Appendix F - *Land Application*

Land Application - Injection

Description: Injection is the most effective manure land application practice for reducing ammonia emissions. Land applied manure is placed directly into the soil, at minimum of 4 inches depth, by the application equipment utilizing injection shanks, knives, or covering disks that are located directly behind the manure application orifice.

Technique	Land use	Ammonia reduction from baseline (%)
Injection		
Closed slot	Cropland – annually established row crops	70

Rationale: Much of the nitrogen contained in animal manure can be lost as ammonia gas. When nitrogen is conserved, manure provides a valuable agronomic nitrogen source for crops, in addition to other nutrients organic matter and improves soil physical properties. Animal manure has a distinct advantage for providing a sustained source of nitrogen for plants. In many cases, the greatest potential for ammonia loss from livestock farms occurs when manure is applied to fields.

Conventional Baseline Practice: The baseline practice for comparison is broadcast liquid manure that is not incorporated.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☐ Storage & Treatment
- ☐ Open Lots/Corrals
- ☒ Land Application

Notes:

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

- ☒ Ammonia 70 % Notes:
- ☐ Hydrogen Sulfide % Notes:

Other Air Quality Considerations Possible odor and VOC reductions; it is expected that hydrogen sulfide will be reduced in a similar manner as ammonia but research does not quantify the reductions at this time

Engineering, O&M requirements: Ammonia emission reductions must be prorated based on the volume of manure applied (i.e., application rates).

Manure injection occurs after crops have been harvested or before primary tillage. Injection occurs in the field between the headlands (ends of field), generally. Manure should also be injected in the headlands, if possible. If manure remains on the field surface in the headlands, the manure should be incorporated, as soon as possible. There should be little or no manure visible at the soil surface in the field, though some manure may protrude from the soil.

Considerations for injection include preexisting soil moisture and soil texture, as it relates to traction.

Confirmation that BMP is working:

- ☒ Record Keeping — Notes:
  - ☐ O&M — Frequency:
  - ☐ Design/construction documents
  - ☒ Other specify Nutrient Management Plan — Frequency:
  - ☒ Visual Inspection — Frequency: after manure application, no visible manure on the soil surface

- ☒ Monitoring — Notes:in accordance with Nutrient Management Plan
  - Parameter: — Frequency:
  - Parameter: — Frequency:

Additional Considerations, references: Land application must be performed in accordance with a nutrient management plan following the NRCS Conservation Practice Standard 590 - Nutrient Management. (NOTE: Additional land application and nutrient management plan requirements apply to CAFO permitted farms. Some of these requirements go above and beyond the NRCS 590 practice standard.) Also see, NRCS Conservation Practice Standard Wisconsin Conservation Planning Technical Note 1.

The main risk with deep injection is soil loss due to soil disturbance caused by the injection process.

This set of practices is not a regulatory end point.

Land Application - Incorporation

Description: Timing of manure incorporation is critical for the reduction of ammonia emissions. Incorporation means mixing the manure or litter with surface soil, to a depth of at least 4 inches, so that at least 80% of applied manure is covered with soil and the application rate is controlled to ensure that applied material stays in place and does not run off. Incorporation includes standard agricultural practices such as tillage or other practices that are the equivalent to providing 80% soil coverage.

Immediate incorporation of liquid manure (low-pressure/high volume) assumes broadcast application using a low-pressure, high volume splash plate followed immediately by incorporation of the manure into the soil. Manure must be incorporated immediately after land application, utilizing implements attached directly to the application equipment or a second tractor operating immediately behind the application equipment. Note: At medium to high manure application rates, delaying the incorporation by more than approximately 15 minutes can allow the soil to absorb manure liquids and become slippery, which can prevent operation of the tractor pulling the incorporation equipment.

A rolling shank soil aerator may be used immediately prior to, or following, broadcast application using a low-pressure, high volume splash plate. A rolling shank soil aerator perforates the soil through punching or cutting with minimal displacement of soil material.

Rapid incorporation of liquid manure (low-pressure/high volume) assumes broadcast application using a low-pressure, high volume splash plate followed by incorporation of the manure into the soil within 12 hours from the initiation of spreading. Manure must be incorporated after land application utilizing a second tractor.

Solid manure incorporation assumes broadcast application and then incorporation of the manure and/or litter into the soil at a depth of 4 inches or deeper within 3 days.

Technique	Manure type	Land use	Ammonia reduction from baseline (%)
Incorporation			
Immediate	Liquid (Low pressure/ high volume broadcast application)	Cropland – annually established row crops	60
Immediate (using an aeration tool)	Liquid (Low pressure/ high volume broadcast application)	Cropland – annually established row crops	40
Rapid incorporation (within 12 hours)	Liquid (Low pressure/ high volume broadcast application)	Cropland – annually established row crops	40
<3 days	Solid manure and/or litter	Cropland – annually established row crops	20

Rationale: Much of the nitrogen contained in animal manure can be lost as ammonia gas. When nitrogen is conserved, manure provides a valuable agronomic nitrogen source for crops, in addition to other nutrients organic matter and improves soil physical properties. Animal manure has a distinct advantage for providing a sustained source of nitrogen for plants. In many cases, the greatest potential for ammonia loss from livestock farms occurs when manure is applied to fields.

Conventional Baseline Practice: The baseline practice for comparison is broadcast liquid manure that is not incorporated. The baseline practice for solid manure is broadcast spreading without timely incorporation.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☐ Storage & Treatment
- ☐ Open Lots/Corrals
- ☒ Land Application

Notes:

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

- ☒ Ammonia % Notes: See table above
- ☐ Hydrogen Sulfide % Notes:

Other Air Quality Considerations Possible odor and VOC reductions; it is expected that hydrogen sulfide will be reduced in a similar manner as ammonia but research does not quantify the reductions at this time

Engineering, O&M requirements:

Confirmation that BMP is working:

- ☒ Record Keeping Notes:
  - ☐ O&M Frequency:
  - ☐ Design/construction documents
  - ☒ Other specify Nutrient Management Plan Frequency:
  - ☒ Visual Inspection Frequency:

- ☒ Monitoring Notes:in accordance with Nutrient Management Plan
  Parameter: Frequency:
  Parameter: Frequency:

Additional Considerations, references: Land application must be performed in accordance with a nutrient management plan following the NRCS Conservation Practice Standard 590 - Nutrient Management. (NOTE: Additional land application and nutrient management plan requirements apply to CAFO permitted farms. Some of these requirements go above and beyond the NRCS 590 practice standard.) Also see, NRCS Conservation Practice Standard Wisconsin Conservation Planning Technical Note 1.

For land application using an aeration tool, where limited soil disturbance is desired, emission reductions will need to be demonstrated to the Department.

This set of practices is not a regulatory end point.

Land Application - Banding

Description: Band spreading of manure involves the application of liquid manure in narrow bands either directly from a spreader hose or through a sliding shoe that rides along the soil surface.

A drop tube (or hose) spreader is a boom which has a number of hoses connected to it, distributing the liquid manure close to the ground in strips or bands. It is fed with liquid manure from a single pipe, relying on the pressure at each of the hose outlets to provide even distribution. Advanced systems use rotary distributors to proportion the liquid manure evenly to each outlet.

A drop tube or hose with immediate incorporation entails immediate incorporation of ammonia using standard agricultural practices such as tillage, or other practices that are the equivalent, directly behind the tube or hose nozzle.

A trailing shoe/sliding foot spreader is a similar in configuration to the drop tube spreader with a shoe added to each hose allowing the liquid manure to be deposited in neat rows under the crop canopy onto the soil surface or just below the soil surface.

Technique	Land use	Ammonia reduction from baseline (%)
Banding		
Drop tube or hose	Cropland – annually established row crops	30
Drop tube or hose with immediate incorporation	Cropland – annually established row crops	35
Trailing shoe/sliding foot	Cropland – annually established row crops and grassland	30
Trailing shoe/sliding foot	No-till	40

Rationale: Much of the nitrogen contained in animal manure can be lost as ammonia gas. When nitrogen is conserved, manure provides a valuable agronomic nitrogen source for crops, in addition to other nutrients organic matter and improves soil physical properties. Animal manure has a distinct advantage for providing a sustained source of nitrogen for plants. In many cases, the greatest potential for ammonia loss from livestock farms occurs when manure is applied to fields.

Conventional Baseline Practice: The baseline practice for comparison is broadcast manure that is not incorporated.

☒ Established ☐ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☐ Storage & Treatment
- ☐ Open Lots/Corrals

☒ Land Application

Notes:

Animal Type:

☒ Bovine
☒ Swine
☒ Poultry
Notes:

Air Toxic Emission Reductions - specific to farm component

☒ Ammonia % Notes: See table above
☐ Hydrogen Sulfide % Notes:

Other Air Quality Considerations Possible odor and VOC reductions; it is expected that hydrogen sulfide will be reduced in a similar manner as ammonia but research does not quantify the reductions at this time

Engineering, O&M requirements:

Confirmation that BMP is working:

☒ Record Keeping Notes:
- ☐ O&M Frequency:
- ☐ Design/construction documents
- ☒ Other specify Nutrient Management Plan Frequency:
- ☒ Visual Inspection Frequency:

☒ Monitoring Notes:In accordance with Nutrient Management Plan
Parameter: Frequency:
Parameter: Frequency:

Additional Considerations, references: Land application must be performed in accordance with a nutrient management plan following the NRCS Conservation Practice Standard 590 - Nutrient Management. (NOTE: Additional land application and nutrient management plan requirements apply to CAFO permitted farms. Some of these requirements go above and beyond the NRCS 590 practice standard.) Also see, NRCS Conservation Practice Standard Wisconsin Conservation PLanning Technical Note 1.

Banding equipment is not currently widely available in Wisconsin, however, emission reductions are well established.

This set of practices is not a regulatory end point.

Land Application - Demonstration

Description: Methods for the land application of manure are described in three established beneficial management practice categories: injection, incorporation and banding. Greater emissions reductions, than those described in the established land spreading BMPs, may be possible, acknowledging differences caused by the effect of manure characteristics, application management (including specific application techniques), soil conditions, or other environmental factors (including temperature, wind, rainfall). This practice allows for the demonstration of additional emission reductions, beyond those described in the established land spreading BMPs.

Rationale: Much of the nitrogen contained in animal manure can be lost as ammonia gas. When nitrogen is conserved, manure provides a valuable agronomic nitrogen source for crops, in addition to other nutrients, organic matter and improves soil physical properties. Animal manure has a distinct advantage for providing a sustained source of nitrogen for plants. In many cases, the greatest potential for ammonia loss from livestock farms occurs when manure is land applied.

Conventional Baseline Practice: The baseline practice for comparison is broadcast liquid manure that is not incorporated. The baseline practice for solid manure is broadcast spreading without timely incorporation.

☐ Established ☒ Demonstration

Farm Component:

- ☐ Nutrition and/or Feed Management
- ☐ Housing
- ☐ Storage & Treatment
- ☐ Open Lots/Corrals
- ☒ Land Application

Notes:

Animal Type:

- ☒ Bovine
- ☒ Swine
- ☒ Poultry

Notes:

Air Toxic Emission Reductions - specific to farm component

- ☐ Ammonia % Notes: Varies by demonstration
- ☐ Hydrogen Sulfide % Notes: Varies by demonstration

Other Air Quality Considerations

Engineering, O&M requirements: Any manure spreading must be performed in accordance with a Nutrient Management Plan

Confirmation that BMP is working:

- ☐ Record Keeping Notes:
  - ☐ O&M Frequency:
  - ☐ Design/construction documents

☐ Other specify Frequency:
☐ Visual Inspection Frequency:

☐ Monitoring Notes:
Parameter: Frequency:
Parameter: Frequency:

Additional Considerations, references: Land application must be performed in accordance with a nutrient management plan following the NRCS Conservation Practice Standard 590 - Nutrient Management. (NOTE: Additional land application and nutrient management plan requirements apply to CAFO permitted farms. Some of these requirements go above and beyond the NRCS 590 practice standard.) Also see, NRCS Conservation Practice Standard Wisconsin Conservation Planning Technical Note 1.

This set of practices is not a regulatory end point.