

Missouri Nutrient Management Plan Missouri Department of Natural Resources (MDNR) Review Document

The objective of this document is to verify compliance with Missouri's state nutrient management requirements found in state regulation at 10 CSR 20-6.300 (3) (G)1. and the MDNR Concentrated Animal Feeding Operation Technical Standard. The owner or operator of a permitted CAFO is required to maintain a copy of a complete and up-to-date Nutrient Management Plan at all times.

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Plan Period: April 2017 - March 2022

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SECTION A General Site Information

1. Farm Contact Information

Farm Contact Information:

Name: Henry Wilson
Address: P.O. Box 220
Carthage, MO 62321

Home Phone:
Office Phone: (217)357-8310
Email: hwilson@hogvet.com

2. Technical Service Provider Contact Information

Nutrient Management Planner

Name: Jeff E. Browning
Title: Professional Engineer
Certification Credentials: Professional Engineer MO Number: E-28664, NRCS TSP 05-4871
E-mail: jeff@grtriver.com

3. Plan Narrative:

This facility is located in the NE ¼ of Section 29, Township 63N, Range 6W, in Lewis County Missouri.

This farm is a three building sow farm producing weaned pigs. The farm will include the construction of a new 175' wide x 443' long farrowing barn, a 153' wide x 692' long breeding/gestation barn and a 101' wide x 270' long gilt development (GDU) barn. Proposed animal numbers are 960 sows & litters, 4,640 breeding/gestating sows & boars, 2,400 gilts > 55 lbs and 500 gilts < 55 lbs. An office will be constructed in the farrowing barn.

All barns are slatted type buildings where hog manure generated from production falls beneath the floor into concrete pits. The farrowing barn has a two-foot deep pit which is periodically drained to the adjacent breeding/gestation barn via a permanent sewer pipe under-ground. The breeding/gestation barn has a 12' deep-pit and the gilt development/nursery barn has a ten foot deep-pit which stores the manure laden wastewater until it can be pumped to nearby farm fields.

The proposed farm will be designed and constructed to meet the current standards of the Missouri Department of Natural Resources. The entire nutrient handling and storage structures operate as a no discharge system. Dead animals will be removed to a rendering plant or composted on the farm.

The plugs in the farrowing barn are pulled approximately once per week. The building pits are not recharged which is typical in farms operated in this manner. The total calculated manure and process water expected to be collected and stored in the gestation barn pit from the farrowing and gestation barns based on MWPS 18 table 7 is 6,384,851 gallons.

The nursery is drained to the GDU deep-pit. The gilts are housed over the 10 foot deep-pit. The total calculated manure and process water collected and stored in the GDU barn pit is 1,066,859 gallons.

Land Application

The land application system will employ drag hoses with an injection system, an irrigation pump and tankwagon to apply wastewater to the land application areas. It is typical to employ custom applicators to apply all wastewater. All waste nutrients will be exported off the farm.

Dead Animals

Dead animals will be disposed of in accordance with the Missouri Department of Agriculture regulations. Dead animals from this operation will be composted or taken to a rendering facility.

Clean Water Diversion

This farm is graded to divert storm water away from buildings, animal confinement areas and manure storage areas.

A potential source of unplanned waste from animal confinement facilities is from storm water coming into contact with pollutants. The pollutants that could potentially contaminate the water are the hogs, manure, mortalities, feed, diesel fuel, and oils and lubricants for farm equipment. All of these potential pollutants are kept under roof at this farm. They do not come into contact with clean rain water or add to the contaminated waste on the farm.

A common way for clean water to become contaminated is by contacting ventilated dust on the ground around the barn. To treat rainwater that becomes contaminated by this dust, the barn will be surrounded by grass. The grass acts as a filter and helps prevent erosion around the barns reducing suspended solids in the runoff.

Other operations at this farm that could potentially contribute to exposed pollutants are the loading and unloading of pigs, feed, manure, and mortalities. When these sources are handled messes can occur. Care should be taken to not create a mess around the door of the barns, the manure pumping ports, or at the base of the feed bins. When messes occur during these operations they will be cleaned up immediately.

Prevention of Direct Contact of Confined Animals to Waters of the State

All confined animals are housed under roof in buildings with no outside access. They have no direct access to waters of the state.

Chemical Handling

If checked, the indicated measures will be taken to prevent chemicals and other contaminants from contaminating process waste water or storm water storage and treatment systems.

	This is not a regulatory-agency permitted facility. This section does not apply.
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	<i>Measure</i>
X	All hog farm chemicals are stored in proper containers. Expired chemicals and empty containers are properly disposed of in accordance with state and federal regulations.
X	Chemical storage areas are self-contained with no drains or other pathways that will allow spilled chemicals to exit the storage area.

	<i>Measure</i>
X	Chemical storage areas are covered to prevent chemical contact with rain or snow.
	Emergency procedures and equipment are in place to contain and clean up chemical spills.
	Chemical handling and equipment wash areas are designed and constructed to prevent contamination of surface waters and waste water and storm water storage and treatment systems.

PLAN STARTING DATE: April, 2017

PLAN DURATION: 5 YEARS

SECTION B

Livestock Production System and Land Description

1. Manure Storage and Animal Inventory

Table B-1-1. Manure Storage Descriptions.

Storage ID	Type of Storage	Pumpable or Spreadable Capacity	Estimated Annual Manure Collected	Units Manure Storage	Estimated Maximum Days of Storage
Gestation Barn	Underfloor liquid storage	7,906,779	6,384,851	Gal	452
GDU Barn	Underfloor liquid storage	1,762,746	1,066,859	Gal	603
Mortality Composter	Animal mortality compost	100	78	Ton	467

Table B-1-2. Animal Inventory.

Animal Group	Type or Phase of Production	Number of Animals	Average Wt. (lbs)	Confinement Period	Manure Collected (%)	Storage ID where Manure will be Stored
Farrowing Sows	Sow & litter	960	450	Early Jan - Late Dec	100	Gestation Barn
Gestation Sows	Gestating sow	4,640	375	Early Jan - Late Dec	100	Gestation Barn
Gilts	Grow-finish pig	2,400	130	Early Jan - Late Dec	100	GDU Barn
Nursery Pigs	Nursery pig	500	30	Early Jan - Late Dec	100	GDU Barn

- (1) Number of Animals is the average number of animals that are present in the production facility at any one time.
 (2) If Manure Collected is less than 100%, this indicates that the animals spend a portion of the day outside of the production facility or that the production facility is unoccupied one or more times during the confinement period.

2. Manure Exports, Imports and Transfers

Table B-2-1. Planned manure exports off the Farm.

Export Month	Export Year	Manure Source Storage ID	Target Export Amount	Export Units	Receiving Operation
11	2017	Gestation Barn	4,000,000	Gal	Export Off Farm
11	2017	GDU Barn	600,000	Gal	Export Off Farm
11	2017	Mortality Composter	40	Ton	Export Off Farm
4	2018	Gestation Barn	2,000,000	Gal	Export Off Farm
4	2018	GDU Barn	300,000	Gal	Export Off Farm
11	2018	Gestation Barn	4,000,000	Gal	Export Off Farm

Export Month	Export Year	Manure Source Storage ID	Target Export Amount	Export Units	Receiving Operation
11	2018	GDU Barn	600,000	Gal	Export Off Farm
11	2018	Mortality Composter	70	Ton	Export Off Farm
4	2019	Gestation Barn	2,500,000	Gal	Export Off Farm
4	2019	GDU Barn	450,000	Gal	Export Off Farm
11	2019	Gestation Barn	4,000,000	Gal	Export Off Farm
11	2019	GDU Barn	600,000	Gal	Export Off Farm
11	2019	Mortality Composter	70	Ton	Export Off Farm
4	2020	Gestation Barn	2,600,000	Gal	Export Off Farm
4	2020	GDU Barn	450,000	Gal	Export Off Farm
11	2020	Gestation Barn	4,000,000	Gal	Export Off Farm
11	2020	GDU Barn	600,000	Gal	Export Off Farm
11	2020	Mortality Composter	90	Ton	Export Off Farm
4	2021	Gestation Barn	2,300,000	Gal	Export Off Farm
4	2021	GDU Barn	500,000	Gal	Export Off Farm
11	2021	Gestation Barn	4,000,000	Gal	Export Off Farm
11	2021	GDU Barn	600,000	Gal	Export Off Farm
11	2021	Mortality Composter	70	Ton	Export Off Farm

Table B-2-2. Planned manure imports onto the Farm.

Import Month	Import Year	Originating Operation	Manure Animal Type	Target Import Amount	Import Units	Receiving Storage ID
No planned manure imports onto the Farm.						

Table B-2-3. Planned internal manure transfers.

Transfer Month	Transfer Year	Manure Source Storage ID	Target Transfer Amount	Transfer Units	Receiving Storage ID
No planned internal manure transfers.					

3. Land Application Equipment

Land application from this farm will be done with a dragline injection system and tankwagon. Compost will be spread with a solid manure spreader. It is planned to hire a custom applicator to land apply nutrients.

Table B-3-1. Summary of manure applicators.

Equipment ID	Spreader or Pump Capacity	Capacity Units	Effective Application Width (ft.)	Land Application Travel Speed (min-max)	Speed Units	Minimum Application Rate	Rate Units	Owned? (Y or N)
Drag Line	1,500	Gal	12		mph	8,000	Gal/Acre	N
Tankwagon	8,000	Gal	12		mph	1,000	Gal/Acre	N
Manure Spreader	6	Ton	20		mph	2	Ton/Acre	N

4. Mortality Handling Narrative

Table B-4-1. Estimated annual amount of animal mortalities.

Animal Group	Type or Phase of Production	Number of Animals ¹	Annual Mortality (%) ²	Total Animals per Year ³	Estimated Average Annual Mortality (tons)
Farrowing Sows	Sow & litter	960	5.8	56	12.6
Gestation Sows	Gestating sow	4640	5.8	269	50.4
Gilts	Grow-finish pig	2400	3.2	77	5
Nursery Pigs	Nursery pig	500	1.4	7	.1
Total	-	8500	-	-	68

¹ Number of Animals is the typical number of animals that are present in the operation during the confinement period.

² As a percentage of number of animals.

³ Calculate as Number of Animals X Annual Mortality.

To decrease non-point source pollution of surface and ground water resources, reduce the impact of odors that result from improperly handled animal mortality, and decrease the likelihood of the spread of disease or other pathogens, approved handling and utilization methods shall be implemented in the handling of normal mortality losses. NRCS Standard 316, Animal Mortality Facility, will be followed for proper management of dead animals.

Plan for Proper Management of Dead Animals

The following table describes the management plan for normal animal mortality in a manner that protects surface and ground water quality.

Dead animals will be composted in a static pile composter with a concrete floor and roof. The proper carbon to nitrogen ratio shall be maintained by using a mix of 100 cubic feet of sawdust per 1000 pounds of carcass or other mix as specified to maintain a carbon to nitrogen ratio of 20-30 to 1. Ammonium nitrate may be added as needed to reach the optimum CN ratio.

The proper moisture content shall be maintained at 50-60 percent by: 1) using damp (but not wet) sawdust, 2) Adding extra water as needed, or 3) allowing green (wet) sawdust to dry before using in compost.

The temperature of the compost shall be monitored and shall reach a minimum of 135 degrees F. The temperature probe shall penetrate one third of the distance from the outside of the pile to the center of mass. Compost that does not reach this temperature shall be dismantled, corrected, and rebuilt in order to reach optimal temperature. When the temperature of the compost reaches 105 degrees F, compost shall be turned to a secondary storage bin.

The following shall be followed: 1) One foot of sawdust shall be placed on the bottom of the bin. 2) Carcasses shall be placed in layers with at least one foot of sawdust in between each layer. 3) Carcasses shall be completely covered with at least one foot of sawdust. 4) Large carcasses shall have one foot of sawdust in between carcasses within a layer. 5) A minimum of 6 inches of sawdust shall be maintained between the carcasses and the sides of the bins.

Compost shall be loaded in bins in the following manner: 1) The first bin shall be filled over a two month period. 2) The second bin shall be filled over the second two month period. 3) After the second two month period, compost from the first bin shall be turned into the third bin for secondary composting. 4) Bin number 1 shall now be filled again for two months. 5) After the two month period, compost from bin 3 shall be removed for final disposal and bin 2 shall be turned to bin 3. 6) bin 2 shall now be filled again. This method shall then be repeated as necessary. Finished compost shall be stored under roof until land applied.

SECTION C

Sustainability/Feasibility Evaluation

1. Farm Nutrient Balances

Table C-1-1. Whole-farm manure nutrient balance accounting for nutrients in manure exported, imported or used for land application.

	N	P ₂ O ₅	K ₂ O
	(lbs.)	(lbs.)	(lbs.)
Manure Nutrients On-Hand at Start of Plan	0	0	0
Manure Nutrients Collected	1,072,621	1,022,927	928,551
Manure Nutrients Imported	0	0	0
Manure Nutrients Exported	976,800	933,080	848,640
Manure Nutrients Applied On-Farm			
Manure Nutrients on Hand at End of Plan (calc)	95,821	89,847	79,911

Table C-1-2. Nutrient balance on spreadable acres accounting for plant-available nutrients applied in manure and other fertilizers and removed by crops.

	N	P ₂ O ₅	K ₂ O
Plant-Available Manure Nutrients Applied ¹ (lbs.)			
Commercial Fertilizer Nutrients Applied (lbs.)			
Available Nutrients Applied (all sources) (lbs.)	0	0	0
Nutrient Utilization Capacity of Crops ² (lbs.)			
Nutrient Balance on Spreadable Acres ³ (lbs.)	0	0	0
Nutrient Balance on Spreadable Acres (lbs./acre)	no acres	no acres	no acres
Nutrient Balance on Spreadable Acres (lbs./acre/yr.)	0	0	0

1. Available manure nutrients applied on the farm accounting for state-specific nutrient losses due to time and method of application.

2. Values indicate nutrient utilization potential of crops grown. For N the value generally is based on crop N recommendation for non-legume crops and crop N uptake or other state-imposed limit for N application rates for legumes. P₂O₅ and K₂O values generally are based on fertilizer recommendations or crop removal (whichever is greatest).

3. Interpretation:

For N,

- Non-trivial positive values indicate the plan was not developed properly;
- Negative numbers may or may not be intentional. For example plans that have legume crops will typically not utilize the full nitrogen removal capacity resulting in negative numbers.

For P₂O₅ and K₂O,

- Positive numbers may indicate build up of P₂O₅ and K₂O above agronomic need and/or removal.

Negative numbers indicate applications below recommended rates or depletion of P₂O₅ and/or K₂O from the soil on some fields. This may be beneficial on fields with high or very high soil test phosphorus.

2. Projected Land Requirements for N-based Versus P-based Management

Farm Attributes:

Table C-2-1. Crop land summary.

Crop and Forage Acres	Acres Suitable for Manure Application (Spreadable Acres)
0.0	0.0

Table C-2-2. Average annual land requirements for N-based versus P-based management of manure.

Calculation Basis	N-based Management	P-based Management
	<i>acres/year</i>	
Projection based on total nutrients collected	1192	3410
Projection based on plant available nutrients applied	821	3410

All estimates assume plant nutrient availability in manure and nutrient utilization by the crop is similar to how manure and crops are managed in the plan.

For these calculations:

Manure nitrogen availability was calculated to be 66%

Crop N utilization was calculated to be 180 lbs. N/acre/year

Crop P₂O₅ utilization was calculated to be 60 lbs. P₂O₅/acre/year.

SECTION D

Land Application Site Information

1. Field Maps (Not Used)

Map D-1-1. Field delineation map showing field and sub-field ID with aerial photo background.

Map D-1-2. Manure application sensitive feature map including manure application setbacks. Map lists field ID, sub-field ID, field size and spreadable acres for each field.

2. Other Field Information (Not Used)

Table D-2-1. Soil survey data.

No fields defined for this plan.

Table D-2-2. Other field information.

No fields defined for this plan.

¹Land Tenure: Owned = Own, Rented = Rent, Spreading Agreement = SA, Other = O.

3. Land Treatment Practices Needed to Meet Manure Management Objectives (Not Used)

Table D-3-1. Land treatment practices (conservation practices) used on a field to meet manure management objectives. List those practices required to reduce erosion and runoff as part of properly implementing the manure management plan.

No fields defined for this plan.

SECTION E: Recurring Activities and Data Related to Land Application of Manure

1. Soil Testing Results (Not Used)

Table E-1-1. Soil test results used to develop the nutrient management plan.

No fields defined for this plan.

2. Crop Fertilizer Recommendations and Crop Removal Values (Not Used)

Table E-2-1. Recommended fertilizer rate and crop removal rate for each crop in each rotation for each field.

No fields defined for this plan.

3. Manure Test Values Used for Planning Purposes

Table E-3-1. Manure test values used in calculating manure application rates for planning purposes.

Provide justification for the selection of manure test values in Appendix 5.

Storage ID	Storage Type	DM (%)	Total N	Ammonia N	Phosphate (P ₂ O ₅)	Potash (K ₂ O)	Units	Analysis Source (date)
Gestation Barn	Underfloor liquid storage		25.0	12.0	25.0	24.0	lbs/1000Gal	MWPS 18, Section 1, Table 7
GDU Barn	Underfloor liquid storage		50.0	33.0	42.0	30.0	lbs/1000Gal	MWPS 18, Section 1, Table 7
Mortality Composter	Animal mortality compost		20.0	4.0	2.0	6.0	lbs/Ton	MU - WQ 351 "Composting Dead Swine"

Phosphorus Loss Assessment

Table E-4-1. Supporting information for fields assessed with the Missouri P Index – other supporting data and results.

No fields defined for this plan.

Table E-4-2. Report steps that will be taken to reduce phosphorus loss from fields rated high or very high by phosphorus loss assessment.

No fields defined for this plan.

Table E-4-2. Report steps that will be taken to reduce phosphorus loss from fields rated high or very high by phosphorus loss assessment.

No fields defined for this plan.

SECTION F

Field-by-Field Planned Manure and Fertilizer Applications and Projected Nutrient Balances

1. Planned Manure and Fertilizer Applications (Not Used)

Table F-1-1. Manure and fertilizer applications – focus on nutrient application rate.

Field	Sub-Field ID	App Month	App Year	Target Crop	Nutrient Source (Storage ID/ Fertilizer Product)	Equipment Type/ Application Method	Rate/Acre	Total Amount Applied	Applied Units	Acres Cov.	Avail N (Lbs/A)	Avail P ₂ O ₅ (Lbs/A)	Avail K ₂ O (Lbs/A)

2. Field Nutrient Balance (Not Used)

Table F-2-1. Field nutrient balance based on crop removal. Note that nitrogen crop values based on fertilizer recommendations for non-legume crops. Note that manure cannot be applied on a field with a phosphate balance greater than 500 lbs/acre.

No fields defined for this plan.

3. Annual Summary of Projected Manure Inventory

Table F-3-1. Summary of projected manure collection, imports, exports and transfers and end-of-year totals.

Manure Source	Plan Period	On Hand at Start of Period	Total Generated	Total Imported	Total Transferred In	Total Applied	Total Exported	Total Transferred Out	On Hand at End of Period	Units
Gestation Barn	Apr '17 - Mar '18	0	6,384,851	0	0	0	4,000,000	0	2,384,851	Gal
Gestation Barn	Apr '18 - Mar '19	2,384,851	6,384,851	0	0	0	6,000,000	0	2,769,702	Gal
Gestation Barn	Apr '19 - Mar '20	2,769,702	6,384,851	0	0	0	6,500,000	0	2,654,553	Gal
Gestation Barn	Apr '20 - Mar '21	2,654,553	6,384,851	0	0	0	6,600,000	0	2,439,404	Gal
Gestation Barn	Apr '21 - Mar '22	2,439,404	6,384,851	0	0	0	6,300,000	0	2,524,255	Gal
GDU Barn	Apr '17 - Mar '18	0	1,066,859	0	0	0	600,000	0	466,859	Gal
GDU Barn	Apr '18 - Mar '19	466,859	1,066,859	0	0	0	900,000	0	633,718	Gal
GDU Barn	Apr '19 - Mar '20	633,718	1,066,859	0	0	0	1,050,000	0	650,577	Gal
GDU Barn	Apr '20 - Mar '21	650,577	1,066,859	0	0	0	1,050,000	0	667,436	Gal
GDU Barn	Apr '21 - Mar '22	667,436	1,066,859	0	0	0	1,100,000	0	634,295	Gal
Mortality Composter	Apr '17 - Mar '18	0	78	0	0	0	40	0	38	Ton
Mortality Composter	Apr '18 - Mar '19	38	78	0	0	0	70	0	46	Ton
Mortality Composter	Apr '19 - Mar '20	46	78	0	0	0	70	0	54	Ton
Mortality Composter	Apr '20 - Mar '21	54	78	0	0	0	90	0	42	Ton
Mortality Composter	Apr '21 - Mar '22	42	78	0	0	0	70	0	50	Ton

Document Source Information

Report based on information from Manure Management Planer MMP 0.3.5.0

Plan:

File: C:\Projects\2016\16-3418 Expedition Acres\expeditionacres.mmp
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Last Saved: 1/26/2017 12:03:21 PM
Exported: 1/26/2017 12:03:31 PM
Title: Southern Hills 2 CNMP
Years in Plan: 5
Plan Start Year: 2017
Plan Start Month: 4

Operation:

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Appendix 1

Narrative Summary of Design

EXPEDITION ACRES, LLC NARRATIVE SUMMARY OF DESIGN

This facility is located in the NE ¼ of Section 29, Township 63N, Range 6W, in Lewis County Missouri. This farm is a three building sow farm producing weaned pigs. The farm will include the construction of a new 175' wide x 443' long farrowing barn, a 153' wide x 692' long breeding/gestation barn and a 101' wide x 270' long gilt development (GDU) barn. Proposed animal numbers are 960 sows & litters, 4,640 breeding/gestating sows & boars, 2,400 gilts > 55 lbs and 500 gilts < 55 lbs. An office will be constructed in the farrowing barn.

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The plugs in the farrowing barn are pulled approximately once per week. The building pits are not recharged which is typical in farms operated in this manner. The total calculated manure and process water expected to be collected and stored in the gestation barn pit from the farrowing and gestation barns based on MWPS 18 table 7 is 6,384,851 gallons.

The nursery is drained to the GDU deep-pit. The gilts are housed over the 10 foot deep-pit. The total calculated manure and process water collected and stored in the GDU barn pit is 1,066,859 gallons.

Land Application

The land application system will employ drag hoses with an injection system, an irrigation pump and tankwagon to apply wastewater to the land application areas. It is typical to employ custom applicators to apply all wastewater. All waste nutrients will be exported off the farm.

Dead Animals

Dead animals will be disposed of in accordance with the Missouri Department of Agriculture regulations. Dead animals from this operation will be composted or taken to a rendering facility.

Clean Water Diversion

This farm is graded to divert storm water away from buildings, animal confinement areas and manure storage areas.

A potential source of unplanned waste from animal confinement facilities is from storm water coming into contact with pollutants. The pollutants that could potentially contaminate the water are the hogs, manure, mortalities, feed, diesel fuel, and oils and lubricants for farm equipment. All of these potential pollutants are kept under roof at this farm. They do not come into contact with clean rain water or add to the contaminated waste on the farm.

A common way for clean water to become contaminated is by contacting ventilated dust on the ground around the barn. To treat rainwater that becomes contaminated by this dust, the barn will be

surrounded by grass. The grass acts as a filter and helps prevent erosion around the barns reducing suspended solids in the runoff.

Other operations at this farm that could potentially contribute to exposed pollutants are the loading and unloading of pigs, feed, manure, and mortalities. When these sources are handled messes can occur. Care should be taken to not create a mess around the door of the barns, the manure pumping ports, or at the base of the feed bins. When messes occur during these operations they will be cleaned up immediately.

Prevention of Direct Contact of Confined Animals to Waters of the State

All confined animals are housed under roof in buildings with no outside access. They have no direct access to waters of the state.

Chemical Handling

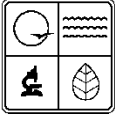
If checked, the indicated measures will be taken to prevent chemicals and other contaminants from contaminating process waste water or storm water storage and treatment systems.

	This is not a regulatory-agency permitted facility. This section does not apply.
--	--

	<i>Measure</i>
X	All hog farm chemicals are stored in proper containers. Expired chemicals and empty containers are properly disposed of in accordance with state and federal regulations.
X	Chemical storage areas are self-contained with no drains or other pathways that will allow spilled chemicals to exit the storage area.
X	Chemical storage areas are covered to prevent chemical contact with rain or snow.
	Emergency procedures and equipment are in place to contain and clean up chemical spills.
	Chemical handling and equipment wash areas are designed and constructed to prevent contamination of surface waters and waste water and storm water storage and treatment systems.

Appendix 2

Example Record Keeping Documents



MISSOURI DEPARTMENT OF NATURAL RESOURCES
 WATER PROTECTION PROGRAM
CAFO RECORD KEEPING FORMS CHECKLIST

INSTRUCTIONS

1. Use the checklist to determine which of the record keeping forms are required for your operation and include them in your record keeping file. Forms for all record keeping requirements of the MOG01 (NPDES) and MOGS1 (State No Discharge) operating permits are included.
2. There will be multiple copies of some pages due to the unique characteristics of each operation. The forms can be filled out on a computer or they can be printed or copied and kept in a binder.
3. Information on the forms can be used to complete the annual report, which must be submitted by Feb. 15, of each year. Only specified forms need to be submitted with the annual report
4. All records must be retained for five years along with your operating permit, and nutrient management plan.

CHECKLIST

OPERATION NAME:	PERMIT NUMBER: MO-	YEAR
MANURE STORAGE		
1A. Spills and Overflows		<input type="checkbox"/>
1B. Liquid Manure Storage Level Readings		<input type="checkbox"/>
1C. Transfers Off-Farm		<input type="checkbox"/>
1D. Rainfall Records (Required only for operations with open liquid storage)		<input type="checkbox"/>
1E. Mortality Management		<input type="checkbox"/>
TESTING RESULTS		
2A. Manure		<input type="checkbox"/>
2B. Soils		<input type="checkbox"/>
INSPECTIONS		
3A. Production Area Visual Inspections		<input type="checkbox"/>
3B. Land Application Area Visual Inspections		<input type="checkbox"/>
3C. Problems and Repairs		<input type="checkbox"/>
LAND APPLICATION		
4A. Operational Monitoring		<input type="checkbox"/>
4B. Nitrogen		<input type="checkbox"/>
4C. Phosphorus		<input type="checkbox"/>

1A - MANURE STORAGE. Spills and Overflows (List any corrective actions taken in 3B.)

PERMIT NUMBER MO-	YEAR
-----------------------------	------

Date	Time	Cause of Discharge	Location	Discharge Rate gallons or cu. ft./Sec	Discharge Duration	Estimated Volume Discharged ¹ gallons or cu. ft.

Notes
¹ Estimated volume = discharge rate in gallons per second or cubic feet per second x duration (seconds). See record keeping requirements of your MOG01 or permit, for additional guidance.

Measure discharge or release of spills from manure handling and overflows from manure storages at the property line or immediately prior to entering the receiving stream.

Any discharge of manure, litter, process wastewater, or mortality by-products to surface waters of the state or release that crosses property boundaries shall be reported to the department as soon as practicable, but no later than 24 hours after the permittee becomes aware of the discharge. MOGS1 permittees see additional reporting requirements in Non-compliance reporting requirements of your permit.

If a discharge or release occurs, submit this page with the annual report.

1B - MANURE STORAGE. Liquid Manure Storage Level Readings

MANURE SOURCE		PERMIT NUMBER	YEAR
		MO	
Week	Date	Level Reading - Feet Below Overflow	
1			
2			
3			
4			
5			
6			
7			
8			
9			
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48			
49			
50			
52			

Instructions: Record the liquid level weekly for each unique liquid manure storage structure. Use a separate sheet for each separate structure.

1C - MANURE STORAGE. Transfers (Off-farm)

PERMIT NUMBER				YEAR		
MO						
Source ¹	Date of Transfer	Amount Transferred (gal. or ton)	Info to Buyer (check)		Name of Buyer	Address
			Current Manure Test Results	NMTS ³		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
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			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>		

Notes
¹ Deep pit, lagoon, basin, tank, sludge, separated solids, litter, mortality compost.
² Agitated, unagitated, cake litter, with or without bedding, composted litter.
³ The current version of the Missouri CAFO Nutrient Management Technical Standard published by the Department of Natural Resources.

1D - MANURE STORAGE. Rainfall (Required for open liquid storage only)

PERMIT NUMBER

YEAR

MO

Day	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1												
2												
3												
4												
5												
6												
7												
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22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Monthly Total												
YTD												

Instructions: Collect rainfall data for operations with open liquid manure storages only.

1E - MANURE STORAGE. Method of Mortality Management

PERMIT NUMBER

YEAR

MO

Composting

Rendering

Sent to Landfill

Incineration

Burial¹

Other

Records²:

Notes

¹ In accordance with 10 CSR 20-8.300(14), Class I operations shall not use burial as a method of disposing of routine mortalities. Burial is allowed for disposal for mass mortalities.

² Information recorded here can include weekly/monthly mortality numbers, mortality and composting procedures, mortality by-product management, or rendering facilities information.

2A - TESTING RESULTS. Manure Test Results (Annual manure analysis is required for all CAFO's, including export only operations.)

PERMIT NUMBER	YEAR
MO	

Source of Manure ¹	Type of Manure ²	Sample Date	Moisture/Dry Matter (%) (Circle one)	Units	TKN	NH ₃ -N	P ₂ O ₅	K ₂ O	NO ₃ -N ³
				lbs./1000 gal lbs/ton					

Notes
¹ Deep pit, lagoon, basin, litter, tank, sludge, separated solids, mortality compost.
² Agitated liquid pit/tank manure, unagitated lagoon/basin effluent, agitated lagoon/basin manure, poultry litter, poultry litter cake, bedded pack manure, stacked manure with or without bedding, composted litter, mortality compost or other composted manure.
³ Report nitrate nitrogen only when applicable.

MOG01 permittees must submit a copy of the lab analysis sheets or this form with the annual report.

2B - TESTING RESULTS. Soil Test

PERMIT NUMBER

YEAR

MO

Field ID¹	Soil Sampling Date	Units ppm or lbs/ac (circle one)	Soil Test P²	Soil Test P Rating	CEC (meq/100g)	Organic Matter (%)

Notes
¹ Name of field as identified in nutrient management plan; only include fields under control (owned, rented, or leased) of the CAFO owner or operator.
² Samples should be analyzed using the Bray-1 P soil extraction procedure. If another procedure is used by the soil testing lab, this must be noted on this sheet.

MOG01 permittees must submit a copy of the lab analysis sheet(s) or this form with the Annual Report if soil samples were taken during the year.

3A - INSPECTIONS. Production Area Visual Inspections (List any deficiencies and corrective actions taken in 3C.)

PERMIT NUMBER

YEAR

MO

Week	Stormwater¹ Date and Initial	Water Lines² Date and Initial	Manure Containment Structure³ Date and Initial
1			
2			
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Notes

- ¹ Record the weekly inspections of all stormwater diversion devices directing clean water away from the production area and channeling contaminated water to manure storages.
- ² Record each week the daily inspections of all wastewater lines within the production area and all drinking or cooling water lines that have the potential to leak into manure, litter or process wastewater structures. Record weekly that you inspected daily.
- ³ Record weekly inspections of all manure, litter and process wastewater storage structures.

3B - LAND APPLICATION. Land Application Area Visual Inspections (List any deficiencies and corrective actions taken in 3C.)

PERMIT NUMBER		YEAR	
MO			
Land Application Equipment ¹ Date and Initial	Perimeter of Field ² Date and Initial	Drifting of Spray ³ Date and Initial	Aboveground Irrigation Pipelines ⁴ Date and Initial

Notes

¹ Periodically inspect land application equipment for leaks.

² Monitor the perimeter of application field to ensure wastewater does not run off.

³ Monitor for drifting of spray irrigation.

⁴ Hourly inspections of aboveground pipelines for leaks when in use.

3C - INSPECTIONS. Problems and Repairs

<small>PERMIT NUMBER</small> MO	<small>YEAR</small>
---	---------------------

Inspection Date	Deficiencies Noted	Date of Repair¹	Corrective Actions Taken

Notes
¹ Deficiencies not corrected within 30 days shall have an explanation as to why corrective actions were delayed.

4A - LAND APPLICATION. Operational Monitoring

PERMIT NUMBER: **MO** YEAR: _____ DATE LAND APPLICATION EQUIPMENT WAS CALIBRATED: _____

Source of Manure ¹	Type of Manure ²	Field ID ³	Date of Application	Weather ⁴	Rainfall ⁵	Soil Condition ⁶	Application Method ⁷	Rate gal/ac or tons/ac	Basis ⁸ N or P	PAN ⁹ (lbs/ac)	P ₂ O ₅ (lbs/ac)	Spreadable Acres	Total applied (gal or tons) Circle one

Notes

¹ Deep pit, lagoon/basin, litter, tank, separated solids, compost.

² Agitated liquid pit/tank manure, unagitated lagoon/basin effluent, agitated lagoon, basin manure, lagoon/basin sludge, separated solids, poultry litter, poultry litter cake bedded pack manure, stacked manure with or without bedding, composted litter, mortality compost, other composted manure.

³ Name of field receiving manure as identified in nutrient management plan; only include fields under control (owned, rented or leased) of the CAFO owner or operator.

⁴ Record the weather conditions at the time of application; insert the codes that apply: CL – clear sky, RN – rain, SN – snowing, OV - overcast, FR – temperature below 32 degrees F.

⁵ Record “Before” or “After” if a rainfall event occurred 24 hours prior to or after application.

⁶ Soil condition at time of application: Dry, saturated, muddy, snow-covered or frozen.

⁷ Injection, partial injection, surface application and incorporated (indicate number of days to incorporation), or surface application only.

⁸ Write N or P to indicate if the application rate of the field is nitrogen based or phosphorus based.

⁹ Plant Available Nitrogen.

4B - LAND APPLICATION MONITORING. Nitrogen Summary

PERMIT NUMBER _____ YEAR _____
 MO _____

Field ID ¹	Spreadable Acres	Planned Crop	Projected Yield (bu. or ton/ac)	Planned N Recommendation ² (lbs/ac)	Actual Applied N (lbs N/ac)			Actual Crop	Actual Yield (bu. or ton/ac)	Actual N Removal ⁴ (lbs/ac)	N Surplus (+) or Deficit (-) ⁴ (lbs N/ac)
					Manure PAN	Other N Sources ³	Total PAN				

Notes

¹ Name of field receiving manure as identified in nutrient management plan; only include fields under control of the CAFO owner or operator.

² University of Missouri fertilizer recommendations should be used.

³ Includes credits from previous legume crops and residual N from previous application.

⁴ Crop N usage rate X actual crop yield, for legumes crop N content X crop yield.

⁵ Total applied PAN minus actual N removal.

4C - LAND APPLICATION MONITORING. Phosphorus Summary

PERMIT NUMBER	YEAR
MO	

Field ID ¹	MO Soil Test P Rating	P Index Rating	Planned P Removal Rate ² (lbs P ₂ O ₅ /ac)	Actual Applied P (lbs P ₂ O ₅ /ac) ³			Actual P Removal ⁴ (lbs P ₂ O ₅ /ac)	*Multi-year P Applications	
				P ₂ O ₅ From Manure	Other P ₂ O ₅ Sources	Total P ₂ O ₅		Previous Balance ⁵	Current Balance ⁶

Notes

¹ Name of field as identified in nutrient management plan that is restricted to a P based application, which received manure or is utilizing a “multi-year phosphorus application;” only include fields under control of the CAFO owner or operator.

² Crop P usage rate X crop yield goal (University of Missouri fertilizer recommendations should be used).

³ Enter amount applied for a yearly application or amount applied for a multi-year phosphorous application.

⁴ Crop P usage rate X actual crop yield.

⁵ Enter value from the current balance column from last year's form.

⁶ For initial year of a multi-year phosphorous application this is the “Total P₂O₅” - Planned P Removal Rate. For subsequent years it is the previous balance - Planned P Removal Rate. If the difference is a negative number enter “0”.

***In accordance with 10 CSR 20-6.300(1)(B)13, fields utilizing a “Multi-year phosphorous application” cannot receive additional applications of manure, litter, or process wastewater until the applied phosphorous has been removed. The amount applied in a multi-year phosphorous application cannot exceed that year’s crop N recommendation.**

Appendix 3

Operation & Maintenance Plan

Operation & Maintenance Plan

INSPECTION PROCEDURE

BARN

In order to ensure continuing DEEP-PIT integrity, the following monitoring procedures will be conducted:

FREQUENCY: Once per week.

1. Visually inspect barn for condition and concrete integrity. Concrete shall be evaluated to ensure the following:
 - a. No cracks
 - b. No leaning of walls
 - c. The presence of rodent burrows/signs of rodent activities
 - d. Signs of erosion (around building foundation)
2. On A Weekly Basis: Check pit level. Read level from the measuring marker stick by dropping the stick between the slatted floor to the pit bottom and then removing the stick to read water level. Measure the level to the nearest .1 foot above the pit floor.

MAINTENANCE

FARM FACILITIES

When problems (e.g. burrowing rodents, etc.) are noted that require follow up but are not considered emergency situations (i.e. no immediate threat to the environment), the following steps shall be taken to ensure the problem is corrected in a timely fashion:

1. Record repairs made to irrigation lines, as well as other equipment associated with land and nutrient management activities. Record the following information:
 - Description of problem
 - Date repair made
 - Material used to complete repair
 - Personnel involved
2. In the event that a maintenance problem occurs which constitutes an immediate threat to the environment, employees are instructed to follow the Emergency Response Plan immediately.

SEWERS

After draining the farrowing pits the plugs must be placed back in the drains to prevent residual sludge from weeping into pipes causing solid build-up and clogs in the line.

MOWING

Periodic mowing is necessary at various locations on the farm to prevent potential environmental problems, and to improve aesthetics.

Barns

A 50' area around the barn is maintained with a cool season grass cover. The primary objectives of the vegetation maintenance program is to:

1. Mow the grass as often as necessary to maintain it at 8" or less in height and to prevent the "heading out" of any grass or weed species that are present.
2. Maintain the grass at as even level as possible.

The area around the barn shall be kept free of burrowing animals so as not to jeopardize integrity of the pit.

EMERGENCY MAINTENANCE

If a problem is discovered that requires immediate attention, take the following actions:

1. If work can be completed in-house, mobilize the appropriate personnel to rectify the problem.
2. If work cannot be completed in-house, enlist any necessary outside service directly to repair the problem.

In situations posing a potential threat to the integrity of the deep-pit operation or any of the land and nutrient management program refer to the **Emergency Response Plan** for guidance in formulating appropriate follow-up actions.

NUTRIENT MANAGEMENT PLANNING

OVERVIEW

Manure is a by-product of any type of livestock operation. At The **Expedition Acres Farm**, the barn pits have numerous air turnovers per hour to ensure a healthy environment for the employees and animals.

Manure components collected in the deep pit barn, namely, nitrogen, phosphorus, and potassium, (as well as trace minerals and nutrients) are beneficial to crops and can be effectively used as replacements for chemical fertilizer in normal farming activities.

Typical crops raised on the farm include but may not be limited to: corn and soybeans.

WASTEWATER NUTRIENTS

The primary nutrients found in Hog manure are nitrogen, phosphorus and potassium. Nitrate nitrogen (nitrate is $\text{NO}_3\text{-N}$, a water soluble, negatively charged ion) in water can be harmful to humans. Excessive nutrients and decomposing organic nutrients (N, P, K, S) can be responsible for algae blooms and weed growth in water, which can reduce available oxygen for aquatic species. Along with the nutrients, manure may increase salinity on some soils. Hog manure does benefit soil quality. Along with nitrogen, phosphorus and potassium, several trace minerals are also found in manure. If properly managed, the nutrients can reduce or eliminate commercial fertilizer needs for many crops. Along with the nutrient value, Hog manure can increase microorganisms and improve soil organic matter, soil tilth, and soil structure. These improvements in soil quality can reduce erosion, improve drainage, and increase soil productivity.

Nitrogen: Nitrogen is important for all plants and animals; the nitrogen in manure is no different than the nitrogen found in synthetic fertilizers. Nitrogen comes from many sources and in many different forms. The nutrient and pollution potential of manure nitrogen depends on the form and amount in the environment. Understanding the different forms allows you to better manage this important nutrient.

The two main forms of nitrogen (N) in Hog manure are organic N (proteins, amino acids and urea, which are unavailable to plants) and inorganic N (ammonium, nitrates, ammonia). Ammonium N is the predominant component of available nitrogen in manure.

When manure is applied to soil, the organic N begins to break down to inorganic N, which is available to plants. This process is called ammonification or mineralization, and is affected by temperature, moisture, and time. Warm conditions have a higher rate of organic N conversion than cooler temperatures. Approximately 33-55% of organic N is converted to ammonium or available N each year after the manure is land applied.

When organic N is converted to available N, it starts as ammonium N. Ammonium N is available for plant uptake and is not mobile in the soil. The process of nitrification eventually converts ammonium N to nitrate N. While nitrate N is available to plants, it is also susceptible to denitrification (loss to the air) and to leaching. Ammonia N can be quickly lost by being converted to ammonium and volatilized.

Phosphorus and Potassium: Phosphorus and potassium are also important nutrient components of manure. Both nutrients are needed for proper plant and root growth. While they generally bind tightly with soil, they can move into surface waters by moving on eroded soil particles. Phosphorus may move directly into surface waters in areas with extremely high phosphorus levels. Excessive concentrations of phosphorus in water can contribute to excessive aquatic plant growth and depletion of oxygen. However, phosphorus and potassium

have little potential for leaching and have no direct toxic effects on humans or wildlife. By using proper conservation techniques (such as conservation tillage, terraces, filter strips, etc.) movement of phosphorus or potassium into surface water can be reduced.

DEVELOPING A NUTRIENT MANAGEMENT PLAN

Several factors are considered in the development of a sound nutrient management plan, including: separated solids analysis, lagoon water analysis, the amount of plant available nitrogen (PAN), amount of land available, cropping program, and application procedures.

WASTEWATER ANALYSIS

Current regulations dictate that nutrient management plans be based on nitrogen and phosphorus levels, therefore land requirements to fulfill land application goals are based partially on the concentration of nitrogen in the wastewater and solid manure to be land applied. More than the other two primary nutrients in manure (phosphorus and potassium) the concentration of nitrogen in wastewater varies with water temperature and weather conditions. In order to develop the best overall estimate of total nitrogen levels in the deep-pit, it must be sampled annually.

SAMPLING PROTOCOL

It is recommended that UMC Science and Technology Guide “Collecting and Preserving Waste and Wastewater Samples for Analysis” and University Extension Water Quality publication “Laboratory Analysis of Manure” be followed.

WASTEWATER

1. Using plastic bottles, collect samples of wastewater at varying depths below surface.
2. Pour 50 ml of liquid into a second sample bottle. Discard the remainder of the first sample into the lagoon.
3. Repeat this process at at least six more spots, each time pouring approximately 50 ml into the second sample bottle so that the second bottle consist of 350 ml of lagoon liquid more or less, collected from a minimum of seven different locations.
4. Secure the lid for each sample bottle and fill out and attach the appropriate sample identification label and date each bottle.
5. Deliver samples directly to laboratory.

SAMPLE ANALYSIS

Each sample shall be analyzed by a qualified analytical laboratory for the constituents identified in the following table:

Table of Analysis Constituents

<u>Constituent</u>	<u>Unit</u>
Kjeldahl Nitrogen	mg/l
Ammonia Nitrogen as N	mg/l
Nitrate Nitrogen as N	mg/l
Total phosphorus as P	mg/l

A copy of the analysis shall be used in the preparation and modification of the annual cropping plans.

DETERMINING LAND NEEDS

Nutrient management plans using DNR recommended methodologies shall be prepared each year for each field in the operation to achieve the best program for even distribution of nutrients from the manure.

It is recommended that University Extension Water Quality Guide “Reduce Environmental Problems with Proper Land Application of Animal Waste” and “Land Application Considerations for Animal Waste” be reviewed by all Land Application personnel.

Crops

Plants have different capacities to utilize nutrients, in particular nitrogen. Current state regulations dictate that cropping plans be developed to account for nitrogen loading and uptake by crops. Several references are recommended by the DNR to determine nutrient uptake potential of different crops. They are:

Midwest Plan Service. 1993. **Livestock Waste Facilities Handbook.**

Buchholz, D. 1983, Reprinted 1989. **Soil Test Interpretations and Recommendations Handbook.** University of Missouri; College of Agriculture.

Natural Resources Conservation Service. **Soil Interpretation Manual.**

Soil Sampling

In order to correctly estimate the available nutrients in the soil, soil tests should be conducted every year.

Sampling locations should be determined based on soil type and statistically sound sampling methods. A standard soil sampling protocol (MU Guide: "How To Get A Good Soil Sample") should be followed.

Deep Pit Pumpdown Levels

Pumping operations will be initiated before the water level reaches the upper pumpdown marker on the pumpdown stick. The pit shall be pumped down as close as possible to the floor each year to insure that full storage is available during the winter and spring months.

The pits have the following pumpdown volumes for each barn:

All Barns

Annual Volume (<i>gallons</i>)	7,451,710
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DETERMINING PLANT AVAILABLE NITROGEN

Plant Available Nitrogen (PAN) is a measurement of the amount of nitrogen in the soil which is in a form which is readily available for use by vegetation. As previously stated, nitrogen exists in many forms, however some forms are more easily accessed by plants than others. Nitrate nitrogen (NO₃) is the form most commonly used by plants. PAN calculations take into consideration the amount of nitrogen present in all forms—the amount of nitrogen available in the manure, nitrogen from "native/soil" sources {sRON} and from previous manure or applications {mRON} – and compares these values with the nitrogen needs of the crop to be grown. The Missouri DNR has developed a worksheet to determine PAN. This worksheet should be used in the formulation of a nutrient management plan. A copy of the worksheet is provided. A professional agronomist or engineer should be employed on an annual basis to aid in completing the calculations.

The procedure for determining PAN follows:

Procedure to Determine Plant Available Nitrogen

1. One Missouri DNR PAN worksheet shall be used for each field on each farm.
2. Fill out worksheet on a field by field basis, using the crop that is planed to be grown the following year in the calculation.

3. Use soil sample analysis to fill in Soil Residual Organic Nitrogen (sRON).
4. Use Wastewater analysis to determine Manure Plant Available Nitrogen (mPAN).
5. Use past pumping records, water use records, and rainfall data to calculate total volume of wastewater to be pumped in upcoming growing season.
6. Using DNR worksheet and crop to be grown, calculate nutrient loading for every field. In no case should nutrient loading projections exceed land use capacity. If PAN requirements exceed nutrient loading capacity of pumping acreage, modifications shall be made to the cropping plan to incorporate crops with a heavier nutrient loading capacity.
7. If modifications to cropping scenario do not alleviate nutrient loading concerns, then additional land shall be secured to apply waste on.

SCHEDULING APPLICATION ACTIVITIES

Several conditions (mostly weather-related) may require modification and adjustment of application schedules. These are described below.

Determining Number of Days Suitable for Application

Application is permitted to occur during seasons when the ground is not frozen, typically from March 1 through December 15 (approximately 285 days). If conditions remain favorable for application beyond the duration of the permitted pumping schedule, then application may continue.

Land application is not permitted during rain events, The normal occurrence of rainy days must be included in the preparation of application schedules for this time period. In order to develop an accurate estimate of the number of non-rainy days during the season, the following shall be conducted, prior to commencing the land application season every year.

1. Review the land application history for the three previous growing seasons.
2. Total up the number of days on which land application occurred during the previous three seasons.
3. Divide by three to determine the number of days available for the current growing season.

4. Include the estimated available land application days in upcoming year's nutrient management plan.

Adjusting Application Rates

The PAN procedure is recommended by DNR to estimate the nutrient loading capacity of each field. Land application procedures, as outlined in this manual detail proper procedures for application. In addition to following proper procedures, the applicator must be capable of modifying the application program to accommodate a number of variables. Methods of addressing several of these variables are detailed below:

Soil Conditions

Precipitation events will reduce soil infiltration capacity while increasing soil moisture content. Overall soil field capacity (to reach saturation) will be reduced as well. Land Application procedures must take into account precipitation events, so that wastewater is not over-applied to an already saturated field. Application rates must be reduced on fields that have received (or are about to receive) significant (0.5") amounts of rainfall. When planning land application activities, the Applicator must consider the following conditions:

Conditions Requiring Adjustment of Application Rates

1. No land application shall be conducted while it is raining.
2. If land application is being conducted and it starts to rain, immediately cease all land application activities.
3. Check the local weather forecast for current weather data every morning before commencing land application activities. If a greater than 80% chance of rainfall is forecast for the next 24 hours, limit land application activities locations which can be quickly stopped should rainfall begin.
4. If a significant chance of rain is forecast, continue checking storm patterns throughout the day to determine if an imminent threat for rain still remains.
5. Following a significant rainfall (>0.5") or prolonged rainfall events, visually inspect the field before commencing land application. Signs of ponding water or saturated soils, should be noted. If these are present, no land application shall be commenced on the field. Continue to check the field to determine when conditions are appropriate to commence land application.
6. Consider the previous long-term weather and site conditions (i.e has it been several days of rain?, are soils already saturated?, or has it been a prolonged dry spell with one

large rain event?) when determining the appropriate time to commence pumping following a heavy rain storm.

7. Consider the prevailing wind, both in terms of intensity and direction. If wind is such that application on specific fields upwind of neighbors could result in unusual level of odor reaching that neighbor's property, than another field shall be selected for application, if possible

Neighbor Considerations

The following program is recommended to insure that pumping activities do not unduly impose on neighbors.

1. No pumping is conducted over Holidays/Holiday weekends unless **absolutely** necessary to meet management standards.
2. If neighbors contact the Farm to inform of a special outdoor event they are planning, then no land application will be conducted upwind of that neighbor's property on the given day.
3. Land application should be minimized on lands upwind of neighbors on those days when winds are excessively strong.

NUTRIENT APPLICATION EQUIPMENT

Aerway with Drag Hose

Injector with Drag Hose

Tank wagons

Manure Spreader

Prior to commencing land application, equipment shall be inspected to ensure that it is in proper working order. If repairs to the equipment are needed, the applicator shall make the repair. If the repair is such that the integrity of land application operations will be jeopardized until it is completed, then no land application shall be conducted using the broken piece of equipment. If land application can be safely continued before the repair is made, then land application may commence. In any case, equipment should be repaired in a timely fashion.

START-UP PROCEDURES

The following general process shall be used every day before beginning land application operations:

LAND APPLICATION

1. Every morning, check the local weather forecast to be sure conditions are right for land application.
2. Select a field for land application, check pumping summary to be sure that the selected field has not yet reached its maximum application nutrient application rate.
3. If field is still able to receive manure, then continue with start up procedures. If field has already reached its maximum loading rate, then repeat selection process to pick another field.

STANDARD LAND APPLICATION PRACTICES

1. **The maximum application rate shall be 1.0 inches per day.**
2. Land application shall take place on the acres defined on the maps enclosed.
3. No surface application shall be conducted on land with greater that 15% slope.
4. Soil-plant filter areas shall have slopes less than 15%. When slopes are greater than 10%, application is limited to .25 inches per day.
5. The separation distances outlined in section 6.2 shall be maintained.

Manure Application Setback Distances

Feature	Setback Criteria	Setback Distance (feet)
Public or private drinking water well or other wells including un-plugged abandon wells	All application methods	300
Public or private drinking water lake or impoundment	All application methods	300
Public or private drinking water intake structure	All application methods	300
Classified waters of the state not used as a water supply as defined in 10 CSR 20-7.031(1)F	Permanently vegetated buffer ¹	35
	No or insufficient vegetated buffer	100
Other public and privately owned lakes and impoundments not used as a water supply including impoundments with no outlet	Permanently vegetated buffer ¹	35
	Up-gradient, no or insufficient vegetated buffer	100
	Down-gradient, no or insufficient vegetated buffer	35

Feature	Setback Criteria	Setback Distance (feet)
Other perennial streams, other intermittent streams, canals, drainage ditches and wetlands	Permanently vegetated buffer ¹	35
	Up-gradient, no or insufficient vegetated buffer	100
	Down-gradient, no or insufficient vegetated buffer	35
Tile line inlet (if left un-plugged during manure application)	Up-gradient, permanently vegetated buffer ¹	35
	Up-gradient, no or insufficient vegetated buffer	100
	Down-gradient	0
Losing stream	All application methods	300
Cave entrance	All application methods	300
Spring	All application methods	300
Active Sinkhole	All application methods	300
Non-owned occupied residence	Spray irrigation	150
Public use area including non-owned businesses	Spray irrigation	150
Public road	All application methods	50
Property boundary	All application methods	50

1. Vegetated Buffer - A permanent strip of dense perennial vegetation established parallel to the contours of and perpendicular to the dominant slope of the field for the purposes of effectively slowing water runoff, enhancing water infiltration, and minimizing the risk of any potential nutrients or pollutants from leaving the field and reaching surface waters.

RECORDKEEPING

Careful record keeping is essential to the success of the Nutrient Management program. The following information shall be recorded with each land application event.

- Date
- Field location
- Crop Type
- Weather conditions
- Application rate
- Estimated total application

The application summaries will provide a detailed overview of application activities; specifically which fields were applied on, total manure applied per field, and a running total of manure applied per field in relation to its total projected application rate in the Land and Nutrient Management Plan developed for the crop year. The summary reports will enable the applicator to apply the proper amount of manure to fields, while properly spacing applications over an appropriate period in the growing season.

Dead Animal Disposal

Dead animal carcasses from the Swine operation will be managed according to the Missouri Department of Agriculture's requirements for dead animal disposal. Dead animals from this site will be composted.

If in the event it is necessary to bury any animals, the following Missouri Department of Agriculture regulations shall be followed:

1) For areas defined by the Department of Natural Resources, Division of Geology and Land Survey, as not having major groundwater contamination potential (Note: this area is defined as such), the maximum loading rate shall be limited to:

a) Seven cattle, **44 swine**, forty seven sheep, and beginning July 1, 1995, four hundred turkey carcasses or 2000 poultry carcasses on any given acre per year; or

b) All other species and immature cattle, **swine**, sheep, and beginning July 1, 1995, turkeys or poultry shall be limited to 7000 pounds of animals on any given acre per year;

2) The maximum amount of land that shall be used for on-site burial of animals on any person's property during a given year shall be limited to ten percent of the total land owned by that person or one acre, whichever is greater; and

3) Burial sites shall not be located in low-lying areas subject to flooding; and

4) The lowest elevation of the burial pits shall be six feet or less below the surface of the ground; and

5) The dead animals shall be immediately covered with a minimum of six inches of soil and a final cover of a minimum of thirty inches of soil; and

6) Carcasses shall not be placed on the ground, in a ditch, at the base of a hill, or in a cavern and covered with soil; and

7) The abdominal cavity of carcasses over 150 pounds shall be punctured to allow escape of putrefactive gasses; and

8) The location of dead animal burial sites shall be in accordance with the following separation distances:

a) At least 300 feet from any wells, surface water intake structures, public water supply lakes, springs or sinkholes; and

b) At least 50 feet from adjacent property lines; and

c) At least 300 feet from any existing neighboring residence; and

d) More than 100 feet from any body of surface water such as a stream, lake pond, or

intermittent stream.

Calibrating Manure Spreaders

Charles D. Fulhage
Department of Agricultural Engineering

Land application is the primary means of using livestock wastes in Missouri. Properly spreading manure on cropland is an environmentally acceptable means of managing wastes and, at the same time, realizing a benefit from the manure's fertilizer value.

With the increased environmental concern and the need to closely match the fertilizer needs of the crop, farmers can no longer afford to just "spread manure." The land application operation should be given the same attention as spreading commercial fertilizer.

With knowledge of crop type, yield goal, soil tests and manure analysis, you can determine the needed rate of manure application. However, another critical step in obtaining this rate in the field is the correct spreader setting, operating speed and travel lane spacing.

Determining these factors is called "calibrating" the manure spreader. Calibrating a manure spreader requires measuring the weight of manure spread on a given ground area with a given travel speed, spreader setting, power take-off speed, lane spacing and other factors.

Determining manure spreader capacity

If the capacity of a manure spreader is known and the land area over which this amount of manure is spread is measured, then the application rate can be calculated by dividing the weight of manure spread by the area covered. It is important to understand the units of measurement used for manure application.

Solid or semisolid manure is usually handled in box-type or open-tank spreaders, and manure application rate is expressed in tons per acre. Nutrient concentrations in pounds per ton can be estimated, or calculated, from the laboratory analysis. Then, the nutrient application rate in pounds per acre is determined because tons per acre of manure application is known.

Liquid, or slurry, manure is usually handled by tank wagons, and the application rate is expressed in gallons per acre. Nutrient concentrations in pounds per gallon (or pounds per 1,000 gallons) are estimated, or obtained, from the laboratory analysis and used with the application rate in gallons per acre to obtain pounds per acre nutrient applied.

For calibration purposes, the capacity of a spreader in tons (for solid manure), or in gallons (for liquid manure) must be known. The volumetric capacity of spreaders is generally provided by the manufacturer. This capacity may be given as a typical "heaped" load condition or as a "struck" load condition. The struck load condition is the volume contained in the level-full box.

Caution should be exercised in using manufacturer's data for spreader volume. The standard used by most manufacturers in calculating spreader volume assumes a 60-degree angle of repose of the heaped

load in the spreader. This may not be attainable with your particular type of manure or loading equipment.

A more accurate approach may be to calculate the volume from measurements of the appropriate dimensions of the spreader box and the height of a typical heaped load. Calculate rectangular box-type spreader capacities by multiplying length by width by height and adding the volume of the heaped portion to obtain total volume (Figure 1).

Schematic of regular-shaped, open-type spreader box. Volume, cuft = $A \times C \times (B + D/2)$ (all dimensions in feet)

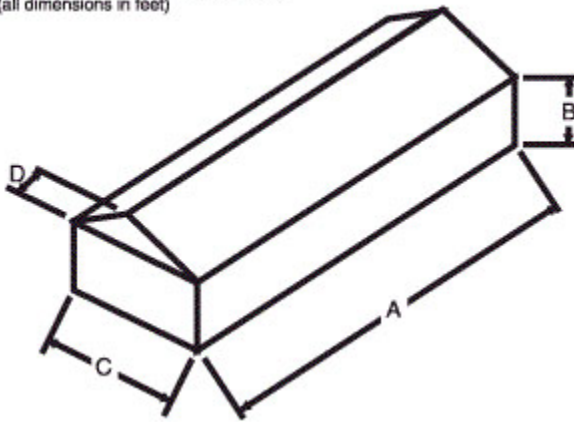


Figure 1

Three-dimensional view of a heaped-box spreader with dimensions and volume calculations.

Spreaders with irregular cross sections are somewhat more complicated. However, volume can be obtained rather easily by calculating volume segments separately and adding them together for the total (Figure 2).

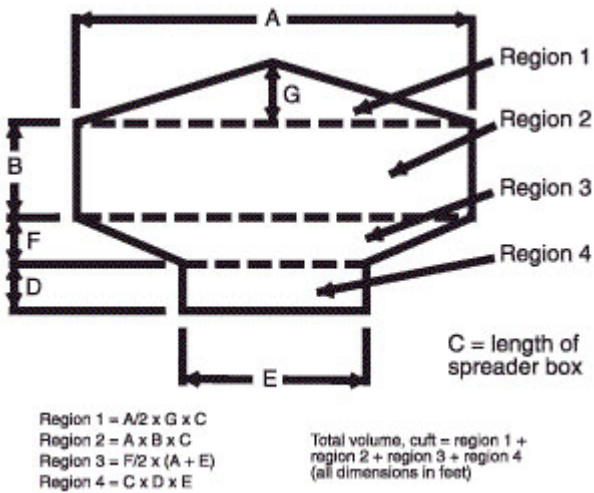


Figure 2

Three-dimensional view of a heaped-irregular shaped spreader with dimensions and volume calculations.

Closed-tank liquid manure spreaders generally have the shape of a cylindrical horizontal tank, and volume is expressed by the manufacturer in gallons. If manufacturer's data is not available, tank volume can be calculated as follows:

$$\text{Tank volume, gallons} = 5.87 \times (\text{tank length, feet}) \times (\text{tank diameter, feet}) \times (\text{tank diameter, feet})$$

Open-tank liquid manure spreaders may have an irregular cross section similar to some open-box solid manure spreaders. In these cases, volume is calculated in a manner similar to that shown in Figure 2. Obviously, open-box liquid manure spreaders will not have a "heaped" volume.

All liquid manure information is calculated on a per gallon basis. The computation of pounds of nutrients per load is found by multiplying the number of gallons per load by the pounds of nutrients per gallon.

All solid and semisolid manure information is calculated on a per ton basis, which requires converting from volume measure to weight measure. In order to make this conversion, the bulk density (weight per cubic foot) of manure must be known, estimated or measured. Bulk density is largely dependent on moisture content of the manure. For example, a spreader load of poultry litter at 20 percent moisture content will be considerably heavier than the same spreader load at 10 percent moisture content. Yet, volume is approximately the same in both cases.

One way to determine bulk density is to weigh the loaded spreader, then divide this weight by the spreader volume. If access to scales is available, some percentage of the loads can be weighed -- one or two of every 10 loads -- and all loads assumed equal to the average of the weighed loads. However, scales are usually not available on-site, and another means of obtaining bulk density is needed.

An alternate method of obtaining bulk density involves weighing a known manure volume then using this information with volumetric spreader capacity to obtain spreader capacity in tons. A five-gallon bucket is usually available, has a volume of about two-thirds cubic feet, and is a convenient known volume to use for this measurement. The following steps outline the proper procedure for obtaining manure bulk density.

- Weigh the empty bucket and write the weight on the side.
- Fill the bucket with manure. Do not compact the manure any more than might occur in the spreader.
- Weigh the full bucket and subtract the empty bucket weight. The result is the manure weight.
- Multiply the manure weight by three, then divide the answer by two. This gives the manure bulk density in pounds per cubic foot.
- Multiply the manure bulk density (in pounds per cubic foot) by the spreader volume (in cubic feet) to get the weight of the spreader load in pounds. Divide by 2,000 to get tons.
- Repeat this procedure several times. Sample the manure at different places. Average the values to obtain a representative composite of the manure.

The pounds of nutrients per load of manure are then found by multiplying the tons of manure per load by the pounds of nutrients per ton (from a laboratory analysis).

Determining application rate

Method A

The average application rate in gallons or tons per acre can be calculated if the area over which one or more loads of manure has been spread is measured.

- To measure the area covered by one spreader load:

- Mark the tractor tire by tying a piece of rope around some point on the tire. Move the tractor forward until the rope is on the ground. Mark the ground below the rope. Drive forward until the rope on the tire is on the ground again. Mark this point. Measure the distance in feet between the two marks on the ground. This is the travel distance for one tire revolution.
- Count the number of times the tire mark comes to the top of the tire while spreading a load of manure in a straight line. Multiply this number by the distance found for one revolution in Step 1a. The result is the total length of manure spreader travel while unloading one load.
- Measure the width of the spread manure path or travel lane spacing in feet.
- Multiply the width of the path by the length of travel and divide by 43,560 to get the acres covered in spreading one load.
- Calculate the manure application rate as follows:
 - Divide the tons or gallons of manure applied by the area covered (in acres) to get tons, or gallons per acre. Also, divide the pounds of nutrients per load by the area covered to get pounds of nutrients per acre.
 - If more than one load is spread and the areas of coverage overlap, then use the net width of the coverage between the first and last path. Use the average length of a travel path multiplied by the net width to find the area.

Method B

This method can be used to measure or adjust the application rate of a spreader without measuring the entire area of application or knowing the capacity of the manure spreader. With this method, a sheet of plastic is placed on the ground in the spreader path. The spreader is passed over the sheet at the normal operating speed. The manure is collected on the sheet and weighed. The application rate is the collected manure weight divided by the sheet area.

- Collect the spread manure.
 - Select a sheet of plastic 8-by-8 feet, or larger.
 - Weigh the sheet.
 - Lay the sheet on the ground.
 - Drive over the sheet while spreading manure at the normal operating speed. Start spreading at least 50 feet away from the sheet.
 - Pick up the sheet and fold it so that you do not lose any manure.
 - Weigh the sheet and manure. Subtract the empty sheet weight to determine the manure weight.
- Calculate the application rate.
 - Determine the area of the plastic sheet by multiplying the width by the length in feet to obtain area in square feet.
 - Multiply the pounds of manure collected by 21.78, then divide the answer by the area of the sheet (in square feet) to obtain the manure application rate in tons per acre.

Repeat the process several times and develop an average to be used as the application rate of the spreader. By conducting Method B at different travel speeds and spreader settings, the proper spreader settings and travel speeds can be determined to obtain the desired application rate.

This method does not account for overlap or space missed between spreader paths and will only give a true picture of the application rate when the manure is uniformly distributed over the field.

Table 1 shows a method of collecting data to determine manure spreader capacity.

Table 1
Manure spreader capacity

A. Description of spreader			
Make _____		Model _____	
Type	Box	Open Tank	Liquid Tank
Capacity (from dealer or measured)			
Box- or open-tank	cubic feet struck load _____	cubic feet heaped load _____	
Liquid tank	gallons _____		
B. For open-tank or box-spreaders, determine the pounds per cubic foot of manure and the weight capacity of the spreader.			
Type of manure		solid	semi solid
1. Determine manure density			
	Trial 1	Trial 2	Trial 3
a. Empty container weight in pounds			
b. Container filled with water weight in pounds			
c. Net weight of water in pound (b minus a)			
d. Container volume in cubic feet (c ÷ 62.4)			
e. Container filled with manure weight in pounds			
f. Net weight of manure in pounds (e minus a)			
g. Manure density in pounds per cubic foot (f ÷ d)			
h. Average of three trials in pounds per cubic foot			

2. Weight capacity of the spreader

	Struck load	Heaped load	
Spreader volume in cubic feet			
Multiplied by manure density in pounds per cubic foot			
Equals load weight in pounds			
Divided by 2,000 (pounds per ton)	_____ tons	_____ tons	

Table 2 is a similar method of collecting data to measure application rate using Method A.

Table 2

Determining the application rate -- Method A

<p>1. Tie a rope around a section of the tractor tire. Drive forward and mark the ground where the rope is directly underneath the tire. Continue forward until the rope is again at the bottom. Measure the distance between the two points on the ground representing the forward travel for one tire revolution. Feet per revolution _____.</p> <p>2. During the spreading of a full load of manure at normal speed, count the number of times the rope on the tire comes to the top. Number of revolutions per load _____.</p> <p>3. Multiply Step 1 by Step 2 to get the total distance traveled. _____ feet.</p> <p>4. Measure the average width of the spread manure path. _____ feet.</p>					
Forward speed or gear/throttle setting					
PTO speed					
Spreader setting					
Width of spread manure in feet (travel lane)					
Number of revolutions (Step 2)					
Times distance (Step 1 = length of spread) Step 3					
Width X distance in feet ÷ 43,560 = acres					
Spreader capacity in tons or gallons					
Amount ÷ area = tons of gallons per acre					
Nutrient application rate = tons per acre X pound nutrient per ton					
Or gallons per acre X pounds nutrient per gallon					

Table 3 shows the proper calculations for determining application rate using Method B.

Table 3

Determining the application rate -- Method B

1. Plastic sheet Width _____ feet x length _____ feet = area _____ square feet					
2. Tare weight of plastic sheet and container _____ pounds					
Forward speed or gear/throttle setting					
PTO speed					
Spreader setting					
Gross weight of plastic, manure and container					
Minus tare weight					
= net weight of manure					
Divided by area of plastic					
= rate in pounds per square foot					
Solid and semi-solid tons per acre-rate X 21.78					
Liquid gallons per acre = rate X 5,445					
Nutrient application rate = tons per acre X pounds nutrient per ton					
Or gallons per acre X pounds nutrient per gallon					

Once a spreader is calibrated, travel speed can be adjusted to give the desired application rate as illustrated in the following example.

Example

A farmer has determined by Method A that a spreader applies manure nitrogen at the rate of 170 pounds per acre for a given spreader setting and travel speed of 3.5 miles per hour. Soil tests recommend a nitrogen application rate of 120 pounds of nitrogen per acre. How should travel speed be adjusted to obtain the desired rate?

Application rate is inversely proportional to travel speed, hence the faster the travel the lower the application rate with other factors such as spreader setting and power take-off speed remaining the same. The proper travel speed to obtain an application rate of 120 pounds of nitrogen per acre is calculated as follows:

Speed, mph = $170 \times 3.51 \div 50 = 4$ miles per hour.

Hence, a travel speed of 4 miles per hour results in the desired application rate of 120 pounds of nitrogen per acre. This method of adjusting ground travel speed to obtain a given application rate obviously would not apply to ground-driven spreaders.

Summary

Anyone spreading manure can be more certain of the amount of fertilizer being applied if a calibrated spreader is used and the nutrient content of the manure is known. Such a practice ensures that manure is being managed in an environmentally sound manner and that maximum benefit from the fertilizer nutrients in the manure is being realized.

References

- Brodie, H. L., and G. L. Smith. *Calibrating Manure Spreaders*. Fact Sheet 419. Cooperative Extension Service, University of Maryland.

WQ213, reviewed May 1994

Appendix 4

Emergency Response Plan

EMERGENCY ACTION PLAN

In Case of an Emergency Storage Facility Spill, Leak or Failure

Implement the following first containment steps:

1. Stop all other activities to deal with the spill. Turn off the tractor or pumps that may be running.
2. Care for any personal injuries.
3. Assess the extent of the emergency.
 - determine how much help is needed.
 - call for help.
4. Contact appropriate emergency, environmental, or county authorities if assistance is needed.
5. Use a tractor with a blade to contain the spill.
6. Pump spilled manure into the manure spreader and land-apply to an open pasture or into the second pit.
7. Pump the manure in the pit down below the point of the leak or failure. Complete the clean-up and repair the necessary components.
8. File required reports.

In Case of an Emergency Spill, Leak or Failure During Transport or Land Application

Implement the following first containment steps:

1. Stop all other activities to deal with the spill. Turn off the pumps, applicator, or transport vehicle.
2. Care for any personal injuries.
3. Assess the extent of the emergency.
 - determine how much help is needed.
 - call for help.
4. Contact appropriate emergency or traffic control authorities if assistance is needed.
5. Use a tractor with a blade to contain the spill.
6. Pump spilled manure into the tank wagon or any available storage vehicle. Complete the clean-up and repair the necessary components.
7. File required reports.

The land application equipment will be constantly monitored by the person conducting the land application of manure. In order to prevent an accident or spill during land application, Mike Ramer should complete an inspection of the land application equipment to ensure proper function prior to performing land application. In addition, weather conditions (wind speed and direction, precipitation, etc.) and field conditions (proper setbacks noted, soil moisture, etc.) should be verified prior to land application.

Table 3-1. Emergency Contacts

Department / Agency	Phone Number
Fire	911
Ambulance	911
Sheriff	(660)727-2911

Table 3-2. Available equipment/supplies for responding to emergency

Equipment Type	Contact Person	Phone Number
Nearest excavation equipment	Philips Farms	(660)341-9403

Table 3-3. Contacts to be made by the owner or operator within 24 hours

Organization	Phone Number
EPA Region 7 Emergency Spill Hotline	(913) 281-0991
MO Emergency Spill Hotline	(573) 634-2436
Lewis County Public Health Department	(573) 767-5312
Lewis County Emergency Management	(573) 248-4789

Be prepared to provide the following information:

- a. Your name and contact information.
- b. Farm location and other pertinent identification information.
- c. Description of the emergency.
- d. Estimate of the amounts, area covered, and distance traveled.
- e. Whether manure has reached surface waters or major field drains.
- f. Whether there is any obvious damage; i.e., employee injury, fish kill, or property damage.
- g. Current status of containment efforts.

Plan for Catastrophic Death Animal Disposal

If the cause of catastrophic loss is from disease, quarantine and euthanize all sick animals.

When catastrophic mortalities do occur contact MO-DNR and the MO state veterinarian for guidance. It is planned that the carcasses will be composted on-farm in the mortality composter. In the event mortalities will not fit in the composter it will be necessary to construct a temporary composter from large round hay bales. Locate temporary composter in a well-drained area and follow CNMP guidance.