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Quick fact! The $ Value of Dairy Manure
Using current fertilizer value (11/12/2019)

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<table>
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<tbody>
<tr>
<td>Urea</td>
<td>$370/ton</td>
</tr>
<tr>
<td>DAP</td>
<td>$405/ton</td>
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<tr>
<td>Potash</td>
<td>$364/ton</td>
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1,000 gallons of dairy manure using book values for the NPM Program’s Fast Facts publication would replace $11 of commercial fertilizer.
Multiply $11 times the application rate that is the fertilizer value of manure (8,000 gallons per acre x $11 = $88 of nutrients per acre).
Solid manure would replace commercial fertilizer at a rate $4/ton of manure applied (20 ton x $4 = $80 of nutrients per acre)

There are added benefits to the soil when manure is applied to cropland: secondary nutrients, micronutrients and organic material!

Tips for Taking Manure Samples
Manure nutrients can vary significantly throughout a storage system:
Proper agitation can greatly reduce nutrient variability
Composite sampling is recommended for each emptying session:
Minimum of 10 sub samples is recommended to make a composite sample
A composite sample should be taken for each emptying event — this could be a day or a few days, or when the practices (and therefore the manure characteristics change significantly)

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Manure Applicators Workbook 2020

University of Wisconsin-Madison, Extension Nutrient Management Team Manure Application Subcommittee:
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Understanding Manure Gases

The four main gases produced with the decomposition of manure are hydrogen sulfide, ammonia, carbon dioxide and methane. The primary hazards of these gases are toxicity, asphyxiation and potential for explosion.

The most serious problems with manure gases occur when manure is agitated or when ventilation systems are inadequate or fail. However, gases are constantly being produced and there is never a ‘safe’ time to enter manure storage facilities or other confined spaces, such as tanks, within a manure handling system.

1. The most serious problems with manure gases occur when manure is ________________ or when ________________ systems are inadequate or _________.

2. Which manure gas is the most toxic? __________________________
Working in Confined Spaces

Follow your company’s confined space procedure. If your company’s procedure indicates no entry, that means no entry. Thinking that an action will only take a second, may take a life.

If your procedures allow for entry, and entry is required, take the following precautions prior to entering a confined space:

1. Ventilate the space
2. Use a retrieval system that includes a safety harness, tripod, and winch and have adequate personnel available
3. Utilize the buddy system with safety attendant
4. Measure hazardous gases using a gas monitor
   The only accurate measure of gas levels is an appropriate gas monitor. When working with manure systems and working in confined spaces, a multi-gas monitor is recommended.

Factors that INCREASE RISK by decreasing gas dispersion from manure storage areas,

- When wind conditions are still
- During temperature inversions
- When impermeable covers are used
- When a heavy crust forms

During normal atmospheric conditions, the air temperature is warmest near the soil surface and cooler at higher altitudes (30-100 feet above the ground). Cooler air is denser than warmer air, so air is constantly moving vertically during normal conditions. During a temperature inversion, the air temperature near the soil surface is cooler than the air above, preventing vertical air movement. Temperature inversions are common during the summer, and typically start in the evening and may last until the next morning. Signs of temperature inversion include low wind speed (< 3 mph), dust or smoke hanging in the air and slowly moving horizontally, and presence of haze in low areas.

3. What is an approved method/device to determine the risk of hazardous gases being present in a confined space or near a manure pit?

_________________________________________

4. List three safety precautions that can be taken prior to entering a confined space:

_________________________________________        ____________________________________        ____________________________________
5. List two safety precautions to take before and during manure agitation:

__________________________________        __________________________________

6. During what stages of agitation are lethal manure gases of greatest concern?

________________________   and  __________________________________
Pump and Pressure Safety

Each year, billions of gallons of liquid manure are pumped through miles of hose. To achieve efficient rates of gallons per minute, high horsepower motors are needed to push manure out to irrigation tractors in the fields from storage pits or transfer tanks. This creates dangerous air and fluid pressure levels in pumps and hoses, which could potentially lead to serious injuries, or even death, if proper safety protocols are not followed.

General Safety Tips
- Anyone operating the pump needs proper training
- Provide proper maintenance to equipment (oil checks, grease, etc.)
- Have an efficient system to communicate regularly with team members (such as a mobile radio system)
- Examples of critical times to communicate: pump start up, sending the pig, switching sections, an issue arises, pump is being cleaned out in the field
- Double check everything!

On the Pump
- Use heavy duty safety chains on caps/covers on pumps and do not operate unless all chains are securely attached
- Use pressure relief valves in chambers with high air pressure
- Use the correct size and type of pins/clips/bolts in locations instructed by the manufacturer
- Insert clips in a direction that they don't have the potential to unclip or fall out
- Be sure caps/covers move freely before disconnecting; if they don't move, the chamber may be holding a dangerous level of air or fluid pressure
- Do not connect the air compressor hose until you are ready to clean out the line; vibrations from the motor could loosen the connection
- Slowly turn manual valve levers

Pressure Protocol
- Know your valve/lever/computer control system; these controls will be different depending on manufacturer and model; not all pumps have the same design
- Monitor pressure levels closely
  - If you lose pressure while the pump is running, safely check hose for leaks
  - If you gain pressure while the pump is running, check valves and pumps
  - Start at lower PSI when first sending manure through the hose and increase pressure once the manure is out to the irrigation tractor

Checking the Hose
- Check regularly for leaks; hose couplers and draglines have higher risk for leaks
- Keep a safe distance from the hose when either fluid or air pressure is being applied
- Keep a safe distance from the area where the pig completes hose clean out
- After blow out is complete, step on the hose to check air pressure before disconnecting
- Keep non-essential personnel or the general public away from your operation

7. List two of the times in the pumping process that it is critical to communicate:
   ____________________ and ____________________

8. You should start at a lower PSI when first sending manure through the hose and increase pressure once the manure is out to the irrigation tractor.  □ True □ False
Following the 4Rs of Nutrient Management

4Rs

Manure applications should follow the 4Rs of nutrient management in order to apply the correct amount of nutrients in the most environmentally friendly way. In addition, applicators need to follow the guidelines for the farm’s 590 NM Plan and/or the NR 243 CAFO permit and plan.

Right Source. Manure, urea, ammonium sulfate, ammonium nitrate, anhydrous ammonia, potash, lime or other nutrient sources are used to meet the crop needs.

Right Place. This includes the right fields and then as surface, incorporated or injected applications. Field maps help applicators apply the manure in the Right Place. Manure needs to be placed so plant roots can reach the nutrients and that nutrients do not run off fields or leach into groundwater. Also, identify areas where manure applications are:

Prohibited — manure cannot be applied at any time, areas include:
- Concentrated flow channels
- Surface waters
- Saturated soils
- Areas of active snow melt

Restricted — manure can be applied under specific conditions.
- Where vegetation is not removed
- Direct conduits to groundwater
- Within 8 feet of irrigation wells
- Within 1000 feet of municipal wells
- Within 50 feet of private wells

Right Rate. Application rate is indicated as gallons per acre for liquid manure or tons per acre for solid manure. In order to apply at the right rate, equipment must be first properly calibrated. Then to adjust the rates, an operator may:
- Drive slower to increase the rate
- Drive faster to decrease the rate
- Increase or decrease pump pressure
- Vary the opening on valves and ports

Right Time. When manure can be applied is based on weather, field conditions and time of year. Do not apply manure prior to an expected major rain or runoff event. Check the Runoff Risk Advisory Forecast (see page 16).
- No winter applications are allowed in Surface Water Quality Management Areas (SWQMAs)
- In winter, liquid manure application rate is limited to 7,000 Gal/A; can be applied on slopes less than 6%

9. What two pieces of information do applicators need to apply manure correctly on a field?
   ________________________ and ________________________

10. Name three areas where manure can never be applied:
    ________________________  ________________________  ________________________

11. List two ways that you can decrease application rate on a calibrated manure applicator:
    ________________________  ________________________
This map shows 3 fields: highlighted areas/icons for wells, shallow bedrock, SWQMAS, P soils, winter manure prohibited area, winter restrictions (slope >6%) areas, intermittent streams and perennial streams.

This is an example of a map that you might receive from a planner or your supervisor. The map should have the field boundaries drawn and clearly labeled. A legend of the layers should also be included. Remember if you have any questions about the maps, always ask and have the information clarified before you begin application!
Understanding Manure Spreading Maps from SnapPlus

SnapPlus is the software used in Wisconsin to write nutrient management plans that comply to the Department of Agriculture, Trade and Consumer Protection's (DATCP) rules, NRCS’s 590 Nutrient Management Standard, DNR’s NR 243 and NR 151 rules. The mapping portion (SnapMaps) generates maps that have layers of information that help planners and applicators visually understand the landscape and where nutrient application can occur. The maps on this and the following page show key layers derived from the complete map on page 8 (note that the map is for a non-permitted farm; CAFOs may have different layers).

Color vision deficiency can also interfere with understanding the information. If you have any questions about the maps, always ask and have the information clarified. Maps can also be printed with a single layer of information per map, making the information easier to see. Inform your supervisor or planner ahead of time if you need additional maps.

Using the above map, answer the following questions:

12. Which field is in SWQMA? ______

13. What field has bedrock depth less than 5 ft? ______

14. Do any of the mapped fields have P soils? ______

15. How many wells (nutrient prohibited areas) are on the map? ______
Using the map on the left, answer the following questions:

16. What field includes a channelized flow buffer of 200 ft? ______

17. Areas with concentrated flow channels do not need special management for winter manure applications to avoid manure runoff.
   - True  - False

Using the map on the left, answer the following questions:

18. Winter is defined by the calendar months of December thru February.
   - True  - False

19. What field has a:  
   - winter manure prohibited area? ______  
   - winter spreading restriction? ______

20. Can manure be applied in winter to the portion of the field that does not have the winter manure prohibited area?
   - Yes  - No
Manure Regulations for CAFOs

A confined animal feeding operation (or CAFO) has 1,000 animal units (AUs) or more (700 mature dairy cows = 1,000 AU). CAFOs are regulated by the Wisconsin Department of Natural Resources (DNR). Under special circumstances, the Wisconsin DNR can designate a smaller farm as a CAFO if they have had a pollutant discharge to surface water or if they contaminate a well. CAFOs must follow the DATCP rules, DNR NR 243 and NRCS 590 Nutrient Management Standard, including but not limited to:

- Every load of manure applied to a field must be documented
- No surface spreading of **liquid** manure February 1st - March 31st
- No surface spreading of **solid** manure February 1st - March 31st IF the ground is frozen or there is greater than 1 inch of snow cover
- No spreading of manure within 100 feet of a private well and 1,000 feet from a community well
- No manure spreading on soils with a depth to bedrock less than 24 inches or soils with groundwater within 24 inches of the surface
- CAFO permits are audited annually

**IMPORTANT NOTE:** CAFOs have additional restrictions when making applications in a SWQMA (including intermittent streams). Each farm selects from multiple strategies for applying manure in a SWQMA, so you must follow the specific instructions and maps for the farm that you are making applications on. **As stated on page 9, CAFOs will have additional map layers and colors for these restrictions.**

There are many other spreading restrictions not listed here, so you must follow the maps and instructions for the specific farm that you are making applications on.

21. What Wisconsin agency regulates CAFO farms? ___________

22. May a farm with less than 1,000 AU be permitted like a CAFO? ☐ Yes ☐ No

23. Every load of manure spread for a CAFO farm must be documented. ☐ True ☐ False

24. When spreading manure for a CAFO farm, how far must you stay away from a private well (Karst areas have increased setbacks - see page 12)? __________ feet

25. All CAFOs use the same strategy for applying manure in a SWQMA. ☐ True ☐ False
Soils serve as a filter for contaminants (such as nutrients and pathogens), reducing the risk of these entering the groundwater that rural residents’ wells pump from every day. Certain soils (sands) do a poor job of filtering contaminants, meaning that nutrients (fertilizer and manure) are more likely to enter groundwater. This is why manure and fertilizer rates are limited/regulated on certain soils.

A second risk factor is the depth of soil over fractured or porous bedrock. This means that there is a higher risk of surface water directly entering groundwater through sinkholes, disappearing streams, and direct infiltration. This water can carry contaminants, such as nutrients, pathogens, and even manure itself into the aquifer that supplies local wells. Soil thickness can vary — it’s not unusual to see less than a foot of soil in one part of a 10 acre field, and more than 15 feet in another part of the same field.

In areas of highest vulnerability (sandy or shallow soils), the nutrient management plan may call for:

- Avoiding summer applications
- Reduced rates year round
- Waiting in fall until after soil temperatures are below 50 degrees F to apply
- Split applications/sidedress applications
- Use of a nitrogen stabilizer in manure or fertilizer

Areas over fractured rock are often called Karst.

Karst areas are defined as the combination of shallow soils and porous bedrock. Some types (such as the fractured limestone on the eastern side of Wisconsin) are considered very high risk, but the potential for sinkholes and karst-like features exists around the eastern, southern and western parts of Wisconsin.

What does Karst mean for me?

In 2018, Wisconsin implemented new regulations (NR 151) in the 15 counties closest to Lake Michigan. Although similar karst type features exist in the other karst areas shown on the map, the new regulations only apply on the eastern side of Wisconsin.

But good manure management practices in all Karst areas is a good idea because snowmelt and rainwater move through the thin soils into these fractures, carrying nutrients, pathogens and contaminants with it. **Manure applicators and farmers need to take special precautions to reduce the risk of contaminating wells.**

Recognizing Karst in the field

Karst features are often hidden by soil or may be downslope in a neighboring field.

- Sinkholes are spots where soil has washed into a crack. Often farmers filled these with rock. In some cases, streams disappear into sinkholes.
- Fractures are cracks that allow water to enter the groundwater. In dry seasons, plants tap into the soil in the cracks, and you can see the pattern in alfalfa growth.

NR 151 Karst regulations

- Well setbacks increase to 250 feet for a private well and 1,000 feet of a community/municipal well.

Some of the regulations vary based on soil thickness.

- Less than 5 feet of soil: Depth to rock must be verified prior to application on fields
- Less than 2 feet of soil: No manure applications
- 2-3 feet of soil: Pre-till and incorporate/injection no deeper than 4 inches (liquid), solid manure rates limited to 15 tons, or manure treatment required
- 3-5 feet of soil: Same as 2-3 feet, except injection depth limited to 6 inches

Complete setbacks should be included in the nutrient management plan.
Handling a Manure Spill
When a manure spill happens, human safety should always be your first concern - call 911 if needed. Then, you need to take action and follow six important steps.

1 Control the spill
2 Notify your supervisor
3 Contain the spill
4 Contact appropriate authorities
5 Clean-up the spill
6 Document the spill

26. A spill is (check all that apply):

☐ a. Any release of manure that has the potential to threaten ground or surface water
☐ b. Any release of manure greater than 1,000 gallons
☐ c. Any release of manure that reaches a stream or pond
☐ d. All of the above

27. You are an employee and are applying manure in a field and a spill occurs; match the correct task to the spill response number.

1_______ a. Begin the cleanup
2_______ b. Call the DNR or appropriate agency
3_______ c. Control the spill by turning off the pumps
4_______ d. Determine the best way to contain the spill (plow, chisel, berm)
5_______ e. Fill out documentation and paperwork
6_______ f. Notify my supervisor

All agricultural or livestock operations, regardless of size, must report manure spills or runoff that may affect Wisconsin's waters to the Department of Natural Resources.

Report manure spills immediately! Call the 24-hour spill emergency hotline: 1-800-943-0003
Spill Response and Public Relations

Consider spill response steps and public relations course of action in the following situations:

28. You are stopped by the state patrol after a complaint that your truck is “very dirty and ruining a Labor Day party” for a family along your route. **How should you respond to this issue?**

29. Your layline ruptured in the ditch just prior to the field entrance and is continuing to pump manure. The flow of manure in the ditch is heading west towards a well. **How should you respond to this issue?**

Route Planning

30. Given the map on the right, what would the best route from the barn to field 3 (draw the route directly on the map)?

31. What road features should you avoid when you have a full load?

32. Should you take a different route back, if so, what route should you take?
Lights and Marking When Operating Implements of Husbandry (IoH)

Not all vehicles used in agriculture are Implements of Husbandry (IoH). Tractors, manure tankers or spreaders, agitators and pumps, would be common IoH. What isn’t an IoH are trucks, truck-tractors, military vehicles or construction machinery.

A slow-moving vehicle (SMV) emblem is a required marking on any type of IoH that usually travels at speeds less than 25 mph. It is to be displayed at all times on the most visible rear area of the vehicle or combination of vehicles.

There are different rules for operating during hours of darkness for IoH and Wide IoH. A best practice is to operate under the Wide IoH lighting and marking requirements as larger equipment is wider than the lane and often crosses the centerline.

**First, what are hours of darkness?** The period of time from 1/2 hour after sunset to 1/2 hour before sunrise and all other times when there is not sufficient natural light to render clearly visible to any person or vehicle upon a highway at a distance of 500 feet.

**Second, what’s the difference between IoH and Wide IoH?** A Wide IoH exceeds 15 feet in total width or extends over the center of the roadway into a lane intended for the opposite direction of travel. Width is determined by the widest measurement of the equipment in a highway transport configuration.

**OK, so what are the rules?** The biggest difference is that for an IoH, lighting or lamps are required to be activated during hours of darkness. However, for Wide IoH, lighting and lamps are required to be activated at all times when vehicle(s) are operated on the road or parked in the right-of-way.

For more detailed descriptions of vehicle lighting and marking requirements, as well as more information about road safety.

https://fyi.extension.wisc.edu/ioh/

Agricultural Vehicles on the Road
UW Center for Agricultural Safety and Health

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33. A SMV sign needs to be displayed at all times on any agricultural vehicle or implement traveling less than _____________ mph.

34. Wide IoH require lights and lamps to be _______________ during the day or night when on the _______________ or working in the road right of way.
Making Healthy Choices at Work

Healthy Practices to Prevent Fatigue and Obesity
(National Institute for Occupational Safety and Health)

- Get more than seven hours of sleep a night
- Drink more water than other types of beverages
- Increase physical activity
- Increase intake of omega-3 fatty acids
- Lose extra weight by cutting down on portion sizes and trying to eat a well-balanced diet
- Eat smaller meals more often during the day to help steady your blood sugar level

Before bed, avoid:

- Heavy or spicy meals
- Liquids, especially alcohol or caffeine
- Nicotine and other stimulants
- Light exposure from television and electronics

Key Guidelines for Truck and Tractor Drivers
(Department of Health and Human Services)

- Move more and sit less throughout the day when possible
- Some physical activity is better than none!
  - Step out of the truck between loads to inspect semi and tanker (check tires, lights, etc.)
  - Walk around when you are not driving (shutdowns, field switching, breakdowns)
- Physical activity has immediate health benefits like reducing anxiety and blood pressure, or improving the quality of sleep and insulin sensitivity
- More physical activity = more health benefits
- Exercise before or after work
  - Engage in at least 2.5–5 hours/week of moderate-intensity physical activity
  - Do muscle strengthening activities of moderate or greater intensity 2+ days/week

Hacking Your Snacks
(USDA Choose My Plate)

- Build your own: Make your own trail mix
- Prep ahead: Portion snack foods into baggies or containers
- Make it a combo: Combine food groups
- Eat vibrant veggies: Spice up raw vegetables with dips
- Snack on the go: Bring ready-to-eat snacks when you’re out

The Wisconsin Manure Management Advisory System is a set of maps to help farmers and others who apply nutrients to identify suitable cropland areas for spreading. There are several maps available, but the Runoff Risk Advisory Forecast map or RRAF is a key “on the ground” tool that you should learn to consult when conditions are questionable.

The runoff forecast provides maps showing short-term runoff risk for daily application planning, taking into account factors including soil moisture, weather forecast, crop cover, snow cover and slope. It is updated three times daily by the National Weather Service. The data is based on a system using four-kilometer grids (1.25 square mile), allowing users to look at conditions at a very local level.

The RRAF is not a regulatory tool but rather a tool to assist in assessing the risk of nutrient application runoff.

The map displays the runoff risk not just for the current day, but 72 hours into the future based on precipitation model forecasts. In the winter, the model looks out up to 10 days using the temperature forecast to predict snowmelt. This ‘look ahead’ allows better planning of manure and other nutrient applications. A few things to keep in mind:

- Assess the risk for the actual field before an application
- Even low risk fields may not be dry enough to spread
- Risk increases with soil moisture
- Some fields are always higher risk areas