solids or treating the water to control plant pathogens may be needed. Grass gullies or runways and filter strips ahead of the collection pond or reservoir will help remove suspended solids. Recirculation of water and nutrient solutions can be accomplished in greenhouses without contamination of the nutrient solution when using closed, flood sub-irrigation systems (Biernbaum, 1993). Flood benches, flood floors, or troughs can be used as methods to provide the water and nutrients by subirrigation. After irrigating, the remaining solution is collected in reservoirs and recycled.

### **Recordkeeping**

#### **22. Maintain records of fertilizer purchases and irrigation water used.**

Recording individual fertilizer applications is difficult since fertilizer may be applied on an almost daily basis. Records of all fertilizer purchases will probably provide the best measure of fertilizer use. Maintaining annual records of irrigation water use or irrigation scheduling to demonstrate water use patterns and conservation is also recommended.

### **LAND APPLICATION OF ORGANIC (BIOLOGICAL) MATERIALS AND BY-PRODUCT LIMING MATERIALS FOR CROP PRODUCTION**

#### **23. The application of organic and by-product liming materials to Michigan soils for crop production is a common and accepted agricultural practice.**

The organic material most commonly applied to soils, excluding plant residues, is animal manure. At one time, most farms had livestock, and the manures generated were a primary source of nutrients for crop production. However, with the introduction of commercial fertilizers and the specialization of farming, only about 40 percent of Michigan farms now have livestock that generate manure nutrients. See current "Generally Accepted Agricultural and Management Practices for Manure Management and Utilization" for recommended management practices when utilizing manure as a source of plant nutrients. In addition to animal manures, other organic materials are applied to soils in Michigan. From an agricultural point of view, the concept of recycling manure nutrients and organic materials back to cropland is highly desirable. However, the consequences of utilizing some organic wastes from industrialized societies should be addressed to avoid potential negative impacts to animals and humans, the soil-plant system, and the environment.

This section briefly discusses the use of organic materials (i.e., those materials primarily of biological origin) which can be used to supply nutrients for crop production and by-product liming materials used to correct soil acidity and maintain desired soil pH. To provide the reader with a better understanding of the kinds of organic (biological)

materials which are produced by our society, the basic categorization used by the U.S. Department of Agriculture (USDA, 1978) was selected. While this USDA report uses the term “organic wastes” to represent the various kinds of organic materials discussed, many of these materials, when used properly, can serve as valuable nutrient resources and organic matter amendments.

The grouping used by the U.S. Department of Agriculture (USDA, 1978) includes most organic materials which might be applied to cropland. The different categories of organic materials and a description of each category follow:

- 1) Animal manure—feces and urine excreted by bovine cattle, horses, sheep, goats, swine, and poultry, with any accompanying bedding or litter.
- 2) Crop residues and green manures—stems, leaves, roots, chaff, and any other plant parts remaining after crops are grazed or harvested; also, plant material, which is green and growing to maturity, that is incorporated into the soil.
- 3) Human wastes—various forms of organic materials containing human feces and urine, such as night soil, septage, sewage wastewater, and sewage sludge (now more commonly called biosolids).
- 4) Food processing wastes—organic by-products from the fruit, vegetable, seafood, sugar, fats, oils, and dairy food processing industries.
- 5) Industrial organic wastes—by-products from paper and allied products; fermentation, including pharmaceutical and food additives; soap and detergent; alcoholic fermentation, including distilleries, wineries, and malt beverage industries; meat packing and related industries, including those producing pet food, seafood, and poultry products; leather tanning and finishing; organic fiber processing; petroleum refining and related industries; and milling.
- 6) Logging and wood manufacturing residues—waste debris in forest after logging, such as limbs, leaves, needles, diseased/decayed wood; manufacturing residues, such as chips, bark, sawdust, etc.
- 7) Municipal refuse (also called MSW, municipal solid waste)—the organic portion of collectable solid wastes generated by households, institutions, offices, commercial and industrial premises, and in the streets of urban areas; would also include raw or composted yard wastes and composted MSW.

Potential hazards that may be encountered when organic materials are applied to the soil-plant system for crop production include poor management of nutrients, additions of undesirable trace elements and trace organic chemicals, pathogens, and creation of soil physical problems. The problem most frequently noted is poor management of organic fertilizer nutrients that can pollute water resources, particularly with N and P. Excess nitrate-N can contaminate groundwater. Excess P may accumulate in surface soils increasing the risk of P runoff/erosion losses to surface water. In addition, odors, disease, and vector attraction can occur if the application of these organic materials is not managed properly.

As noted above, the current GAAMPs for Manure Management and Utilization provide recommended management practices for utilization of manure as a source of plant nutrients. Crop residues and green manures produced on cropland are already part of the soil-plant system. The land application of many other organic materials described in the above categories is regulated by EGLE, and these residuals are defined by state and federal environmental regulations as “wastes.” The generator of any waste is responsible for characterizing its waste, determining the waste’s suitability for land application, and obtaining all necessary approvals for a land application program.

For these regulated wastes, EGLE established guidelines for isolation distances of land application sites from surface water, domestic wells or municipal water supplies, residences and commercial buildings, public roads, and property lines. EGLE also has requirements for the incorporation of certain organic materials and restrictions on applications to snow-covered or frozen soils. In addition, any approval granted by EGLE to a waste generator for a land application program carries with it the responsibility to prevent adverse environmental effects, including losses from runoff and leaching.

Commercial and industrial generators of organic residuals or by-product liming materials are required to obtain authorization to land apply these materials. Unless a material is declared inert by the EGLE Materials Management Division (MMD), such authorizations typically take the form of an Agricultural Use Approval (AUA), which is issued through MMD. For more information regarding AUAs, contact MMD at PO Box 30241, Lansing, Michigan 48909-7741, or at (517) 582-3445.

Municipal and privately owned treatment works that treat sewage may obtain authorization to land apply biosolids (wastewater treatment sludges) through the EGLE Water Resources Division (WRD). For more information regarding authorizations to land apply municipal biosolids and/or septage, contact WRD at P.O. Box 30273, Lansing, Michigan 48909-7773, or at (517) 284-5567.

The land application of certain organic residuals, food processing residuals and by-product liming materials to agricultural or silvicultural land is authorized under the authority of Part 115. Section 11506 (1)(h) conditionally exempts agricultural and silvicultural uses that involve the land application of certain food processing residuals, garbage (defined in Section 11503 as rejected food waste including waste accumulation of animal, fruit, or vegetable matter used or intended for food or that results from the preparation, use, cooking, dealing in, or storing of meat, fish, fowl, fruit, or vegetable matter), precipitated calcium carbonate from sugar beet processing, lime from kraft pulping (paper) processes generated prior to bleaching, wood ashes resulting solely from a source that burns only wood that is untreated and inert, aquatic plants, or source separated materials approved by EGLE.

In addition to the materials listed above, the generation of new by-products is increasing in Michigan and the U.S. from crop-based bioenergy plants producing ethanol from corn and soy diesel blends from soybeans. Two primary by-products are dried distillers’ grains and

wet distillers' grains. These by-products can be utilized as livestock feed and are exempt from regulation as a solid waste and permit requirements, if these by-products are land applied at an agronomic rate consistent with the current GAAMPs specified in the following section (pages 25-39).

Changes to Part 115 in September 2014 define a new class of materials called "beneficial use by-products." EGLE's beneficial use by-products website is at:

[https://www.michigan.gov/egle/about/organization/materials-management/solid-waste/beneficial-](https://www.michigan.gov/egle/about/organization/materials-management/solid-waste/beneficial-use#:~:text=The%20Beneficial%20Use%20program%20is,and%20environmental%20health%20is%20protected.)

[use#:~:text=The%20Beneficial%20Use%20program%20is,and%20environmental%20health%20is%20protected.](https://www.michigan.gov/egle/about/organization/materials-management/solid-waste/beneficial-use#:~:text=The%20Beneficial%20Use%20program%20is,and%20environmental%20health%20is%20protected.)

A certain class of beneficial use by-products, beneficial use 3, may be agriculturally land applied provided they are first registered or licensed by the generator under MDARD as a fertilizer, soil conditioner or liming material. The generator needs to provide labeling for these materials for the consumer. MDARD's beneficial use application details are available at <https://www.michigan.gov/mdard/plant-pest/fertilizer>. The materials eligible for registration or a license are coal bottom ash, foundry sand from ferrous and aluminum foundries, cement kiln dust, lime kiln dust, lime water softening residuals, flue gas desulfurization gypsum, soil washed or otherwise removed from sugar beets, and dewatered concrete grinding slurry.

The generator of the land applied materials, along with the applicator and landowner, share responsibility for following the practices. If the land application of the above referenced materials is not managed in a manner consistent with these practices, then the generator of the material is required to obtain the necessary permits and approvals from EGLE.

### Composting Organic Materials

Section 11506. (1)(h) of the NREPA also conditionally exempts the land application of composted organic materials. Composting is a self-heating process carried on by bacteria, actinomycetes, and fungi that decompose organic material in the presence of oxygen. Composting of organic materials prior to land application can result in a rather stable end product that does not support extensive microbial or insect activity, if the process and systems are properly designed and managed. The potential for odors during the composting process depends upon the moisture content of the organic material, the carbon-nitrogen ratio, the presence of adequate nutrients, the absence of toxic levels of materials that can limit microbial growth, and adequate porosity to allow diffusion of oxygen into the organic material for aerobic decomposition of the organic material. Stability of the end product and its potential to produce nuisance odors, and/or to be a breeding area for flies, depends upon the degree of organic material decomposition and the final moisture content. Additional information and guidance about alternatives for composting organic materials are available in the "On-Farm Composting Handbook" (Rynk, 1992) and the National Engineering Handbook (USDA, 2000).



The occurrence of leachate from the composting material can be minimized by controlling the initial moisture content of the composting mixture to less than 70 percent and controlling water additions to the composting material from rainfall. Either a fleece blanket<sup>1</sup> or a roofed structure can be used as a cover to control rainfall additions and the production of leachate from composting windrows.

If the composting process is conducted without a cover, provisions must be made to collect any surface runoff and/or leachate, so it can be either temporarily stored (see Section IV of the current Manure GAAMPs) and applied to land (see Section V of the current Manure GAAMPs), added to the composting material for moisture control during the composting process, or applied to grassed infiltration areas (See Section II of the current Manure GAAMPs). Therefore, depending on how the composting process is conducted, any leachate or runoff generated from composting material and/or from the composting site, must be controlled and/or treated in a manner to protect groundwater and surface water.

Organic materials generated on a farm, or brought onto a farm, for on-farm composting may be applied to cropland (belonging to that farm operation) as nutrient resources for crop production or as organic matter amendments and is considered an acceptable practice (See GAAMP #23). Composted organic by-products that are land applied should follow the practices specified in the following section.

The “practices” referred to in the NREPA, Public Act 451 of 1994, as amended, that must be followed to conditionally exempt various organic materials, composted organic materials, liming materials, and source separated materials like cull eggs from Solid Waste Management regulations are specified in the following section. Responsibility for determining whether these practices are being followed to qualify for this conditional exemption is shared by MDARD and EGLE, as described in the “Memorandum of Understanding (MOU) between MDARD and EGLE Regarding State Agency Response Actions to Environmental and Nuisance Complaints about Farm Operations” and the “MDARD/EGLE Waste Complaint Response Procedure.”

### **LAND APPLICATION OF CONDITIONALLY EXEMPTED ORGANIC MATERIALS, COMPOSTED ORGANIC, AND LIMING MATERIALS**

As was indicated above, various by-products that can supply nutrients for crop production, or correct soil acidity when applied to agricultural or silvicultural land, are conditionally exempt from regulation as a solid waste and permit requirements, if these by-products are applied at an agronomic rate consistent with the current GAAMPs described in this section.

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<sup>1</sup> A fleece blanket is a non-woven textile material made from synthetic fibers, such as polypropylene. The non-woven texture of a fleece blanket prevents rainfall from penetrating into the composting material but allows the necessary exchange of carbon dioxide and oxygen.

Practices #24-25 apply to all conditionally exempted organic and inorganic by-products. Management practices #26-35 pertain to organic by-products or composted organic by-products that are used as nutrient sources. Practice #36 discusses wood ashes that have liming value in addition to potash ( $K_2O$ ) value, and management practice #37 discusses by-product liming materials used to correct soil acidity. Management practice #38 discusses the application of soil removed from sugar beets or other root vegetables by mechanical means or by washing with water. The final GAAMP in this section, practice #39, discusses recommended recordkeeping for the application of all by-products to agricultural or silvicultural land.

- 24. The by-product should be handled in such a manner as to prevent spillage during transport to application sites. Temporary staging or stockpiling of by-product at the field application site prior to land application should be managed in a manner to prevent runoff and/or leaching of nutrients or by-product lime to surface water or groundwater, and to minimize odor impacts upon neighbors. If conditions of the temporary staging or stockpiling site result in adverse environmental effects, the stockpiled by-product should be immediately removed and properly land applied.**
- 25. All fields to which by-products are applied should have soils sampled and tested on a regular basis to determine where by-product nutrients or by-product lime can best be utilized (see GAAMP #7).**
- 26. Use fertilizer recommendations, consistent with those of MSU or Tri-State to determine the total nutrient needs for crops to be grown on each field where by-products will be applied (see GAAMP #8).**
- 27. To determine the nutrient content of a by-product material, analyze it for percent dry matter (solids), ammonium N ( $NH_4-N$ ), and total N, P, and K.**

One goal of a well-managed land application program is to utilize soil testing as a basis for fertilizer (nutrient) recommendations and agricultural lime recommendations. The quantity of nutrients recommended for the crop and yield to be grown will likely need to be supplied by a combination of by-product nutrients and commercial fertilizer nutrients. For soils with low pH's, agricultural lime recommendations to correct soil acidity should be based on soil testing results. By-product liming materials can be substituted for agricultural lime, as discussed in management practices #36 and #37.

In order to effectively manage by-product nutrients for crop production, the nutrient content of the by-product material needs to be known. Because of variation in the nutrient content of by-product materials, a representative sample(s) of the by-product should be obtained and analyzed by a laboratory to determine its nutrient content. To establish "baseline" information about the nutrient content of a by-product material, the by-product should be sampled and tested for at least two years. When there is a change in the kind of material being processed or the process by which the by-product is produced, additional testing for baseline nutrient composition should be done. MSU

Extension and/or MDARD can provide information on collecting representative by-product samples and where to send samples for analysis.

- 28. The agronomic (fertilizer) rate of N recommended for crops should not be exceeded by the amount of available N added, either from a by-product applied alone or from a by-product plus fertilizer N applied together. For legume crops, the amount of N removed by the legume may be used as the maximum N rate for by-product applications. The available N per ton of by-product material should be determined by using a by-product analysis.**

Excessive by-product applications to soils can: (a) result in excess nitrate N not being used by plants or the soil biology that may increase the risk of nitrate N being leached through the soil and into groundwater; (b) cause P to accumulate in the upper soil profile and increase the risk of contaminating surface waters with P where runoff/erosion occurs; and (c) create nutrient imbalances in soils, which may cause poor plant growth or animal nutrition disorders for livestock eating crops grown on by-product-amended soils. The greatest water quality concern from excessive by-product nutrient loadings, where soil erosion and runoff are controlled, is nitrate N losses to groundwater. Therefore, the agronomic fertilizer N recommendation, or crop N removal value for legumes, should never be exceeded.

The availability of N in by-products for plant uptake will not be the same as, highly soluble, fertilizer N. Therefore, total by-product N cannot be substituted for that in fertilizers on a pound-for-pound basis because a portion of the N is present in by-product organic matter which must be decomposed before mineral (inorganic) forms of N are available for plant uptake.

The rate of decomposition (or mineralization) of by-product organic matter is usually less than 100 percent during the first year and will vary depending on the type of by-product utilized. In order to estimate the amount of available N that will be provided by each ton of by-product, the total N and  $\text{NH}_4\text{-N}$  content from the by-product analysis can be used with a mineralization factor of 50 percent to calculate this value. This calculation is similar to that used for estimating available N in animal manures. (See Manure Management Sheet #2, MSU Extension Bulletin E-2344 by Jacobs *et al.*, 1993, for more explanation.)

Many of the by-products from fruit, vegetable, or sugar beet processing contain less than one percent N on a fresh weight basis. By-products may be used to meet some or all of the N requirements of the crop, but it may not be practical or wise to apply these by-products as a sole source of N. The rate of application should allow for ease of incorporation when needed and should not adversely affect the permeability of the soil or physically restrict the growth of plants.

- 29. When the soil test level for P reaches 75 ppm Bray P1 (150 lbs./acre<sup>2</sup>) or**

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<sup>2</sup> If the Mehlich 3 extractant is utilized for the soil fertility test instead of the Bray P1 extractant, then the following

**100 ppm Mehlich-3P (200 lbs./acre<sup>2</sup>), by-product applications should be reduced to a rate where by-product P added does not exceed the P removed by the harvested crop. (If this by-product rate is impractical due to by-product spreading equipment or crop production management, a quantity of by-product P equal to the amount of P removed by up to four crop years can be applied prior to the first crop year. However, no additional fertilizer or by-product P may be applied for the remaining crop years, and the by-product rate used cannot exceed the N fertilizer recommendation for the first crop grown.)**

**If the soil test level for P reaches 150 ppm Bray P1 (300 lbs./acre<sup>2</sup>) or 200 ppm Mehlich-3P (400 lbs./acre<sup>2</sup>), by-product applications should be discontinued until nutrient harvest by crops reduces P test levels to less than 150 ppm Bray P1 or 200 ppm Mehlich-3P. To protect surface water quality against discharges of P, adequate soil and water conservation practices should be used to control runoff and erosion from fields where by-product is applied.**

The availability of P and K in by-products is considered to be close to 100 percent for K but considerably less than 100 percent for P. Periodic soil testing can be used to monitor how additions of by-product P and K will affect soil fertility levels.

If by-products are applied to supply all the N needs of crops, the P needs of crops will usually be exceeded, and soil test levels for P will increase over time. If the Bray P1 soil test P levels reach 150 ppm (300 lbs./acre)<sup>2</sup> or Mehlich-3P reaches 200 ppm (400 lbs./acre), the risk of losing soluble P and sediment-bound P by runoff and erosion (i.e., non-point source pollution) increases.

Therefore, adequate soil and water conservation practices to control runoff and erosion should be implemented. In addition, when Bray P1 soil test P levels reach 150 ppm or Mehlich-3P reaches 200 ppm, no more by-product (or fertilizer) P should be added until nutrient harvest by crops reduces P test levels to less than 150 ppm Bray-P1 or less than 200 ppm Mehlich-3P.

To avoid reaching the 150 ppm Bray P1 or 200 ppm Mehlich-3P test levels, by-product applications should be reduced to provide the P needs of crops rather than providing all of the N needs of crops and adding excess P. Therefore, when the Bray P1 soil test level for P reaches 75 ppm Bray P1 (150 lbs./acre) or 100 ppm Mehlich-3P (200 lbs./acre), by-product applications should be reduced to a rate where by-product P added does not exceed the P removed by the harvested crop. The quantity of by-product P<sub>2</sub>O<sub>5</sub><sup>3</sup> that should be added can be estimated by using Crop Nutrient Removal Tables 1 and 2 and a realistic yield goal for the crop to be grown. For example, if a yield of 130

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equivalent Mehlich 3 soil test levels can be used for Michigan soils: 150 lbs. P/acre (Bray P1) = 200 lbs. P/acre (Mehlich 3) and 300 lbs. P/acre (Bray P1) = 400 lbs. P/acre (Mehlich 3).

<sup>3</sup> Fertilizer P recommendations are given in, and fertilizer P is sold as, pounds of phosphate P<sub>2</sub>O<sub>5</sub>.

bu/acre for corn grain is anticipated, the amount of by-product  $P_2O_5$  added to this field should be limited to about 46 lbs./acre (130 bu/acre x 0.35 lb.  $P_2O_5$ / bu).

If the rate of by-product application based on P removal by the crop is lower than the by-product spreader can physically apply or is not realistic when planning for crop production management, the rate of by-product application can be increased. The higher rate of by-product application can be equal to the P removal (See Table #1 and 2) for up to four crop years, as long as this rate does not exceed the N fertilizer recommendation for the first crop grown after the by-product is applied.

If this higher rate of by-product application is used, no fertilizer or by-product P should be applied during the remaining crop years, or until the accumulative  $P_2O_5$  removed by crop harvest equals the amount of by-product  $P_2O_5$  applied. A good recordkeeping system should be used to track the amounts of  $P_2O_5$  applied and the  $P_2O_5$  removed by harvested crops, when this higher rate of by-product application is used.

**30. By-products should be applied to soils in a uniform manner. The amount of by-product applied per acre (tons/acre) should be known, so that by-product nutrients can be managed effectively.**

As is true with fertilizers, lime, and pesticides, by-product materials should be spread uniformly for best results in crop production. Also, to know the quantity of by-product nutrients applied the amount of by-product applied must be known.

Determining the tons/acre applied by spreading equipment can be accomplished in a variety of ways. One method is to measure the area of land covered by one spreader load of by-product.

A second method is to record the total number of spreader loads applied to a field of known acreage. With either approach, the capacity of the spreader (in tons) must be known, and some way to vary the rate of application will be needed by adjusting the speed of travel or changing the discharge settings on the spreading equipment.

Guidance is available from MSU Extension or the equipment manufacturer to help determine the rates of by-product application that spreading equipment can deliver.

**31. By-products should not be applied to soils within 150 feet of surface waters or to areas subject to flooding unless: (a) by-products are injected or surface-applied with immediate incorporation (i.e., within 48 hours after application) and/or (b) conservation practices are used to protect against runoff and erosion losses to surface waters. By-products should be applied in a manner to optimize nutrient utilization and prevent nutrient runoff to surface water.**

To reduce the risk of runoff/erosion losses of by-product nutrients, by-product materials should not be applied and left on the soil surface within 150 feet of surface waters.

By-products that are surface applied with immediate incorporation can be closer than 150 feet if conservation practices are used to protect against runoff and erosion. A vegetative buffer between the application area and any surface water is a desirable conservation practice. By-products should not be applied to grassed waterways or other areas where there may be a concentration of water flow, unless used to fertilize and/or mulch new seedlings during waterway construction. By-products should not be applied to areas subject to flooding unless immediately incorporated. In all cases, by-products should not be applied to land within 50 feet of surface water, a residence, a single family residential well, or within 200 feet of a public water supply well.

- 32. As land slopes increase from zero percent, the risk of runoff and erosion also increases. Adequate soil and water conservation practices should be used which will control runoff and erosion for a particular site, taking into consideration such factors as type of by-product to be applied, surface residue or vegetative conditions, soil type, slope, etc.**

As land slopes increase, the risk of runoff and erosion losses to drainage ways, and potentially to surface waters, also increases. Soil and water conservation practices should be used to control and minimize the risk of non-point source pollution to surface waters, particularly where by-product materials are applied. Surface application of a by-product should be avoided when the land slope is greater than six percent. However, a number of factors, such as the amount of liquid associated with a by-product(s) application, amount of residues present on the soil surface, soil texture, drainage, etc., can influence the degree of runoff and erosion associated with surface water pollution. Therefore, adequate soil and water conservation practices to control runoff and erosion at any particular site are more critical than the degree of slope itself.

- 33. Where application of by-product is necessary in the fall, rather than spring or summer, using as many of the following practices as possible will help to minimize potential loss of  $\text{NO}_3\text{-N}$  by leaching: (a) apply to medium or fine rather than to coarse textured soils; (b) delay applications until soil temperatures fall below  $50^\circ\text{F}$ ; and/or (c) establish cover crops before or after by-product application to help remove nitrate N by plant uptake.**

By-product and fertilizer nutrients should be applied as close as possible to, or during, periods of maximum crop nutrient uptake to minimize loss from the soil-plant system. Therefore, spring or early summer application is best for conserving nutrients, whereas fall application generally results in greater nutrient loss, particularly for nitrate N on coarse soils (i.e., sands, loamy sands, sandy loams)

- 34. Application of a by-product to frozen or snow-covered soils should be avoided, but where necessary, by-product materials should only be applied to areas where slopes are six percent or less. In addition, provisions must be made to control runoff and erosion with soil and water conservation practices, such as vegetative buffer strips between surface waters and soils where the by-product is applied**

Winter application of by-products is the least desirable in terms of nutrient utilization and prevention of nonpoint source pollution. Frozen soils and snow cover will limit nutrient movement into the soil and greatly increase the risk of by-product being lost to surface waters by runoff and erosion during thaws or early spring rains. When winter application is necessary, appropriately sized buffer strips should be established between surface waters and frozen soils where by-products are applied to minimize any runoff and erosion of by-product materials or nutrients from reaching surface water.

**35. By-products should be managed and applied to cropland in a manner to control odors and reduce the potential for complaints concerning excessive odor.**

By-products tend to generate odors that are not typical of agricultural operations and may be offensive to neighbors. Therefore, it is important that by-products be applied to land in a manner which reduces the possibility of odor complaints. The following is a list of practices that can be used to reduce odor in the application of by-products to land:

- a. Avoid spreading when the wind is blowing toward populated areas.
- b. Avoid spreading on weekends/holidays when people are likely to be engaged in nearby outdoor and recreational activities.
- c. Spread in the morning when air begins to warm and is rising, rather than in the late afternoon.
- d. Use available weather information to best advantage. Turbulent breezes will dissipate and dilute odors, while hot, humid weather tends to concentrate and intensify odors, particularly in the absence of breezes.
- e. Take advantage of natural vegetation barriers, such as woodlots or windbreaks, to help filter and dissipate odors.
- f. Establish vegetated air filters by planting conifers and shrubs as windbreaks and visual screens between cropland and residential developments.
- g. Incorporate by-product materials into the soil as soon as possible after application (e.g., within 48 hours). However, incorporation may not be feasible where by-products are applied to pastures or forage crops, such as alfalfa, or where no-till practices are used. When incorporation of the by-product is not feasible, and the potential exists for an odor complaint, it may be advisable to find a more appropriate site for the application.
- h. Open-air stockpiling or storage of by-product materials at field applications sites should be managed in a manner to avoid odor complaints.

**36. Wood ashes should be applied at rates based on their potash (K<sub>2</sub>O) value and/or their acid-neutralizing value as a substitute for agricultural lime.**

The primary value of wood ashes is their potash value and their acid-neutralizing ability. Because of variation in the nutrient content of wood ashes, a representative sample(s) should be obtained and analyzed by a laboratory to determine its K<sub>2</sub>O content. The K<sub>2</sub>O

content per ton of wood ash should then be used to determine the appropriate rate of wood ash to use to meet K<sub>2</sub>O fertilizer recommendations.

The wood ash should also be tested to determine its minimum neutralizing value in terms of calcium carbonate equivalent. This information, along with lime recommendations from soil test results, can then be used to determine acceptable wood ash application rates to neutralize soil acidity. Rates applied should be consistent with recommendations of MSU Extension Bulletin E-498 (Warncke *et al.*, 2010). When there is no lime requirement recommended, wood ash can still be applied for its potash value, as long as the accompanying liming addition will not interfere with achieving desired crop growth. To avoid potential growth problems from unneeded lime additions, growers should monitor soil test values for pH, P, K, and micronutrients by establishing baseline values prior to applying wood ashes on soils with pH>6.8.

**37. By-product liming materials should be applied at rates based on soil pH, lime requirement and neutralizing value of the liming material.**

The Michigan Liming Materials Law, Public Act 162 of 1955, as amended, requires that vendors of by-product liming materials determine and present the minimum neutralizing values in terms of calcium carbonate equivalents. This information, along with lime recommendations from soil test results, should be used to determine acceptable by-product lime application rates. By-product liming materials are usually used to neutralize soil acidity and should be applied in amounts consistent with recommendations of MSU Extension Bulletin E-498 (Warncke *et al.*, 2010). When there is a desire to apply by-product liming materials on high pH (alkaline) soils, one to two tons per acre of material may be applied to medium and fine textured soils with a pH above 6.8. Research has shown that this practice will not appreciably change soil pH or soil test values for P and K and will not harm crop yields. As a management tool, growers should monitor soil test values for pH, P, K, and micronutrients by establishing baseline values prior to application of any liming material.

**38. Soil removed from sugar beets or other root vegetables by mechanical means or by washing with water should be applied to cropland at depths that can be physically mixed into the top four to eight inches of the receiving soil.**

Dry soil removed from sugar beets or other root vegetables, before processing or use as fresh market produce, can be returned to fields where these crops were harvested without obtaining a permit to do so from EGLE. To accomplish physical mixing of these removed soils into the receiving soil, application depths will depend on the type of tillage equipment used. Suggested depths for applying these soils are one to two inches when a disk or chisel-plow is used and three to four inches when a moldboard plow is used.

Soil removed by commercial processors, by washing with water (from a source as specified in Part 22 Rules, R 323.2211) and collected in some type of storage pond or other facility, can also be air dried and returned to fields without an EGLE permit, if no



chemical additives, other than lime, are made to this soil/water slurry. These soil/water slurries can be applied to drying beds or placed in seepage ponds/lagoons and the water allowed to drain into the ground under the following conditions: 1) the discharger must obtain a 2211 (permit by rule with notification) authorization; 2) the volume discharged towards groundwater is <50,000 gallons/day; and 3) EGLE must be notified if the wash water contains an additive. Generators of this type of wash water should refer to the Part 22 Groundwater Quality Administrative Rules for more specific information pertaining to these types of groundwater discharges. The soil slurries collected by commercial processors can also be discharged into a storage pond or facility that does not allow seepage of the water to occur, but additional care is needed (i.e., a permit from EGLE may be required) to properly handle any decant water that is removed or any leachate water lost from slurried soils during handling and other processes used to air dry these soils. Once these soils are air dried, they can be applied to fields per the guidance above.

**39. Records should be kept of materials analyses, soil test reports, and rates of material application for individual fields.**

Good recordkeeping demonstrates good management and will be beneficial for the crop producer. Records should include material analysis reports, rates of material applied, and information for individual fields as suggested under management practice #15.

When planning material applications, consider normal weather patterns; the availability of land at different times during the growing season for different crops; and availability of manpower and equipment relative to other activities on the farm. Having adequate storage capacity to temporarily hold materials can add flexibility to a management plan when unanticipated weather occurs, preventing timely applications. Nevertheless, unusual weather conditions do occur and can create problems for the best of management plans.

Finally, good recordkeeping is the "basis" of a good management plan. Past analysis results for materials should be good predictors of the nutrient content in materials being produced and applied today. Changes in the P test levels of soils with time due to material P additions can be determined from good records, and that information can be helpful in anticipating where material rates may need to be reduced and when additional land areas may be needed.

Table 1. Approximate nutrient removal (lb./unit of yield) in the harvested portion of several Michigan field crops.<sup>4</sup>

Crop		Unit	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
			----- lb. per unit -----		
Alfalfa	Hay	ton	45 <sup>5</sup>	13	50
	Haylage	ton	14	4.2	12
Barley	Grain	bushel	0.88	0.38	0.25
	Straw	ton	13	3.2	52
Beans (dry edible)	Grain	cwt	3.6	1.2	1.6
Bromegrass	Hay	ton	33	13	51
Buckwheat	Grain	bushel	1.7	0.25	0.25
Canola	Grain	bushel	1.9	0.91	0.46
	Straw	ton	15	5.3	25
Clover	Hay	ton	40 <sup>5</sup>	10	40
Clover-grass	Hay	ton	41	13	39
Corn	Grain	bushel	0.90	0.37	0.27
	Grain <sup>6</sup>	ton	26	12	6.5
	Stover	ton	22	8.2	32
	Silage	ton	9.4	3.3	8.0
Millet	Grain	bushel	1.1	0.25	0.25
Oats	Grain	bushel	0.62	0.25	0.19
	Straw	ton	13	2.8	57
Orchard grass	Hay	ton	50	17	62
Potatoes	Tubers	cwt	0.33	0.13	0.63
Rye	Grain	bushel	1.1	0.41	0.31
	Straw	ton	8.6	3.7	21
	Silage	ton	3.5	1.5	5.2
Sorghum	Grain	bushel	1.1	0.39	0.39
Sorghum-Sudan grass	Hay	ton	40	15	58
	Haylage	ton	12	4.6	18
Soybeans	Grain	bushel	3.8	0.80	1.4
Spelt	Grain	bushel	1.2	0.38	0.25
Sugar Beets	Roots	ton	4.0	1.3	3.3
Sunflower	Grain	bushel	2.5	1.2	1.6
Timothy	Hay	ton	45	17	62
Trefoil	Hay	ton	48 <sup>5</sup>	12	42
Wheat	Grain	bushel	1.2	0.63	0.37
	Straw	ton	13	3.3	23

<sup>4</sup> Source: Nutrient Recommendations for Field Crops in Michigan. (Warncke et al., 2009) or Tri-State Fertilizer Recommendations (Culman, Fulford, Camberato, and Steinke, 2020).

<sup>5</sup> Legumes get most of their nitrogen from air.

<sup>6</sup> High moisture grain.

Table 2. Approximate nutrient removal (lb./unit of yield) in the harvested portion of several Michigan vegetable crops.<sup>7</sup>

Crop <sup>8</sup>	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
	----- lb./ton <sup>9</sup> -----		
Asparagus, crowns new planting, or established	13.4	4.0	10.0
Beans, snap	24.0	2.4	11.0
Beets, red	3.5	2.2	7.8
Broccoli	4.0	1.1	11.0
Brussels Sprouts	9.4	3.2	9.4
Cabbage, fresh market, processing, or Chinese	7.0	1.6	6.8
Carrots, fresh market or processing	3.4	1.8	6.8
Cauliflower	6.6	2.6	6.6
Celeriac	4.0	2.6	6.6
Celery, fresh market or processing	5.0	2.0	11.6
Cucumbers, pickling hand or machine harvested)	2.0	1.2	3.6
Cucumber, slicers	2.0	1.2	3.6
Dill	3.5	1.2	3.6
Eggplant	4.5	1.6	5.3
Endive	4.8	1.2	7.5
Escarole	4.8	1.2	7.5
Garden, home	6.5	2.8	5.6
Garlic	5.0	2.8	5.6
Ginseng	4.6	1.2	4.6
Greens, Leafy	4.8	2.0	6.0
Horseradish	3.4	0.8	6.0
Kohlrabi	6.0	2.6	6.6
Leek	4.0	2.6	4.8
Lettuce, Boston, bib	4.8	2.0	9.0
Lettuce, leaf, head, or Romaine	4.8	2.0	9.0
Market Garden	6.5	2.8	5.6
Muskmelon	8.4	2.0	11.0
Onions, dry bulb or green	5.0	2.6	4.8
Pak Choi	7.0	1.6	6.8

<sup>7</sup> Source: Nutrient Recommendations for Vegetable Crops in Michigan. (Warncke et al., 2004)

<sup>8</sup> Values used for some crops are estimates based on information for similar crops.

<sup>9</sup> 1 ton = 20 cwt.

Table 2. Continued

<b>Crop</b>	<b>N</b>	<b>P<sub>2</sub>O<sub>5</sub></b>	<b>K<sub>2</sub>O</b>
	----- lb./ton-----		
Peppers, bell, banana, or hot	4.0	1.4	5.6
Parsley	4.8	1.8	12.9
Parsnip	3.4	3.2	9.0
Peas	20.0	4.6	10.0
Pumpkins	4.0	1.2	6.8
Radish	3.0	0.8	5.6
Rhubarb	3.5	0.6	6.9
Rutabagas	3.4	2.6	8.1
Spinach	10.0	2.7	12.0
Squash, hard	4.0	2.2	6.6
Squash, summer	3.6	2.2	6.6
Sweet Corn	8.4	2.8	5.6
Sweet Potato	5.3	2.4	12.7
Swiss Chard	3.5	1.2	9.1
Tomatoes, fresh market or processing	4.0	0.8	7.0
Turnip	3.4	1.2	4.6
Watermelon	4.8	0.4	2.4
Zucchini	4.6	1.6	6.6

## APPENDICES

### **APPENDIX I -- References on State and Federal Laws and Regulations**

A person applying, distributing, and storing fertilizer or organic materials in Michigan, must comply with the relevant state and federal laws and regulations promulgated under these statutes, including but not limited to:

1. The Superfund Amendments and Reauthorization Act (SARA) of 1986 Title III: Emergency Planning and Community Right-to-Know. This federal law provides mechanisms to prepare for chemical emergencies. Persons storing anhydrous ammonia above the "Threshold Planning Quantity" of 500 pounds must notify the State Emergency Response Commission within EGLE, the Local Emergency Planning Committee, and the local fire chief that they store this chemical above threshold at some time. The location of the storage facility and name and telephone number of a responsible person must also be reported. If there is a spill or release of anhydrous ammonia above the "reportable quantity" of 100 pounds, the same organizations must be notified. MSU Extension Bulletin E-2575 contains information to help farmers comply with this law.
2. Public Law 92-500, the Federal Water Pollution Control Act of 1972, as amended. This Act established a central goal to "restore and maintain the chemical, physical and biological integrity of the nation's water". The Water Quality Amendment Act of 1987 added provisions for the management of nonpoint source pollution. As part of Michigan's nonpoint source pollution control management strategy, Best Management Practices (BMPs) for fertilizer use and storage have been developed to meet requirements of the U.S. Clean Water Act.
3. Public Act 451, the Natural Resources and Environmental Protection Act of 1994, as amended. This Michigan law was enacted to protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; and to regulate the use of certain lands, waters, and other natural resources of the state.
  - A. Part 31. This part provides a broad substantive basis for protection and conservation of surface water and groundwater resources of the state. Under Part 31, it is unlawful for any person directly or indirectly to discharge into the waters of the state any substances which are or may become injurious to the public health or ecosystem. Violations of Part 31 subject the violator to civil fines up to \$25,000 per day and to criminal penalties including two years in prison. Part 31 defines "waters of the state" as the groundwaters, lakes, rivers and streams and all other watercourses and waters within the confines of the state, as well as the Great Lakes bordering the state.

- B. Part 55. The Michigan Department of Environment, Great Lakes and Energy has statutory authority, powers, duties, functions and responsibilities for rule-making and for issuance of permits and orders to control air pollution. This part provides for control of air pollution which may be in the form of a dust, fume, gas (including anhydrous ammonia), mist, odor, smoke or vapor in quantities which are or can become injurious to human health or welfare, animal life, plant life or to property, or which interfere with the enjoyment of life or property.
  - C. Part 83. This part regulates registration, distribution, labeling, storage, disposal, and application of pesticides in Michigan.
  - D. Part 85. This part regulates the manufacture, distribution, sale, labeling, advertising, and storage of fertilizers, soil conditioners, peat and peat moss, and composted materials. Regulation No. 641, Commercial Fertilizer Bulk Storage. This set of rules regulates the commercial storage of bulk fertilizer. Regulation No. 642, On Farm Fertilizer Bulk Storage. This set of rules regulates the on-farm storage of bulk liquid fertilizer
  - E. Part 115. This part is to protect the public health and environment; to provide for the regulation and management of solid waste, such as rubbish, ashes, incinerator ash, incinerator residue, street cleanings, municipal and industrial sludges, solid commercial and solid industrial wastes, and animal waste other than organic waste generated in the production of livestock and poultry; and to regulate materials that can be placed in licensed solid waste disposal facilities, such as sanitary landfills. A person shall not apply sludges, ashes, or other solid waste to the land without authorization under the Act, unless a plan for managing the wastes as non-detrimental materials appropriate for agricultural or silvicultural use has been approved by the director of the Michigan Department of Environment, Great Lakes, and Energy.
  - F. Part 201. This part provides for the identification, risk assessment, and priority evaluation of environmental contamination and provides for response activity at certain facilities and sites. This part also provides exemption from liability for farmers if they follow generally accepted agricultural and management practices.
4. Public Act 154, the Michigan Occupational Safety and Health Act (MIOSHA) of 1974, as amended. The Michigan Department of Health and Human Services and Michigan Department of Licensing and Regulatory Affairs jointly enforce this law to protect workers. Employers are required to have available for employees' review Material Safety Data Sheets (MSDS) on all hazardous chemicals that are present in the workplace. Employers must also develop and implement a written employee training program and ensure that all hazardous material containers are properly labeled.

5. Public Act 162, Michigan Liming Materials Law of 1955, as amended. This Act provides for the licensing and inspection of agricultural liming materials and regulates the labeling and sale of these products. In addition, this law prescribes penalties for violations. Liming materials, as defined by this Act, include any form of limestone, lime rock, marl, slag, by-product lime, industrial or factory refuse lime, water softener lime, and any other material used to correct soil acidity.
6. Public Act 346, the Commercial Drivers' License Law of 1988, as amended. This Act may require farmers to obtain endorsements on their commercial drivers' licenses for transporting U.S. Department of Transportation classified hazardous materials including anhydrous ammonia. This requirement applies if the total vehicle weight (i.e., towing and trailing vehicles) exceeds 26,000 pounds gross vehicle weight rating (GVWR).
7. Public Act 368, the Michigan Public Health Code of 1978, as amended. An Act to protect and promote the public health; to codify, revise, consolidate, classify, and add to the laws relating to the public health; to provide for the prevention and control of diseases and disabilities; and to provide for the classification, administration, regulation, financing, and maintenance of personal, environmental and other health services and activities.
8. Public Act 399, the State of Michigan Safe Drinking Water Act of 1976, as amended. An Act to protect the public health; to provide for supervision and control over public water supplies; to provide for the classification of public water supplies; and to provide for continuous, adequate operation of privately owned, public water supplies. This Act sets forth standard isolation distances from any existing or potential sources of contamination and also regulates the location of public water supplies with respect to major sources of contamination.

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# Generally Accepted Agricultural and Management Practices for Cranberry Production

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**DRAFT 2025**

Michigan Commission of Agriculture & Rural  
Development  
PO BOX 30017  
Lansing, MI 48909

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**In the event of an agricultural pollution emergency such as a chemical/fertilizer spill, manure lagoon breach, etc., the Michigan Department of Agriculture and Rural Development and/or Michigan Department of Environment, Great Lakes, and Energy should be contacted at the following emergency telephone numbers:**

**Michigan Department of Agriculture and Rural Development: 800-405-0101  
Michigan Department of Environment, Great Lakes, and Energy: 800-292-4706**

**If there is not an emergency, but you have questions on the Michigan Right to Farm Act, or items concerning a farm operation, please contact the:**

**Michigan Department of Agriculture and Rural Development (MDARD)  
Right to Farm Program (RTF)  
P.O. Box 30017  
Lansing, Michigan 48909  
517-284-5619  
877-632-1783  
517-335-3329 FAX**



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## PREFACE

The Michigan legislature passed into law the Michigan Right to Farm Act (Act 93 of 1981, as amended) which requires the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs). These practices are written to provide uniform, statewide standards and acceptable management practices based on sound science. These practices can serve producers in the various sectors of the industry to compare or improve their own managerial routines. New scientific discoveries and changing economic conditions may require necessary revision of the Practices.

The GAAMPs that have been developed are as follows:

- 1) 1988 Manure Management and Utilization
- 2) 1991 Pesticide Utilization and Pest Control
- 3) 1993 Nutrient Utilization
- 4) 1995 Care of Farm Animals
- 5) 1996 Cranberry Production
- 6) 2000 Site Selection and Odor Control for New and Expanding Livestock Facilities
- 7) 2003 Irrigation Water Use
- 8) 2010 Farm Markets

These practices were developed with industry, university, and multi-governmental agency input. As agricultural operations continue to change, new practices may be developed to address the concerns of the neighboring community. Agricultural producers who voluntarily follow these practices are provided protection from public or private nuisance litigation under the Right to Farm Act.

This GAAMP does not apply in municipalities with a population of 100,000 or more in which a zoning ordinance has been enacted to allow for agriculture provided that the ordinance designates existing agricultural operations present prior to the ordinance's adoption as legal non-conforming uses as identified by the Right to Farm Act for purposes of scale and type of agricultural use.

The website for the GAAMPs is <http://www.michigan.gov/righttofarm>.

## INTRODUCTION

Michigan has the climate, soils, and processing infrastructure necessary to support a cranberry industry. High market demand and price have stimulated interest in cranberry production outside traditional cranberry producing areas. Several individuals have recently begun growing cranberries in Michigan; numerous others are considering this crop, and Michigan cranberry production is expected to increase over the next few years.

The cranberry plant is a wetland crop species (an obligate hydrophyte) that is grown commercially in natural or artificial wetlands managed for crop production. Since the production of cranberries is a water dependent activity, many unique cultural and management practices have been developed for their production. Five to ten acre-feet of water may be needed annually per acre of cranberry bed. Farming within a wetland environment presents considerable potential for adversely affecting existing natural resources or the function of those resources. Cranberry producers need to minimize these risks by utilizing environmentally sensitive and sound management practices.

Cranberries are commercially produced in the mild marine climate of western Oregon and Washington, the moderate climate of Massachusetts, New Jersey, and Maine, and the harsh continental climate of Wisconsin. Some management practices differ from one region to another to reflect these climatic differences. For example, winter flooding and ice cover is a necessity in Wisconsin, but no winter protection is required in Oregon and Washington. Some characteristics of Michigan's climate fall between these extremes. Therefore, Michigan growers may eventually find that management practices employed in other states may not be completely suited to all areas of Michigan. Recommendations for commercial cranberry production in Michigan will likely change as the industry develops and technologies change.

These current Generally Accepted Agricultural and Management Practices (GAAMPs) were developed as a result of a Memorandum of Agreement between the Michigan Department of Agriculture and Rural Development (MDARD) and the Michigan Department of Environment, Great Lakes, and Energy (EGLE). These agencies have a mutual interest in the development of a viable cranberry industry in Michigan and are dedicated to protecting environmental quality. The GAAMPs are intended to provide technical and regulatory guidance that is economically viable and environmentally sensitive. Farm operations voluntarily following these GAAMPs will be provided nuisance litigation protection and other provisions pursuant to the Michigan Right to Farm Act, PA 93 of 1981 (RTFA), as amended (MRFA). The Michigan Commission of Agriculture and Rural Development (Commission) has the responsibility to define GAAMPs under the RTFA and has identified the need for these GAAMPs to address the unique issues relative to cranberry production. GAAMPs will be reviewed annually and revised by the Commission when necessary.

## SITE SELECTION

Nearly all regions of Michigan meet the climatic requirements of cranberries. However, it is necessary that cranberry production operations be located in sites with proper soil and hydrologic conditions for successful commercial production. These conditions will directly influence the design, construction and operational costs of the farming operation. Because cranberries require the existence or establishment of wetland conditions and large quantities of water, certain regulatory requirements may also need to be met for a specific site. Site selection, farm design, construction of beds and associated facilities, and operational activities must take into account the federal, state, and local regulatory requirements. The presence of regulated wetlands and water bodies within, or adjacent to, a site considered for cranberry production, and possible permit requirements regarding wetland alterations or impacts to bodies of water should be considered, and may influence site selection, as well as farm design and placement and construction of cranberry beds, reservoirs, dikes, and associated management facilities. A cranberry site review team composed of MDARD, EGLE, and MSU staff can provide technical assistance in determining the suitability of potential cranberry sites.

### **Sites need to meet the soil and water requirements of cranberries.**

Cranberries require a growing media of sand or organic soil with an acidic pH (below 5.5). Higher pH materials are suitable if pH can be reduced economically. A nearby source of suitable sand is needed for construction and future sanding practices. Hydrologic and soil characteristics should provide the capacity to maintain the water table at or near the bed surface. Preferred sites also have minimal slope, since flat areas generally require less earth moving to develop. A ready supply of water is needed, which is physically and legally usable. Water with an acidic pH is preferred. More detailed cranberry site selection considerations are provided in Appendix III. The USDA Natural Resources and Conservation Service (NRCS) can provide copies of local soil surveys and other soils data.

### **Regulatory requirements must be met.**

Site selection, farm design, construction and operational activities need to consider all applicable federal, state and local regulatory requirements, and any tribal laws and regulations. Prior to establishing a cranberry production site, producers should consult with the Water Resources Division (WRD, formerly the Land and Water Management Division) of EGLE and all other appropriate agencies to determine if any permits are required. All required permits need to be obtained prior to initiation of any regulated activities, such as, construction of cranberry beds and associated facilities. Regulatory programs are described in Appendix II. Early contact will advance the identification of possible permit requirements and the application review process. The MDARD Environmental Stewardship Division and Michigan State University Extension may also be helpful in identifying potential sites.

The selection of a site for growing cranberries that recognizes environmental concerns along with proper farm design and operation will ease compliance with

applicable regulatory requirements. A qualified environmental consultant who is familiar with regulatory requirements may be helpful in the site selection and design process. The grower or their consultant should contact the regulatory agencies in the initial stages of site selection and design of the farm operation.

The following information on site selection is provided to help identify locations that either do not require a wetland or other state permit(s) for development, or represent sites that are more acceptable under permit review criteria.

**A. Sites that are considered either upland sites or prior wetland areas that have previously been drained for agricultural use and no longer meet the regulatory definition of a wetland. These are the more desirable sites for cranberry development and do not require a wetland permit for bed development but may require other local, state, or federal permits.** In a number of regions in Michigan, former wetland areas with suitable soils have been drained for agricultural use and may be suitable for cranberry growing if steps are taken to restore the high water table (e.g. placement of water control structures on drainage outlets) and other criteria are met.

**B. Sites having soils which have been drained for agricultural use, but which do meet the state and federal definitions of a wetland. These sites require permits for construction of cranberry beds and associated facilities. However, permits will likely be issued unless other resources would be adversely impacted by the proposed conversion.** For sites which are still technically a wetland, but which have reduced wetland values due to past or current agricultural drainage, EGLE wetland review criteria will not be more stringent than federal permit review requirements. The applicant will need to minimize impacts on wetlands and associated resources, and should locate support facilities within upland areas where feasible.

**C. Permits are required for construction of cranberry beds in natural, undisturbed wetlands.** Permit review requirements will be consistent with federal programs regarding construction of cranberry beds in natural, undisturbed wetlands, and will weigh the impacts and benefits of the proposed project.

EGLE will evaluate applications for permits involving potential sites for cranberry development on a case-by-case basis, including sites that do not clearly meet the above criteria. As required by the 2009 amendments to Part 303, Wetland Protection of the Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended, the Commission in consultation with the EGLE is to prepare informational maps that identify a total of 5000 acres of land in Michigan considered suitable for cranberry production. When completed, these informational maps will be made available to the public on the EGLE website.

## DESIGN AND CONSTRUCTION OF CRANBERRY FARM OPERATIONS

An economically feasible and environmentally sound cranberry farm operation depends on appropriate planning for facility design and construction activities. The NRCS provides useful information on most aspects of design and construction for erosion and sedimentation control. The Conservation Practice Standards and Specifications are contained in the NRCS electronic Field Office Technical Guide (eFOTG), available at <http://www.nrcs.usda.gov/technical/efotg>. Additional technical assistance may also be obtained from local NRCS or conservation district offices or private sector professional engineering firms or technical service providers.

### **Cranberry beds need to meet the growth requirements of the plants and facilitate management.**

Arrangement, dimensions, and elevations of beds depend on the topography and other site characteristics. Construction procedures are site specific, but some general steps are followed. To construct cranberry beds, the surface soil is usually removed and, if suitable, often used to build dikes and roads. In most cases, clean sand is spread over the bed, and the surface is leveled. Drainage ditches are usually dug around the perimeter of the beds. Subsurface (tile) drain and pumping plant for water control may also be installed.

### **Water management facilities need to meet the annual water requirements.**

The large quantity withdrawal of either surface and/or groundwater statutorily requires the property owner or their authorized agent to use the EGLE's online (<https://www.michigan.gov/egle/about/organization/water-resources/water-use/permits#:~:text=A%20Water%20Withdrawal%20Registration%20is,%242000%20application%20fee%20is%20required.>) water withdrawal assessment tool to evaluate and determine if the proposed withdrawal is acceptable or requires a site specific review by the WRD of the EGLE. The tool is intended to assist in water use planning decisions and to prevent adverse resource impacts to surface waters that can result from the withdrawal of too much water. The registration of an acceptable large quantity withdrawal (LQW) may be completed using the online tool. If the tool indicates that the LQW may cause an adverse resource impact, the property owner may submit a request to the EGLE for a site-specific review.

A detailed water budget should be calculated to help ensure an adequate and timely water supply. An example of a water budget evaluation is provided in Appendix IV. Ponds are usually constructed to serve as water reservoirs. Wells may supplement the water supply. Various drainage ditches, dikes, canals, bulkheads, and irrigation and drainage systems are usually installed to move water to and away from beds.

All new cranberry growers should consider designs that allow for water recycling. These systems are referred to as "closed systems" because surface runoff and drainage water from the beds is retained and later reused. Properly managed closed systems can provide a higher level of environmental protection.

Closed systems usually have an upper reservoir that serves as the water source and a lower recovery reservoir. It is desirable to have the beds at a lower elevation than the

water source. Water is temporarily stored in the down slope reservoir where potentially nutrient-bearing sediments are trapped and some breakdown of pesticides occurs. Generally, water levels in the down slope reservoir should be kept low when pesticides are applied. Pesticide residues moving out of beds in the drain water can then be retained and degraded in the down slope reservoir. This will help to protect groundwater and surface water quality. This water can also be pumped back into the beds or an upslope reservoir and reused. Recycling water in this manner reduces the water capacity required in the upslope reservoir and the need for water from other sources. In sites where a large amount of surface water runoff from higher land may inundate the bed area, diversion ditches may channel excess water from the beds.

Cranberry operations that divert surface water runoff, and drainage water from beds to streams or other surface water bodies (and do not collect and recycle water) are called "open systems". After a pesticide application, any water in the treated area needs to be held for no less than the time indicated on the pesticide labels before it can be released. Open systems have a greater potential than closed systems to adversely affect the environment. Proper design and management of an open system should minimize the potential for adverse environmental impacts.

#### **Control soil erosion and sedimentation during construction.**

Soil erosion control is an important component of agricultural non-point source pollution prevention programs, because soil itself can be a pollutant and may be a carrier of pollutants, such as adsorbed pesticides and nutrients. Avoid disturbing soil during heavy rain or windstorms. Blowing dust and wind erosion can be reduced by sprinkling water on dry soil or sand. Excavated sand should be stockpiled away from open water. Consider lining stream and ditch banks with silt fences to prevent sedimentation. Grass or vegetation should be established on roadways, dike roads, etc. as soon as possible to reduce the likelihood of soil erosion.

## **WATER MANAGEMENT**

Water is essential to cranberry production; it is used for spring reflow, frost protection, irrigation, harvest, and winter protection. Depending on the site, water may be obtained from or discharged into sources such as lakes, rivers, streams, drains, or reservoirs, as allowed by common law water rights and subject to obtaining necessary state permits. Water movement in and out of beds is controlled by a system of dikes and ditches. Excessive water may be drained or pumped to various water recovery or release areas.

#### **Dikes, ditches, reservoirs and flumes should be maintained.**

Dikes control water movement and support production equipment. Since wind, water, and burrowing animals deteriorate dikes, maintenance and upgrading are essential for efficient water containment and movement, and safe vehicle passage. Burrowing animals are the primary cause of dike failure and must be controlled. Establish grass or other vegetation on dikes and ditch banks to stabilize the soil. However, vegetation should be mowed so that it does not produce seed and increase weed pressure in the beds. Ditch bank erosion commonly occurs when saturated, unstable soil materials are subject to high velocity water

flow. Erosion can be reduced by installing geofabric or geogrid material, rock cover, or riprap to unstable embankments and down gradient sides of flumes, and by lowering water levels in ditches to improve bank stability during periods when the soil is wet, because saturated soil has little strength. Designed soil erosion control practices, such as those identified above, can be requested from the USDA Natural Resources Conservation Service (NRCS) and the local conservation district or technical service providers.

Private ditches and waterways need to be free of excessive vegetation and sedimentation that can impede drainage. If beds have adequate soil drainage, some live aquatic vegetation left in the ditches during the growing season may help filter nutrients and pesticides from the water. In this case, delay cleaning ditches and waterways until later in the season to take full advantage of this filtering action.

When cleaning private ditches, ponds, or reservoirs, be careful not to undercut ditch banks or to dig ditches too deep, since undercutting leads to instability and bank failure. If sediment being dredged from ditches has a fine texture, a silt fence is effective to capture sediments before they move offsite. Cleaning ditches from the point most distant from the flume (moving towards the flume) will enhance sediment settling. Dispose of spoils on established dikes or other upland areas. Allow ample time for excess water to drain out of dredged sediments before being moved. Use silt fences to keep sediments contained. Growers should employ all reasonable sediment control and removal techniques to receive and cleanse waters exiting the bed. Growers should also consider diverting sediment-charged water to holding ponds to allow settling of solids.

Worn or damaged flume or bulkhead boards should be replaced regularly to prevent the escape of ditch or flood water. Keep boards free of debris and consider using rubber gasket strips on channel guides or a tension activated tie down system to decrease leakage. Consider locking flume or bulkhead boards in place.

**Reduce ditch water levels as much as possible before applying nutrients and pesticides.**

Lower water levels in ditches before applications to allow for absorption of nutrients and pesticides into ditch sediment and vegetation, and increase water holding time.

**Adequate drainage is needed in all beds.**

Proper soil drainage is needed for healthy vines. Healthy vines may require less fungicide because they are less prone to diseases such as root rot. Drainage may be improved by installing surface drainage, main or laterals or subsurface (tile) drains, or by winter sanding.

**Anticipate weather.**

Heavy rainfall can wash nutrients, especially nitrogen and pesticides off the target area. Follow weather forecasts and halt fertilizer and pesticide applications when rainstorms are forecasted or frost protection is required.

**IRRIGATION**



Sprinkler irrigation is essential for cranberry culture to protect plants from spring and fall frost damage, supply water during the growing season, and apply nutrients and pesticides. To perform these functions effectively, irrigation systems should be engineered and maintained to provide maximum water application uniformity. The current Generally Accepted Agricultural and Management Practices for Irrigation Water Use (MDARD) provide useful general guidance on irrigation use.

**Irrigation systems should be designed for uniform water application.**

Irrigation systems should deliver uniform application rates of 0.1 to 0.15 inches per hour. To optimize uniformity, reduce system pressure losses by protecting pipes from dents and limit the number of 90-degree elbows. Reduce plugging by installing clean out plugs at lateral ends and a strainer basket on the intake pipe. Secure risers to a vertical stake to limit wobble. Straight, stationary risers provide more uniform water application.

**Irrigation equipment should be maintained in effective operating condition.**

Follow manufacturer recommendations for pump, valve, and sprinkler head maintenance. Inadequate maintenance can result in breakdowns at critical times, reduced system uniformity, and inappropriate application rates. Precautions should be taken to prevent fuel leaks or spills.

**Irrigation application rates and uniformity should be tested periodically.**

Irrigation system uniformity should be tested regularly. Systems with low uniformity cause some areas to receive adequate water while others receive too little or too much. Coefficient of Uniformity (CU) of less than 60 percent indicates the system needs updating or was not properly installed. The NRCS recommends a CU of 85 percent, an attainable goal using current technology. Uniformity may be affected by sprinkler rotation speed, pattern type and spacing (closer spacings give higher uniformities), nozzle pressure, wear, and size, different trajectory angles resulting from leaning risers, friction losses in laterals, different sprinkler elevations, and wind. Data collected from an irrigation uniformity test can be used to calculate the system's irrigation rate, and modifications can be made by changing operating pressure or nozzle size.

**Irrigation should be applied at appropriate rates and intervals.**

Newly set plants should receive frequent, light applications of water for the first two weeks or until roots form. To promote deeper rooting, irrigate newly planted beds less frequently but longer after plants become established. Established beds require one to two inches of water per week. Irrigation rates should be reduced to reflect rainfall received in lieu of irrigation water. Apply up to 0.5 inches per irrigation event.

Irrigation should be used to cool plants when ambient air temperatures reach 85°F or higher. Cool plants by irrigating for about one hour to thoroughly wet the plants and soil surface. Irrigate again when temperatures rise to 85°F. Drain surface pipes between irrigations to prevent scalding caused by hot water in pipes.

When irrigating for frost control, monitor both temperature and growth stage, since lethal temperatures vary with growth stage. Begin irrigating when temperatures at bed level are one to two degrees above the critical temperature, and stop irrigating when temperatures rise safely above the critical temperature. Effective frost protection requires irrigation rates

of at least 0.1 inches per hour. This rate protects buds and fruit to a temperature of 20°F (under wind conditions of 0 to 1 mph). Sprinklers should rotate at least once per minute to provide frost protection.

## **FLOODING**

Cranberry beds are flooded in the fall to harvest berries following dry harvest to remove trash and debris, during the winter to protect plants from cold injury and in the spring to control some pests, remove frost from the soil and protect plants from severe freezes.

### **Harvest.**

Hold harvest flood water in beds for at least one day, and then slowly pump or drain the water from the beds.

### **Winter flooding.**

The cranberry is an evergreen plant that can be damaged by cold and fluctuating temperatures. Beds are usually flooded in early winter so that ice covers the plants and protects them from cold, windy weather. This ice layer also makes it possible to apply sand.

Winter flood water should be applied when the surface layer of soil has frozen. The water needs to come from a surface source rather than ground water. Having the ground frozen decreases the potential of losing flood water through seepage. Using surface water that is already near freezing also reduces the chance of removing frost from the ground. The winter flood water should be applied as quickly as possible without causing soil erosion. Fast flooding reduces the chance of the wave action of the water pulling out the plants.

Drain flood water slowly to minimize water fluctuations and sedimentation in water recovery or release areas.

## **NUTRIENT MANAGEMENT**

Cranberry beds require fertilizer applications to produce economic yields. However, nutrients such as nitrogen (N) and phosphorus (P) can harm water quality if not managed properly. Excessive use of fertilizers can injure cranberry plants and reduce yields. Refer to the GAAMPs for Nutrient Utilization, Michigan Commission of Agriculture and Rural Development, for general information on how fertilizers should be handled and used to minimize environmental impacts. Refer to university recommendations for guidance on fertilization practices.

### **Nutrient use should be based on plant performance, tissue analysis, and soil test results.**

Beds on organic soils may require as little as 10 lbs. N per acre per year, whereas those on sandy soils may need as much as 60 lbs. per acre. Determine the appropriate rate for specific beds based on vine growth and yields, tissue N levels, and previous fertilization

practices. Refer to the Compendium of Blueberry and Cranberry Diseases (APS Press) for descriptions of nutrient deficiency and toxicity symptoms.

**Plan fertilizer applications to correspond with crop demand.**

Fertilizers containing N and P should be applied between bud break and late August, when plants are most able to utilize nutrients. This reduces chances of N or P loss to the environment. Fall or early spring applications of fertilizer increase the risk of nutrient losses through leaching and should be avoided. Potential for leaching is greatest on coarse textured soils. Lower rates applied when the plants are able to use the nutrients reduce runoff potential and increase nutrient efficiency.

**Ammonium forms of N should be used.**

Cranberries prefer ammonium-N over the nitrate form. Ammonium-N adsorbs to clay and organic matter in the soil, so it is less mobile than nitrate-N, and less prone to leaching.

**Fertilizer application equipment should be calibrated.**

Fertilizer is applied to cranberry beds with spreaders or booms, airplanes, or helicopters, or through irrigations systems. All application equipment should be calibrated according to the manufacturer's recommendations to ensure the proper amount of fertilizer is applied.

**Direct application of fertilizers to open water on cranberry beds should be minimized.**

When applying fertilizer to cranberry beds through irrigation systems, use part-circle sprinklers or sprinkler guards to minimize fertilizer applications to open water on cranberry beds, which can result in off-site movement.

**Soil pH should be maintained in the proper range.**

Nutrient utilization and plant growth are optimized when soil pH is between 4.0 and 5.5. Additions of sulfur may be needed to keep soil pH sufficiently low. Sulfuric acid may need to be added to irrigation or flood water that is high in alkalinity. Water discharged off the site should be in compliance with water quality standards. Safety precautions should be followed to prevent inadvertent contact with concentrated sulfuric acid.

## **INTEGRATED PEST MANAGEMENT (IPM)**

Commercial cranberry production requires management of insect pests, diseases, and weeds. Integrated Pest Management (IPM) integrates biological, cultural, and chemical control practices to manage these production problems. IPM requires knowledge of pest life cycles and identifying characteristics, and an understanding of all available control options. By scouting cranberry beds and understanding pest biology and control options, growers are able to make appropriate pest management choices. Useful references may be found in Appendix I.

## **PESTICIDE APPLICATIONS AND HANDLING**

The current version of the GAAMPs for Pesticide Utilization and Pest Control, Michigan Commission of Agriculture and Rural Development, provides general guidance on agricultural pesticide use. These GAAMPs describe information on applicator certification, application equipment, methods and record keeping, pesticide handling and safety, disposal of excess spray mixtures, and unused pesticides and pesticide containers. Instructions on the pesticide label must be followed. They are the law. Pesticide applicator certification is required to purchase or apply restricted use pesticides. Certification is recommended for all persons applying pesticides. Pesticide users also must comply with the Federal Worker Protection Standards. Keeping accurate records of pesticide applications is essential for farm planning and performance evaluation. Some considerations in pesticide use that are specific for cranberries are discussed below.

### **Understand alternatives to pesticide, which are available for the crop to be grown.**

The options for pest management in agricultural crops include non-chemical and chemical control. The pesticide user should consider alternatives and make conscious decisions concerning pesticide use that evaluate potential site contamination, pest management, and economics of use. Non-chemical means of control include sanding, flooding, and biological controls including Bts, nematodes, etc.

### **Calibrate application equipment properly.**

Proper calibration ensures equipment is delivering the correct amount of pesticide and applying it uniformly over the target area. Over-application creates needless risks to water resources and increases economic inputs and must be avoided. Under-application will result in inadequate control and economic loss.

### **Develop a plan to follow in case of pesticide emergencies.**

Pesticide applicators should develop an emergency plan that lists actions to take and persons to contact in case of pesticide poisoning, spill, fire, or other accidents. Compliance with SARA Title III regulations is described in MSU Extension Bulletin E-2175.

### **Keep pesticide applications out of surface waters by avoiding over-spray and drift.**

Prevent non-target application by shutting off sprayer when boom or mist blower crosses ditches or waterways. In most cases, label language prohibits application directly to open or surface waters. Follow label guidelines regarding wind speeds and equipment requirements in order to direct applications to the target. Application of pesticides during excessive wind (greater than five mph) causes unnecessary non-target application, reduces uniformity of the application, and reduces pesticide efficacy. Use anti-drift agents when appropriate. Regardless of application method, every effort should be made to keep pesticides confined to the bed and out of open or running water.

### **Consider the vulnerability of water and other natural resources when making pest management decisions.**

The risk of inadvertent contamination of surface and groundwater resources differs for each farm. Pesticide users should include the risk to water resources as criteria of pest management decisions. The potential for contaminating groundwater is influenced by soil characteristics, depth and type of bedrock, and depth to the water table.

**Apply pesticides only as needed.**

When making pesticide applications, use the lowest effective rate. IPM allows for better management of pest problems. IPM can provide information on pest populations that allows spot treatments and improves timing of treatments. These two strategies can lead to a reduction in overall use due to increased efficacy and earlier control.

**Hold water containing pesticide residues for required or recommended times.**

Holding water in ditches allows for degradation and dissipation of pesticide residues. All waters in contact with the beds must be retained for the length of time required by the label and, ideally, held as long as practical to allow maximum degradation. Low water levels in ditches prior to application increases the water holding capacity of a bed.

**When aerial applications of pesticides are made on beds adjacent to or near a road or highway, consider using flag people to control or stop traffic flow during application.**

Inadvertently spraying pesticides on motor vehicles traveling on public roads is illegal and will initiate an investigation by the MDARD. Repeated occurrences could jeopardize continued availability of aerial pesticide applications. Posting of flag people to stop traffic along both approaches to the bed, prior to a pesticide application, will minimize the incidence of accidental exposure.

**When chemigating, make sure your system complies with federal and state laws.**

Label instructions must be followed when applying chemicals through the irrigation system (chemigation). Pay particular attention to application, reentry, pre-harvest and water retention times. If an irrigation system is used to apply pesticides, it must be fitted with a check valve, low pressure drain, vacuum breaker, low pressure shutoff switch, and injection port on the discharge side of the pump. Pesticides cannot be legally introduced into an irrigation system through the suction side of the pump. Refer to MSU Extension Bulletin 2099 for chemigation techniques and compliance rules. Determine the amount of time it takes a pesticide to travel through an irrigation system by injecting a dye into the system and monitoring its flow through the system with a stopwatch. This information is necessary to optimize pesticide performance. Pesticide will be left in the irrigation lines if the system is operated for less than the injection time, whereas running the system for too much time can result in pesticide being washed off the target area. Pesticide injection times of greater than ten minutes may adversely affect pesticide performance.

Check your irrigation system and property before every pesticide application. Effective insect and disease control requires that the irrigation system performs satisfactorily. Confirm that main and lateral lines are not leaking and sprinkler nozzles are not plugged. Inspect the entire property to insure people or animals are not present at or near the

pesticide application area. These procedures should be followed if the pesticides are applied by the grower or custom applicator. Inspect property after application to be sure all signs are properly posted and that there are no people or animals present or near the application site.

Chemigation should only be practiced when uniformity, as measured by Coefficient of Uniformity Test, exceeds 60 percent. Non-uniform application of pesticides can pose a serious environmental and food safety risk. Optimize irrigation system performance before using chemigation as a pesticide application technique. Use of part-circle sprinklers can be effective in keeping pesticides out of surface water and off dikes and travel lanes.

## **WEED MANAGEMENT**

Weeds in cranberry beds need to be managed. Effective weed control usually requires the integrated use of chemical and cultural strategies.

### **Scout for weeds.**

Weeds must be identified correctly in order to choose effective control measures. Several references listed at the end of these GAAMPs may be useful in identifying common weed species. In scouting, note the species, infestation severity, and location for future management decisions.

### **Use cultural practices where possible.**

Sanding and hand weeding can be effective weed management practices, especially in young plantings. Weed competition can be reduced by maintaining a low soil pH and encouraging healthy, vigorous vine growth that competes with weeds.

### **Use herbicides judiciously and always according to label instructions.**

Refer to university recommendations for specific suggestions on herbicide use. Always read and follow label instructions and use the lowest effective rates. Consider bed conditions such as soil composition, weed pressure and species, and drainage in choosing herbicides and rates. Spot treat if possible. Use markers or dyes to double check where you have already applied herbicides. Apply herbicides when vines and beds are dry. Splitting applications of granular herbicides may result in better control and minimize off-site movement.

Herbicide application equipment should be calibrated annually or each time a new material is applied. Check for changes in output due to equipment wear. Ground equipment is the preferred method of granular application, providing uniform coverage and minimal off-target exposure. Understand the leaching potential of each herbicide.

### **Prevent weeds from establishing in beds.**

Start with a clean, weed free bed. Control weeds when they first appear and before they spread. For example, hand wipe or pull brambles, tree seedlings, and dodder. Mow dikes and other adjacent areas to prevent weeds and weed seeds from moving into the bed.

## **INSECT MANAGEMENT**

Various insect pests may infest cranberry beds and require chemical and cultural control practices in order to avoid crop losses.

**Avoid resistance.**

Repeated use of the same insecticide can rapidly select for resistance in certain insects and should be avoided by rotating insecticides used, integrating biological and cultural controls into management programs, and reducing insecticidal inputs to a minimum. Spot treat whenever possible.

**Predict insect infestations to increase scouting efficiency.**

Heat unit accumulation models, migration prediction systems, pheromone and light trapping networks, and other predictive technologies should be used to maximize scouting efficiency, optimize timing of applications and improve pesticide decisions made by growers.

**Protect natural controls.**

Natural predators and parasites play an important role in regulating pest insects. Their role should be enhanced wherever possible by minimizing exposure of beneficial insects to disruptive insecticidal treatments. Beneficial insect populations can be encouraged by conservation and reduced reliance on chemical control practices.

**Adopt biological controls that are effective alternatives to insecticides.**

In cases where biological controls play a major role in regulation of pests in natural systems, such controls should be utilized. When natural controls are present, these should be encouraged and protected to achieve maximum potential. In the absence of natural controls, parasites or predators may sometimes be introduced and successfully established.

**Consider the environmental risk when selecting insecticides.**

When insecticide applications are needed, select products that will provide control and minimize the potential for adverse environmental effects. Factors such as risk to non-target organisms, toxicity, persistence and potential for contamination of ground and surface water should be considered. If the potential exists for adverse aquatic effects, consider less toxic compounds.

**DISEASE MANAGEMENT**

Cranberry diseases can be best managed by integrating cultural and chemical control practices. The susceptibility of cranberry vines to disease is often associated with the overall plant health and vigor, as well as environmental and cultural conditions. The strategies and practices below may help increase disease resistance in the plant and make conditions in the bed less favorable for disease development. Optimum integration of several of these practices, where appropriate, will help manage diseases with minimal chemical input and environmental impact in an economically feasible and profitable way.

**Growers should be familiar with disease symptoms and pathogen biology.**

Refer to references in Appendix I for information on cranberry disease diagnosis and life cycles. Beds should be scouted regularly to determine disease presence and severity. Make sure the disease is correctly diagnosed before deciding on control measures.

### **Optimize nutrient practices to increase disease resistance in plants.**

Plants that are stressed by inadequate nutrition may be more susceptible to some diseases. Also, excessive nitrogen can result in rank vine growth that is susceptible to pathogen attack. Overgrowth often results in increased humidity and extended vine wetness, which encourages pathogen activity.

### **Adopt cultural disease control practices.**

Cultural practices aimed at removing or disrupting pathogens should be employed when feasible. The practice of sanding buries pathogen infested duff and proper disposal of trash piles following harvest removes inoculum. In some regions, spring floods can effectively disrupt pathogen activity. New beds should be planted with vines from healthy beds or plug plants, using disease tolerant varieties where practical. Reduce soil, water, and plant material movement from diseased beds to non-infested beds in order to limit the spread of pathogens.

Plants stressed by too little water, over watering, and/or poor drainage may be more susceptible to pathogen attack and disease development. Practices that improve drainage where needed and minimize the time during the growing season when plants are wet, should be considered. Optimizing irrigation system uniformity will improve drought management, reduce freeze damage due to inadequate frost protection, and improve disease control where chemigation is practiced.

### **Optimize uniformity of fungicide applications.**

The degree of disease management with fungicides is highly dependent on uniform application coverage. Enhance disease management by making cost effective improvements to application systems where needed, to optimize uniformity of coverage across the bed and on the target plant parts. For each chemical application systems used to apply fungicides, determine and use the optimum amount of water, pressure, injection timing, etc., needed to obtain desired product application.

### **Optimize number and timing of fungicide applications.**

For most fungal diseases in cranberries, control is best or only obtained by preventing initial attack by the pathogen. Understand life cycles and the influences of weather, and apply protective fungicides only during infection periods. Complete control is not always needed or cost effective, so only make applications when the fungicide provides substantial economic benefit.

### **Choose fungicide and formulation best suited to the current target problem.**

A steady increase or a noticeable change in disease problems over a few years may indicate a need to change fungicides or rates to better manage fungal populations. Pathogen populations and activity change from year to year for many different reasons, so fungicides may lose effectiveness. Choose the fungicide that will provide adequate control but is also the most cost effective and environmentally compatible. Choose formulations



best suited for your application system. Use less persistent, but effective, fungicides late in the growing season to reduce fungicide residues on fruit. Use the lowest effective fungicide rate.

## **WILDLIFE MANAGEMENT**

Gates and fencing may be needed to control access to cranberry operations and reduce deer damage and, in some cases, vandalism and theft by humans. Muskrats and other burrowing animals need to be monitored and controlled, since they damage dikes and roads. Contact the Michigan Department of Natural Resources (DNR) Wildlife Division for regulations regarding trapping of nuisance animals. Noisemakers, projectiles and other scare devices may be used to minimize damage from all forms of wildlife, as warranted.

## **POLLINATION**

Cranberries require bees for pollination. During the bloom period (mid-June to mid-July), honeybee hives are placed in the production area. One or more hives should be used per acre of cranberries. Insecticides that may harm bees should not be applied during bloom. Bumble bees may also be used for pollination.

## **PRUNING**

Vines should be mechanically pruned periodically to remove excessive growth and encourage upright production. Vines removed during pruning may be sold or used to establish new beds or renovate less productive beds.

## **HARVESTING**

Cranberries should be harvested when they have met the proper maturity indices (primarily color). Harvest will be from late September through October.

### **Flood harvest.**

Berries to be sold for processing are generally harvested by flooding the beds and mechanically removing the berries. The berries float and are corralled to one side of the bed and removed by elevators or suction pumps. When flooding for harvest, flood as quickly as possible without causing bed erosion. Harvesters should contain food grade hydraulic oil and each harvester must have an oil containment kit and the operator instructed on how to properly use it. Flood water should be pumped or drained slowly after harvest is complete. Trash collected from beds at harvest should be removed from the planting area to reduce disease inoculum.

### **Dry harvest.**

Berries sold for fresh consumption are generally dry harvested. Typically, berries are mechanically removed from the plants, placed in bins and removed from the bed for cleaning and storage. Dry harvested beds may be flooded after the berries are removed so the trash can be floated off. This sanitary practice removes diseased fruit and vegetation, and reduces the disease pressure the following season. All flood water should be released slowly to minimize erosion.

## **SANDING**

### **Cranberry beds should be sanded every two to five years.**

Sanding encourages growth and suppresses some insect pests and diseases. Sanding on top of the ice is preferred to applying sand in water since ice sanding usually provides a more uniform application. Ice sanding may also have less environmental impact because the water is usually held for sufficient time to allow silt-sized particles to settle out before water is discharged. Always release flood waters slowly.

## **NEIGHBOR TO NEIGHBOR RELATIONS**

U.S. Census data indicates people are leaving urban population centers for suburban and rural areas. Some people move to rural areas with certain expectations that conflict with agricultural practices. Several management practices listed here can be helpful in maintaining good relations with your neighbors.

### **Keep your cranberry farm and adjoining property clean and free of debris.**

A clean and well managed cranberry operation demonstrates pride of ownership and portrays a high level of professionalism to outsiders, whether it be residential neighbors or regulatory agency personnel. If stockpiles of pipe, culverts, and equipment parts must be maintained, try to keep material orderly and not in view.

### **Communication is the key to good neighbor relations.**

Effective communication with neighbors helps prevent and resolve problems. Inform neighbors about all aspects of cranberry production. Consider hosting tours around a social event or to observe harvest. This gives you the opportunity to explain cranberry growing firsthand. Once your neighbors have a better understanding of what you do, they may be more comfortable with your activities. It also gives you the opportunity to hear their concerns and develop positive relationships with them.

Explain to neighbors the importance of safe and ecologically-sound crop management practices, including IPM, pesticide use, and the importance of adhering to pesticide notices and sign posting. Be selective in crop management practices and evaluate the human and environmental risks associated with their use.

Be sensitive to concerns of neighbors. Be aware there are strong odors associated with certain pesticides. Post your property with appropriate signs prior to pesticide applications. Consider notifying neighbors before pesticide applications.

Much of the information in this document was derived from the Wisconsin State Cranberry Growers' Association, "Cranberry Grower Resource Notebook" of March, 1995, and "Standard Agricultural Practices for Cranberry Production in Wisconsin" of February, 1992.

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## APPENDICES

### APPENDIX I. REFERENCES

#### GENERAL CULTURE

- *Best Management Practices Guide for Massachusetts Cranberry Production Bulletin 445*. University of Massachusetts.
- *Cranberry Production in Wisconsin*. University of Wisconsin.
- *Cranberry Agriculture in Maine Grower's Guide*. Maine Dept. of Ag., Food & Rural Resources, Division of Production Development, State House Station 2.
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- *Cranberry IPM Notebook*. University of Massachusetts.
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- *Cranberry Production in the Pacific Northwest*. Washington State University. PNW-27.
- *Michigan Fruit Management Guide*. Michigan State University Extension Bulletin No. 154.

#### PEST AND DISEASE MANAGEMENT

- A field identification guide: Insect pests. University of Massachusetts.
- *Black Rot of Cranberry*. University of Wisconsin A3197.
- *Botryosphaeria Fruit Rot & Leaf Drop*. University of Wisconsin A3351.
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- *The Cranberry Fruit Worm IPM Fact Sheet*. University of Massachusetts.
- *The Cranberry Girdler*. University of Wisconsin A3188.
- *The Cranberry Weevil IPM Fact Sheet*. University of Massachusetts.
- *The Southern Red Mite IPM Fact Sheet*. University of Massachusetts.
- *Viscid Rot & Upright Dieback of Cranberry*. University of Wisconsin A3195.
- *Yellow Rot of Cranberry*. University of Wisconsin A3350.

## **WATER AND NUTRIENT MANAGEMENT**

- *Cranberry Tissue Testing for Producing Beds in North America*. EM-8610. Oregon State University.
- *Fertilizer Guide, South Coastal Oregon Cranberries*. Oregon State University FG75
- *Fertilizer Guide, Irrigation Water Quality*. Oregon State University. FG76
- *Nitrogen in Bearing Cranberries in North America*. Oregon State University
- *Phosphorus for Bearing Cranberries in North America*. University of Wisconsin.
- *Sprinkler Irrigation Application Rates & Depths*. Washington State University Bulletin EB1305.

## **WEED MANAGEMENT**

- *Aquatic Vegetation Management & Control*. Washington State University PNW224.
- *Calibrating & Using a Backpack Sprayer*. Washington State University PNW320.
- *Control of Aster & Birdsfoot Trefoil in Cranberries with Napropamide*. Washington State University.
- *Cranberry Pest Control Weed Identification Series*. University of Wisconsin.
- *Cranberry Weed Control in Wisconsin*. University of Wisconsin A2226.
- *Field Guide to Common Weeds in Southeastern MA*. University of Massachusetts.

## **PESTICIDE USE AND REGULATIONS**

- *Chemical Applications in Agriculture, Methods and Equipment for Field Sprayers*. Michigan State University NCR 520.
- *FARM\*A\*SYST for Michigan Producers*. FAS-107. Michigan State University
- *SARA Title III, The Farmer's Responsibility Under the Emergency Planning and Community Right-To-Know Law*. Michigan State University E-2175.
- *Using Chemigation Safely and Effectively*. Michigan State University E-2099.

## **MISCELLANEOUS**

- *Conservation Practice Standards and Specifications*. USDA Natural Resources Conservation Service Technical Guide (available through local NRCS offices).
- *Right-To-Farm Generally Accepted Agricultural and Management Practices for Irrigation Water Use*. Michigan Department of Agriculture & Rural Development,

Right to Farm Program

- *Right-To-Farm Generally Accepted Agricultural and Management Practices for Nutrient Utilization*. Michigan Department of Agriculture & Rural Development, Right to Farm Program.
- *Right-To-Farm Generally Accepted Agricultural and Management Practices for Pesticide Utilization and Pest Control*. Michigan Department of Agriculture & Rural Development, Right to Farm Program.
- *Frost Protection Guide for Massachusetts Cranberries*. University of Massachusetts.

## TO ORDER REFERENCES

**Michigan Department of Agriculture & Rural Development, Right to Farm Program.**

P.O. Box 30017, Lansing, Michigan 48909

**Michigan State University.** MSU Bulletin Office, 117 Central Services, MSU, East Lansing, MI 48824-1001 Phone: 517-353-6740. <https://www.shop.msu.edu>

**Oregon State University.** Agriculture Communications, Admin. Services A422, Corvallis, OR 97331. <http://extension.oregonstate.edu/catalog/>

**University of Massachusetts.** Cranberry Experiment Station, Glen Charlie Road, P.O. Box 569, East Wareham, MA 02538.

<https://ag.umass.edu/cranberry/publications-resources>

**University of Wisconsin.** Cooperative Extension Service, 630 Linden, Madison, WI 53706. <http://learningstore.uwex.edu/>

**Washington State University.** Long Beach Research & Extension Unit, Route 1, Box 570, Long Beach, WA 98631. <https://longbeach.wsu.edu/cranberries/>

## **APPENDIX II. AGENCIES, PERMITS AND REGULATORY PROGRAMS**

### **AGENCIES**

Prospective cranberry growers should have a general knowledge of the programs and responsibilities of federal, state, and local agencies and their regulatory programs that may be involved in cranberry production and harvest activities. Prior to establishing a cranberry production site, producers should consult with the EGLE Water Resources Division (WRD), and all other appropriate state and federal agencies to identify potential permit requirements. All required permits need to be obtained prior to initiation of any regulated activities, such as construction of cranberry beds and associated facilities.

### **STATE AGENCIES AND REGULATORY PROGRAMS**

#### **MICHIGAN DEPARTMENT OF AGRICULTURE & RURAL DEVELOPMENT (MDARD)**

administers the Soil Survey Act, Conservation Districts Act, Michigan Right to Farm Act, Michigan Drain Code, Fertilizer and Pesticide Control Act, and others, and is responsible for assembling agricultural statistics and promoting agricultural development in Michigan. The MDARD is involved in a joint effort with the EGLE and the Michigan Cranberry Council to ensure consistency regarding the administration of the Memorandum of Agreement (MOA) on Cranberry Production and Environmental Protection between the two departments. Landowners may contact the Environmental Stewardship Division, MDARD for information on development and operation of cranberry production facilities. One function or purpose of the MOA is to ensure that staff of both agencies receive clear guidance on how to make decisions relative to cranberry production in Michigan.

#### **MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY**

**(EGLE)** administers the state's regulatory programs involving wetlands, lakes, streams and similar water bodies and floodplains. The key EGLE regulatory and permitting programs that may be involved with the production of cranberries are commonly referred to as Part 303 Wetlands Protection Part 301, Inland Lakes and Streams, and the Floodplain Regulatory Authority found in Part 31, Water Resources of the Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended. EGLE also administers Section 404 of the Federal Clean Water Act in the non-coastal areas of Michigan through a Memorandum of Agreement with the U.S. EPA. Permit applications for work in regulated wetlands, lakes, streams or floodplains are submitted to EGLE's WRD.

#### **STATE WETLAND PERMIT PROGRAM.**

The construction of commercial cranberry farm operations in Michigan will typically include activities that involve regulatory programs administered by the WRD. Part 303 requires that an individual obtain a state permit for work in any regulated wetland. Wetlands are defined as "land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life and is commonly referred to as a bog, swamp, or marsh, and which is any of the following: - Contiguous to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or stream.

- Not contiguous to the Great Lakes, an inland lake or pond, or a river or stream; and more than 5 acres in size.

- Not contiguous to the Great Lakes, an inland lake or pond, or a river or stream; and 5 acres or less in size if EGLE determines that protection of the area is essential to the preservation of the natural resources of the state, from pollution, impairment, or destruction and EGLE has so notified the owner.

The term, "Contiguous" is further defined within the Part 303 Administrative Rules, as meaning any of the following:

(i) A permanent surface water connection or other direct physical contact with an inland lake or pond, a river or stream, one of the Great Lakes, or Lake St. Clair.

(ii) A seasonal or intermittent direct surface water connection to an inland lake or pond, a river or stream, one of the Great Lakes, or Lake St. Clair.

(iii) A wetland is partially or entirely located within 500 feet of the ordinary high watermark of an inland lake or pond or a river or stream or is within 1,000 feet of the ordinary high watermark of one of the Great Lakes or Lake St. Clair, unless it is determined by the department, pursuant to R 281.924(5), that there is no surface water or groundwater connection to these waters. (iv) Two or more areas of wetland separated only by barriers, such as, dikes, roads, berms, or other similar features, but with any of the wetland areas contiguous under the criteria described in paragraph (i), (ii), or (iii) of this subdivision.

The connecting waters of the Great Lakes, including the St. Marys, St. Clair, and Detroit rivers, shall be considered part of the Great Lakes for purposes of this definition.

A state wetlands permit is required for any grading, filling, drainage, construction of dikes, ditches, or reservoirs, or placement of other structures within a regulated wetland. There is no fee for a pre-application assessment for cranberry production activities.

For a fee, EGLE has available a Wetland Identification Program (WIP) whereby a person can request EGLE to assess whether a parcel of property or portion of a parcel is wetlands and regulated under Part 303. The findings of EGLE under the WIP are guaranteed for a 3-year period. Application forms to request a WIP assessment can be obtained at:

<https://www.michigan.gov/egle/about/organization/water-resources/wetlands/wetland-identification-program>

County wetland inventory maps, which combine information from the Michigan Resources Inventory (MIRIS); United States Fish and Wildlife Service, National Wetland Inventory (NWI) maps; and the United States Department of Agriculture, Natural Resources Conservation Service, soil surveys, are available at the County Register of Deeds, the County Clerk's office, or the County Extension Services offices. In addition, county wetland



inventory maps and information regarding county wetland inventory maps are available at the following EGLE website:

[Wetland Inventory Maps \(michigan.gov\)](http://michigan.gov)

The National Wetland Inventory maps for Michigan are available at the U.S. Fish and Wildlife Service offices with county soil surveys available at USDA Natural Resources Conservation Service county offices. Although these sources may be helpful initially in identifying potential wetlands areas, EGLE has final authority for identifying regulated wetland areas based upon site visits.

## **OTHER STATE REGULATORY PROGRAMS.**

In addition to a wetland permit, Part 301 - Inland Lakes and Streams requires that an individual obtain a permit for construction of upland reservoirs, construction of stream crossings, construction activities in a water body to facilitate water withdrawal, placement of water control structures or for alteration of lakes and streams, as defined by the statute.

An individual planning a cranberry farm operation should be aware that in addition to construction permits that may be required under Part 301 and/or 303, additional construction permits may also be required from the WRD under the Floodplain Regulatory Authority (Part 31) and the provisions of Part 315, Dam Safety. In applying for state permits, the WRD requires the submittal of a single application form for permitting programs, administered by the WRD. A separate and different permit application form is required to be submitted to Wildlife Division, DNR for impacts to a listed, threatened, or endangered species. In addition, depending on the operation of the cranberry facility, there may be water reporting requirements for withdrawal of water under provisions of the water use reporting authority of Part 327 NREPA.

Part 31, Water Resources protection of NREPA, Section 3109, states that: "A person shall not directly OR INDIRECTLY discharge into the waters of the state any substance that is OR MAY BECOME injurious to any of the following: (a) to the public health, safety, or welfare. (b) to domestic, commercial, industrial, agricultural, recreational, or other uses that are being made or may be made of such waters. (c) to the value or utility of riparian lands. (d) to livestock, wild animals, birds, fish, aquatic life, or plants or to their growth or propagation thereof be prevented or injuriously affected; or whereby (e) to the value of fish and game. (Emphasis added)

Part 31 defines "Waters of the state" as groundwaters, lakes, rivers, and streams and all other watercourses and waters within the jurisdiction of the state and also the Great Lakes bordering the state. Additional state permits may be required for discharges to surface waters of the state. The property owner and/or producer should check with the WRD to identify potential permit requirements for discharges to waters of the state.

**LOCAL APPROVAL.** If a project involves a change to or use of a designated county drain, the producer should check for necessary approvals from the county drain office.

**THE MICHIGAN RIGHT TO FARM ACT**, PA 93 of 1981, as amended, cites the following MCL 286.473, Sec. 3 (3): "A farm or farm operation that is in conformance with subsection (1) shall not be found to be a public or private nuisance as a result of any of the following:

- (a) A change in ownership or size.
- (b) Temporary cessation or interruption of farming.
- (c) Enrollment in governmental programs.
- (d) Adoption of new technology.
- (e) A change in type of farm product being produced."

## **FEDERAL AGENCIES AND REGULATORY PROGRAMS**

**UNITED STATES ARMY CORPS OF ENGINEERS (COE)** is the permitting authority for Section 404 of the Clean Water Act, except as modified by the Michigan's administration of the Federal Section 404 Program.

**ENVIRONMENTAL PROTECTION AGENCY (EPA)** has veto authority over the COE decisions and is the lead agency for the Clean Water Act.

### **FEDERAL SECTION 404 PERMIT PROGRAM.**

In addition to the state permit requirements under Michigan's regulatory programs, Section 404 of the Federal Clean Water Act regulates placement of fill and dredge materials in waters of the United States, including wetlands. In most states, a permit must be obtained from the COE for dredge and fill activities that would result in the placement or redistribution of material in wetlands and waters of the United States. In 1984, the U.S. Environmental Protection Agency (EPA) authorized Michigan to administer the Federal Section 404 program in most areas of Michigan. In those areas where Michigan has Section 404 authority, a state issued inland lakes and streams or wetland permit also authorizes activity under the Federal Clean Water Act. Michigan's Section 404 program is required to meet Federal Clean Water Act standards as long as Michigan administers the federal permit program. Action taken under the state-assumed Section 404 program is a state action taken under state law, not a federal action. EGLE may not issue a permit that carries Section 404 authority if the EPA objects to the project.

The COE has retained Section 404 jurisdiction over traditionally navigable waters including the Great Lakes, connecting channels, and other waters connected to the Great Lakes where navigational concerns are maintained. The COE also retained Section 404 jurisdiction in wetlands directly adjacent to these waters. Therefore, in Great Lakes coastal areas and adjacent wetlands, both state and federal permits are required for dredge and fill activities within wetlands and surface waters. To avoid confusion to the permit applicant, the Detroit District COE and EGLE provide a joint application process that utilizes the same application form. The application is submitted to EGLE, which forwards copies of the application to the COE if there is separate federal jurisdiction. Application forms and additional information on materials to submit with the application for a proposed cranberry farm operation can be obtained from the WRD, EGLE at:

<https://www.michigan.gov/egle/about/organization/water-resources/wetlands/state-and-federal-wetland-regulations>

**U.S. DEPARTMENT OF INTERIOR, FISH AND WILDLIFE SERVICE (FWS)** has an advisory role in the permitting process and mitigation decisions.

**U.S. DEPARTMENT OF AGRICULTURE (USDA):** Three USDA agencies may be helpful with cranberry production issues. The Natural Resources Conservation Service (NRCS) is the lead agency for soil surveys and soil information, such as prime, unique and important agricultural land. NRCS also provides highly erodible land and wetland determinations for purposes of USDA program eligibility. NRCS also provides direct technical assistance to landowners to develop and implement their conservation plans. The Farm Service Agency (FSA) is responsible for providing, filing, and maintaining the official copy of the land determinations provided by the NRCS. FSA uses this and other information to identify farms and land areas suitable for different uses. FSA also provides loans and grants as per farm bills and farm programs. Rural Development (RD) is responsible for providing financial assistance to rural businesses and both financial and technical assistance to cooperatives. RD may consider the market value of brand names, patents, or trademarks.

## **THE FEDERAL FARM BILL**

The 1935 Farm Bill is an Act to provide protection of land resources from soil erosion and sedimentation, and also protect water resources. In 1977, USDA's OGC reinterpreted the 1940 Presidential reorganization, permitting the Soil Conservation Service, presently the NRCS, to work on tribal lands situated within boundaries of a conservation district. In 1980, the USDA extended conservation assistance to Indians on tribal lands. The 1985 Farm Bill (Food Security Act of 1985), as amended by the 1990 Farm Bill (Food, Agriculture, Conservation and Trade Act of 1990), the 1996 Farm Bill (Federal Agriculture Improvement and Reform Act of 1996), the 2002 Farm Bill (Farm Security and Rural Investment Act of 2002) and the 2008 Farm Bill (Food, Conservation and Energy Act of 2008), addresses producer eligibility for USDA programs such as the Conservation Security Program (CSP).

Proposed cranberry production on existing wetlands will be exempted for USDA program benefit eligibility as a Manipulated Wetland (Wx). This exemption will require that a Wx plan be developed and filed with the Natural Resources Conservation Service (NRCS). An application for an exemption must be submitted to and approved by the local NRCS office before conversion activities begin. The area will then be labeled Wx and recorded on the USDA Farm Services Agency aerial photography.

Cranberry production is allowed on prior converted wetlands as defined in USDA Farm Bill legislation. Prior converted croplands (PC) are wetlands that were drained, dredged, filled, leveled, or otherwise manipulated, including the removal of woody vegetation, before December 23, 1985, for the purpose of, or to have the effect of, making the production of an agricultural commodity possible, and an agricultural commodity was planted or produced at least once prior to December 23, 1985. Prior converted croplands converted before December 23, 1985, are exempt from Farm Bill Swampbuster provisions and may

not be considered to be waters of the United States subject to regulatory jurisdiction under Section 404 of the Clean Water Act. Certified wetland determinations made by NRCS and accepted by the Corp of Engineers for Clean Water Act purposes will be considered valid by the Corps for five years.

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## **APPENDIX III. CRANBERRY SITE REQUIREMENTS**

The three basic considerations in choosing a suitable cranberry site are climate, soils, and water. These items will be addressed separately, although they are related to some degree. The climatic considerations can be discussed on a regional basis. However, the suitability of a specific location is based primarily on the soil and water characteristics. Since these characteristics are very site specific, we will discuss soil and water requirements in a general sense.

### **Climate**

The American cranberry is native to Maine and Nova Scotia, west to Minnesota, and as far south as Virginia and Tennessee. This represents a wide range of climatic conditions. Commercial production areas also vary enormously from the moderated marine climates of western Oregon and Washington to the harsh continental climate of central and northern Wisconsin. The suitability of Michigan regions for cranberry production can be assessed by comparing the climate to perhaps the harshest production area, Wisconsin.

There is little doubt that most of Michigan offers suitable climate. Cranberries have been successfully grown experimentally and commercially in the severe conditions of the U.P. In most respects, the climate in southern Michigan is less challenging.

### **Minimum Winter Temperatures**

Cranberry leaves and buds are subject to cold injury during the winter. Generally, midwinter temperatures below 10°F will injure plants and higher temperatures may cause injury if accompanied by wind. Since these temperatures are common in Wisconsin, Massachusetts and New Jersey, bogs in these states are typically covered during the winter with a protective layer of ice.

The USDA Hardiness Zones reflect primarily average minimum winter temperatures. Cranberry production regions range from Zone 3 (northern Wisconsin) to Zone 9 (Pacific Northwest). Michigan falls between these extremes (Zone 4 in the Western U.P. to Zone 6 in Southwest Lower Michigan).

The fact that Michigan winters are more moderate than those in Wisconsin, presents some questions about winter protection. Wisconsin growers are able to maintain ice on beds throughout the winter. Southern Michigan frequently experiences "winter thaws", when ice cover would likely be lost. Beds would periodically need to be re-flooded to form new ice. Southwest Michigan also receives more snow than production areas of Wisconsin, which could impede ice formation and cause oxygen shortages beneath the ice. Growers in this area may need to develop winter protection strategies more similar to those in Massachusetts or New Jersey than Wisconsin.

### **Soils**

Most traditional cranberry sites are on two general soil types - acid organic soils or poorly drained mineral soils. The properties of these soils include a pH of 3.5 to 5.0 in the surface

and a water table at six to 12 inches during the growing season. These traditional sites are easily converted and have adequate water. The disadvantage of these soils is that they are wetlands with surface water systems, and their development requires permitting. The following characteristics of traditional cranberry sites are fundamental plant requirements:

1. Surface Texture - usually a peat or muck organic soil surface or sandy mineral soil.
2. Depth - greater than 40 inches to bedrock.
3. Slope - zero to two percent.
4. Water Table - ranges from 1.5 to 3.0 feet during the growing season (generally poorly drained or very poorly drained soils).
5. Reaction - surface horizon pH of 4.0 to 5.5.

Some cranberry operations have recently been developed by modifying nontraditional sites so that the basic requirements above are met. This approach has been taken to avoid wetland and water use regulations, and because these sites are readily available in some areas. Other non-traditional soils have been proposed for cranberries, but they have not been tested. It is important to recognize that although several basic non-traditional sites have been proposed, the basic requirements listed above need to be met in order to successfully produce cranberries. This may require significant additional development costs. We have categorized non-traditional sites into two alternatives:

**Somewhat poorly drained and moderately well drained sands with regional water tables.**

These soils have sandy surfaces with varying amounts of organic matter, pH of 4.0 to 5.5 in the surface, and water tables one to three feet (somewhat poorly drained) to 2.5 to 6.0 feet (moderately well drained) during the growing season.

An advantage of these soils is that they are not typically classified as wetlands. The major disadvantage is their high permeability, which could lead to problems maintaining desired water table levels or with movement of chemicals into groundwater. Several existing cranberry operations in Wisconsin have expanded into these upland sites.

**Water**

Cranberry production requires large amounts of water. Water is needed to protect plants against frost damage in the spring and fall. Traditionally, plantings were flooded before predicted frosts. Most growers now frost protect by sprinkling water on plants, since this requires much less water than flooding. Irrigation is also needed throughout the growing season to meet the water demands of the plants. Cranberry plants are shallow rooted and desiccate easily. Sprinkler systems may also be used to cool the plants during hot summer weather. Beds that are wet harvested are flooded in October with one foot of water to remove the berries, and a second one-foot flood may be used to remove trash from the bed. Beds are again flooded with one foot of water in the winter to protect plants from winter weather.

Actual water requirements vary with location and management practices, and are often expressed in acre-feet. One acre-foot is the water needed to cover an acre to a depth of one foot (about 330,000 gallons). Water use estimates range from 5.1 acre-feet in Maine, to 6 acre-feet in Wisconsin, and 7.8 acre-feet in Massachusetts. However, if beds and reservoirs are designed to recycle water, actual water use may be as little as 1.5-acre feet. This system would require impervious soil substrata to prevent deep seepage losses of water, and a topographical layout that allows cycling of water from one bed to another and from beds to reservoirs.

Seasonal Water Need Estimates (acre-feet) for Cranberries			
Time	Use	Maine <sup>1</sup>	Massachusetts <sup>2</sup>
April – May	Spring frost protection	0.5	1.7
June - August	Irrigation, cooling, chemigation	1.2	1.1
September - October	Fall frost protection	0.4	
October	Harvest flood	1.0	2.0
October - November	De-trash flood	1.0	
December	Winter flood	1.0	2.0
Winter	2 <sup>nd</sup> Winter flood		1.0
	<b>Annual Total</b>	<b>5.1</b>	<b>7.8</b>
<sup>1</sup> Cranberry Agriculture in Maine Grower's Guide. Maine Cranberry Development Comm., 1993 <sup>2</sup> Massachusetts Cranberry Production. Univ. Mass. Coop. Ext. Serv., 1993			

Acquiring and discharging water are prime concerns in selecting cranberry sites. Cranberry operations typically use surface water from existing sources (lakes, streams, drainage ditches) or from reservoirs. Access to water from lakes or streams may require permits. Construction of reservoirs of sufficient size may also require permits if they are located on existing wetlands. Wells typically do not have the capacity to supply the large volumes of water required at specific times. Well water may also be difficult to use for winter floods because it requires more time to cool and freeze. Wells can be used to replenish smaller reservoirs.

In addition, relatively large volumes of water may be discharged to drainage ditches, streams or lakes. Discharge may also require permits, since the temperature and chemistry of receiving waters can be affected.

### Agricultural Water Use Reporting

Water use reporting is one of the tools that Michigan uses to catalogue water use for the protection of the state's water resources from diversions to other regions of the country, and

to improve Michigan's stewardship of this precious resource. The original legislation, now Part 327 of NREPA was signed into law in 2003. Michigan law requires that all new or increased large quantity water withdrawals (groundwater or surface water) use the Michigan Water Withdrawal Assessment Tool, to register an acceptable water withdrawal, or seek a site-specific review from EGLE to determine whether a proposed large quantity withdrawal will cause an "adverse resource impact". A large quantity withdrawal (LQW) is defined as one with a pump capacity that exceeds 100,000 gallons per day or greater from all sources (excluding residential use) under common ownership or farm as defined by the Michigan Right to Farm Act. Once a large quantity water withdrawal is registered with the state, the operator is required to continue to report their water use on a yearly basis to the MDARD. For access to the Michigan Water Withdrawal Assessment Tool and information on water use reporting or registering a new withdrawal go to:

[Water Use Program \(michigan.gov\)](http://michigan.gov)

### **Spring and Autumn Frost Potential**

The average time between the last killing spring frost and the first killing fall frost defines the growing season. In natural environments, cranberries need about 150 frost free days to mature the berry crop. The growing season in cranberry production areas is longest in Oregon and Washington (280 days) and shortest in Wisconsin (110 days in some northern areas and 160 days in the south). The growing season in Michigan ranges from 100 days in the western U.P. to 170 days in southwest Lower Michigan. Cranberry growers protect against frosts and extend the effective growing season by sprinkle irrigating or flooding. However, production in short season areas will require more frequent frost protection and thus greater management costs.

### **Precipitation/Evapo-transpiration: Irrigation Requirements**

Irrigation requirements are dependent on the amount of precipitation and evapotranspiration or amount of water lost to the air from leaves and the soil surface. Annual precipitation in major production areas ranges from 30 inches in Wisconsin to 80 inches in parts of Oregon and Washington. Average annual precipitation in Michigan ranges from 28 inches in parts of the U.P. to 36 inches in southern Michigan. Warm-season precipitation (April-September) provides an indication of the need for supplemental irrigation during the growing season. Production areas in Wisconsin receive 20 to 22 inches between April and September, whereas warm season totals for Michigan range from 16 to 22 inches. The lowest April to September totals in Michigan (16 inches) occur in the eastern U.P. and the extreme northern portion of the Lower Peninsula.

The evapo-transpiration from cranberry bogs in Michigan would likely be similar to bogs in Wisconsin. Air temperatures and relative humidity, which largely control evapo-transpiration, are generally similar in Wisconsin and Michigan. Because water losses through evapo-transpiration and precipitation are similar, irrigation requirements are generally expected to be similar between the two states.

Sprinklers are also used to cool cranberry plants during very warm days. High temperatures or dry winds early in the season may cause new growth to desiccate and



"blast", whereas hot weather later in the season may cause scalding of the berries. Temperatures as low as 80°F can injure plants in the normally cool Pacific Northwest, whereas 85°F may cause injury under New Jersey conditions. Plantings in Michigan may require less water for cooling than plantings at similar latitudes in Wisconsin.

### **Heat Units and Growing Degree Days**

Temperatures during the growing season may have affected the growth of cranberry plants and fruit differently. Optimum temperatures appear to be 60 to 80°F. Lower temperatures may limit yields by slowing growth and berry development. Higher temperatures can cause sun burning of berries during the summer, and inhibit color development if occurring during the fall. Growing degree days (GDD) are a measure of the heat accumulation during the season. Production areas in Wisconsin usually accumulate 2500 (north-central areas) to 3000 (central) GDD base 45°F. The U. P. of Michigan typically accumulates 2300-2500 GDD base 45°F, and extreme southern Michigan sees up to 3800 GDD. On average, GDDs in the U.P. are slightly lower than those in even the cooler production areas of Wisconsin, and the GDDs in southern Michigan are comparable to those in southern Wisconsin.

This worksheet addresses questions that should be considered for proposed cranberry sites. Each cranberry operation is unique in regard to the source of water, layout, etc., so only consider those questions that pertain to your operation (i.e., if your cranberry operation has a river as its water source, answer the questions under River/Stream and not those under Groundwater and Lake). Calculations, assumptions and sources of information should be retained.

## **I. DESCRIBE YOUR WATER SOURCE(S)**

### **A. River/Stream**

1. Use gauging data if available; if not available, provide best calculations based on drainage area, land use, etc., or data from a similar stream and watershed located as near as possible to the project site.

Average annual flow in cubic feet per second (cfs)

CFS flow and elevation for 100-year flood event

7Q10 flow (lowest 7-day flow in 10-year period)

7Q2 flow (lowest 7-day flow in a 2-year period)

Quantify the anticipated stream diversion, cfs /day, number of days.

2. Provide a map (to scale, 1"= 1,000') showing that portion of the project area within the 100-year floodplain and/or floodway.
3. Provide a cross-sectional drawing of the stream, upstream and downstream of the operation, showing water level at average annual flow and at 7Q2 and 7Q10.

## **B. Lake/Reservoir**

1. Describe the surface elevation, surface acreage and acre-feet (AF) of storage of the lake/reservoir during average, high water, and drought conditions.
2. Is the lake/reservoir isolated or connected to other lakes and/or river systems? Describe. Provide map as appropriate.

## **C. Watershed Information**

1. Size (acres or square miles).
2. Average slope of watershed.
3. Characterize soils of the watershed (percent peat, percent sand, percent clay, percent impervious surfaces, etc.) using the county soil survey (if none has been prepared for your county, provide best available information).
4. Characterize watershed land use (percent in upland forest, wetland, lakes, cranberry reservoirs, cranberry beds, other agriculture, urban, etc.)
5. If there are existing cranberry reservoir(s) on site, describe the distance from the project area, surface elevation, surface area, and AF of storage capacity during:
  - a. Average conditions.
  - b. High water conditions.
  - c. Drought conditions (e.g. 1976 and 1988).

## **D. Groundwater**

1. Average depth to water table.
2. Describe springs and seeps (e.g. number, location, estimated flow (in gallons per minute [gpm], etc.)
3. Describe the permeability rate of the soil(s) involved at your site (refer to county soil survey information).
4. If reservoirs are to be constructed or enhanced, include the permeability rate of soils in the area. If a county soil survey is not available, take representative core samples to estimate permeability using methods similar to those utilized in soil surveys.
- 5 Identify wetlands that may be drained as a result of groundwater removal.

## **II. DESCRIBE HOW YOUR WATER SUPPLY SYSTEM WOULD WORK**

- A. What is the total water supply (in AF) combining river/stream, lake/reservoir and/or groundwater sources? What percentage would each contribute to your

water supply?

- B. If the proposal is an expansion of an existing cranberry operation, describe how the proposed expansion would tie in.
- C. Identify discharge points on the site plan and for each indicate the frequency, duration, and volume. (If more than one point, give percentages for each):
  - 1. Reservoir(s) - (Give estimated detention time for reservoirs used as temporary detention basins.)
  - 2. Natural lake.
  - 3. Stream/river.
  - 4. Wetland complex.

### **III. WATER USE**

Precipitation, evapo-transpiration, and runoff amounts vary throughout Michigan. Data for specific locations can be obtained from the State Climatologists Office, Room 417, Natural Science Building, Michigan State University, East Lansing, MI 48824, 517-355-0231. the average annual water use for cranberry production is 6 AF per acre of bed. Average annual precipitation ranges from 28 to 36 inches, and runoff from 6 to 21 inches.

- A. Water requirements of your cranberry operation (acres of beds x 6 AF), both proposed and existing (if applicable) .
- B. Estimate, in AF and percentage of total water use, how much water would be reused (i.e., pumped back into reservoir), during what time period.
- C. Estimate how much water would be lost due to seepage.
- D. Estimate AF of water discharged from the cranberry operation (i.e., to river or lake).
- E. Complete a balance sheet of water sources (river, lake, reservoir, groundwater, net precipitation, etc.) and water uses (6 AF per bed, seepage, discharged outside of cranberry operation, etc.) for a one-year period assuming average conditions.

### **IV. IMPACT ANALYSIS**

Prior to completing the following elements, the owner and/or operator is required to run the online EGLE Water Withdrawal Assessment Tool to determine if the withdrawal, as proposed, withdrawal is acceptable or requires a site-specific review by EGLE to determine

if there is sufficient water available or if the proposed use will result in an adverse resource impact.

#### **A. River/Stream Water Source**

1. Provide a water quantity analysis evaluating the in-stream impacts, both upstream and downstream, of withdrawing water for your cranberry operation.
2. Under a worst case situation, such as the drought of 1976 or 1988, what percent of the cfs flow of the river/stream would be diverted to your cranberry operation?

Use cross-sectional drawings similar to those in Part I.A.3. to show downstream water levels under average conditions and at 7Q2 with the proposed project in place.

#### **B. Lake/Reservoir Water Source**

1. How much would the surface elevation be lowered during the maximum short-term withdrawal (e.g. putting on the winter flood)?
2. If a reservoir (impoundment) is used, what is the distance and difference in elevation to the nearest occupied buildings located downstream and laterally (adjacent to the reservoir) considering both on your property and neighboring properties?

#### **C. Groundwater Water Source**

Describe the effect on the groundwater elevation due to proposed dikes, reservoirs, etc. (e.g. would the proposed reservoir raise the groundwater elevation? If so, how much?)

#### **D. Summary**

Describe how your water use could affect neighboring property owners (both upstream and downstream), wildlife refuges, recreational areas, public or private water supplies, other cranberry operations, and/or other agricultural users.

## ADVISORY COMMITTEE

Listed below are the annual review committee members for the Generally Accepted Agricultural and Management Practices for Cranberry Production

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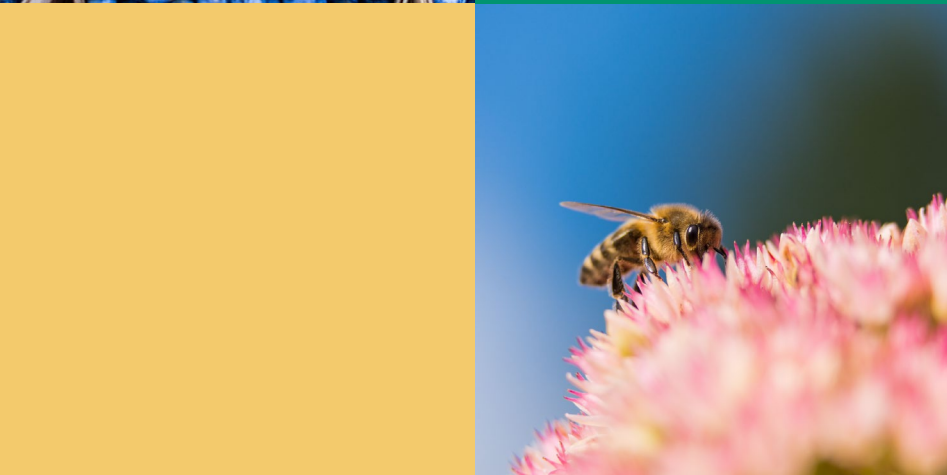
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	A	B	C	D	E
1	<b>Public comments for the Generally Accepted Agricultural Management Practices (GAAMPS) 2025</b>				
2	<b>Name</b>	<b>Date</b>	<b>Description of GAAMP</b>	<b>Description of Public Comment</b>	<b>Response to Public Comment</b>
3	Charles Rhines	2/27/2024	Care of Farm Animals	Like to propose a change to the GAAMPS in the following manner, which would eliminate these unnccessary challenges and errant measures to seek the target elevation sought. X = Distance from the property line; Y= Matsuzawa establised a glide slope of 60%; Z= property line elevation +6 feet above entrance. This simple equation would improve accuracy of achieving the target goal and to mitigate challenges in neighbor relations. Added to this I agree that a setback minimum of 3 feet is a good idea as expressed in illustration from the City of Portland Oregon. And as to sidewalks and other public high intensity use should also have a minimum distance requirement.	The Advisory Committee has provided updated language in response to public comment to the Honey Bee section of th Care of Farm Animal GAAMPS
4	Elizabeth Bourcier	3/21/2024	Care of Farm Animals	I believe language used in the GAAMPS should be stronger and concise. Words such as consider, should, and recommended allow for ambiguity when investigating and conforming to the GAAMPS. Also GAAMPS listed in areas such as the Honey Bee section should be enhanced to increase safety to honey bees and neighbors. Some suggestions I have include adding back policy from the 2021 GAAMPS for Hive placement and Hive management but increasing language. For example instead of saying Recommendations for considerate hive management (in which beekeepers do not have to consider), the language should be changed to Hive Management Adherence: Beekeepers need to maintain the following standards to be in compliance: (then list the points in the GAAMPS). Also I believe adding these additional points would enhance safety for bees and humans: 1.Honeybees are not permitted to be located within 200 feet of neighboring properties without written permission/agreement from surrounding neighboring property owners. 2.For properties that cannot situate hives at least 200 feet in any direction from all property lines, who have neighboring agreement, barriers must also be used. 3.Beekeepers must assure an adequate source of fresh water for their bees prior to establishing an apiary. The adequate source of water needs to be on the beekeepers property to ensure safety from possible pesticide exposure. 4. Hives must be located in a quite area of the lot. Quiet area would be 200 feet away from children's play areas, schools, commercial buildings, parks, highways, sidewalks, roads, and public rights of way.	The Advisory Committee has provided updated language in response to public comment to the Honey Bee section of th Care of Farm Animal GAAMPS
5	Stephon Bagne	8/29/2024	Care of Farm Animals	To allow incidental indoor or outdoor public viewing arears to be permitted in association with equestrian uses. Changes to the two opening sentences in the Management Overview.	Concerns have been submitted to the Advisory Committee for review
6	Attorneys for Animals	8/30/2024	Care of Farm Animals	Would like the Care of Farm Animals to mention Highly Pathogenic Avian Influenza (HPAI)	Animal Disease and Zoonotic Disease Transmission The major functions of the World Organization for Animal Health (WOAH) are to collect and disseminate information on distribution and occurrence of animal diseases and to ensure that scientifically based standards govern international trade in animals and animal products. The WOAH helps to achieve this through the development and revision of international standards for diagnostic tests and vaccines, and for the safe trade of animals and animal products. The USDA APHIS-VS is authorized under the Animal Health Protection Act11 to take actions to prevent the spread of animal diseases. The USDA APHIS-VS protects and improves the health, quality, and marketability of our nation's animals, anir products and veterinary biologics by preventing, controlling and(or) eliminating animal diseases (Determination of Extraordinary Emergency Reference), and monitoring and promoting animal health and productivity. Within Michigan th MDARD Animal Industry Division (AID) protects the public's health and the health of livestock. The State Veterinarian is responsible for overall livestock and poultry disease programs and toxic substance contamination concerns as they rel to animal health. The MDARD AID also works on the eradication of animal diseases under authority of the Michigan Ani Industries Act12.
7		8/16/2024	Farm Market GAAMP	The proposed GAAMP for farm markets would give rise to confusing interpretations by local enforcement officials due to the inclusion of the appendix. The introduction on the one hand says it is not to be interpreted as binding, the text of the appendix goes on to give specific examples of things that are not allowed under the proposed GAAMP.	The current Farm Markets GAAMPS is clear and can function without <i>Appendix A</i> (the changes to <i>Parking and Drivewa</i> and <i>Signage</i> are necessary). However, the Committee agreed that inclusion of <i>Appendix A</i> would provide additional clarity to the preemptive protections and limits of Right to Farm and Farm Markets GAAMPS, promoting earlier conflict resolution and limiting litigation. Moving forward, should the Commission adopt <i>Appendix A</i> , the Committee intends to propose additional amendments to the appendix, such as addressing State Building Code, etc.

	A	B	C	D	E
8	Marc Santucci	8/16/2024	Farm Market GAAMP	<p>I believe the discussion of Appendix A consideration for farm markets - nonfarm product sales, processing, and miscellaneous activities has the potential of eliminating some of the activities that are promoted by the Farm Market GAAMP itself.</p> <p>The purpose of the farm market GAAMP is to provide the farmer with the opportunity to add value to his farm product and sell it directly to the consumer. It also provides a protection against local government organizations that, responding to the non-farm members of the community, create restrictions that end up denying the farmer the ability to add value and sell his product.</p> <p>The Farm Market GAAMP already restricts what a farmer can produce, process, and sell at the farm stand. Why give the local government the ability to limit what a farmer can process such as baking pies or cooking dinners. The GAAMP should clearly recognize and support that activity. The only restriction should be that it be done in accordance with state and local health regulations to the extent there is any regulation.</p> <p>Allowing this statement to remain in the appendix will end up encouraging local governments to restrict what is otherwise promoted by the GAAMPS.</p> <p>Farming in the 21st century is far different than it was even twenty-five years ago. As a cherry farmer for years almost all of my income came from selling my cherries to processors. For the past five years it has not been profitable to sell my production in that manner. I am fortunate enough to have recognized the trends and several</p>	<p>The addition of <i>Appendix A</i> does not eliminate or reduce any protection provided for in the current, or any previous, version of the Farm Markets GAAMPs. A MDARD Inspector cannot utilize the appendix for conformance determination. Additionally, this addition does not contradict provisions for marketing as the Farm Markets GAAMPs specifically refers “<i>farm products</i>” under <i>Marketing</i>. I believe the confusion lies in a common false premise that the Right to Farm Act ar Farm Market GAAMPs provides preemption from local zoning for activities that are assumed to fall under the definition <i>farm</i> or <i>farm operation</i> but are, in actuality, a non-agricultural commercial operation not preempted by the Right to Far Act. Also, while the Right to Farm Act clearly provides preemptive protection for production (growing of crops, raising animals, etc.) and sales, the Act does not provide any protection for on-site processing (making grapes into jelly, wine, etc.). The Farm Market GAAMPs allows sales of processed farm products. Any attempt by the Committee to intentiona include non-agricultural commercial operations as part of the definition in the Farm Markets GAAMPs would artificially expand the legislative intent and clear definitions of the Right to Farm Act.</p>
9	Mario Tabone	8/26/2024	Farm Market GAAMP	<p>Farm Markets need more ability to draw in people. Include offering processed items like cider, pies, james, wine ect. Selling merchandise containine the farms logos. Include events, birthday parties, school trips, music, or any host of other activities to draw in more customers to buy farm products while also entertaining the customers.</p>	<p>There exists much confusion among many farmers, municipalities, residents and attorneys over the extent of Right to Farm preemption and limits of local zoning authority as it relates to Farm Markets GAAMPs. The intent of <i>Appendix A</i> i provide a framework for all interested parties to better understand these boundaries without subjecting farmers or MD/ inspectors to additional regulations necessary for conformance determination and to preemptively mitigate conflicts a litigation.</p>
10	Lee Lutes	8/26/2024	Farm Market GAAMP	<p>Farm Markets need more ability to draw in people. Include offering processed items like cider, pies, james, wine ect. Selling merchandise containine the farms logos. Include events, birthday parties, school trips, music, or any host of other activities to draw in more customers to buy farm products while also entertaining the customers.</p>	<p>There exists much confusion among many farmers, municipalities, residents and attorneys over the extent of Right to Farm preemption and limits of local zoning authority as it relates to Farm Markets GAAMPs. The intent of <i>Appendix A</i> i provide a framework for all interested parties to better understand these boundaries without subjecting farmers or MD/ inspectors to additional regulations necessary for conformance determination and to preemptively mitigate conflicts a litigation.</p>
11	Chris Baldyga	8/28/2024	Farm Market GAAMP	<p>Reject to changes due to removing all the protections previous versions of the GAAMPs provided to MI farmers and threaten the viability of businesses.</p>	<p>There exists much confusion among many farmers, municipalities, residents and attorneys over the extent of Right to Farm preemption and limits of local zoning authority as it relates to Farm Markets GAAMPs. The intent of <i>Appendix A</i> i provide a framework for all interested parties to better understand these boundaries without subjecting farmers or MD/ inspectors to additional regulations necessary for conformance determination and to preemptively mitigate conflicts a litigation.</p>
12	Chris Baldyga	8/28/2024	Farm Market GAAMP	<p>Object to Appendix A looks to create ambiguity and remove many of the previous protections for farming operators which threatens the viability of family farming statewide.</p>	<p>The addition of <i>Appendix A</i> does not eliminate or reduce any protection provided for in the current, or any previous, version of the Farm Markets GAAMPs. A MDARD Inspector cannot utilize the appendix for conformance determination. Additionally, this addition does not contradict provisions for marketing as the Farm Markets GAAMPs specifically refers “<i>farm products</i>” under <i>Marketing</i>. I believe the confusion lies in a common false premise that the Right to Farm Act ar Farm Market GAAMPs provides preemption from local zoning for activities that are assumed to fall under the definition <i>farm</i> or <i>farm operation</i> but are, in actuality, a non-agricultural commercial operation not preempted by the Right to Far Act. Also, while the Right to Farm Act clearly provides preemptive protection for production (growing of crops, raising animals, etc.) and sales, the Act does not provide any protection for on-site processing (making grapes into jelly, wine, etc.). The Farm Market GAAMPs allows sales of processed farm products. Any attempt by the Committee to intentiona include non-agricultural commercial operations as part of the definition in the Farm Markets GAAMPs would artificially expand the legislative intent and clear definitions of the Right to Farm Act.</p>
13	Christopher Patterson	8/30/2024	Farm Market GAAMP	<p>Further clarify the role of local regulations in relation to farm markets as to work towards reducing ambiguity regarding the applicability and scope of the Farm Market GAAMP.</p>	<p>There exists much confusion among many farmers, municipalities, residents and attorneys over the extent of Right to Farm preemption and limits of local zoning authority as it relates to Farm Markets GAAMPs. The intent of <i>Appendix A</i> i provide a framework for all interested parties to better understand these boundaries without subjecting farmers or MD/ inspectors to additional regulations necessary for conformance determination and to preemptively mitigate conflicts a litigation.</p>

	A	B	C	D	E
14	Alex Lagina	8/30/2024	Farm Market GAAMP	They remove all protections previous versions of the GAAMPs and threaten the viability of our businesses. Appendix A is a direct contradiction with the provisions of the acutal GAAMPs, which, far from being "educational" actually creates more vagueness and conveys contradictory information to Michigan citizens, which will do nothing but invite conflict.	The addition of <i>Appendix A</i> does not eliminate or reduce any protection provided for in the current, or any previous, version of the Farm Markets GAAMPs. A MDARD Inspector cannot utilize the appendix for conformance determination. Additionally, this addition does not contradict provisions for marketing as the Farm Markets GAAMPs specifically refers “ <i>farm products</i> ” under <i>Marketing</i> . I believe the confusion lies in a common false premise that the Right to Farm Act ar Farm Market GAAMPs provides preemption from local zoning for activities that are assumed to fall under the definition <i>farm</i> or <i>farm operation</i> but are, in actuality, a non-agricultural commercial operation not preempted by the Right to Far Act. Also, while the Right to Farm Act clearly provides preemptive protection for production (growing of crops, raising animals, etc.) and sales, the Act does not provide any protection for on-site processing (making grapes into jelly, wine, etc.). The Farm Market GAAMPs allows sales of processed farm products. Any attempt by the Committee to intentiona include non-agricultural commercial operations as part of the definition in the Farm Markets GAAMPs would artificially expand the legislative intent and clear definitions of the Right to Farm Act.
15	Karl Witkovsky	8/19/2024	Manure Management	The application of liquid manure on fields, we have a farmer that put down liquid manure. It is over 4 weeks and not worked in the ground. At the time it was applied it was a wheat stubble field with hay planted first, at this time of application there was 2% hay growing not classifying this as a hay field. We are asking that when the manure is applied machinery work it in the ground, they have machinery to do this at time of application. The smell is so strong a person can not enjoy fresh air coming threw windows or sit on nice deck looking at the stars. This is also a problem with health concerns with people with breathing concerns. As time goes on this is getting to be a big problem across Michigan , when this was passed in the 1980's by Michigan Department of Ag there was no consideration for the average home owner close to the fields. Thank you very much. The application of liquid manure on fields, we have a farmer that put down liquid manure. It is over 4 weeks and not worked in the ground. At the time it was applied it was a wheat stubble field with hay planted first, at this time of application there was 2% hay growing not classifying this as a hay field. We are asking that when the manure is applied machinery work it in the ground, they have machinery to do this at time of application. The smell is so strong a person can not enjoy fresh air coming threw windows or sit on nice deck looking at the stars. This is also a problem with health concerns with people with breathing concerns. As time goes on this is getting to be a big problem across Michigan , when this was passed in the 1980's by Michigan Department of Ag there was no consideration for the average home owner close to the fields. Thank you very much.	Concerns have been submitted to the Advisory Committee for review
16	Milan Siroky	8/21/2024	Pesticide GAAMP	was wondering if we can set up a noise limit on air / propane cannons at farm edge to coincide with local Township rules for ALL OTHER RESIDENTS please!How is it fair for ALL RESIDENTS other than farmers to have to abide by township rules and let farmers do whatever and whenever they want?! This country does not abide by rules for thee but not for me!	Concerns have been submitted to the Advisory Committee for review
17	Reamer, Suzanne	8/5/2024	Siting GAAMP	1. Page 18 /link for NRCS is incorrect and needs to be corrected. 2. Page 20 Section IV: Manure Storage Structure change or installation at Existing Livestock Facilities; property line setbacks "nearest point of the livestock facility" use of the wording "property line setbacks" should be changed. 3. "Concern 2: “ All variances from minimum property line setbacks must be proposed in advance of Site Suitability Approval.” This sentence at the last Siting GAAMPS committee meeting (July 22, 2024) was agreed to be removed. The first part of this section states, “A manure storage structure change or installation at an existing livestock facility is not required to complete the site	All links identified by NRCS as the "wrong link" or "recommended to include" should be added to the Draft 2025 GAAMP. other concerns identified by NRCS are important issues that warrant full Task Force discussion. These concerns will receive top priority during the 2026 review of the Site Selection GAAMP.





# Regenerative Agriculture

Best Practices

Commission of Agriculture and Rural  
Development

November 6, 2024

A close-up photograph of tea plant leaves, showing their serrated edges and vibrant green color, set against a warm, orange-hued background.

# What is Regenerative Agriculture?

## MDARD's definition

Regenerative agriculture is an active approach to land management driven by improving soil health. Rather than a rigid set of rules, it embraces a blend of sustainable farming methods tailored to each farmer's needs.





# MDARD Regenerative Agriculture Program

## Mission

Our mission is to champion a regenerative approach to agriculture, resulting in greater farmer prosperity, improved farm ecosystems, increased community health, and vibrant food systems in the Great Lakes region.

# MDARD Regenerative Agriculture Program

## Vision

Michigan agriculture can become a beacon for sustainability within the Great Lakes region. Our communities are nourished by a robust local food supply chains and supported by farmers committed to regenerative principles and practices.

Through innovation, education, and collaboration, MDARD helps cultivate a landscape where farm profitability, environmental stewardship, and community well-being thrive in harmony.







# Core Principles

- Understanding the context of your farm operation
- Minimizing soil disturbance
- Maximizing diversity
- Keeping soil covered
- Maintaining living roots year-round
- Integrating livestock and increasing biodiversity

By adopting regenerative agricultural practices, farmers and landowners can be profitable while restoring healthy soils and safeguarding our natural resources for future generations.



# Why regenerative agriculture?

Consistently following the principles of regenerative agriculture leads to:

- Increased soil health
- Biodiversity
- Water management
- Carbon sequestration
- Economic resilience

Regenerative agriculture considers the environment as a whole, aiming to mimic its natural processes. By reinstating the biological and physical processes found in nature, farmers can decrease the synthetic inputs and build resilience to markets and climate fluctuations.





# Residue Management

Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while limiting soil-disturbance activities used to grow and harvest field crops in systems where the surface is tilled prior to planting.





# Cover Crop

- Grasses, legumes, forbs, or other herbaceous plants established for seasonal cover and conservation purposes.
- **Sunlight harvesters**



# Prescribed Grazing

Managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives.

# FY2024-2027 Strategic Plan

Establish the Regenerative Agriculture Unit, systems, and support.

- Hiring and onboarding of staff, developing training and work plans, and establishing a soil health advisory committee.

Increase our understanding of the barriers and opportunities for regenerative agriculture systems.

- Support and/or lead strategic field trials and research.

Increase the adoption of regenerative agriculture practices.

- A multi-faceted approach that involves increased educational and training opportunities for farmers, exploring networking and farmer-led support programs, increasing market opportunities, and showcasing successfully implemented regenerative practices.



# What to expect in FY2025

**Training for our staff, conservation technicians, and farmers.**

The trainings will be offered through various platforms which will include a variety of online training courses, field days that feature both classroom and hands-on learning opportunities, and one-on-one farmer focused trainings where producers will be provided custom tailored information on regenerative agriculture depending on their resource concerns.





# What to expect in FY2025

## **Regenerative agriculture technical assistance for farmers:**

- Soil Health Tests - We will offer to take three soil health samples per selected farm that is engaged or interested in regenerative agriculture.
- Soil Health Assessments - Technicians will also be provided equipment and perform in-field soil health assessments to document soil color, differences in surface temperature based on residue levels, and compaction using a penetrometer.
- Surveys - Gauge farmers' understanding of regenerative agriculture, identify barriers to implementing practices, understand factors influencing on-farm decision making, and other related topics.



# What to expect in FY2025

## **Demonstration of regenerative principles and practices at the Working Lands Climate Corps (WLCC) site.**

The WLCC member cohort will be receiving hands-on training and support over 12 months while assisting with implementation of regenerative principles on the site. The WLCC members are tasked with recruiting veterans interested in learning about regenerative farming and assisting in training them on the implementation of regenerative agriculture practices.



# What to expect in FY2025

**Farmer-led network grants will be awarded to farmer groups with five or more members via a partner nonprofit or local government entity.**

The program seeks to improve soil health and water quality, support farmer collaboration and farmer support networks, encourage and test innovative conservation approaches, increase economic opportunity, and de-risk transition to regenerative agriculture. Groups will be able to disperse funds in pre-approved categories directly to farmers.



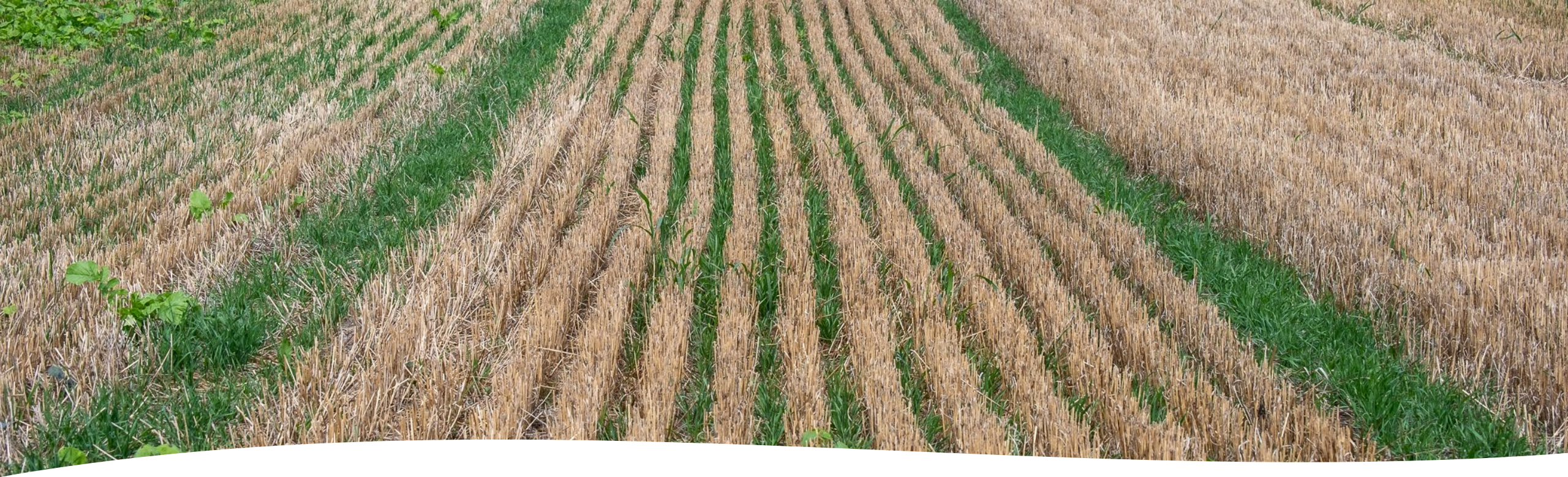
# What to expect in FY2025

## Development of a Soil Health Advisory Committee.

The committee will provide guidance on policy, programs, research priorities, and provide a space for stakeholders to collaborate and coordinate programming efforts at a state level.







# Thank you!

Many of our goals cannot be completed by the Regenerative Agriculture Program alone, therefore; we're actively seeking collaborative relationships with outside stakeholders.



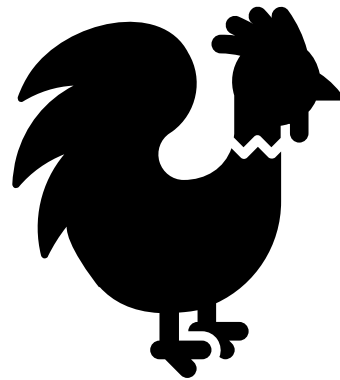
# Contact Information

Erik Palm

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GRETCHEN WHITMER  
GOVERNOR

STATE OF MICHIGAN  
DEPARTMENT OF TREASURY

RACHAEL EUBANKS  
STATE TREASURER

**DATE:** October 3, 2024

**TO:** Tim Boring, Director  
Department of Agriculture and Rural Development

**FROM:** Rachael Eubanks *Rachael Eubanks*  
State Treasurer

**SUBJECT:** Inspection Fee Inflation Adjustments  
Nursery Stock Grower  
Nursery Dealer, Import, Export and Special

MCL 286.206(6) provides that:

. . . the director [of the Department of Agriculture and Rural Development] shall adjust the schedule of fees for the costs of making the various inspections of nursery stock, plants, and plant materials as required by this act. The director shall review and adjust its schedule of fees for the inspections at the end of each fiscal year. **In any given fiscal year, the director may raise inspection fees by not more than an amount determined by the state treasurer to reflect the cumulative annual percentage change in the Detroit-Ann Arbor-Flint consumer price index over the 1-year period. An adjustment under this subsection shall not exceed 5% even if the amount determined by the state treasurer to reflect the cumulative annual percentage change over the 1-year period is more than 5%.** If the cumulative annual percentage change over the 1-year period is less than zero, a cumulative annual percentage change of zero shall be used for the adjustment. The adjustment shall be rounded to the nearest dollar to set each year's fee under this subsection, but the absolute value shall be carried over and used to calculate the next annual adjustment. The commission of agriculture and rural development shall approve all adjustments to the fees before they are adopted.

As we have in the past to calculate maximum nursery fee amounts:

We calculated the percent increase in the Detroit-Ann Arbor-Flint (now, Detroit-Warren-Dearborn) consumer price index for fiscal year 2024 using the six published values for the year (the six even numbered months of the year).

**Using the six published months of data yields a 3.5 percent increase in the Detroit-Warren-Dearborn CPI for fiscal year 2024.**

In fiscal year 2024, inspection fees are as follows:

Nursery Stock Grower Inspection Fee:

\$65 for the first acre inspected

\$39 per acre for each additional acre inspected

Nursery Dealer, Import, Export and Special Maximum Inspection Fee

\$71 per hour

Thus, given that the Detroit CPI rose 3.5 percent in FY 2024 the maximum fees that may be charged in FY 2025 are as follows:

**Fiscal Year 2025 Nursery Stock Grower Maximum Inspection Fee:**

**\$67 for the first acre inspected**

**\$40 per acre for each additional acre inspected**

**Fiscal Year 2025 Nursery Dealer, Import, Export and Special Maximum Inspection Fee:**

**\$74 per hour**

Please contact Jim Birney at [BirneyJ@michigan.gov](mailto:BirneyJ@michigan.gov) or Andrew Lockwood at [LockwoodA@michigan.gov](mailto:LockwoodA@michigan.gov) if you have any questions.

cc: Mike Philip, Director, Pesticide and Plant Pest Management Division, MDARD  
Sylvia Renteria, Director, Finance and Budget, MDARD  
Eric Bussis, Department of Treasury  
Andrew Lockwood, Department of Treasury  
Jim Birney, Department of Treasury  
Katherine Kratz, Department of Treasury

**Michigan Commission of Agriculture and Rural Development**  
**November 6, 2024**  
**Request for Approval to Increase Nursery and Related Inspection Fees**

**Purpose**

The Pesticide and Plant Pest Management Division (PPPMD) requests the Commission of Agriculture and Rural Development to approve proposed increases in its nursery and related inspection fees.

**Authority**

The Insect Pest and Plant Disease Act, P.A. 189 of 1931, authorizes PPPMD to:

- Charge an inspection fee based on the cost of doing an inspection.
- Annually adjust inspection fees based on the percentage change in the Detroit-Ann Arbor-Flint (now Detroit-Warren-Dearborn) Consumer Price Index (CPI) (determined by the State Treasurer):
  - Adjustment not to exceed 5% in a one-year period.
  - Commission must approve adjustment.

**Fiscal Year Review of the Cost of an Inspection**

PPPMD evaluates the cost of conducting plant and plant product inspections at the end of each fiscal year. For the 2024 fiscal year, this evaluation found that:

- Inspection and license fees totaled \$930,000 which did not cover the approximately \$3.9 million cost of these programs.
- Approximately \$2.97 million in general fund was required to support these programs.

**Consumer Price Index (CPI)**

The State Treasurer notified MDARD on October 3, 2024, that the Detroit-Warren-Dearborn CPI rose 3.5% in FY 2024.

**Inspection Fee Schedules**

<u>Current:</u>	\$71/hour	<u>Proposed:</u>	\$74/hour [\$3/hour increase]
	\$65/acre (first acre)		\$67/acre [\$2/acre increase]
	\$39/acre (subsequent acres)		\$40/acre [\$1/acre increase]

Revenue increase: estimated at \$17,232.

**Persons Affected by Inspection Fee Increases**

- Nursery stock growers and dealers
- Exporters of plants and plant products
- Christmas tree growers shipping cut trees out of state
- Importers of foreign-source nursery stock
- Persons requesting inspections under special circumstances

**Effective Period**

January 1, 2025 – December 31, 2025

**Notification of Proposed Inspection Fee Increases and Effective Period**

On October 21, 2024, PPPMD notified the following organizations about the proposed changes in fees:

- Michigan Nursery and Landscape Association
- Michigan Green Industry Association
- Michigan Christmas Tree Association
- Michigan Greenhouse Growers Council
- Michigan Agri-Business Association