



Soil Sampling for Concentrated Animal-Feeding Operations (CAFOs)

Who should read this guide?

If you own or operate a concentrated animal-feeding operation (CAFO) and you apply animal waste (liquid or solid) to land for beneficial use or to enhance soil productivity, then you need to follow this guidance.

Following this guide will help you implement a soil sampling plan that will meet regulatory objectives, reduce sample variability, and increase project quality.

This guide does not take the place of any applicable rules or laws. Soil sampling requirements for CAFOs are found in Title 30, Texas Administrative Code, Chapter 321, Subchapter B, and in the CAFO General Permit. In this guide, questions are written as you might ask them.

What is the purpose of soil sampling?

Before you begin to apply waste, and after you begin applying waste in accordance with the CAFO rules and General Permit, you are required to collect and analyze representative soil samples from each permitted land management unit (LMU) or waste application area identified in a CAFO permit as needing to be sampled.

The goal of dividing the waste application area into LMUs represented by composite samples is to make sure you identify areas with significantly elevated nutrient concentrations. Each composite sample that is sent for analysis is taken from a mixture of *10 to 15 (preferably 15)* discrete soil cores.

What are the objectives?

It is especially important to generate accurate soil data because of the potential implications for your business and the environment. Soil data should be generated

within a sampling scheme developed and implemented to achieve the following objectives:

- reduce sampling error,
- protect sample integrity, and
- document the representativeness of the data.

What steps should I follow?

Following is a checklist of steps to remember as you make plans to collect soil samples.

Take standard safety precautions

Follow the kind of health and safety precautions that are appropriate for outdoor activities, field sampling, and dealing with animal waste. These precautions include wearing appropriate attire, using safety gear, having first aid equipment on hand, and knowing how to get to the nearest emergency medical facilities.

Coordinate with an agronomic soil laboratory

The person who is responsible for collecting the samples—either the CAFO operator or an environmental professional—should first coordinate with the analytical laboratory to ensure that appropriate details are addressed during sampling. **(Operators in segments 1226 and 1255 of the North Bosque Watershed that are required to have an individual permit must use a third party to collect their samples as required in 30 TAC 321.42(k)).**

Coordinate with the lab on the following details:

- size and type of sample containers,
- requirements for sample preservation,
- drying soils and homogenizing samples,
- maximum holding time for each constituent,
- chain of custody, and

- appropriate soil test methodology found in the Standard Operating Procedures (SOPs) for the Texas AgriLife Extension Service Soil, Water and Forage Testing Laboratory. See on the web at <http://soiltesting.tamu.edu/webpages/s_wftlmethods1209.html>.

Follow approved sampling methods

All approved sampling methods can be used to collect and composite subsamples from within each LMU. By dividing the waste application area into LMUs represented by composite samples, you can be sure of identifying areas with significantly elevated nutrient concentrations.

Sampling procedures must employ accepted techniques of soil science for obtaining representative analytical results. A representative composite sample typically should be composed of a composite of 10 to 15 (preferably 15) discrete subsamples for each depth increment within an LMU, as defined in the rule referenced earlier.

What are the approved methods for soil sampling?

Methods for locating subsamples include the following: professional judgment, grid and GPS Grid. These methods are illustrated in Figures 1, 2 and 3. Each figure represents an LMU, and each X represents a subsample location.

Whatever method you choose to use, make sure to do the following:

- Exclude buffer areas where waste has not been applied.
- Avoid sample locations that may not be representative of the LMU as a whole—for example, low areas where runoff might pool, eroded areas and areas under trees where grazing or lounging animals might congregate.
- Ensure size and designation of the LMU being sampled is consistent with the CAFO permit.
- Avoid sampling directly through fertilizer bands or manure.
- Select appropriate spatial distribution of locations being sampled by using a random

number generator for the grid sampling method and your judgment and field history from the producer for the professional judgment sampling method.

- If you are required to take 0–2 in and 2–6 in samples, collect a 0–6 in sample and divide according to depth.
- If you cannot collect the entire 6–24 in sample for more than the minimum 10 subsamples, specify the average depth that was obtained for the LMU.
- Collect samples in a manner that minimizes cross contamination of a soil sample(s) by the surface sample(s).
- Collect samples with clean sampling tools and place the subsamples according to depth increments into clean plastic buckets or other non-metallic containers for each LMU, thoroughly mix each sample, and remove a pint (or more if additional tests are desired) as a composite sample for each LMU.
- Ensure that sampling equipment is clean and that residual soil is not carried from one LMU to the next.
- If you dry samples prior to mailing, air dry the samples on clean, white paper with no ink; a clean surface; or in a clean container such as a pie pan.
- Submit approximately 1 pint of soil per sample in a clearly labeled sample bag with a list of all samples submitted.
- Mail or deliver the soil samples as soon as possible to your selected agronomic soil testing laboratory.

Operators in segments 1226 and 1255 that are required to have an individual permit must comply with the above listed requirements and the following additional requirements, as applicable:

- Collect soil samples using no larger than a 1 in tube soil probe, for the 0 to 6 in sample.
- Plant residue may not be removed from the soil surface in the field. Any plant residue on the soil surface or in the sample should be removed by the lab.
- Send all samples to the lab to be dried.
- Send the entire amount of soil collected for the 0 to 6 in sample to the lab to be dried and composited by the lab.

- Third-party fields used for waste application must be sampled per this guidance document.

Professional Judgment

(Operators in segments 1226 and 1255 that are required to have an individual permit cannot use this method)

This method relies on the experience and knowledge of the soil sampler to select the soil sample locations (see Figure 1). Procedures for collecting soil samples when using the professional judgment method are explained in the *Soil Sample Information Form, D-494*, for the Texas AgriLife Extension Service Soil, Water & Forage Testing Laboratory. (To find the online form, see “Where can I get more information?”). The TCEQ executive director has the discretion to require facilities to GPS each subsample location and maintain the information for a period of two years, or use other soil sampling methods where necessary to deal with compliance issues.

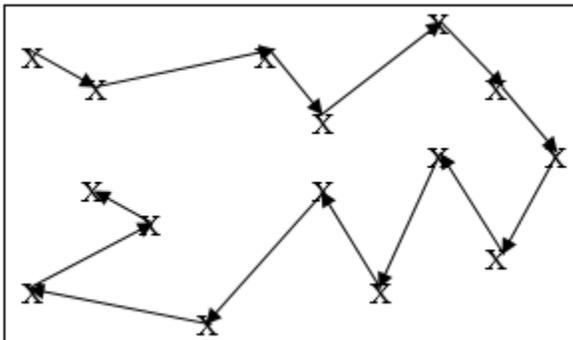


Figure 1. Using professional judgment to locate subsamples on a land management unit.

Grid Sampling Method

Using a grid to locate subsamples is also known as simple random sampling. It involves dividing an LMU into either a numbered set of equal-sized areas called grid boxes, or into grid box intersections (see Figure 2). Either can be used to randomly select a desired number of sample locations.

X							X		
			X					X	
	X			X					
X						X			X
					X				
	X								
		X						X	
							X		
				X					

Figure 2. Dividing a land management unit into a grid to locate subsamples.

Once the grid is completed for the field, use a random number generator to select the sampling sites. When you are in the field sampling, if one of the subsample sites is a watering/feeding area, eroded area, or other location where animals will congregate, move to one of the adjoining grids that is not adjacent to another sampling grid if possible. Be sure to obtain information from the producer about historical areas where animals might have congregated if it is not clearly visible currently. GPS each subsample location and maintain the information for a period of two years.

GPS Grid Method

Digital maps of the LMU to be sampled can have a grid layered on the LMU. Sampling is conducted annually using the same grid layout to improve field sub-sampling consistency. GPS each subsample location and maintain the information for a period of two years (see Figure 3).

X	X	X	X	X
X	X	X	X	X
X	X	X	X	X

Figure 3. Layered grid on the LMU.

Where can I get more information?

Water Quality Assessment (MC 150)
Texas Commission on Environmental Quality
PO Box 13087
Austin, TX 78711-3087
512-239-4671
<www.tceq.texas.gov/permitting/wastewater/cafo/cafo.html>

Texas AgriLife Extension Service, Soil, Water
and Forage Testing Laboratory
Soil and Crop Sciences, Texas A&M University
College Station, TX 77843-2474
979-845-1460
<<http://soiltesting.tamu.edu>>

Natural Resources Conservation Service
W. R. Poage Federal Building
101 South Main Street
Temple, TX 76501-7682
254-742-9885
<www.tx.nrcs.usda.gov>

Texas State Soil and Water Conservation Board
PO Box 658
Temple, TX 76503
800-792-3485
<www.tsswcb.state.tx.us>

*Testing Your Soil: How to Collect and Send Soil
Samples*, E-534, Texas AgriLife Extension
Service, Texas A&M University.
<<http://forages.tamu.edu/PDF/Soiltest.pdf>>

Mehlich III ICP method
<<http://soiltesting.tamu.edu/webpages/swftlmethods1209.html>>

Phosphorus Assessment Tool for Texas,
Natural Resources Conservation Service.
<https://nutrientmanagement.tamu.edu/content/tools/txtechnote15_rev.pdf>

Nutrient Management, Natural Resources
Conservation Service
<https://efotg.sc.egov.usda.gov/references/public/TX/2012_Texas_590_NM_Standard_Finalupdate2016.pdf>

Soil Sample Information Form, D-494, Texas
AgriLife Extension Service, a part of Texas
A&M System.
<<http://soiltesting.tamu.edu/files/soilwebform.pdf>>