NRCS Natural Resources Conservation Service

NORTH CAROLINA TECHNICAL NOTE August 20, 2007

# CONSERVATION PLANNING GUIDELINES FOR OUTDOOR SWINE OPERATIONS

## Background

There are a growing number of outdoor swine operations being established across North Carolina. Such operations are appealing because of the ability to serve a growing consumer demand for meat not raised in conventional confined feeding operations, and the lower initial costs of establishment associated with hog houses, lagoons, and other waste management components. Unfortunately, unless outdoor swine operations are properly sited, operated, and managed to protect the natural resources, environmental degradation can be significant.

As producers request both technical and financial assistance from NRCS, it is the responsibility of planners to ensure that producers are aware of the natural resource concerns associated with these operations, and that technical assistance provided is based on applicable North Carolina laws and regulations, and NRCS conservation planning policy as found in the National Planning Procedures Handbook, Field Office Technical Guide, and this NC Technical Note.

***It is important for planners and reviewers of this document to note that suggested stocking rates are based on observations of conditions on existing operations, estimates of waste nutrient loading (using NCSU/NCDA waste data tables) and the presumptive impact on water quality, and the demonstrated impact of high stocking rates on nutrient-removing and erosion-reducing vegetative cover. Through a USDA-approved 2007 Conservation Innovation Grant, NRCS is partnering with NC State University to identify and implement appropriate conservation management practices for outdoor swine operations using this document as a "starting point" for evaluation of conservation management scenarios. Closely monitored farm demonstrations and technical training will be designed through this CIG agreement, which will run through 2009. The CIG is supported by many interests: the Center for Environmental Farming Systems (CEFS), the Whole Foods Market, NCDA & CS, NC A&T State University, and the Center for Agricultural Partnerships. Results of CIG-based demonstrations and technical training will be incorporated into this document as warranted. Members of the NC Interagency Nutrient Management Committee have had an opportunity to comment on this guidance. These comments can be found at http://www.nc.nrcs.usda.gov/technical/TechRef/nut-mgt-comm.html.***

## Outdoor Swine and Water Quality

Conservation planning for outdoor swine poses greater challenges than planning for other livestock grazing operations. Why?

1. The rooting and wallowing habits of swine result in more ground disturbance and pressure on the vegetative cover, with an increased potential for soil erosion and surface runoff carrying nutrients.
2. Unlike cattle and most other grazing operations, supplemental feed typically provides close to 100 percent of the animals' needs in outdoor swine operations, and consequently, the surface vegetation is often not considered a resource to be protected from complete destruction.
3. In a conventional grazing operation, nutrients are recycled from the soil, to the grass, to the grazing animal, and largely re-deposited back to the soil in manure. In outdoor swine operations, there is much more rapid build up of nutrients, especially phosphorus. As the concentration of nutrients in the soil increases, the potential for off-site transport also increases.
4. Swine often preferentially deposit manure in certain areas, with non-uniform distribution of nutrients.

These characteristics result in a high potential for excessive loss of nitrogen and phosphorus, transported in

soluble form in surface runoff, attached to soil particles moving through soil erosion, or transported directly in floating manure. The potential for subsurface transport may also be increased on coarse-textured soils with a high leaching potential.

Just as with conservation planning on all other types of livestock operations, planners must understand the potential for sediment and nutrient transport, and develop a system of practices that address these concerns.

## Types of Outdoor Swine Operations

1. A Pasture-Based Pork operation (PBP) is one where a plan is developed and implemented that maintains at least a 75% vegetative cover at all times through a carefully planned stocking rate, intensive short-term rotation of animals, and appropriate vegetation selection and management. Narrow ungrazed (by pigs) vegetated buffers are used to protect surface water from runoff. This approach includes a "sacrifice area" that can be used to maintain animals during periods of the year to protect the vegetation in the primary grazing areas.

2. A Dry Lot operation is one where the animals are allowed to destroy natural or established vegetative cover, and water quality concerns are addressed through (1) long-term rotation of the animals to alternative sites and (2) the use of crops during rest periods to remove nutrients after each grazing period. This approach also includes wide ungrazed vegetative buffers to protect surface water from runoff.

## General Guidance for Providing Assistance to Pasture-Based Pork (PBP) Operations

Because of the unique conservation challenges with outdoor swine operations, animal stocking rate is a critical factor to address with clients early in the planning process. When stocking rates are too high, there is **no known technical solution** that will maintain protective vegetative cover.

The **maximum** stocking rate to be recommended in conservation planning for a PBP operation is as follows:

**# Sows (including litters) <= (Acres of Permanent Grass) + (Acres of Cropland/5)**

While at first glance, this stocking rate may seem somewhat restrictive, it can result in a large number of animals on a given acre of land at times during the year. See **Tables 6 & 7** for stocking scenarios that show animal live weight that must be supported during a given year.

## General Guidance for Providing Assistance to Dry Lot Operations

Operations that cannot or elect not to perform the intensive management necessary to maintain vegetative cover are considered Dry Lot operations. Recommended stocking rates for dry lot operations are as follows:

**# Sows (including litters) <= Proposed rotation acres x Proposed Crop P removal rate/105***

*Because dry lot operations are based on a long-term rotation, the total number of acres needed for a dry lot operation will depend on the crops selected for nutrient removal during "rest periods". Rest periods of multiple years will be necessary to achieve required nutrient removal*. For each year the dry lot is used, it is followed by a rest period, where the length of the rest period is planned such that crops will remove 75% of the phosphorus applied during the year the dry lot is used. On operations that do not have land available or suitable cropping rotations to remove P at the specified 75% level, NRCS planning assistance will be limited to practices that will mitigate water quality impacts such as exclusion fencing along streams, buffers, and surface runoff management.

***105 in the stocking rate equation above derived from 140 lbs (approx.) Plant Available P generated annually by a sow multiplied by the specified 75% Phosphorus crop removal rate. Crop P removal rates for specific NC soil types by county are available at http://nutrients.soil.ncsu.edu/yields/*

## Steps and Criteria in Planning Outdoor Swine Operations

### Step 1 – Identify problems & opportunities.

In most cases, planning assistance is requested on outdoor swine operations for technical assistance to address some observed resource concern, or as part of an application for financial assistance through cost-sharing programs. It is important for planners consider that, in many cases, outdoor swine operations may be a part of a small or limited resource farming operation. Additionally, many outdoor swine operations target a niche consumer market which may have conservation objectives or criteria beyond those of basic NRCS conservation planning criteria.

### Step 2 – Determine client objectives.

***Planning Requirement: The client's objectives must be documented in the conservation plan.***

The client's goals may have a significant impact on how the conservation system is designed. Examples:

- If the client's objective is to sell meat to a buyer interested in only pasture-raised pork, then dry lots are probably not an option. Planning a system that will not maintain 75% vegetative cover may limit the clients' ability to sell their products.
- If the client wants to sell to a market that demands animals throughout the year, then the system must be designed with enough paddocks to accommodate keeping certain groups separated at critical times.
- If the client wants to integrate the swine into an existing cropland operation, then adding periodic gleaning of crop residue is an option that may reduce the nutrient loading pressure on the primary forage areas.

### Step 3 – Conduct a Resource Inventory

***Planning Requirement: All current and potential resource concerns identified on the planning area must be documented in a resource inventory (NRCS Inventory of Planning Area form).***

There are a number of potential resource concerns that may exist on outdoor swine productions sites:

- Excessive off-site transport of particulate or soluble nutrients to surface or shallow ground water. Loss pathways to consider include surface runoff, erosion, or leaching.
- Soil erosion and sediment delivered from denuded areas, shade areas, feeding pads wallows.
- Off-site transport of pathogens from manure.
- Visual and aesthetic concerns of the area.
- Degraded soil quality due to animal traffic (compaction) and loss of vegetation.
- Excessive build up of nutrients (phosphorus) or other contaminants in the soil profile.
- Odor.
- Animal health (stress to animals from heat in un-shaded pastures may be a concern to some producers).
- Impact on wildlife and beneficial insect habitat.
- Impact on tree health and forest resources.

***Planning Requirement: NRCS planners must document environmental compliance with the NEPA, NHCP, and other federal and state laws, using the NC-CPA-52 form.***

Of particular importance for outdoor swine operations are regulations associated with: wetlands and in-stream activities; impact on threatened, endangered, and other declining species; and animal waste related permits through DWQ.

## Step 4 – Analyze the Resource Data

The data that must be collected to complete the conservation plan includes:

- Type of operation (dry lot, pasture operation)
- Field sizes, and current and planned vegetative cover (crops, grasses).
- Soil types & slopes, with particular attention to hydric soils, flooding potential, and susceptibility to leaching.
- Soil tests for each grazing area.
- Location of sensitive resources, such as streams, wetlands, steeps areas, ditches, etc.
- Animal herd information (number of sows & boars, breeding schedule, number of breeding periods/groups in the year, number of feeder/stocker animals and tenure on site)
- How the growth phases are physically managed (e.g. separation of animals, etc.)
- Estimated number of pigs each sow will produce per year.
- Specific buyer demands.
- Source of water for animals.
- Desired farrowing areas.

## Step 5 & 6 – Formulate & evaluate alternatives.

***Planning Requirement: Each of the following factors must be addressed in the conservation plan:***

**1. General Site Selection.**

Whenever possible, sites for outdoor swine operations should be selected considering the suitability of the soils. Hydric soils and areas with a potential for flooding should be avoided. Similarly, steep areas should be avoided due to erosion concerns. To mitigate nutrient leaching concerns, soils with fine and medium textured B horizons (i.e. clay, clay loams, sandy loams, silt loams etc) should be selected for outdoor swine operations if possible. Selecting sites on flatter, well-drained areas as far from surface water or concentrated flow areas as possible will minimize potential runoff into drainage ways.

**2. Excluding sensitive areas.**

In all cases, an early step in the planning process is to identify and protect all environmentally sensitive areas from grazing. Sensitive areas include permanent, seasonal, and intermittent streams; sinkholes, wetlands, and steep areas where erosion and surface runoff cannot be controlled. An appropriate buffer area should be identified and included in the Plan Map around all sensitive areas. The width of the buffers shall be 20 to 100 feet, with width determined based on the type of operation planned.

For dry lot operations, NRCS conservation plans should not include having pigs on steep slopes or highly erodible soils where the Erosion Index (RKLS/T), using the current version of RUSLE, is greater than 8 because of the potential for severe erosion and surface runoff.

While not an environmental concern, aesthetics and community concerns must be considered in the planning process. Excluding areas adjacent to public roads, property lines, or other residences should be considered.

**3. Stocking Rate.**

Stocking rates are designed to address soil erosion and nutrient loading on the planning area. The nutrient budgeting concepts for outdoor swine operations are similar to confinement/sprayfield operations. Continued application of nutrients, either from a sprayfield or outdoor swine, that exceed the nutrients removed will eventually result in excessive loss of nutrients to surface or shallow ground water.

How the stocking rate concept is applied varies by the type of operation. Before determining a final stocking rate, the planner should work with the producer to develop rotation scenarios (this is especially important for sow operations with multiple groups of pigs) that will allow for cover maintenance and/or nutrient removal through rest periods. The fewer acres that are available for pig rotation, the more difficult to rotate adequately at equation-based stocking rates, and in fact, rotational needs will likely restrict stocking rates below maximum recommended levels.

**Pasture-Based Pork Operations.** The stocking rate for pastured swine is designed to address both nutrient loading and protection of vegetated cover.

The maximum stocking rate to be recommended in the plan for a PBP farrow to finish sow operation is as follows:

**# Sows (including litters) <= (Acres of Permanent Grass) + (Acres of Cropland / 5**)

(Although PBP operations are primarily grass-based systems, cropland may occasionally be used to provide "recovery periods" for permanent grassland. Winter & Summer annuals are examples of acceptable "cropland" vegetation for pig rotations. Cropland may also be used for limited periods of time following harvests, with annuals planted for nutrient removal after pigs rotated back to grassland.)

*Example: Area available for the outdoor swine operation:*
*5 acres of permanent grassland and 5 acres of cropland*

*Maximum stocking rate equals:*
*5 acres grassland + (5 acres cropland/5) =*
*5 + 1 = 6 sows maximum stocking rate (total maximum number of pigs during overlapping breeding periods would equal the 6 sows x 20 pigs each sow = 120 + 6 sows + 1 boar = 127 pigs maximum in this scenario)*

For a feeder-to-finish operation, the maximum stocking rate to be recommended in the plan for a PBP operation is as follows:

**# Finishing Pigs <= (11 x Acres of Permanent Grass) + (2 x Acres of Cropland)**

*Example: Area available for the outdoor swine operation:*
*5 acres of permanent grassland and 5 acres of cropland*

*Maximum stocking rate equals:*
*11 x (5 acres grassland) + 2 x (5 Acres Cropland)*
*55 + 10 = 65 finishing pigs*

*Note*: the established average live weight for 1 Farrow/finish sow = 11 finishing pigs per NCDA/NCSU Waste Data Tables (**See Table 1**). Also, Plant Available Nutrients generated by 1 sow + pigs in a farrow to finish operation annually = approximately 11 finishing pigs per NCDA/NCSU Waste Data Tables (**See Tables 2 & 3**).

***Tables 5 & 6*** *are stocking scenarios which show the numbers and total live weight of pigs that would on-site during each month of the year.*

Planners should note that the stocking rates for PBP operations still generate a significant number of pigs and manure on a site in a year. It may surprise producers to realize that for a farrow-to-finish operation, 1 sows and associated piglets will generate 143 lbs of P2O5 in one year. If applied to a single acre with no removal of P205 by crops, it is estimated that this will raise the soil P-I by 29 **each year**! At the end of five years, **2** sows and piglets will generate 1428 lbs of P2O5, and increase the soil phosphorus index by 298 (about 5 to 6 times what is considered an agronomic "HIGH". Similarly, 177 lbs of N will be applied at this stocking rate each year, with 884 lbs N applied by the end of five years.

**Dry Lot Operation**. The stocking rate for a dry lot operation is designed to address nutrient loading, based on a strategy for long term rotation and crop removal of nutrients.

The maximum stocking rate to be recommended in the plan for a dry lot operation is as follows:

**# Sows (including litters) <= Proposed rotation acres x Proposed Crop P removal rate/105**

Example: Total area available for swine rotation: 10 acres of cropland/dry lot
Assume 40 lbs crop P removal during "rest periods"
Maximum stocking rate equals:
10 x 40= 400
400 divided by 105 = 3.8 sows on rotational area
**3.8 should be rounded down to 3 sows due to limited P crop removal on rotational area available**

**Crop P removal rates for specific NC soil types by county are available at**
**http://nutrients.soil.ncsu.edu/yields/**

Wooded areas, when used for shade, should not be included in computing stocking rates. However, if trees are managed in a manner that ensures survival and encourages growth, then nutrient uptake by woody species will occur.

*Because dry lot operations are based on a long-term rotation, the total number of acres needed for a dry lot operation will depend on the crops selected for nutrient removal during "rest periods". Rest periods of multiple years will be necessary to achieve required nutrient removal*. The planner should assist the producer to understand that the length of time required for the rest period depends upon the stocking rate during the one-year period when the dry lot is used.

## 4. Establishing/Maintaining Vegetative Cover & Removing Nutrients

Dry Lots. For dry lot operations and identified sacrifice areas, maintaining 75% vegetative cover during use periods is not a planned objective. The conservation objective for dry lots is to trap pollutants in runoff through the use of buffers while the pigs are in a paddock, then use crops to remove nutrients in the soil during the rest periods. There should be no concentrated flow through a dry lot. All surface water should be diverted to create a sheet flow that will allow buffers to perform their nutrient and sediment removal functions. It is likely that maintenance will be necessary at fence lines to negate pig rooting to the extent possible and ensure continuation of sheet flow.

Pasture Operations. For PBP operations, establishment and maintenance of a minimum 75% plant cover is essential to protecting water quality by reducing erosion and surface runoff. The key to a successful PRP operation is the careful selection of grass or cover, maintaining an appropriate stocking rate, and frequent rotation when bare soil is visible on 25% of surface of the paddock.

The selection of preferred plants will depend on whether or not the pasture is managed as (1) a source of feed or (2) for tolerance to heavy animal use (with little regard for forage supply and quality). If stocking rates exceed 1 sow per acre, then selecting for tolerance to traffic is recommended.

a) The plant species most tolerant of heavy traffic include:
   i) Bermudagrass--locally adapted common or winter-hardy seeded types may provide denser stands of grass than some of the hybrids, but they are more likely to spread around the farm through seed, and they cannot be effectively controlled in subsequent crops as compared to hybrid varieties.
   ii) Tall fescue--it is best to use endophyte infected or non-toxic endophyte-containing fescue if grazing management cannot be ideally controlled.

iii) Kentucky bluegrass and redtop--may be mixed with the tall fescue in the piedmont or mountains to potentially provide a thicker stand of grass.

b) The plant species that provide the highest quality feed and could be maintained with proper grazing management include:
   i) white or red clover
   ii) alfalfa
   iii) orchardgrass
   iv) Non-toxic endophyte-containing tall fescue
   v) Kentucky bluegrass mixed with fescue or orchardgrass
   vi) summer annual grasses (millet, sudangrass)
   vii) winter annual grasses (smallgrains, ryegrass)
   viii) rape, kale or turnips
c) Native grasses are of high quality, but very careful grazing management is required for plant establishment and survival. They do grow tall and could even provide some shade if rooting and grubbing of the plants can be controlled. Having one or more paddocks in a native grass may be an option for enhanced summer grazing.

***See Table 8 for growing season specific tables of crops and cropping rotations that could be utilized in rotational management systems.***

Nose rings have been identified as a method of deterring pig rooting and preventing destruction of vegetation. Producers should consult Animal Welfare Institute guidelines and their market buyers to determine whether nose rings are appropriate for their herds.

*Determining cover percentage*. Although simple in concept, clear guidance should be provided to the producer on **how** to make the 75% vegetated cover determination. Up to 15 percent of the paddock may be totally bare soil areas used for depressional wallows, and watering/feeding sites. Make the 75% cover determination on the remaining 85 percent of the paddock. This determination may be made through a visual estimation, or using one of the sampling methods, such as the residue cover calculation tool. If visual estimation is used, then one of the actual sampling approaches should be used as producers learn to make this estimation.

Producers should always check with potential buyers who are seeking “pasture-raised” pork to determine how they plan to assess cover.

### 5. Rotations & Sacrifice Areas

As stated above, rotation is a critical planning component for a successful outdoor swine operation. It should be noted by planners and producers that because of the necessity, especially with sow operations, of rotating multiple groups of pigs on a basis that will maintain cover at the 75% level or will allow for dry lot “rest periods”, that maximum stocking rates per the equations given may not be possible because of pig rotation methods and dynamics.

*Dry Lots*. Planning for a dry lot operation is designed around a **long-term** cropping rotation, where the animals are maintained in an area for not more than one year, then that area is allowed to “rest” for some number of years after that before pigs are allowed to re-enter the area. During the rest period, crops are used to remove nutrients, primarily phosphorus. As a minimum, the goal of the rotation should be to remove 75% of the phosphorus applied during the year the dry lot is used. The length of the rest period for an area depends upon the stocking rate during the period used by the pigs.

For example, each sow (with piglets) generates 143 lbs $P_2O_5$ per year. Bermudagrass hay can remove 60 lbs of $P_2O_5$ per year (see example below), with a yield of 4.9 tons/acre. So, for each sow (with piglets, in a farrow to finish operation), it would take 2 years of Bermudagrass hay removal to remove 75% of generated plant available phosphorus. *Plant available nutrient generation levels for sow and finishing operations are shown in **Tables 2 & 3**, and should be used with crop P removal*

*rates to determine required rest periods.*

YEARS OF REST PERIOD FOR ACTIVE CROP P REMOVAL REQUIRED FOLLOWING EACH YEAR OF DRY LOT USE TO REMOVE **75%** OF THE APPLIED PHOSPHORUS. (Example given for Johnston Co, Cecil Loam 2-6% slopes)

*Phosphorus crop removal rates for all NC counties & soils are available at http://www.soil.ncsu.edu/nmp/yields/. See **Table 5** for yields and P crop removal rates used in calculating the rest periods shown below.*

| Stocking rate (# sows/ac) | Bermudagrass Hay (4.9 tons/ac) | Fescue Hay (4.9 tons/ac) | Corn (Grain) (123 bu/ac) | Soybeans (Full) (49 bu/ac) | Wheat Grain (59 bu/ac) | Sorgh. Sudan (4.7 tons/ac) | Vegetables(Bell peppers @9 tons/ac) |
|---|---|---|---|---|---|---|---|
| 1 | 2 years | 2 years | 2 years | 3 years | 4 years | 2 years | 3 years |
| 2 | 4 | 3 | 4 | 6 | 8 | 4 | 5 |

The planned cropping system should be considered when setting up the schedule for rest periods.

(1) Shifting animals off site in the fall would favor smallgrains, followed by soybeans, sorghum, tropical corn, peas, sudangrass or millet for the following seasons.
(2) Shifting animals off site in spring would favor many crops, but would depend on the target planting dates of the specific crop.

Anytime animals will be off a dry lot paddock more than 60 days, a cover crop should be specified for cover and nutrient uptake. Temporary crops should be planted immediately following removal of swine. Use crops that germinate quickly and grow rapidly for soil cover:

(1) In early to midsummer months, consider millet, sudangrass, sorghums, crabgrass, cowpeas, or beans,
(2) In late summer through fall, consider small grains such as rye, triticale, oats or wheat, or brassicas, such as turnips, kale or rape.

Nitrogen transported offsite during the year the dry lot is used will depend upon buffers for trapping and denitrification. Because of the mobility of nitrogen, it does not remain available in the soil on a long term basis as phosphorus does, and additional inorganic N will probably need to be applied to dry lot sites after the first year of the rest period in order to achieve the planned P removal. The nutrient management aspect of this document for dry lot planning scenarios is primarily focused on crop removal of phosphorus during "rest periods". It is acknowledged that generation of waste-related nitrogen by pigs on areas that do not have established vegetation presents a risk of substantial nitrogen loss. It is essential that buffers be well-established to mitigate the impact of nitrogen loss to the maximum possible extent.

Even in a dry lot operation, the plan should include rotation between small sub-areas during the year to facilitate a more uniform distribution of nutrients and production of crops during the rest period.

*Pasture-Based Operations*. Unlike dry lots, the objective in pastured swine operations is to maintain at least 75% vegetative cover at all times, and this requires a plan for **short-term** grazing rotations. The rotation frequency depends upon the stocking rate, species and vigor of vegetation, weather, soil type, and other factors; however, rotation will likely be required anywhere from less than a week to several weeks.

It is critical in this type of operation that the vegetation not be overgrazed, as this damages the ability of the vegetation to quickly regrow when not being grazed. As with dry lot operations, it is important to encourage cover crop establishment during periods of grass dormancy or rotational rest in order to protect the primary vegetative cover species and promote nutrient uptake.

It is desirable to allow the vegetation to reach a substantial height before reintroducing the pigs, as there is some evidence that this tends to minimize or delay rooting behavior. In general, vegetation should be allowed to obtain the height as shown in the following table:

| Pasture Species | Minimum Desired Grass Height When Pigs are Reintroduced |
|---|---|
| Bermudagrass | 4-6 inches |
| Fescue/orchardgrass | 6-8 inches |
| Crabgrass/warm season mix | 6-8 inches |
| Switchgrass/native species | 14-16 inches |
| Alfalfa | 8-12 inches |
| Overseeded small grains | 8-10 inches |

Because there will be weather extremes or other situations that prevent the ability to maintain 75% cover in some cases at the stocking rates specified above, all PBP operations must include a "sacrifice area" that can be used whenever there are no paddocks with sufficient vegetative cover or there may be conditions where vegetative cover is likely to be jeopardized. The sacrifice area should be identified early in the planning process and clearly labeled on the plan map, and should be as far from water, wetlands, and concentrated flows as possible. Sacrifice areas should be planned with at least 100 feet of vegetation as a buffer between it and surface water. (See the section below on buffer requirements). The sacrifice area should be approximately 100 square feet per animal. For a 250 animal operation, this would require approximately one-half acre.

An alternative method of utilizing the sacrifice area/PBP concept is to periodically rotate the sacrifice area containing feeding and watering sites while allowing continuous access to both the designated sacrifice area and rotational grassland. This method of pasture-based management would not improve uniformity of nutrient distribution, but could help preserve existing or new grassland.

It is also critical that producers understand that a continuously stocked pasture-based swine operation is **not sustainable** on a long term basis without nutrient removal through grazing/haying and site removal. Therefore, the pasture based system should include periodic harvesting and removal of the forage to reduce nutrient buildup. Periodic grazing with cattle or other animals can remove or control the growth of the pasture grasses and remove about 50-75% of the nutrients as would a hay harvesting operation. If nutrients are continually applied to a site and not removed, there will be a buildup in P concentration to levels that will result in excessive P loss through either runoff or leaching. All conservation plans for outdoor swine must inform the producer that at some point in the future, all areas used will need to have a rest period when crops are used to remove phosphorus from the site before reintroducing pigs. How long this rest period will need to be will be determined by the stocking rate and frequency of rest periods.

*EXAMPLE*: BUILD-UP OF P-I AND RELATED PLAT RATING IN FARROW TO FINISH OPERATION
*Scenario 1*: 1 sow per acre, pastured operation, Norfolk (NoA), Duplin County, soil loss 2 t/a/y, bermudagrass pasture (good condition), 20 ft filter strip

| Year | Starting Soil test P-I | N applied lbs | P2O5 applied lbs | Estimated Ending P-I | Estimated PLAT Rating |
|---|---|---|---|---|---|
| 1 | 60 | 88 | 143 lbs | 89 | Low |
| 2 | 89 | 88 | 143 lbs | 118 | Low |
| 3 | 118 | 88 | 143 lbs | 147 | Medium |
| 7 | 234 | 88 | 143 lbs | 263 | Deep Soil Sample Needed |

*Scenario 2*: 1 sow per acre, pastured operation, Appling (ApB), Orange County, soil loss 3 t/a/y, fescue pasture (fair condition), 20 ft filter strip

| Year | Starting Soil test P-I | N applied lbs | P2O5 applied lbs | Estimated Ending P-I | Estimated PLAT Rating |
|---|---|---|---|---|---|
| 1 | 83 | 88 | 143 lbs | 112 | Low |
| 2 | 112 | 88 | 143 lbs | 141 | Low |
| 3 | 141 | 88 | 143 lbs | 170 | Medium |
| 4 | 170 | 88 | 143 lbs | 199 | Medium |
| 11 | 373 | 88 | 143 lbs | 402 | High |

These tables illustrate the crucial importance of maintaining a reasonable stocking rate and good (>75%) vegetative cover on PBP operations. More extreme P restrictive conditions would occur on many NC soil types and higher stocking rates (even at 2 sows/ac) would result in a much more rapid buildup of surface level P.

## 6. Nutrient management planning & soil testing.

Because of the significant potential for off-site transport of nutrients from outdoor swine operations, a modified nutrient management plan should be prepared as part of the outdoor swine planning process. Unlike typical nutrient management planning, the plan for crop uptake for outdoor swine operations is based on crop removal during the rest periods. It is important for planners to understand that because commercial feed generally provides 90-100 percent of the nutrition for outdoor pigs, the manure generated by the pigs should be considered an applied organic source in the nutrient management plan. This means that soil testing and PLAT should be used to assess the potential for excessive P loss from the planned operation at the time the initial plan is developed. It is recommended that PLAT be rerun on OSOs at least every three years. Under USDA policy on nutrient management, the nutrient management plan is valid for five years, after which the plan should be updated and PLAT rerun if: (1) requested by producer, or (2) required for USDA program or NC regulatory purposes.

Using PLAT for Outdoor Swine Operations

Although PLAT was not developed for this purpose, it serves as a tool for assessing the potential excessive loss of P from outdoor swine operations. For the Application Source & Rate data, use Dairy-Scraped, and enter 17 tons of manure per sow/litter, or 1.5 tons of manure per finishing pig, with 12 lbs of P2O5 per ton. For dry lots, the application rate should be annualized for the period covering year the lot is used plus the rest period.

For pasture-based operations that meet the vegetation and rotation criteria identified in this Technical Note, a Hydrologic Condition of 'GOOD' may be used in PLAT. Although this may seem generous, it is important to keep in mind that through most of any given year, each paddock will not be grazed, and should never be less than 75% cover. Additionally, Hydrologic Condition is an index associated with surface runoff. Because much of the bare area in an outdoor swine operation is either a depressional wallow or frequently disturbed due to rooting, the infiltration rate is likely higher than a compacted animal trail or lounging area associated with a cattle operation.

For dry lot operations, a Hydrologic Condition of 'FAIR' should be used because of the "rest periods" with vigorous stands of site vegetation that would follow the period of dry lot use . It is recognized that PLAT was not developed to evaluate mutli-year vegetative conditions—this use is only to assess limits of conservation planning assistance and a broad perspective of potential P loss on dry lot sites.

For soils subject to leaching, a deep soil sample (28-32") will be required by PLAT when the surface soil test P-I exceeds the identified threshold for the specific soil series.

Interpreting the PLAT results

If PLAT rating is LOW or MEDIUM, then the stocking rate for the operation is specified in the conservation plan according to the guidance this Technical Note, with buffer practices established to address nitrogen and phosphorus transport.

If the PLAT rating is HIGH, then the stocking rate and/or length of rest periods are determined based on 100 percent crop removal of P applied through manure after each year's use.

If the PLAT rating is VERY HIGH, then NRCS may not provide assistance, other than buffer strips and exclusion from environmentally sensitive areas.

Hoop Houses or Similar Structures

It is recognized that Hoop Houses or other similar structures that allow for collection of animal waste materials is a viable method of housing outdoor swine, and would likely assist producers in capture and removal of nutrients. However, the use of the hoop house concept may raise other issues of concern, including cost, definition, confinement permitting, and adequate land available for waste application. Nutrients that are captured and spread agronomically on pasture or cropland areas that are not included in the swine rotational area could allow producers more flexibility in stocking rates and required paddock rest periods. If waste materials can be collected in a "hoop house" type structure, then producers should work with a designated conservationist to develop a nutrient management plan that will enable an evaluation of the amount of nutrients that are applied away from the rotational management area.

*Nutrient Distribution.* In contrast to the lagoon/sprayfield uniform land application method of confined swine operations, outdoor pigs managed by either the PBP or Dry Lot type of system will distribute waste materials/nutrients in an erratic manner that has little uniformity in the rotational area. It is important that producers set up rotational frequencies and paddock sizes that will maximize nutrient distribution efficiency in order to ensure that grassland and cover crops have sufficient nutrient bases to promote crop health. Uniform distribution of nutrients to the maximum possible extent will also help prevent accumulated "point" nutrient sources in either in the soil or in surface runoff from negatively impacting ground and surface water quality.

## 7. Buffers and Diversions.

Buffers between grazed areas and permanent or seasonal streams should be planned for all outdoor swine operations. For PBP operations (which maintain at least 75% vegetative cover), the planned filter strip must be at least 20 feet wide or a planned riparian forest buffer must be at least 35 feet wide. Because the surface runoff and sediment delivery is higher on dry lots and the identified sacrifice area, the planned filter strip must be at least 100 feet wide or a planned riparian forest buffer must be at least 100 feet wide and include a zone 3 filter strip of at least 20 feet. Planned buffers should not be grazed at any time during the year. Special attention should be given by planners to ensure sheet flow through the buffers, as concentrated flows would bypass buffer treatment. Land shaping, diversions, or other surface water runoff management practices may be necessary.

Buffers should not be "grazed" by pigs at any time during the year. If possible, it would be best to harvest the growth as hay and remove nutrients from the buffer. However, short duration graze periods (less than 3 days) by cattle, goats, horses or sheep could be used periodically.

To reduce soil erosion and runoff of soluble nutrients, surface water must be diverted from entering dry lot paddocks, sacrifice areas, and farrowing areas through the use of diversions or land shaping.

### 8. Numbers and Arrangement of Paddocks

The number of paddocks required will be determined by the type of operation, the number of breeding groups that are planned, and the breeding schedule. The use of temporary electric fencing for subdividing paddocks provides the maximum flexibility in planning and adjusting rotations through the year.

Planners should always identify buffer areas and sacrifice areas first in the planning process, before laying out a design for the rotational paddocks. Access by the producer to work, feed, and water the animals should be considered in the layout. In some cases, the arrangement of the paddocks can reduce the number of water and feeding stations required.

### 9. Providing water and feed.

Because of the pigs' rooting habits, all feeding and watering must be planned as portable structures that can be relocated or rotated as needed to facilitate a more uniform distribution of nutrients. Permanent feed or watering facilities with heavy use areas shall not be planned for outdoor swine.

- Feeding and watering sites shall be selected away from drainageways or low areas.
- Locating feeding sites away from water and shade can also favorably impact nutrient distribution and vegetation survival.
- Consider frequent moving of feeding and watering sites within a paddock. This may be done with feeders mounted on skids, sleds, or wheels.

### 10. Visual and/or odor barriers.

Many outdoor swine operations are on small tracts, and consequently often have high visibility from public roads and/or adjacent landowners. Because of the nature of outdoor swine operations, especially dry lot operations, there may be aesthetic or odor-related resource concerns associated with the operation. For all outdoor swine operations, the planner should address these potential concerns as follows:

- Evaluate the potential for Hedgerow Planting (FOTG 422) or other barrier practices such as Windbreak/Shelterbelt (FOTG 380) to control odors and to screen sites. Consider prevailing winds if odor or wind erosion from dry lots is a concern. Always consider the use of native grasses, shrubs, and/or trees. In areas where space is extremely limited and the potential for complaints is high, consider the use of board fences as visual screen.
- Consider maintaining deep bedding on bare areas or lounging areas can address odor issues and trap nutrients.
- Consider maintaining ground cover and target grazing height of vegetation will optimize nutrient uptake soil quality attributes and a diverse insect and biota which can favorably impact nutrient recycling and odor control.
- Encourage a "neighbor impact buffer" between swine rotation areas and neighboring property, whenever possible, even when the landscape position and slope would not normally require a buffer for water quality purposes.

### 11. Managing shade.

Planners should discuss shade requirements with producers to evaluate alternatives for providing seasonal shade as needed.

General shade issues:

- Providing shade away from drinking water sites can minimize competition for water and the potential for excessive waste of drinking water.
- It is estimated that shade needs for pigs are around 30 sq ft/animal, with enough shade during crucial periods to accommodate 75% of the herd.

- There will be less pollution potential if shade areas are dry, but animal comfort and performance may be marginalized without cooling mist or wallows. If shaded area is wet from misters or wallows, it may be necessary to manage the runoff and/or accumulated nutrients buildup from manure and urine. Diversions, terraces or vegetative buffer placement may be useful in preventing offsite movement of pollutants.

Utilizing woodland. Providing seasonal access to wooded areas is an option; however, the following should be considered.

- Because this practice will result in the destruction of the understory and leaf litter on the surface, erosion control and runoff management is a significant concern.
- Planners should consider that often wooded areas were left wooded because they were too steep or wet to be cropped, or because of perennial, seasonal, or intermittent streams are located in these areas. None of these conditions are good candidates for outdoor swine use. Because of the inability to establish a good vegetated ground cover in shaded woodlands, access to wooded areas should be limited to those times when shade is needed.
- In some cases thinning of the trees may allow the establishment of understory shade-tolerant vegetation while still providing sufficient shade.
- Extended access to trees will likely result in damage to the trees, through girdling and rooting around the trunks. In some cases, even short infrequent exposure times can impact tree survival and quality. In general, the growth of marketable timber is not compatible with extended swine access, unless the trunk or drip line of the tree is protected from animal contact through fencing. Some producers indicate that some tree species (e.g. sweetgum) are less susceptible to girdling by hogs. Similarly, some producers have observed increased girdling activity when the sows are gestating.
- Woodland areas should not be considered as a permanent part of rotational management areas, and should not be considered when determining land needed for selected stocking rates. Because of the factors described above, persistent use of woodland area will result in high levels of erosion and surface runoff, which may lead to surface and subsurface N & P loss.

Artificial shade/shelters. As an alternative to using wooded areas, consider the use of artificial shade:

- Strategic placement and rotation of mobile shade or shelters can impact nutrient distribution patterns, runoff and soil cover. Such shelters should always be portable.

## 12. Managing cooling pools or wallows

The highest priority is to locate wallows away from drainage patterns to the maximum extent possible. Some considerations include:

- Manage to minimize channelized runoff from the wallows. Consider the use of diversions and terraces to contain or manage the runoff.
  Consider some type of “constructed” pool or “tub” structure as a mobile wallow as a way to minimize unmanageable craters in the paddock.
- Consider the use of deep stack straw, leaves or bark in wallowing and lounging areas to absorb moisture and reduce evaporation, reduce odor, and bind nutrients. This practice might increase fly numbers and it would require more labor to bring in mulch and distribute it after it absorbs nutrients.
- Consider how the wallows will be filled and smoothed when paddock is being cropped during rest periods.

## 13. Fencing

A number of fencing types are suitable for outdoor swine. Guidance for fencing types is available in Fencing, FOTG 382 standard.

Outdoor swine tend to root up an area along the perimeter fence quickly after entering a new area. This can create a drainage problem as this mound of soil material acts as a dam, interrupting the

sheet flow of surface water from the paddock and into the buffer. Because the mound of soil material is under the perimeter fence, it can be difficult to reshape this area when the animals are later rotated out of the paddock. A solution used by some producers is to place temporary electric wire about 10 inches off ground and 12 to 24 inches inside of the actual perimeter fence. This provides a way for the producer to easily remove the temporary fence and reshape the rooted perimeter area with having to move the permanent perimeter fence.

## Step 7 & 8 – Making Decisions and Implementing the Plan

***Planning Requirement: Document the decisions in the conservation plan.***

For pasture-based operations that meet the stocking rate criterion, planners should work with producers to develop an RMS or progressive conservation plan according to the guidance in this Technical Note. Conservation plans should minimally consider the following practices:

(1) stocking rate and rotation frequency,
(2) establishing and maintaining vegetative cover (FOTG 327),
(3) fencing to allow rotation (FOTG 382),
(4) portable water to facilitate rotation (FOTG 614, 642, and support practices).
(5) exclude swine from sensitive areas, such as streams, concentrated flow areas, wetlands, and steeps areas, using fencing (FOTG 382),
(6) establish vegetated buffers to protect water quality, using filter strips (FOTG 393), riparian forest buffers (FOTG 391), and
(7) establish visual and odor barriers, using windbreak/shelterbelt (FOTG 380) as needed.

The above referenced FOTG practices could be considered for potential cost-sharing for pasture-based operations.

All operations that cannot meet the stocking rate criterion for a pasture-based operation, will be considered a dry lot operation. For dry lot operations, conservation plans must address all regulatory requirements, and should consider the following practices as needed for the specific site:

(1) stocking rate, rotation schedule, and removal of nutrients through crops,
(2) excluding swine from sensitive areas, such as streams, concentrated flow areas, wetlands, and steeps areas, using fencing (FOTG 382),
(2) establish vegetated buffers to protect water quality, using filter strips (FOTG 393), riparian forest buffers (FOTG 391),
(3) establish visual and odor barriers, using windbreak/shelterbelt (FOTG 380) as needed, and

The above referenced FOTG practices could be considered for potential cost-sharing for dry lot operations.

*For both pasture-based and dry lot operations, cost-sharing on operations that stock above the maximum stocking rate recommended by this document will be limited to practices that help mitigate water quality impacts, such as exclusion-type fencing, buffer practices, and surface water management.*

**Table 1. Nutrient output for two swine classes (Feeder to finish and Farrow to finish).**

| Animal Subclass | Animal Live Wt. (lbs) | | | Total Output | | | Plant Available Output | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | N | $P_20_5$ | $K_20$ | N | $P_20_5$ | $K_20$ |
| | Initial | Final | Mean | Lbs/animal- class/year | | | | | |
| Feeder to finish, each pig | 50 | 220 | 135 | 19.5 | 18 | 13.5 | 7.8 | 12.6 | 9.5 |
| Farrow to finish ( 20 pigs+sow) | 0 | 0 | 1417 | 221 | 204 | 153 | 88 | 143 | 107 |

**Table 2. Nutrient loading for farrow to finish operation with 1 sow and 20 pigs per acre Stocking rate when site is used for 1 to 5 years continuously. Crop response to P application does not change when P-I from Soil Test is above 80 (which is equal to about 390 lbs of available $P_2O_5$ / acre {based on Mehlich-3 extractant procedure}).**

| Stocking Rate / acre | | Years of continuous use | Total nutrients excreted onto the site lbs/acre | | | Plant Available Nutrients excreted onto the site lbs/acre | | | Estimated Soil Test P-Index with added PAP |
|---|---|---|---|---|---|---|---|---|---|
| Animal units based on 1000 lbs | (sow/litter units) | YR | N | $P_20_5$ | $K_20$ | N | $P_20_5$ | $K_20$ | P-I |
| 1.4 | 1 | 1 | 220 | 204 | 153 | 88 | 143 | 107 | 29 |
| | | 2 | 440 | 409 | 306 | 177 | 286 | 214 | 58 |
| | | 3 | 660 | 613 | 459 | 265 | 428 | 321 | 88 |
| | | 4 | 880 | 817 | 611 | 354 | 571 | 428 | 117 |
| | | 5 | 1100 | 1021 | 764 | 442 | 714 | 536 | 146 |

**Table 3. Nutrient loading from Feeder to Finish operation at various stocking rates when same site is used continuously for 1 to 3 years. Crop response to P application does not change when P-I from Soil Test is above 80 (which is equal to about 390 lbs of available P2O5 / acre {based on Mehlich-3 extractant procedure}).**

| Stocking Rate/acre for 1 to 3 years on same site | | | Total nutrients excreted onto the site lbs/acre | | | Plant Available Nutrients excreted onto the site lbs/acre | | | Estimated Soil Test P-Index with added PAP |
|---|---|---|---|---|---|---|---|---|---|
| Animal Units, based on 1000 lbs | Feeder-Finishers, Hd (based on 220 Mkt Wt.) | Years on same site | N | $P_2 0_5$ | $K_2 0$ | N | $P_2 0_5$ | $K_2 0$ | P-I |
| 1.4 | 10 | 1 | 195 | 180 | 135 | 78 | 126 | 95 | 26 |
| 2.7 | 20 | 1 | 390 | 360 | 270 | 156 | 252 | 189 | 51 |
| 4.1 | 30 | 1 | 585 | 540 | 405 | 234 | 378 | 284 | 77 |
| 1.4 | 10 | 2 | 390 | 360 | 270 | 156 | 252 | 189 | 51 |
| 2.7 | 20 | 2 | 780 | 720 | 540 | 312 | 504 | 378 | 103 |
| 4.1 | 30 | 2 | 1170 | 1080 | 810 | 468 | 756 | 567 | 154 |
| 1.4 | 10 | 3 | 585 | 540 | 405 | 234 | 378 | 284 | 77 |
| 2.7 | 20 | 3 | 1170 | 1080 | 810 | 468 | 756 | 567 | 154 |
| 4.1 | 30 | 3 | 1755 | 1620 | 1215 | 702 | 1134 | 851 | 232 |

**Table 4. Nutrient output per acre based on length of stay on areas of various sizes for one hog growing from weaning to market weight. Assumes N (.021 lb PAN/hd/day) and $P_2O_5$ (.035 lb PAP /hd/day) output from the growing hog is the same for each day based on the average weight between weaning and market wt of 220 lbs. (Source: Barker et. al.).**

| Area/pig sq ft. | Days on site | | | | | |
|---|---|---|---|---|---|---|
| | 30 | 90 | 120 | 30 | 90 | 120 |
| | PAN, lbs/acre | | | PA $P_2O_5$, lbs/acre | | |
| 100 | 279 | 838 | 1117 | 451 | 1353 | 1804 |
| 400 | 70 | 209 | 279 | 113 | 338 | 451 |
| 1000 | 28 | 84 | 112 | 45 | 135 | 180 |
| 2000 | 14 | 42 | 56 | 23 | 68 | 90 |

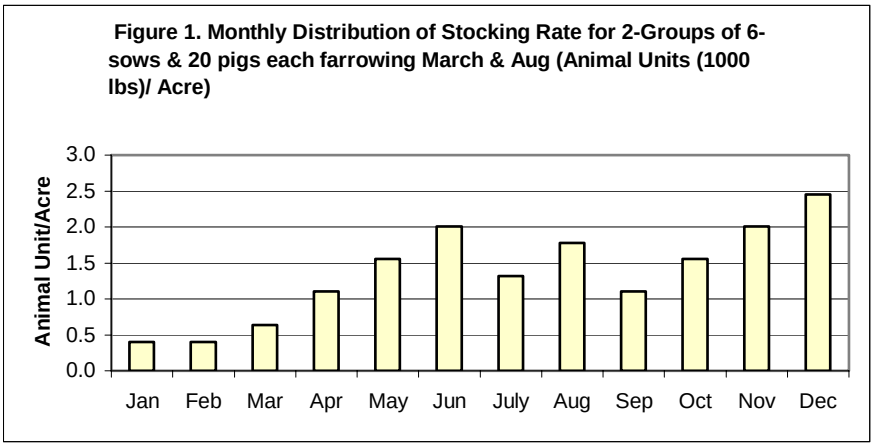
**Table 5. Nutrient (N and $P_20_5$) removal estimates for selected crops.**

| crop | Yield | N | $P_20_5$ |
|---|---|---|---|
| | | lbs/acre | |
| | | | |
| Corn grain, bu | 123 | 136 | 54 |
| Soybeans full season, bu | 49 | 191 | 39 |
| Wheat Grain, bu | 59 | 118 | 29 |
| Sweet potatoes, bu (+vines) | 300 | 70 | 22 |
| | | | |
| Bermudagrass Hay, tons | 4.9 | 218 | 60 |
| Fescue hay, tons | 4.9 | 218 | 77 |
| Mixed cool grass hay, tons | 3.4 | 152 | 49 |
| Sorghum Sudan hay, tons | 4.7 | 232 | 65 |
| | | | |
| Bell Peppers, tons | 9 | 137 | 52 |
| Cabbage, tons | 20 | 130 | 35 |
| White potatoes, tons (+vines) | 15 | 151 | 68 |

The following Tables (6,7) and Figures (1-2) provide estimates of the concentration of animals and their weight on a farm throughout the year based on the assumptions shown in Tables 6a and 7a. Figures 1-2 present the monthly stocking rate based on an Animal Unit (1000 lbs live wt.; a sow and 20 pigs in farrow to finish on an annual basis is equal to 1.4 AU).

**Table 6. Monthly live-weight distribution for 12 sows & 240 pigs Farrow-to-Finish when there are 2-Groups of 6-sows farrowing starting in March and again in August.**

| Month of year | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **July** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| **WEIGHT OF sows and GROWING PIGS on the last day OF THE MONTH** | | | | | | | | | | | |
| 2400 | 2400 | 5280 | 7980 | 10680 | 13380 | 2400 | 5280 | 7980 | 10680 | 13380 | 16080 |
| 2400 | 2400 | 2400 | 5280 | 7980 | 10680 | 13380 | 16080 | 5280 | 7980 | 10680 | 13380 |
| **Total Wt of herd** | | | | | | | | | | | |
| **4800** | **4800** | **7680** | **13260** | **18660** | **24060** | **15780** | **21360** | **13260** | **18660** | **24060** | **29460** |
| **Average wt of all animals on farm at end of month** | | | | | | | | | | | |
| 400 | 400 | 107 | 100 | 141 | 182 | 219 | 162 | 100 | 141 | 182 | 223 |
| **Number pigs on farm at end of month** | | | | | | | | | | | |
| 0 | 0 | 60 | 120 | 120 | 120 | 60 | 120 | 120 | 120 | 120 | 120 |
| **Average wt of pigs on the farm at end of month** | | | | | | | | | | | |
| 0 | 0 | 48 | 71 | 116 | 161 | 183 | 138 | 71 | 116 | 161 | 206 |
| **AU on farm at end of each month** | | | | | | | | | | | |
| 4.8 | 4.8 | 7.7 | 13.3 | 18.7 | 24.1 | 15.8 | 21.4 | 13.3 | 18.7 | 24.1 | 29.5 |
| **AU per acre each month** | | | | | | | | | | | |
| 0.4 | 0.4 | 0.6 | 1.1 | 1.6 | 2.0 | 1.3 | 1.8 | 1.1 | 1.6 | 2.0 | 2.5 |
| **Average AU/acre for farm…….** | | | | | | **1.4** | | | | | |




**Tabel 6a. Assumptions for informa presented in Table 6.**

| | |
|---|---|
| Days/month | 30 |
| Growth rate | 1.5 |
| Birth weight, lbs | 3 |
| Pigs / sow/farrowing | 10 |
| Sows, # | 12 |
| Sow weight, lbs | 400 |
| farrowing groups | **2** |
| # pigs / group | 60 |
| Month to start farrowing | March |
| Acres | 12 |
| Sale wt, lbs | 220 |
| Finished wt of all pigs | 13200 |
| Finished wt of all pigs + sows | 15600 |

**Table 7. Monthly liveweight distribution for 12 sows & 240 pigs Farrow-to-Finish when there are 4-Groups of 3-sows starting to farrow in March and again in August.**

| 2008 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec |
| WEIGHT OF sows and GROWING PIGS on the last day OF THE MONTH | | | | | | | | | | | |
| 1200 | 1200 | 2640 | 3990 | 5340 | 6690 | 1200 | 2640 | 3990 | 5340 | 6690 | 8040 |
| 1200 | 1200 | 1200 | 2640 | 3990 | 5340 | 6690 | 1200 | 2640 | 3990 | 5340 | 6690 |
| 6690 | 1200 | 1200 | 1200 | 2640 | 3990 | 5340 | 6690 | 1200 | 2640 | 3990 | 5340 |
| 5340 | 6690 | 1200 | 1200 | 1200 | 2640 | 3990 | 5340 | 6690 | 1200 | 2640 | 3990 |
| total wt of herd, lbs | | | | | | | | | | | |
| **14430** | **10290** | **6240** | **9030** | **13170** | **18660** | **17220** | **15870** | **14520** | **13170** | **18660** | **24060** |
| Average wt of all animals on farm | | | | | | | | | | | |
| 200 | 245 | 149 | 125 | 129 | 141 | 169 | 156 | 142 | 129 | 141 | 182 |
| Number pigs on farm | | | | | | | | | | | |
| 60 | 30 | 30 | 60 | 90 | 120 | 90 | 90 | 90 | 90 | 120 | 120 |
| Average wt of pigs on the farm | | | | | | | | | | | |
| 161 | 183 | 48 | 71 | 93 | 116 | 138 | 123 | 108 | 93 | 116 | 161 |
| AU on farm each month | | | | | | | | | | | |
| 14.4 | 10.3 | 6.2 | 9.0 | 13.2 | 18.7 | 17.2 | 15.9 | 14.5 | 13.2 | 18.7 | 24.1 |
| AU per acre each month | | | | | | | | | | | |
| 1.2 | 0.9 | 0.5 | 0.8 | 1.1 | 1.6 | 1.4 | 1.3 | 1.2 | 1.1 | 1.6 | 2.0 |
| **Average AU/acre for farm** | | | | | **1.2** | | | | | | |

**Figure 2. Monthly Distribution of Stocking rate for 4-Groups of 3 sows & 20 pigs each farrowing March & Aug (Animal Units[1000 lbs]/Acre).**

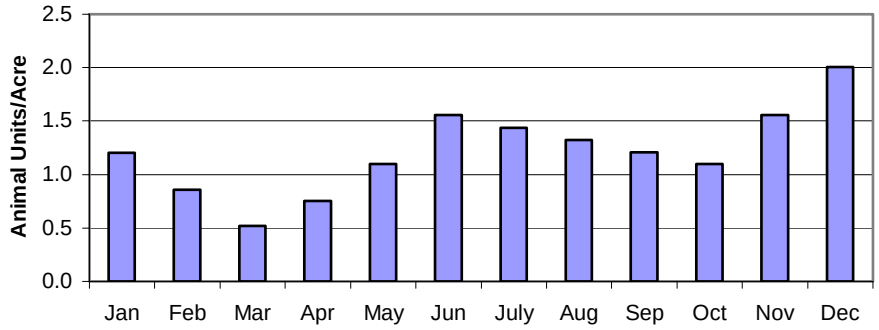
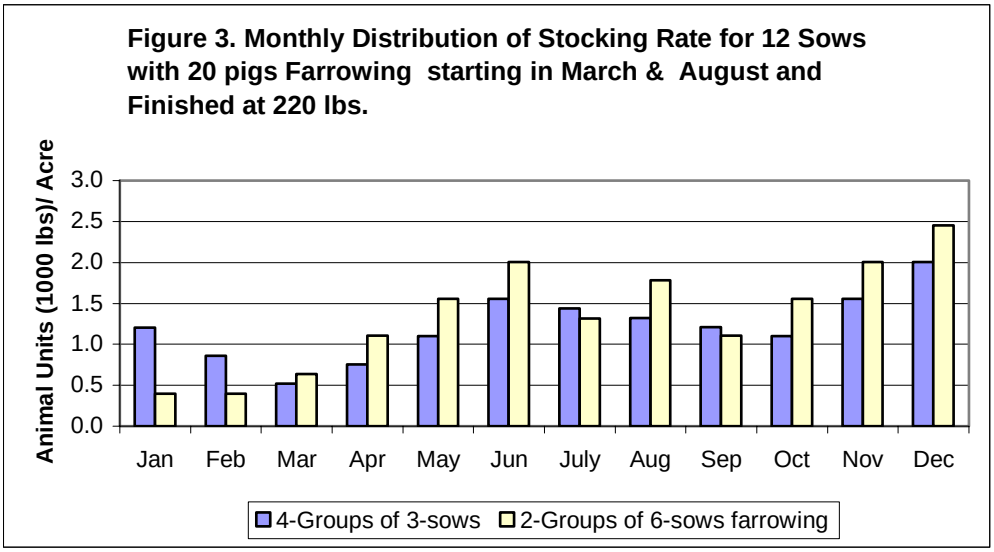



**Table 7a. Assumptions for information presented in Table 7.**

| | |
|---|---|
| Days/month | 30 |
| Growth rate | 1.5 |
| Birth wt, lbs | 3 |
| Pigs / sow/farrowing | 10 |
| Sows, # | 12 |
| Sow weight, lbs | 400 |
| Farrowing groups | 4 |
| # pigs / group | 30 |
| Month to start farrowing | March |
| Acres | 12 |
| Sale wt, lbs | 220 |
| Finished wt of all pigs | 6600 |
| Finished wt of all pigs + sows | 7800 |

Farrowing months and animal numbers can be manipulated to match potential plant growth characteristics or other environmental impacts such as soil moisture.




The general growth curve for cool and warm season grasses overlap in some areas, but still have several months when vegetative cover will have to be maintained from previously stockpiled or accumulated growth.

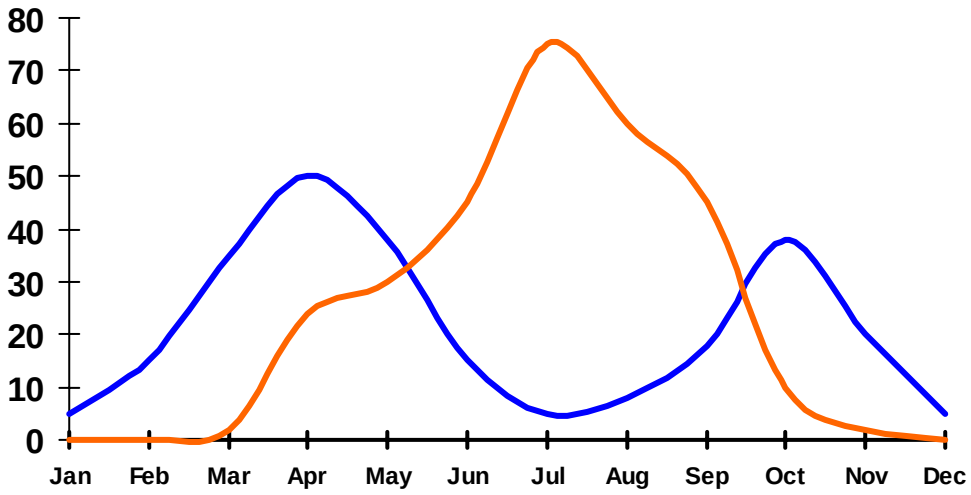


**Table 8. Possible times of year that various crops may be available for use by hogs.**

| Crop Type | Primary Seasons of Use | | | | |
|---|---|---|---|---|---|
| | **Dec-Jan-Feb** | **Mar-April** | **May-June** | **July-Aug** | **Sep-Oct-Nov** |
| **Tall Fescue** | Graze Stockpiled growth | Use through May or early June if growth adequate | | Do not use | Could use or stockpile for later use. |
| | Fescue would be stockpiled in Sept-Nov then grazed in winter; no grazing in July-Aug. | | | | |
| **Bermudagrass** | Limited use of dormant | Use cautiously in March-April during "green-up" and perhaps through Oct | | | |
| | Bermuda would be used most anytime except Dec-Feb; However, could be on dormant bermuda if pigs do not root up plants. | | | | |
| **Ladino White Clover, mostly in mixture with perennial grasses** | Very limited use during this period | Base the grazing management on what will favor the associated grass in the mixture. Realize that hogs relish white clover leaves and stolons, therefore rooting of this plant may be more extensive and controlling the stocking density and frequency of animal movement will be paramount for the plant's survival. | | | |
| **Alfalfa & Red Clover** | Do not graze during this period | May start grazing when alfalfa reaches the bud stage of growth in April | Graze on monthly basis through September | | Allow plants to reach 12" height prior to first frost and limited use just before leaf drop from frequent frosts. |
| **Annual Crops** | Hogs **should not** graze on these crops during this period unless grass is more than 8 inches tall. | Smallgrains or Annual ryegrass or other winter could be used when >8" height | No grazing in this period if summer crops are being grown | | No grazing during smallgrain establishment |
| | | | | | Corn stubble could be used |
| | | | A corn-smallgrain system provides grazing for about 45 days in fall and again in spring (total of 90+-) | | |
| | | | Sudangrass, Millet or Crabgrass germinating in April and May could be grazed from June through September. | | No grazing during establishment of smallgrain, ryegrass or other winter annuals. |
| | | | If ryegrass or spring oats are used in April-May, then the summer annuals will be planted late, and it will delay the grazing until July. | | |
| | | In systems where winter annual forages are planted in the fall and grazed out in the spring followed by the planting of summer annual forages one could expect limited early winter grazing (less than 30 days) and 60-90 days in March-May, followed by 45-90 days in July-September. Assuming everything is favorable, the potential days of grazing could range from 180-210. | | | |
| **Dry lot** | Dry lots may be used if properly buffered and subsequently cropped to maintain nutrient balance, especially for P. | | | | |
| **Sacrifice Lot** | Sacrifice lots to be used in combination with pasture and would be for short term use when pasture plants need a rest from grazing or trampling. | | | | |
| **Woodlots** | Woodlots may be used for shade, but one cannot expect timber growth or even tree survival unless the stocking density is extremely low and/or the time of contact is extremely short; for example, animals may have access to a specific area for maximum of a few days once or twice per year. Consider keeping animals away from the "drip-line" of trees to minimize root and trunk damage. | | | | |